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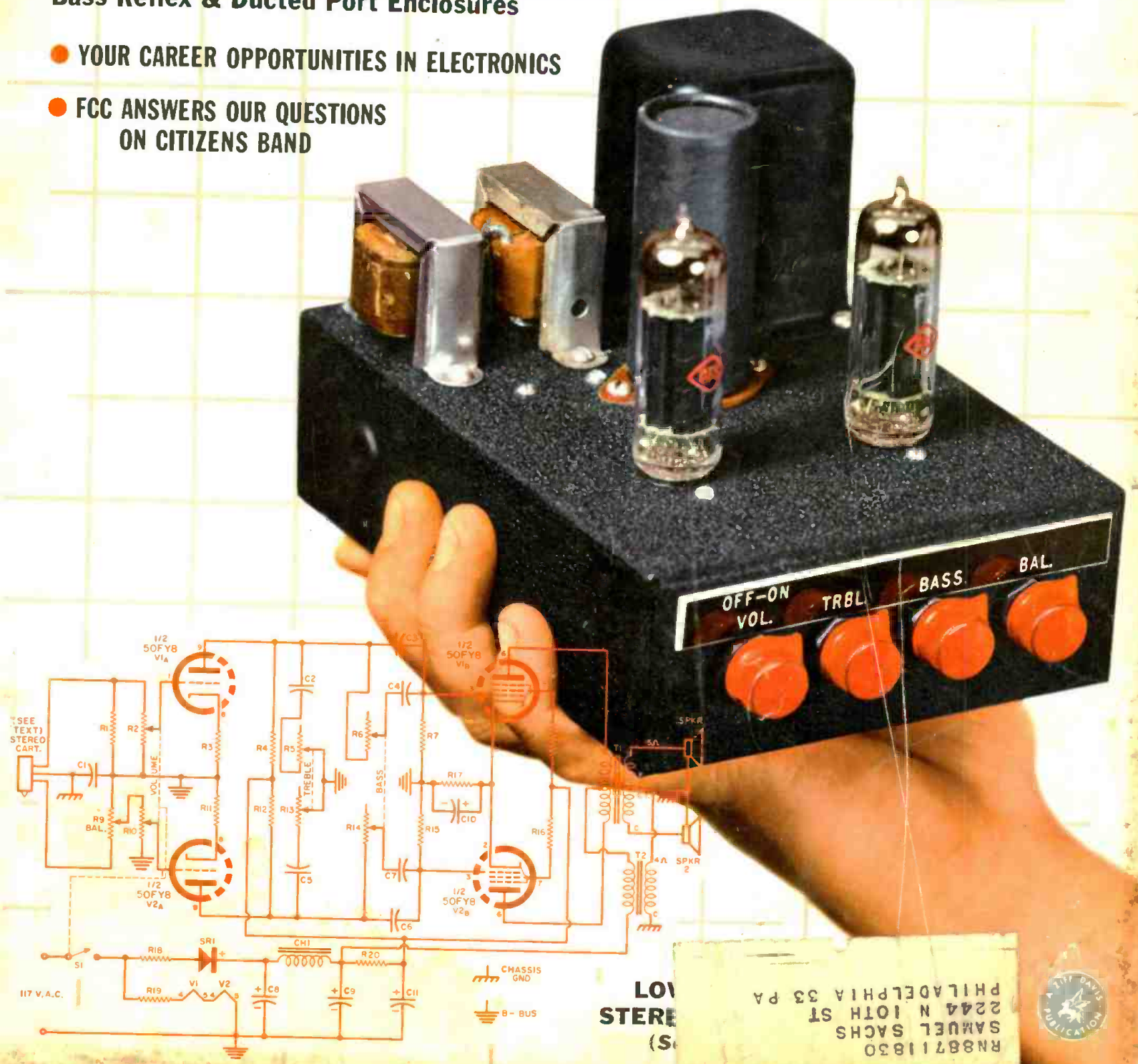

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First in radio-television-audio-electronics

CONTENTS

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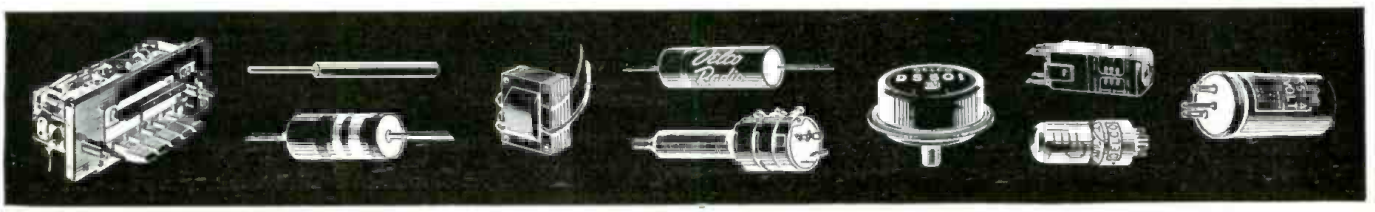

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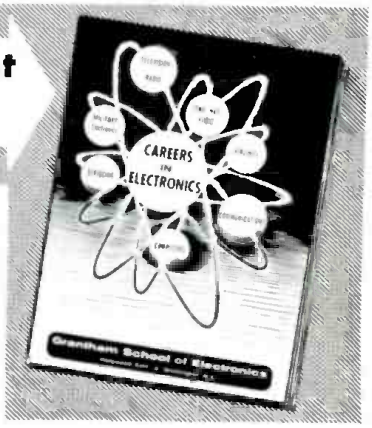

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John W. Dempsey, Box 55, Rising Sun, Md.	1st	12
Donald H. Ford, Hyannis RD, Barnstable, Mass.	1st	12
Richard J. Falk, 2303 Holman St., Bremerton, Wash.	1st	22
Denson O. McNully, 1117 N. Houston St., Amarillo, Texas	1st	9
James D. Hough, 400 S. Church St., East Troy, Wisc.	1st	12
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...for the Record

By W. A. STOCKLIN
Editor

SOVIET DREAMS ON DISPLAY

AS this is written we have just returned from a special press preview of the Soviet Exhibition held at the New York Coliseum. Needless to say, we were fascinated by the tremendous displays that obviously cost the USSR a small fortune to assemble and transport. It was, in essence, a show of peace.

We saw full-size models of all of the Russian satellites, models of an atomic power plant and a nuclear-operated ice breaker, in addition to working TV sets, high-fidelity equipment, navigational gear, and computers. To most people who saw the show, it presents an impressive image of the scientific ability of the Soviet nation. But was the image real and did all the displays represent actual achievements or was it more "wishful thinking" on their part? This is the facet of the exhibition which interested us the most.

We do know that the satellite displays are not dreams for the future and we have, in the past, doffed our hats to the Soviet scientists for their ability in this particular field.

As to the nuclear-operated ice breaker "Lenin," although it was launched in 1957 it is not yet in operation. They still hope to have it finished by the end of this year.

The atomic power plant turned out to be strictly a dream for the future. They do not now have such a plant in operation nor, as far as we could find out, is the construction of such a plant even started. Apparently, it is a paper design of what they would like to have.

The TV sets did not provide a picture quality equal to ours and upon inquiring further we were advised that their picture tubes were probably not as good as those manufactured in the United States. They did show a working model of an all-transistor portable TV set with about 30 transistors and a 10-inch direct-view type picture tube. This model was not actually in production but is one that is being planned for marketing later this year. A color TV set was demonstrated and, although the quality of reproduction was good, it did not have the vividness of its American counterparts.

We did not see any ham equipment, but we did see many large posters emphasizing the importance of the Russian amateur fraternity. Most of the equipment shown on the posters appeared to be of limited power and home made. In one particular case they showed a receiver that is similar in appearance to a *Hammarlund* set produced not too long ago.

Although our primary interest was in the electronics and nuclear fields, we couldn't help but being diverted by the working models of their automobiles. The "Zil-III", which possibly compares with American limousines, was impressive but upon inquiry we found that the number built to date was less than 100. "The "Volga", which is quite similar to the West German "Opel", is priced at 25,000 rubles which is the equivalent of $2500.00 (at the tourist rate of 10:1).

Much has been said in this country about the scientific ability of the Russian engineer but we were not too impressed by some of the display attendants. We talked to quite a number who were supposedly there to answer all questions. However, it was a rare instance when we could find one who could provide the simplest technical details. One attendant at the TV display did not know the number of screen lines standard in their TV system, nor did they know the number of frames per second. Another was not sure about the number of transistors in their all-transistor TV set. These are just a few examples. It wasn't that we were unable to get the answers but simply that the answers were forthcoming only after a conference among three or four of the attendants. Although their English wasn't perfect, we had no problem in conversing. If only we could speak Russian as well as they could speak English!

One of the most interesting phases of our visit was a lengthy discussion with one of the attendants. He was 27 years old and a graduate of an electronic engineering college, having spent five years at college and ten years in pre-engineering training. After five years of working as an engineer he now lives in Leningrad with his wife and two children in a two-room apartment with bath. He works 48 hours per week and owns a TV receiver and a radio set. Apparently it is quite common for families in large cities to have TV sets but this engineer did not own an automobile. It wasn't, according to his comment, that he couldn't afford a car. It was a question of his being unable to buy one. We did not question him any further as to whether or not he was permitted to have one or whether there just weren't enough cars available to the public.

One thing that impressed us was that irrespective of who we talked to there was the feeling of friendliness—a feeling that they were trying to be as courteous as possible and provide us with as honest answers to our questions as they could. —30—

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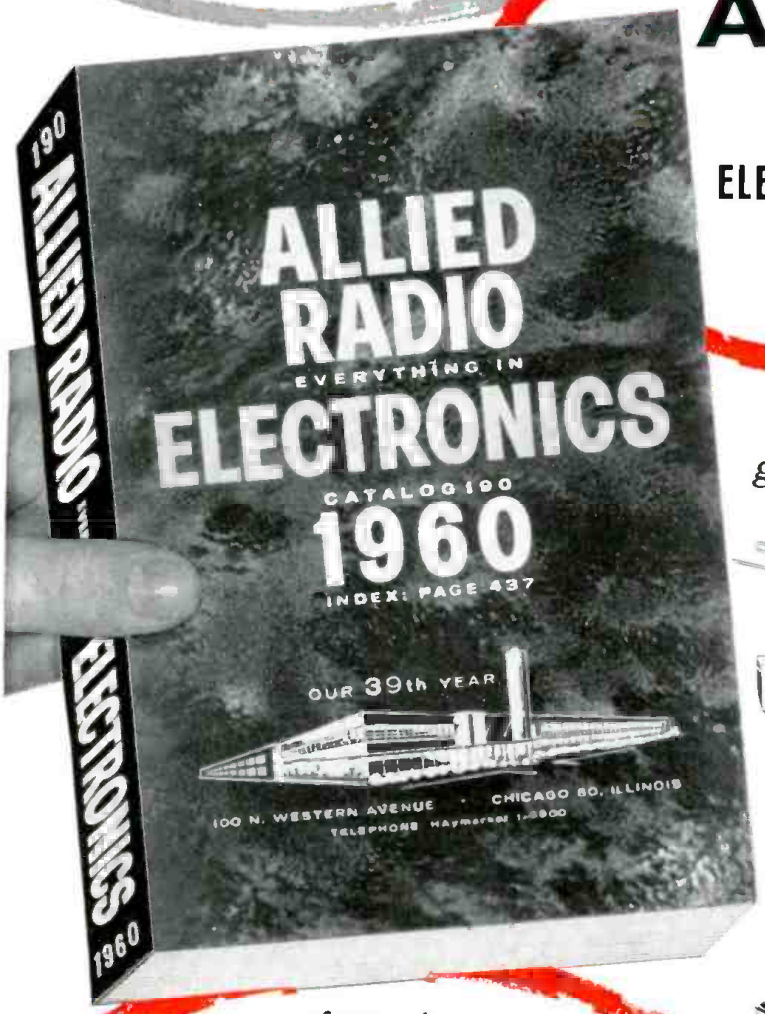

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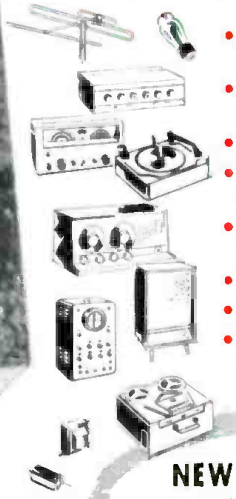

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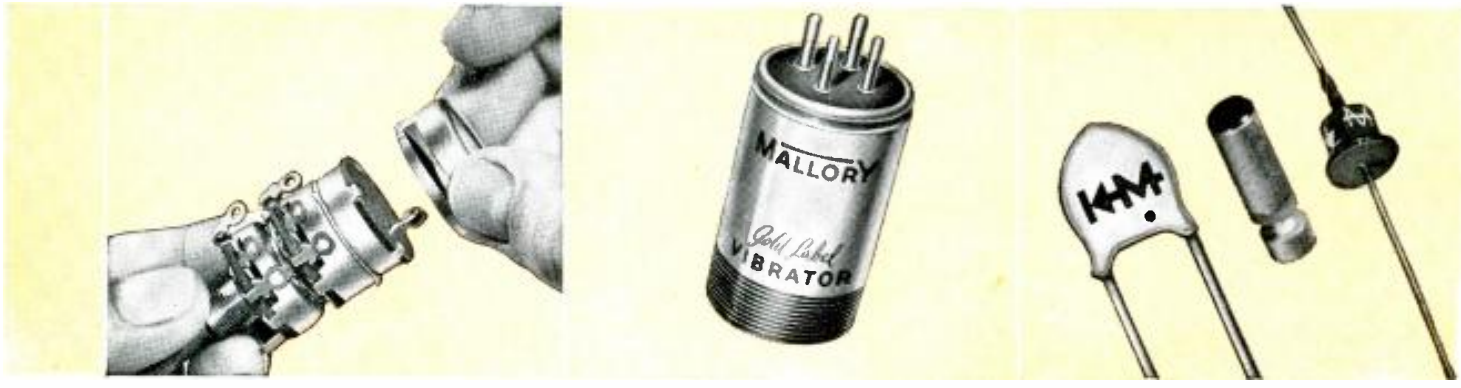

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ELECTRONICS IN NIGERIA

To the Editors:

On behalf of the people of Nigeria, I wish to thank you for your article "Electronics in Nigeria," which appeared in the April issue of this magazine. Many Nigerians are now realizing the potentialities of electronics in the country's communication and industries.

We sincerely hope that Americans will lend a helping hand in our struggle to place our country on the map of the world. I hope that American electronic industries will investigate the possibilities of investing in Nigeria. The Nigerian government has set up a liberal policy for all foreign investments. This policy goes far beyond what other under-developed countries will offer. Electronics in Nigeria is yet a baby—but a fast-growing baby.

KANU OKORONKWO
Nigerian Electronics Engineer
CBS-TV
New York, New York

Thanks to Reader Okoronkwo for his comments on the above article. We are always pleased to learn of our readers' reactions.—Editors.

* * *

HI-FI CROSSOVER NETWORKS

To the Editors:

Authors Cohen and Cohen have done a very excellent piece of work on the two-part article "Hi-Fi Crossover Networks," which appeared in your April and May issues.

After studying the article, there is still a question in my mind. I have several excellent speakers that I would like to combine into a system, but the woofers have 16-ohm impedance and the tweeters have 8-ohm impedance. What is the correct hookup to be used in this case?

ROY J. DOW
Northford, Connecticut

This has been a frequent question. In general, if your amplifier has both 8- and 16-ohm output taps, the answer is simplified. A 16-ohm circuit is used with the 16-ohm speaker, and this is connected to the 16-ohm output tap. An 8-ohm circuit is used with the 8-ohm speaker, and this is connected to the 8-ohm output tap. Author Cohen will have a little more to say on this very subject in one of our forthcoming issues.—Editors.

* * *

OTL HI-FI AMPLIFIER

To the Editors:

In the May issue, Mr. Futterman seems to be in error on two counts in his article "Ultra-stable OTL Hi-Fi Amplifier." In reference to Fig. 1, Mr. Futterman says, "Signal voltage developed across the plate load resistor of V_2 is applied between grid and cathode of output tube V_3. Likewise, signal voltage 180 degrees out-of-phase, developed across the cathode load resistor of V_3, is applied between grid and cathode of output tube V_4." Careful examination, however, will reveal that the signals are impressed between grid and plate of each output tube, not between grid and cathode.

The author also says, "In this circuit, the output tubes are working as cathode followers . . ." Certainly, V_4 cannot be considered to be working as a cathode follower. Its cathode is at signal ground.

W.C.H.
East Lansing, Michigan

In response to Reader W.C.H's letter, here is what Author Futterman has to say.—Editors.

Dear W.C.H.:

You are certainly correct in saying that the signals from the phase-splitter are applied between grid and plate of each output tube, and not between grid and cathode. Fig. 1 clearly shows this and my manuscript said "grid and plate." Somewhere along the line this was changed to "grid and cathode," which is clearly in error, as you point out.

As regards V_4 working as a cathode follower, surely this is so. It is not a condition that the cathode of a tube be at signal ground to define a cathode follower. Granted, this is the usual mode of operation. However, as I see it, a tube cathode follower is a circuit wherein the input signal is applied between grid and plate and the output taken between cathode and plate, the plate being the common terminal.

The output signal has the same polarity as the input signal; that is, it follows the input—hence the name "cathode follower." In my circuit grounding the cathode does not change this operation.

JULIUS FUTTERMAN
New, York, New York

* * *

THIRD-CHANNEL CIRCUIT

To the Editors:

I have read with interest Mr. Burstein's article "Phantom Channel for Stereo" in your June issue.

A simple modification will eliminate the high crosstalk that Mr. Burstein found when using the circuit shown in Fig. 4. The direct connection between 4-ohm taps in this circuit causes the high crosstalk and will also increase distortion and cause instability in some amplifiers. The addition of a

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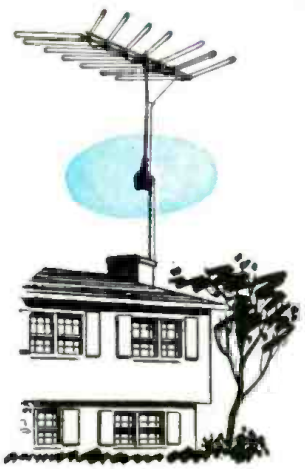

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Step up from a lower quality 4 conductor wire to a top quality 3 conductor wire at no increase in cost.

Big Performance Advantage

On runs of 100 feet or more, however, 4 conductor wire is recommended, *with the fourth conductor doubled up on the power line.* This reduces line loss, brings more voltage to the rotator, and provides higher torque than rotators which must use 4 conductors.

3 conductor rotor wire is sold only through Channel Master distributors!

CHANNEL MASTER CORP.
ELLENVILLE, N. Y.

3 Tenn-A-Liner Models to Choose From

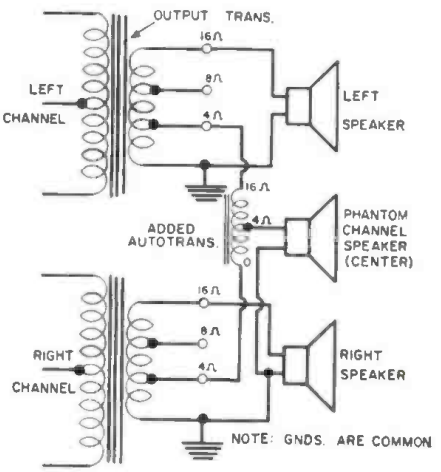
It's here! The world's first automatic rotator that lets you aim your antenna *exactly* where you want it... not 6, 10, or 15 degrees off course... but right on target, *accurate to one degree!*

the first entirely new automatic in five years!

- **New dual synchronized motor design** provides absolute control over antenna direction. You can even make one degree adjustments.
- **No relays,** springs, or excessive linkage to mar performance. Fewer moving parts mean longer life, more dependable performance.
- **Noiseless nylon gears** end irritating "whirr."
- **No solenoids** to cause electrical interference on the TV screen.
- **New circuit design** delivers full voltage, produces higher torque to turn heaviest antenna arrays.

center-tapped autotransformer as shown here will eliminate these undesirable effects.

The voice-coil winding of an output



transformer works well in this application. Use the ground and 16-ohm leads as ends, and the 4-ohm lead for a center tap. (Leave primary leads open.) The quality of the transformer is relatively unimportant as long as the d.c. resistance is low so that any old junk-box transformer will do, even for a high-quality system.

Care should be taken with both Figs. 3 and 4 to observe speaker polarity as incorrect polarity can produce poor system bass response.

JACK A. CRAWFORD
Electronic Scientist
U.S. Naval Ordnance Test Station
China Lake, California

We wish to thank Reader Crawford for submitting the foregoing circuit.

Our readers may also be interested in seeing a brief item ("New Third Channel Approach"), which ran in our August issue, on a technique being used by Allied Radio *to obtain a phantom channel. In this case, 4-ohm taps are grounded and signal is obtained from the common terminal of the output transformer in a sort of push-pull arrangement.—Editors.*

* * *

SAGE COMPUTERS

To the Editors:

In your June issue there was a short article called "Chip Chasing" by D. L. Reiffin. This article states that in alteration of the large *Burroughs* computers used in the SAGE system, clay is used to maintain chip control. While it is a small error, *all* the SAGE computers are made by *International Business Machines Corporation.* Equipment made by *Burroughs* is used to bring information to the computers and to accept processed information from them.

EUGENE F. LUCAS
IBM Corporation
Duluth Air Defense Sector
Duluth, Minnesota

The suggestions made by Author Reiffin are still good, regardless of whose equipment is used.—Editors.

-30-

Channel Master puts Stereo Brilliance within the reach of everyone !

the superbly engineered CHANNEL MASTER Stereophonic Amplifier model no. 6600, only

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16 WATTS PER CHANNEL

If you've been led to believe that high price is the only measure of high fidelity, just listen to the Channel Master model 6600! For here is an amplifier which, at its original price, was universally acclaimed by critical audio experts. Now this quality instrument, providing the ultimate in stereo reproduction and listening pleasure, is available at a new lower price that brings it within the reach of virtually everyone.

Performance Specifications

FREQUENCY RESPONSE: Uniform from 20 to 30,000 cycles at 1 watt ± 1 db.
POWER OUTPUT: 16 watts per channel (total 64 watts peak).
HUM AND NOISE: Phono: better than 60 db below 10 millivolts at full output. Tape: better than 55 db below 3 millivolts at full output. All channels better than 80 db at full output at minimum volume.
DISTORTION: Less than 1% at full output.

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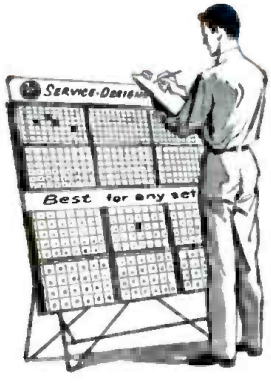
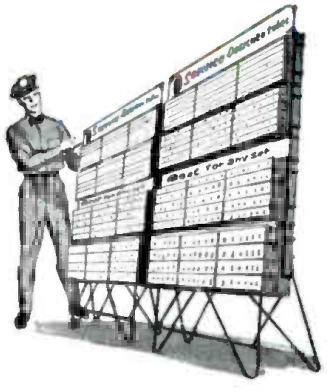
Display rack with wall hanger $23.95, or free with purchase of 650 General Electric tubes. Rack with floor easel, $25.95 or 700 G-E tubes.

Streamlines Your Tube Sales for Fast Turnover, Top Volume!

Missing cartons show what tube types you should reorder.



Your tube inventory can easily be checked at a glance.



A second display will accommodate additional supply of tubes.

Rack can be hung on a wall if floor space is not available.

A General Electric "first"...that sells more tubes, saves record-keeping, *provides the tubes you need when you need them!* This is G.E.'s new PROFIT* Program, packaged for you in the finest, most complete tube display rack ever offered to TV technicians.

See (left) how easy it is to select types... how stock rotation is assured by orderly tube removal and replacement! Note the Display's ample dimensions—44″ high plus 16″ for easel base; 40½″ wide—providing plenty of space for a scientifically planned tube inventory!

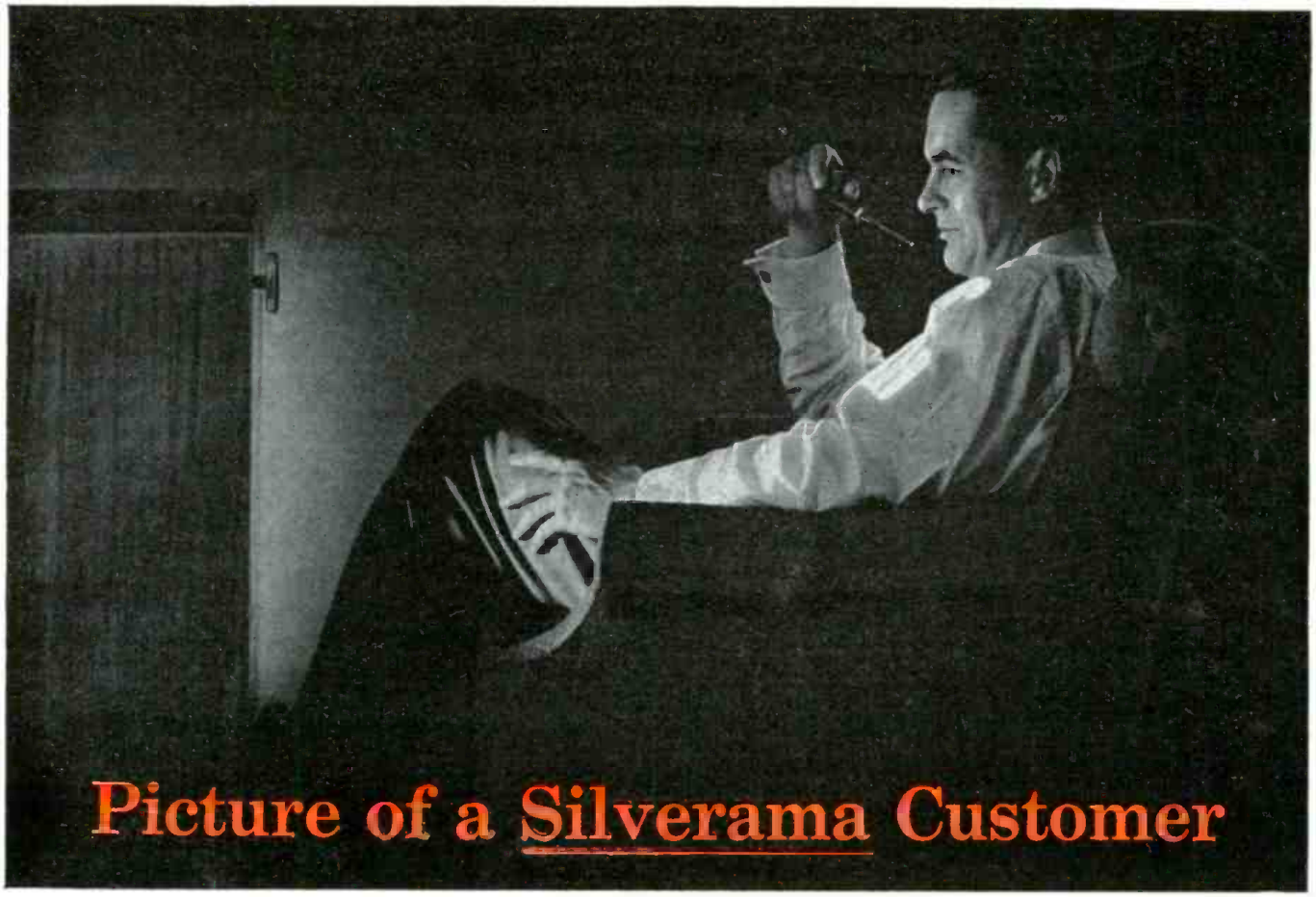
If you invite customer self-service, the Display is ideal for that purpose. Also, your stock of tubes can be checked visually at any time. Missing cartons tell you what types to reorder, and how many, since the type numbers of all tubes taken out can be recorded in back. Book-keeping is virtually eliminated.

Over-stocking and tube shortages: both are banned by the Balanced Inventory feature. Your tube dollars work harder than ever before. See your nearby G-E tube distributor today about General Electric's Service-Designed Tube Display with brand-new, built-in inventory control! *Distributor Sales, Electronic Components Division, General Electric Company, Owensboro, Kentucky.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

2-111-222



Picture of a Silverama Customer

This man needed a replacement picture tube for his TV set—and he wanted the best. So his TV technician installed an RCA Silverama—the premium picture tube made of all-new glass and all-new parts. It's the finest picture available today—just right for the customer who expects top quality and top performance.

Sell RCA Silverama with the assurance that you're delivering a completely new tube—a premium product that can command a premium price and premium profits for *you!*

★ ★ ★ ★ ★

Is your customer budget minded? Offer him an RCA Monogram—factory-rebuilt by RCA to dependable quality standards. There's no finer rebuilt made—just right for the customer whose primary consideration is price.

Sell RCA Monogram with assurance—your customers will get satisfactory performance—and you will have fewer call-backs.

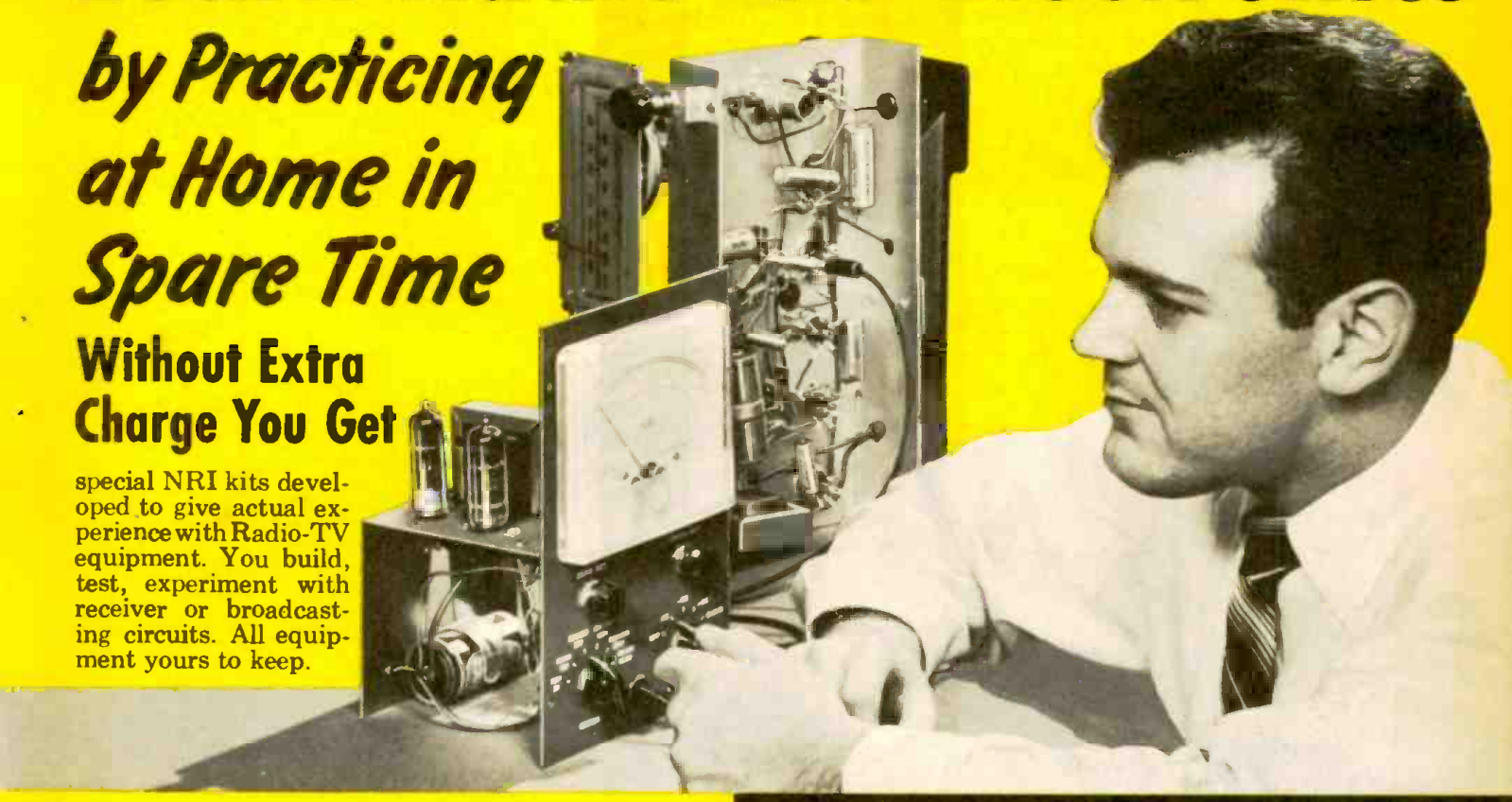
Remember...

- RCA picture tubes—warranted for one full year and fit virtually every make and model TV set.
- RCA picture tubes—backed by a brand name you can sell with confidence.
- RCA picture tubes—pre-sold by an extensive and continuing national advertising campaign.

RADIO CORPORATION OF AMERICA
Electron Tube Division Harrison, N. J.

Learn Radio-TV Electronics

by Practicing at Home in Spare Time



Without Extra Charge You Get

special NRI kits developed to give actual experience with Radio-TV equipment. You build, test, experiment with receiver or broadcasting circuits. All equipment yours to keep.

Have High Pay, Prestige, Good Future as a Skilled Radio-TV Electronic Technician

People *look up to* and depend on the Technician, more than ever before. Offices, plants, homes everywhere are obliged to buy his knowledge and services. His opportunities are great and are increasing. Become a Radio-TV Electronic Technician. At home, and in your spare time, *you* can learn to do this interesting, satisfying work—qualify for important pay. To ambitious men everywhere *here* in the fast growing Radio-TV Electronic field is rich promise of fascinating jobs, satisfaction and prestige as well as increasing personal prosperity.

Increasing Opportunities in Growing Field

A steady stream of new Electronic products is increasing the job and promotion opportunities for Radio-Television Electronic Technicians. Right now, a solid, proven field of opportunity for good pay is servicing the tens of millions of Television and Radio sets now in use. Color TV, Hi-Fi is growing. The hundreds of Radio and TV Stations on the air offer interesting jobs for Operators and Technicians.

More Money Soon—Make $10 to $15 a Week Extra Fixing Sets in Spare Time

NRI students find it easy and profitable to start fixing sets for friends and neighbors a few months after enrolling. Picking up $10, $15 and more a week gives substantial extra spending money. Many who start in spare time soon build full time Radio-Television sales and service businesses—enjoy security.

Act Now—See What NRI Can Do for You

NRI has devoted over 40 years to developing simplified practical training methods. You train at home in spare time. Get practical experience, learn-by-doing.

NATIONAL RADIO INSTITUTE
Washington 16, D.C.

NRI Has Trained Thousands for Successful Careers in Radio-TV

Studio Engr., Station KATV
"I am now Studio Engineer at Television Station KATV. Before enrolling, I was held back by limitation of a sixth grade education." BILLY SANCHEZ, Pine Bluff, Ark.

Has All the Work He Can Do
"I have repaired more than 2,000 TV and Radio sets a year. NRI training certainly proved to be a good foundation." H. R. GORDON, Milledgeville, Georgia.

Has Good Part Time Business
"Early in my training I started servicing sets. Now have completely equipped shop. NRI is the backbone of my progress." E. A. BREDA, Tacoma, Washington.

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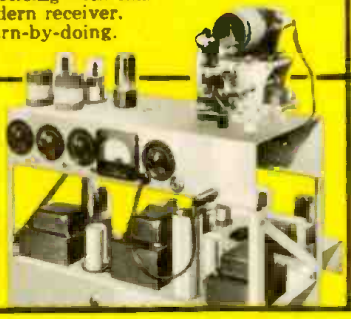
NRI Servicing Course includes all needed parts. By introducing defects you get actual servicing experience practicing with this modern receiver. Learn-by-doing.

YOU BUILD This 17 Inch Television Receiver

As part of your NRI course you can get all components, tubes, including 17" picture tube, to build this latest style Television receiver; get actual practice on TV circuits.



YOU BUILD Broadcasting Transmitter

As part of NRI Communications Course you build this low power Transmitter, learn commercial broadcasting operators' methods, procedures. Train for your FCC Commercial Operator's License.

YOU BUILD Vacuum Tube Voltmeter

Use it to earn extra cash fixing neighbors' sets; bring to life theory you learn from NRI's easy-to-understand texts.

For Higher Pay, Better Jobs
Be a Radio-TV Electronic Technician

Servicing Needs More Trained Men

Portable TV, Hi-Fi, Transistor Radios, Color TV are making new demands for trained Technicians. Good opportunities for spare time earnings or a business of your own.

Broadcasting Offers Satisfying Careers

4000 TV and Radio stations offer interesting positions. Govt. Radio, Aviation, Police, Two-Way Communications are growing fields. Trained Radio-TV Operators have a bright future.

J. E. Smith, Founder

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NRI is America's oldest and largest home study Radio-Television school. The more than 40 years' experience training men for success, the outstanding record and reputation of this school—benefits you in many ways. NRI methods are tested, proven. Successful graduates are everywhere, from coast to coast, in small towns and big cities. You train in your own home, keep your present job while learning. Many successful NRI men did not finish high school. Let us send you an actual lesson, judge for yourself how easy it is to learn.

No Experience Necessary—NRI Sends Many Kits for Practical Experience

You don't have to know anything about electricity or Radio to understand and succeed with N R I Course. Clearly written, well-illustrated NRI lessons teach Radio-TV Electronic principles. You get NRI kits for actual experience. All equipment is yours to keep. You learn-by-doing. Mailing the postage-free card may be one of the most important acts of your life. Do it now. Reasonable tuition. Low monthly payments available. Address: **NATIONAL RADIO INSTITUTE, Washington 16, D. C.**

NRI Graduates Do Important Work

Now Quality Control Chief
"Had no other training in Radio before enrolling, obtained job working on TV amplifiers before finishing course. Now Quality Control Chief." T. R. FAVALORO, Norwich, N. Y.

NRI Course Easy to Understand
"I opened my own shop before receiving my diploma. I have had to hire extra help. I am independent in my own business." D. P. CRESSEY, Stockton, Cal.

Works on Color-TV
"NRI changed my whole life. If I had not taken the course, probably would still be a fireman, struggling along. Now Control Supervisor at WRCA - TV." J. F. MELING, New York, N.Y.

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SEE OTHER SIDE

"THE NATIVE HOLLANDER WEARS WOODEN SHOES."

A Bell Telephone Laboratories experiment in noise appraisal

"The native Hollander wears wooden shoes."

"Nebraska has no seacoast."

"The daisy is a common wildflower."

As these syllables, words and sentences come in over the telephones, stand-ins for millions of Bell System subscribers rate them for clarity of reception.

From these tests, Bell Telephone Laboratories engineers determine what is objectionable noise, and work to minimize it in telephone circuits. They begin by tape recording background noise associated with working telephone circuits. Test statements of appropriate length and content (such as those above) are read onto a second tape, and both are fed onto the test circuit under carefully controlled conditions. A third tape, of normal room noise, is played through a loudspeaker in the test lab.

Several hundred listeners, meeting in small groups several times a day for weeks at a time, are then asked to rate the effect of noise on transmission of the various simulated telephone calls.

For the Bell System, the results of the study will become part of the over-all transmission objectives. At Bell Laboratories, they will influence apparatus and systems development work.

Noise is a major distraction of modern day living. It is also an enemy of the Bell System. In a telephone receiver during a call, it might be power line hum, switching or thermal noise, or perhaps atmospheric static. Bell Laboratories spends a great deal of time, effort and money to keep this extraneous noise from becoming annoying and to assure you of a trouble-free connection.

BELL TELEPHONE LABORATORIES

World center of communications research and development

Within the Industry

DR. J. EARL THOMAS, JR. has been appointed to the newly created post of director of research and engineering for the semiconductor division of *Sylvania Electric Products Inc.*, a wholly owned subsidiary of *General Telephone & Electronics Corp.*

Dr. Thomas joined the organization on an advisory basis in January. In his new assignment he will be responsible for all of the division's product research and engineering activities.

He attended Johns Hopkins University, where he received a Bachelor of Arts degree in physics and mathematics in 1939. In 1943 Dr. Thomas received a Doctor of Philosophy degree from the California Institute of Technology at Pasadena. He is a member of Phi Beta Kappa, Tau Beta Pi, and Sigma Xi, honor fraternities, as well as the American Physical Society and the Institute of Radio Engineers.

* * *

DANIEL DENHAM, sales manager of the magnetic products division, *Minnesota Mining and Manufacturing Co.*, has been named chairman of the Magnetic Tape Section, Electronic Industries Association Parts Division. This new section has just been formed as part of an over-all division reorganization which includes the establishment of a number of new sections representing various segments of the components manufacturing industry.

* * *

PAUL P. WICKMAN has been named vice-president for industrial and government sales, *Radio Shack Corporation*. He was formerly with the electronic components division of *General Electric Company*.

While associated with that firm Mr. Wickman held positions in the marketing division of the broadcast department; as district sales manager of Boston district sales; and as merchandise manager, distributor sales, tube department.

Mr. Wickman is a graduate of Holy Cross College.

* * *

WESTERN ELECTRONIC MANUFACTURERS ASSOCIATION, the nation's second largest electronic trade association, is the new name of the group formerly known as the West Coast Electronic Manufacturers Association. The name change is said to reflect the current growth pattern of the West's electronics industry. Companies headquartered on the West and East Coasts are now locating branch operations in Arizona, Utah, Colorado, New Mexico, and Texas—where practically no electronics industry existed five years ago.

The Association's officers for 1959 are: president, John A. Chartz, vice-president and general manager, *Dalmo Victor Co.*; vice-president, Richard B. Leng, vice-president, technical products division, *Packard-Bell Electronics Corp.*; vice-president, William Ivans, Jr., vice-president, engineering, *Kin-Tel*, a division of *Cohu Electronics*; vice-president, L. R. Rockwood, vice-president, engineering, *ESI, Inc.*; secretary, J. D. McLean, president, *Hoffman Laboratories*, a division of *Hoffman Electronics Corp.*; and treasurer, Phillip L. Gundy, vice-president, *Ampex Corp.*

* * *

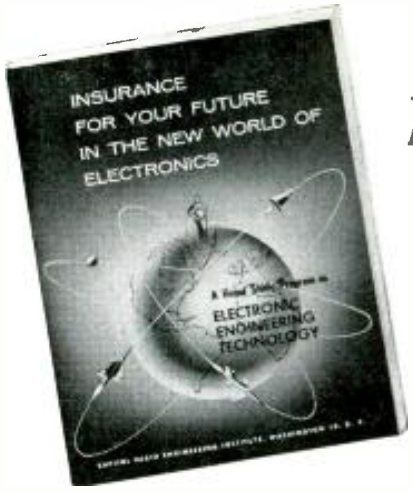
H. W. (HANK) SHEPARD has been appointed to the newly created position of administrator of color television market development, *RCA Victor Home Instruments*.

Mr. Shepard has been general manager of WAMP and WFMP, Pittsburgh radio stations, which are owned and operated by the *National Broadcasting Company, Inc.* He has held this post since 1957.

He is a graduate of New York University and served 46 months with the U. S. Army during the Second World War, attaining the rank of Captain before his discharge.

* * *

ELECTRONIC INSTRUMENT COMPANY, INC. (EICO), has acquired 20,000 square feet of space, bringing the company's total factory area to 60,000 square feet. This additional space is being used to expand the engineering and sales departments . . . **SYLVANIA ELECTRIC PRODUCTS INC.** has moved its executive offices and several of its corporate staff departments to the new *General Telephone* building at 730 Third Avenue, New York, N. Y. The company is a subsidiary of *General Telephone & Electronics Corporation*, which also moved its headquarters into the new building . . . **MB MANUFACTURING COMPANY** is planning to change its name to **MB ELECTRONICS** . . . **ACOUSTICA ASSOCIATES, INC.** has opened its new plant at Plainview, Long Island, N. Y. This new plant consolidates the company's executive headquarters and Eastern Division production and research operations which were previously con-



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Send for your Free Copy today!

This is a brand new edition of the book which has launched thousands of men on good-paying careers in electronics.

It brings you completely up to date—answers important questions on newest career developments in electronics, including Automation, Instrumentation, Industrial Electronics, Aeronautical Electronics, Guided Missiles, Radar, Servomechanisms, Computers, Astronautics, Telemetering, Communications and Manufacturing.

This book, "Insurance for Your Future in the New World of Electronics," also shows you how CREI Home Study leads the way to greater earnings in the booming electronics world.

However, CREI does not promise you a "snap." With accredited technical school curricula such as CREI offers, you must study to convert your ambition into technical knowledge which you can sell in the fabulous field of Electronics. Since its founding in 1927, CREI has provided thousands of professional electronics men with technical education. During World War II, CREI trained thousands for the Armed Services. Leading firms recommend CREI home study courses for their own personnel. Among them: United Air Lines, Canadian Broadcasting Corporation, National Broadcasting Co., Florida Power and Light Co., The Martin Co., Columbia Broadcasting System, All-America Cables and Radio, Inc., Gates Radio Co., Canadair, Ltd., Federal Electric Corp., and U. S. Information Agency (Voice of America).

CREI courses are prepared by recognized experts, in a practical, easily understood manner, and constantly revised to meet the new electronic challenges of our time. You get the benefit of time-tested study assignments under the personal supervision of a CREI staff instructor. Your studies are accomplished on your own time, during hours selected by you, and controlled by your own willpower. This complete education is the reason that graduates find their CREI diplomas keys to success in even the most advanced of electronic applications. CREI alumni hold top positions in America's leading firms. At your service is the CREI Placement Bureau, which maintains constant contact with electronic industry, and cooperates with employers and graduates in making satisfactory placements. This free service is available to students, as well as graduates. Fill out the coupon below *completely* and mail it now. We'll promptly send you your free copy of "Insurance for Your Future in the New World of Electronics." The rest—your future—is up to you!

CREI ALSO OFFERS residence training in Washington, D. C. . . . at the same high technical level. Day and evening classes start at regular intervals. Qualified residence school graduates earn degree as "Associate in Applied Science." If you have had a high school education, and experience in electronics—you can qualify for a CREI home study course. (Electronics experience is not required for admission to CREI Residence School.) Check and mail coupon if you prefer residence or home study information . . . or write Capitol Radio Engineering Institute, Dept. 119F, 3224 - 16th St., N.W., Wash. 10, D. C.

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ducted in four different plants . . . **THE DEUTSCH COMPANY** is planning the opening of its new, air-conditioned electrical connector plant in Banning, California. Finishing touches are now being made on the more than 35,000 square feet of space to be used for a completely integrated production and engineering facility for the company's electrical connectors.

* * *

ELECTRONIC INDUSTRIES ASSOCIATION's Credit Committee has reported that the over-all business decline of 1958 was reflected in the electronics industry. The Committee's report covered the twelve-month period ending April 30 and was prepared by Chairman D. B. Shaw, *Howard W. Sams & Co., Inc.*

While there was an over-all gain of 15 per-cent in the number of companies experiencing financial difficulties in 1958-59 as compared with the previous year, the level still is below 1955 or 1956. The report noted that 31 electronic manufacturing concerns and 16 distributors had financial trouble during the twelve-month period as compared with 27 manufacturers and 14 distributors in the 1957-58 period. These totaled 47 and 41, respectively, as against combined totals of 52 concerns in 1956-57 and 51 in 1955-56.

The study also indicated that during 1957 the average recovery was about 35 per-cent but that during 1958 the average recovery was around 20 per-cent. Of the manufacturing companies in financial difficulties only 16 are continuing in business, according to the Association's survey.

* * *

JACK E. ARNDT has been promoted to the position of consumer product line manager, *Heath Company,* and **ROGER S. WHITLOCK** to the post of technical product line manager . . . *CBS Electronics* has elevated **EVERETT B. BOISE** to manager of applications engineering, receiving tubes . . . *Gabriel Electronics Division, The Gabriel Company,* has appointed **JOHN S. HALL** manager of manufacturing . . . *Collins Radio Company* has announced the following executive appointments for the recently organized Cedar Rapids Division: **J. C. McELROY** has been named director of development; **DR. R. L. McCREARY,** director of research; and **W. W. ROODHOUSE,** director of sales . . . **MAURICE FRIEDMAN** has been appointed vice-president and general manager of *General Instrument Corporation's* semiconductor division . . . **RICHARD P. PALMGREN** has been named assistant credit manager for *CBS Electronics.*

* * *

AMERICAN AUDIO INSTITUTE has named Edwin T. Calkin, A.E.S., technical director of its Independent Audio Testing Laboratory. He and his staff will he charged with the testing of high-fidelity components and the preparation of the Institute's Evaluated Reports for publication to the consumer.

Mr. August A. Perticone, B.A., M.A., has accepted an appointment to the Institute's Professional Advisory Coun-

cil. He is working on psycho-acoustic research and is engaged in the development of the Institute's fidelity perception test for music listeners.

* * *

WILBERT E. STEVENSON has been elected a vice-president of *Raytheon Company*. He is president and director of *Machlett Laboratories, Inc.*, a subsidiary firm.

Mr. Stevenson was elected president of the company in 1955 and had previously been vice-president in charge of sales for 20 years, beginning with 1935.

He is a graduate of Rutgers University and Worcester Polytechnic Institute and was a director of Electronic Industries Association (EIA) in 1958.

* * *

ROYAL INDUSTRIES, INC. of Los Angeles has announced completion of negotiations for the acquisition of **AUDIO COMPANY OF AMERICA INC.** of Phoenix, Arizona, manufacturers of miniaturized hearing aids. The purchase price was not disclosed. The firm will operate as a wholly owned subsidiary and no changes in management or location are being considered . . . **AMERICAN MACHINE AND METALS, INC.** has purchased the capital stock and business of **GLASER-STEERS CORPORATION**, Newark, N. J., for a cash consideration. The purchase price was not disclosed. The company will be operated as a wholly owned subsidiary of the parent firm, under the present management. Julius Glaser will continue as president of the subsidiary and Fred Steers as vice-president. Both men have been associated with the electronics industry for over twenty years.

* * *

SAMUEL RUBEN, inventor of the *Mallory* mercury battery which powered the radios of the "Explorer" and the "Pioneer IV" satellites, has been awarded an honorary doctor of science degree from Butler University.

Other Ruben inventions, developed in association with *Mallory*, include a power rectifier and a dry electrolytic capacitor, of the type now found in radio and TV sets.

* * *

JEROME KASS has been named vice-president and editorial director of *John F. Rider, Publisher . . . Utah Radio Products Corp.* has re-elected **FRANK L. PYLE** president and **ADOLPH H. SCHENKEL** secretary-treasurer . . . *Delco Radio Division, General Motors Corp.*, has made known the following appointments: **ARTHUR E. BEETY**, director of purchases; **CHARLES A. RINE**, manufacturing manager; and **DEAN S. ALLSOP**, works manager . . . **FRANCIS X. URRICO** is now section head in charge of the electronic equipment development department of the semiconductor division of *Sylvania Electric Products Inc.* . . . **GEORGE L. CARRINGTON, SR.**, chairman of the board of *Altec Companies, Inc.*, and vice-chairman of the board of *Ling Electronics, Inc.*, died recently at the age of 57. —30—

How to Get a Commercial FCC License

do you know what an FCC license really can do for you in Electronics?

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The average person spends over 50% of his waking hours on the job (or going to and from the job). Therefore doesn't it make sense to have a job that is really interesting and also pays well?

The chances are very good that if you are reading this magazine you can qualify for the really good jobs in electronics like those shown in the pictures at the left . . . and it won't take long to do it. Your past training and experience in basic electronics (such as radio and TV repair, armed forces electronics, ham operators, etc.) can be the foundation for a profitable career as an "across-the-board" electronics technician.

Whether you run your own shop or work for someone else, the real money, the interesting work, is available to the man who can effectively handle the more complex electronic gear. Home receiver repair can provide a good living, but it can't match the opportunities open to a skilled electronics technician.

The Career Information Material shown below will show you how you can qualify for a government certificate of competency . . . a commercial FCC License . . . and acquire a really fine technical education. Find out how your success with the FCC examination is guaranteed . . . or your money back.

You will also find out which jobs require the FCC License . . . where technicians are needed . . . what a technician needs to know about electronics . . . and many other facts about opportunities for you in electronics.

It will cost you only the price of a postage stamp to get all the facts. If you are in any type of electronics work . . . or if you have had previous training or experience in electronics . . . you owe it to yourself to ask us to send you information on profitable careers in electronics.

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- ☐ Manufacturing
- ☐ Amateur Radio
- ☐ Broadcasting
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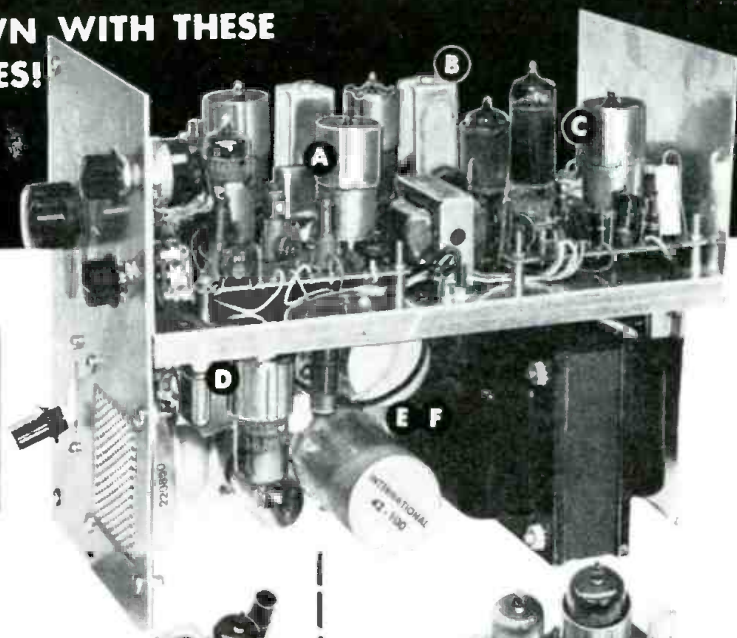
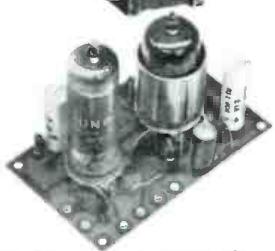


G Cabinet (all metal) includes hardware, switches, speakers, panel, case, etc. Complete instructions. Shipping weight 10 lbs. $20.00

A RF Converter (printed circuit prewired), two-tubes, crystal controlled. Use with IF unit B. Shipping weight 2 lbs. $14.00.

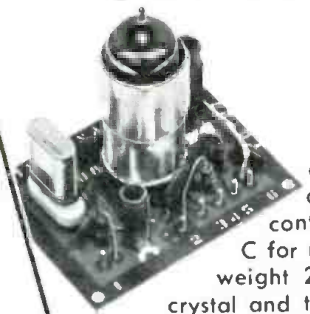
B IF Unit (printed circuit prewired) consists of mixer and tunable local oscillator feeding 262 KC IF stage. Includes noise-limiter and squelch circuits. Designed to work with units A and C. Makes dual conversion receiver. Shipping weight 2 lbs. $16.00.



C Audio Unit (printed circuit prewired), speech amplifier for crystal or carbon microphone, first audio for receiver and power amplifier/modulator stage. Designed to follow unit B. Includes output transformer but not speaker. Shipping weight 2 lbs. $13.50

E Power Supply 115 VAC (not prewired). All parts necessary to construct power supply to operate Units A, B, C and D. Shipping weight 10 lbs. $12.00.

F Power Supply 3-way 6 VAC, 12 VDC or 115 VAC (not prewired). Shipping weight 10 lbs. $20.00.



D Transmitter Unit (prewired and tuned) Oscillator and amplifier. Crystal controlled. Requires Unit C for modulation. Shipping weight 2 lbs. Complete with crystal and tube certified .005% tolerance. $14.50.

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Spot News

Latest Information on the Electronic Industry

By ELECTRONICS WORLD'S WASHINGTON EDITOR

BALLOON-COMMUNICATIONS-SATELLITE LAUNCHING SCHEDULED FOR DECEMBER--Early in December, the National Aeronautics and Space Agency plans to launch the first of a series of communications satellites--a 100-foot aluminized balloon--designed to serve as a passive reflector to beam signals from a West Coast government installation to a Bell Labs depot on the East Coast. These earth-searching reflectors, which will be put into orbit after ejection from a rocket about 1000 miles above the earth, are expected to be visible from 10 to 20 minutes a day when their orbit is correct for coast-to-coast relays. Subsequently, NASA disclosed, they expect to place a reflector into orbit at a 22,000-mile point; a height at which the satellite would orbit around the earth at the same speed as the earth turns, or once every 24 hours, establishing a stationary position over one point on the earth. It has been estimated that 30 satellites of the passive type could provide global coverage and eventually be used to permit world-wide radio and TV broadcasting, improve navigation, revolutionize weather forecasting, and increase communications facilities for millions of additional signals.

SYMBOLS NOW ASSIST ELECTRONIC BRAIN IN READING SCIENTIFIC JARGON--Modern electronic processing machines are capable of solving many complex problems, but when it comes to reading scientific texts they are only at the grammar-school level. To overcome some of the vexing problems involved in machine storage and reading back such material, a special set of symbols or notation system has been devised by staff researchers of the Office of Research and Development of the Patent Office and the Massachusetts Institute of Technology. The new symbols make it possible to distinguish between a period at the end of a sentence and a period after an abbreviated word, or to recognize an italicized word, or a word in bold face type. The unique system, now being used in language analysis programs and in research into rapid patent searching methods, is actually a means by which the raw text of any publication can be translated into patterns of holes in a punched card or spots on a magnetic tape. All this can be done without loss of any typographical detail of the original text despite the small number of different characters that can normally be presented on the punched cards.

OVER 40-MILLION TAX RETURNS PROCESSED ELECTRONICALLY--Electronic processing of Federal income tax returns soared to a new record this year making possible speedier refunds to taxpayers and more effective detection of would-be tax evaders. According to Commissioner Dana Latham of the U.S. Internal Revenue Service, some 47 million returns were processed with high-speed electronic equipment this year, compared with 38 million last year and 1 million five years ago. Next year the government expects to process 60 million returns electronically. Three centers--in Ogden, Utah, Kansas City, Mo., and Lawrence, Mass.--house the electronic equipment which is used to verify mathematics on individual returns, compute tax owed, schedule refunds, issue tax bills, and process notices of payments due.

ELECTRONIC USAF MACHINE READS TYPEWRITTEN PAGES--The Air Force Research and Development Command has announced the successful development of an electronic information machine which reads ordinary typewritten sheets having both upper- and lower-case alphabetical characters; numerals which are self-checking for accuracy; and even reads the punctuation symbols. As it scans a line at a time, the device reads the information one character at a time and, upon identification, using stored electronic logic, it simultaneously converts the information into electrical signals at the rate of 200 characters per second. The reader uses a scanner to produce TV-like video impulses from the typewritten characters on a page and then analyzes the video pattern for various identification clues. Unlike most other electronic machines, this model can ask itself a question; that is, test for identification clues, simultaneously and continuously. This enables the print reader, after answering "yes" or "no" to a few of its own questions, to make a very sophisticated analysis in identifying the pattern.

-30-

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Model 77
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Model G-77 (Complete with G-Stand),
Chrome Finish, $97.45.

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When you're looking for the ultimate in cardioid microphones, consider these advanced features of Astatic's Model 77 and see if you don't agree that no other manufacturer has SO MUCH TO SING ABOUT—the most positive anti-feedback characteristics ever achieved, -18 db; exclusive Mylar diaphragm that is pop-proof and blast-proof, retains like-new flex properties for more years; an exclusive sintered bronze method of acoustic phase shifting that creates the industry's top directional characteristics; -52 db output and exceptionally flat response through 30 to 15,000 cps.

Do one thing for your own satisfaction. On your next installation, make a direct comparison of the Astatic 77 with any other cardioid. We'll guarantee —when anyone mentions the word "cardioid" again, you'll sing the praises of this incomparable Astatic instrument.

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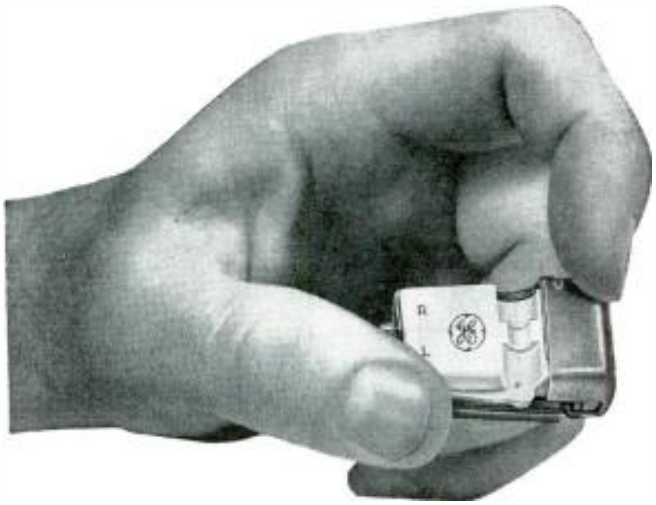

VR-225 .5 mil diamond stylus. For professional-type tone arms, $27.95.

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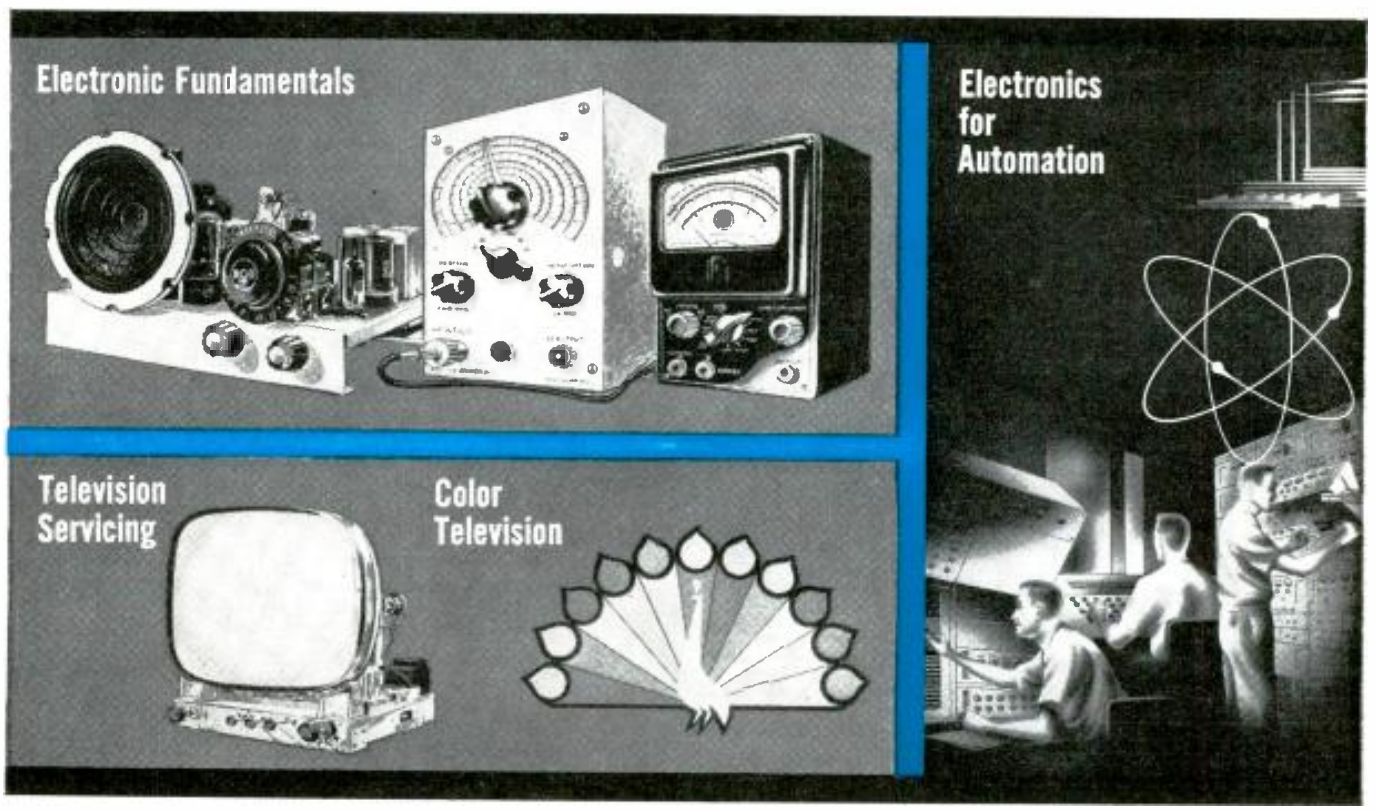

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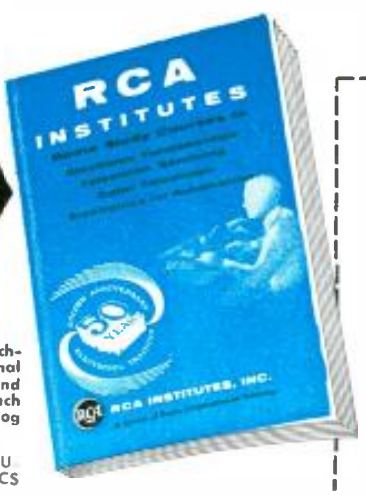

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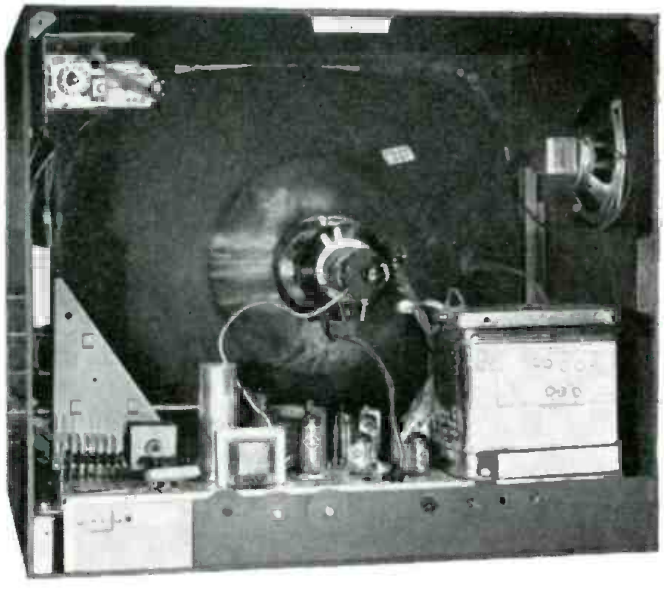

CBS TUBES TOP-RATED BY LEADING SET MANUFACTURERS

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Stereo Amplifier-Preamplifier HF81

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70W Stereo Power Amplifier HF87
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FM Tuner HFT90
AM Tuner HFT94

Stereo Integrated Amplifier AF4

12W Mono Integrated Amplifier HF12
Other Mono Integrated Amplifiers:
50, 30, & 20W (use 2 for stereo)

2-Way Bookshelf
Speaker System HFS1
3-Way Speaker System HFS3
2-Way Speaker System HFS5

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HF81 Stereo Amplifier-Preamplifier selects, amplifies, controls any stereo source & feeds it thru self-contained dual 14W amplifiers to a pair of speakers. Provides 28W monophonically. Ganged level controls, separate balance control, independent bass & treble controls for each channel. Identical Williamson-type, push-pull EL84 power amplifiers. "Excellent" — SATURDAY REVIEW; HI-FI MUSIC AT HOME. "Outstanding quality . . . extremely versatile."—ELECTRONICS WORLD LAB-TESTED. **Kit $69.95. Wired $109.95.** Includes cover.

HF85 Stereo Preamplifier is a complete, master stereo preamplifier-control unit, self-powered for flexibility & to avoid power-supply problems. Distortion borders on unmeasurable even at high output levels. Level, bass, & treble controls independent for each channel or ganged for both channels. Inputs for phono, tape head, mike, AM, FM, & FM-multiplex. One each auxiliary A & B input in each channel. Switched-in loudness compensator. "Extreme flexibility . . . a bargain."—HI-FI REVIEW. **Kit $39.95. Wired $64.95.** Includes cover.

New HF87 70-Watt Stereo Power Amplifier: Dual 35W power amplifiers of the highest quality. Uses top-quality output transformers for undistorted response across the entire audio range at full power to provide utmost clarity on full orchestra & organ. IM distortion 1% at 70W, harmonic distortion less than 1% from 20 to 20,000 cps within 1 db of 70W. Ultra-linear connected EL34 output stages & surgistor-protected silicon diode rectifier power supply. Selector switch chooses mono or stereo service; 4, 8, 16, and 32 ohm speaker taps, input level controls; basic sensitivity 0.38 volts. Without exaggeration, one of the very finest stereo amplifiers available regardless of price. Use with self-powered stereo preamplifier-control unit (HF85 recommended). **Kit $74.95. Wired $114.95.**

HF86 28W Stereo Power Amplifier Kit $43.95. Wired $74.95.

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New AF-4 Stereo Amplifier provides clean 4W per channel or 8W total output. Inputs for ceramic/crystal stereo pick-ups, AM-FM stereo, FM-multi stereo. 6-position stereo/mono selector. Clutch-concentric level & tone controls. Use with a pair of HFS-5 Speaker Systems for good quality, low-cost stereo. **Kit $38.95. Wired $64.95.**

HF12 Mono Integrated Amplifier provides complete "front-end" facilities and true high fidelity performance. Inputs for phono, tape head, TV, tuner and crystal/ceramic cartridge. Preferred variable crossover, feedback type tone control circuit. Highly stable Williamson-type power amplifier circuit. Power output: 12W continuous, 25W peak. **Kit $34.95. Wired $57.95.** Includes cover.

New HFS3 3-Way Speaker System Semi-Kit complete with factory-built ¾" veneered plywood (4 sides) cabinet. Bellows-suspension, full-inch excursion 12" woofer (22 cps res.), 8" mid-range speaker with high internal damping cone for smooth response, 3½" cone tweeter. 2¼ cu. ft. ducted-port enclosure. System Q of ½ for smoothest frequency & best transient response. 32-14,000 cps clean, useful response. 16 ohms impedance. HWD: 26½", 13⅞", 14⅜". Unfinished birch **$72.50.** Walnut, mahogany or teak **$87.95.**

New HFS5 2-Way Speaker System Semi-Kit complete with factory-built ¾" veneered plywood (4 sides) cabinet. Bellows-suspension, 5⅛" excursion, 8" woofer (45 cps res.), & 3½" cone tweeter. 1¼ cu. ft. ducted-port enclosure. System Q of ½ for smoothest frequency & best transient response. 45-14,000 cps clean, useful response. HWD: 24", 12½", 10½". Unfinished birch **$47.50.** Walnut, mahogany or teak **$59.50.**

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

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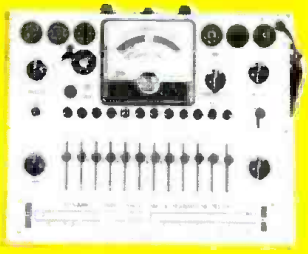

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KIT $29.95
WIRED $49.95

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KIT $79.95 WIRED $129.50
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C **150 kc to 435 mc with ONE generator** in 6 fund. bands and 1 harmonic band! ±1.5% freq. accuracy. Colpitts RF osc. directly plate-modulated by K-follower for improved mod. Variable depth of int. mod. 0-50% by 400 cps Colpitts osc. Variable gain ext. mod. amplifier: only 3.0 v needed for 30% mod. Turret-mounted, slug-tuned coils for max. accuracy. Fine and Coarse (3-step) RF attenuators. RF output 100,000 uv, AF output to 10 v.

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

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

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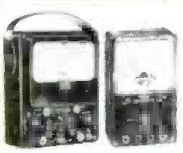

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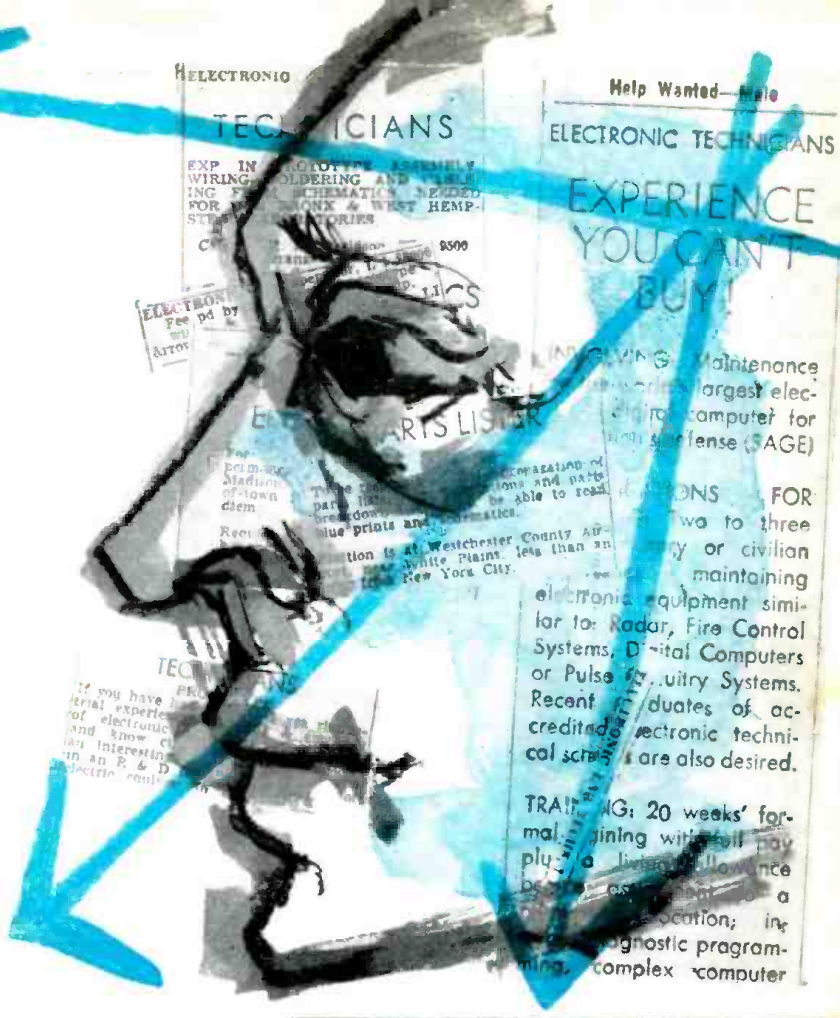
Name .....
Address .....
City ..... Zone ..... State .....

Land-based operator in an extensive ship-to-shore communications system.

Career Opportunities in Electronics

This technical illustrator, with an electronics background, adds nomenclature to drawing to be used in a technical manual.



Technical writers for the Ford Instrument Company prepare various electronics books.

By **WALTER H. BUCHSBAUM** / Industrial Consultant, ELECTRONICS WORLD

Enormous industry growth rate and shortage of skilled personnel pave the way for the non-graduate engineer and technician. Learn what and where the openings are, also the background and training that will be required.

ANY stock market analyst will vouch for the fact that the electronics industry is booming. With a total revenue of 13.2 *billion* dollars, the electronics industry has become not only a major factor in the entertainment world and the defense of our country, but has entered the area of economic importance shared by such industries as steel, automobiles, etc.

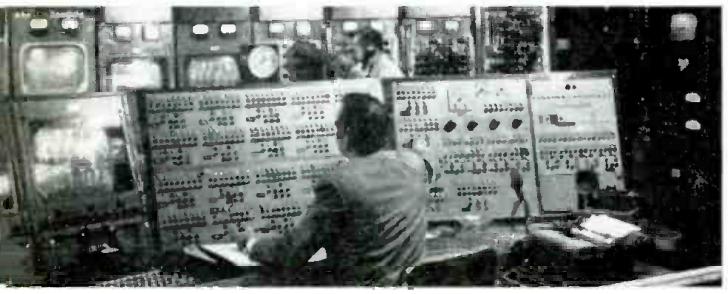
The size of the electronics industry is even more spectacular since less than fifty years ago it was practically nonexistent. Typical examples of recent growth are the increases in home and auto radios from 99 million in 1950 to 143 million in 1958 and the boost in television sets from 10,600,000 in 1950 to 49,700,000 in 1958. The entertainment segment of the electronics field is not alone in experiencing this phenomenal growth. In 1954 industrial electronics accounted for 650 million dollars and four years later, in 1958, this portion of the industry accounted for revenue of 1 billion, 380 million dollars!

These encouraging statistics are not merely of interest to the person investing his capital in the electronics industry but are of even greater significance to the person deciding on a career. It is true that extraordinary ability in any field can bring success, but in a field that is constantly growing every level of ability and effort will be richly rewarded. The opportunities for growth and advancement that exist in the electronics industry are unparalleled in any other field simply because electronics is still on the threshold of a much greater and more rapid growth than thus far achieved. In the fields of communication, computers, and industrial controls, new techniques together with new components will open up areas so vast that it is difficult for the human mind to grasp the potentialities. It is quite foreseeable that electronics in our lifetime will drive automobiles, fly airplanes, and control most production machinery. The realm of science fiction has been superseded by reality and, in most cases, it has been electronics which has made these technological advances possible. It is for these reasons that a career in the electronics field is bound to offer almost unlimited opportunities for advancement as well as growing financial rewards. It is easiest to grow in an industry that is growing.

Together with the spectacular growth of the industry, an equally astonishing personnel shortage has developed. The most publicized portion

There are many civil-service and other government positions for individuals with backgrounds in electronics. These include maintenance, installation, and repair of mobile communications systems in conjunction with such emergency services as fire control (upper left) and police work (below).

Many electronic technicians work in radio and TV broadcasting. The one at the lower left is operating an elaborate master control console in one of the NBC television studios.



of this shortage is in the ranks of graduate, experienced engineers and scientists, but supporting technical personnel is also in short supply, although less publicity has been given to this problem. To relieve the engineering shortage, many firms have undertaken reorganizations which are intended to provide engineers with more technical and administrative assistance, thus improving the efficiency of graduate engineering personnel. These reorganizations always involve the hiring of additional non-graduate technical personnel. Another great need for such people has developed in the testing, quality control, and field service departments of all electronic equipment manufacturers, government agencies, and in the broadcast-telecast field.

As is the case with most industries, the salaries of electronics personnel have risen to keep pace with inflation but, in most instances, have increased more than wages in other industries because of the inflexible law of "supply and demand." The supply of skilled technical help is limited, the demand is great and thus this type of labor commands higher pay. Efforts are being made to entice more and more young people into engineering careers by means of scholarships, job offers, and good wages, but it will take many years before the insatiable needs of this ever-growing industry can be fully met.

Readers of this magazine not already professionally engaged in electronics have sufficient background to build on. Many of these readers are young people not yet decided on a career and many others are working in some other field even though their main interest lies in electronics. Some of those working in the electronics industry often have been sidetracked, have reached a blind alley from which the opportunities for growth and profit seem very remote.

The table of career opportunities in electronics accompanying this article is intended to serve as a guidepost and reminder of the great variety of jobs available in our industry. Since graduate engineers are immediately snapped up by the eager recruiters of competing companies and since this article is addressed primarily to the non-graduate, none of the positions shown in the table requires a college degree. We have not listed jobs where a degree assures preference or where some specialized background other than in electronics is required. Actually, there are still more opportunities for people who can combine technical "know-how" with other skills.

Typical of this is the field of technical writing where a combination of technical "know-how" and a flair for conveying this information factually is needed. The combination of sales and technical ability is particularly well rewarded and technical salesmen or sales engineers are in great demand. Sales engineering is developing into a very substantial field in itself and invariably some technical knowledge is required. This seems obvious when we realize that the radio jobber's counterman must be able to understand the technician who buys a part just as the component sales engineer must speak the same language as the design engineer who evaluates a particular component. A general background in electronics and a good briefing by the manufacturer is usually sufficient to start an alert young man off in sales engineering. We know a number of men who started out ten years ago with a very basic knowledge of electronics, worked first as sales engineers, then as independent manufacturer's representatives, and now earn more than the president of the company which gave them their start in the field.

This field engineer is making a waveform check of a Univac II by Remington Rand. Rear of the Univac is in the background.

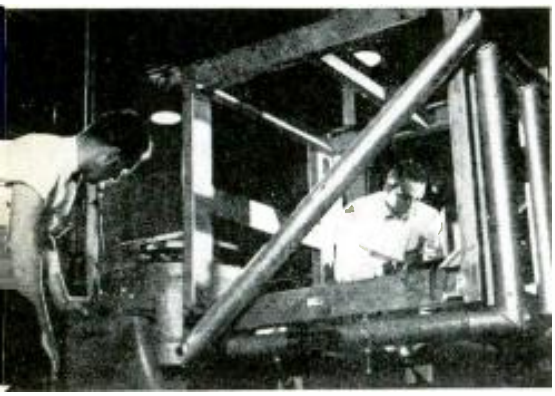
Levels of Skill

It is difficult to arrive at a universal method of grading the levels of skill and technical knowledge which qualify an individual for a particular job. The Armed Services have a system of grading skill levels and most manufacturers have their own methods of determining qualifications. Experience shows that in practically all instances an employer will try to determine just what a person can do rather than hire by a fixed, mathematical system of levels. For purposes of job evaluation, however, some kind of system is necessary. In the following paragraphs we have compiled a list of eight grades based on technical ability. Some of these grades may overlap, some may not apply in certain special cases, but they will allow the reader to get an idea into what grade he fits and then which of the career opportunities in the table are open to him.

It should be understood, of course, that a person having Grade 6 background can easily qualify for all Grade 5 positions. He would surely know how to use technical references and build circuits from them if he has graduated from a 2-year technical institute. On the other hand, if he is still attending school in his spare time, but already qualifies for Grade 4, his advancement will be more rapid than that of a person who has "completed"

FIELD	POSITION AND DUTIES	QUALIFICATIONS (Grade)	TRAINING	SALARY RANGE
Electronic Equipment Manufacturers	Design Engineer	8	Technical Inst. or 2-yr. College	$ 7 5-10,000
	Product Engineer	8	Technical Inst. or 2-yr. College	8-12,000
	Test Engineer: Plan procedures	7	Technical Institute	7-9500
	Quality Control Engr.: Supervise inspectors	7	Technical Institute	6.5-9500
	Assistant Engineer	7	Technical Institute	6-8000
	Junior Engineer	6	Technical Institute	5-7000
	Lab Technician: Build and test	4	Technical School	4.5-7000
	Field Engr.: Coordinate service	6	Technical Inst. or 2-yr. College	6-8000*
	Field Repairmen: Maintain and repair	4	Technical School	5-7500*
	Draftsman	3 plus	Technical School-Drafting Course	5-8000
	Foreman	3 plus	Technical School	6.5-9500
	Tester: Production Testing	3	Technical School	5.2-7000
	Inspector: Parts & Product Testing	2	Company Training	4-5500
	Assembler	1	Company Training	3.2-5500
Radio and TV Station	Transmitter Engineer: Adjust. equip.	5 plus FCC ticket	Technical School	5-12,000
	Technician: Repair & maintenance	3	Technical School	4.5-7000
	Camera Man	Special	Technical School	7.5-12,000
Communications Companies	Transmitter Engineer	6 plus FCC ticket	Technical School	6.5-8500
	Technician: Maintenance	3	Technical School	4.5-7500
	Lab Technician: Construct & test	4	Technical School	6-7500
Airlines	Radio Operator	4 plus FCC ticket & special training	Technical School & Company Training	6.5-9000
	Technician: Installation & maintenance	5	Technical School	6.5-8000
Business Machine Companies & Computer Firms	Field Service Engr.: Installation	5 plus	Technical School & Company Training	6.5-9000
	Programmer: Plan machine operation	5 plus	Technical School & Company Training	7-9500
	Field Service Technician	4	Technical School	5.5-7000
	See "Electronic Equipment Manufacturers" for additional positions			
Industrial Control Manufacturers	Field Engineer: Installation	6	Technical Inst. or 2-yr. College	6-9000*
	Field Technician	4	Technical School	5.5-7000*
	See "Electronic Equipment Manufacturers" for additional positions			
Component Manufacturers	Junior Engineer: Test Parts	5	Technical School	5-7000
	Field Engineer: Customer Contact	6	Technical Inst. or 2-yr. College	6.5-9000*
Nuclear Instrument Co.	See "Electronic Equipment Manufacturers" for positions			
Technical Manuals	Technical Writer: Prepare data, manuals	6 plus writing	Technical Inst. or 2-yr. College	6.5-10,000
	Draftsman	3 plus	Technical School-Drafting Course	5.5-8000
Radio and TV Manufacturer (Including hi-fi gear)	Field Engr.: Contact distributors	6	Technical Inst. or 2-yr. College	6.5-10,000*
	Field Repairman	4	Technical School	5.5-7500*
	See "Electronic Equipment Manufacturers" for additional positions.			
Radio-TV Distributor	Service Technician	3	Technical School	5.5-7500
Radio-TV Dealer	Service Technician	3	Technical School	5.5-7500
Community TV Company	Installer	2	Technical School	4.5-6000
	Service Technician	3	Technical School	6-8000
Fire, Police Municipal Governments	Operator: Adjust & transmit	4 plus FCC ticket	Technical School	6-7500
	Mobile Installation Technician	3 plus FCC ticket	Technical School	5.5-7000
Public Utilities	Transmitter Engineer	4 plus FCC ticket	Technical School	6-7500
	Installer & Repairman	3 plus FCC ticket	Technical School	5.5-7000
	Technician: Microwave maintenance	5	Technical School	6.5-8000
Phone Companies	Technician: Equipment maintenance	2-6	Technical School & Company Training	4.3-8500
Sales Organization	Field Engineer: Technical liaison	5	Technical School	5.5-9000*
	Sales Engr.: Sells technical items	3 plus	Technical School & Sales Training	6-15,000*
Military Electronics (Civilian Contractors)	Technical Repr.: Liaison with military	5 plus	Technical School & Military Service in Electronics or Administrative work	6.5-10,000*
	Field Service Engr.: Installation	6 plus	Technical Institute & Company Training	6.5-10,000*
	Field Service Technician	3 plus	Technical School & Company Training	5.5-7500*
	See "Electronic Equipment Manufacturers" for additional positions			
Military Electronics (Civil Service & Armed Forces)	Civil Service: Grades GS-5 to GS-15	3 plus	Technical School & Special Courses	4490-12,770
Other Govt. Electronics (Civil Service, NBS., FCC, FAA, etc.)	Civil Service: Grades GS-5 to GS-15	3 plus	Technical School & Special Courses	4490-12,770

* Plus travel and per diem expenses.



Testers (above) study stress in a computer frame at Burroughs Research Center.

An electronic technician (right) in an industrial job. He works with a Hughes electronic control system that turns out machine tools fully automatically.

Technicians hired by IBM (below) get advanced instruction in a company school.

his education with no further plans.

Personnel "Grades"

The following background and job experience or training would be required in each instance—with the qualifications outlined cross-referenced in the accompanying "job table."

Grade 1: Can wire, solder, assemble, and operate simple machine tools.

Grade 2: Can read and understand circuit diagrams, knows electrical components, units of measurement.

Grade 3: Knows fundamental radio theory as taught in trade schools, can service electronic devices by following detailed instructions.

Grade 4: Can construct simple devices and troubleshoot them from circuit diagrams only, can use basic test equipment.

Grade 5: Can design and build simple equipment from technical handbooks, can use all test equipment with manuals, and knows some algebra and trigonometry.

Grade 6: Is graduate of 2-year course at technical institute or has 2 years of general college subjects with some radio theory background.

Grade 7: Has three or more years' experience as technician in lab, servicing, or equivalent military experience. Can use all test instruments and troubleshoot any equipment with instruction manual and diagrams.

Grade 8: Has had two or more years' experience as a junior engineer. Can take accurate measurements, perform any type of test, and is able to design basic circuits.

Practically every reader below the engineering level will already fit into one of the grades noted, with many rating in the higher grades. Progressive advancement, from grade to grade, is almost always the rule with people who work in the electronics industry. In most instances a fairly ambitious man can pass from Grade 1 through Grade 5 in less than two years. Going through Grades 6, 7, and 8 takes more time because here the years of experience rather than theoretical knowledge is of greater importance. But even at the 7th and 8th grade levels, persons with a year or two of college, special experience in military service, or exceptional ability can often jump the time barrier and reach into higher level jobs.

From the foregoing we see that technical knowledge is like a ladder where one steps upward from the rung one has just reached.

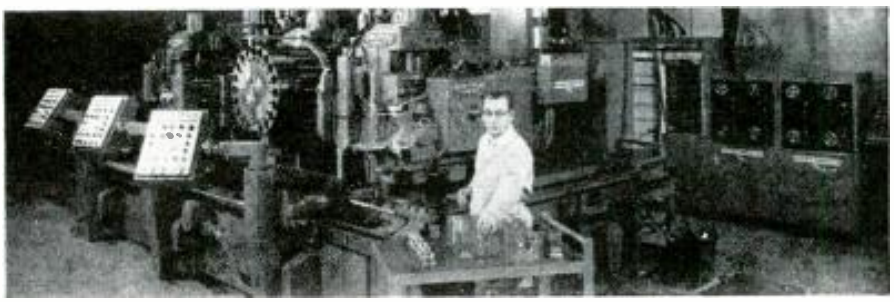
It is an unfortunate attribute of many young people that they want to make a living with a minimum of preparation and background. It is true that a young fellow without any training can get some kind of a job where he can sometimes earn almost as much as the technically trained man can expect at the start, but his earning power differs greatly once the trained man has a few years' experience. Technical knowledge, however basic it seems at first, has a way of growing. The hardest thing in starting a technical career is, unlike most other fields, buckling down to serious study. Getting a job right after graduating from a technical school will be much easier in the electronics industry than in any other field because there are so many jobs open. It is that small incentive that is needed to get started on a technical education that eventually spells the difference between working in a growing, well-paying industry or drifting from one unskilled job to another.

How to Get Training

Younger people, not yet far advanced toward final educational goals, have the enviable chance to start their technical education from the ground up. They can concentrate on physics and math courses and, in many places, they can attend a vocational high school where electronics is taught as part of the regular curriculum. After finishing such a school they can either go on to college and an engineering degree or they can attend a technical institute where a 2-year course will provide a solid footing in their chosen field. A 2-year course at a technical institute is probably the next best thing to getting a bachelor's degree, especially if the course includes substantial theoretical training. The advantages of this type of course include the practical work done in the shop, the use of fairly extensive test gear, and the invaluable first-hand advice from competent instructors. Rubbing elbows with the other students enables one to learn from their mistakes and gives this type of instruction an extra attraction. The ready acceptance by industry of technical institute graduates is further proof of their efficiency. Many individuals who now hold important positions in electronics launched their careers through such training. Their acceptance is likely to increase rather than decrease.

In many instances correspondence

(*Continued on page* 134)



FCC Answers Our Questions on Citizens Band

EDITOR'S NOTE: *There has been tremendous interest from our readers in the new Class D Citizens Radio Service. To give a better over-all picture of the intended purpose of this service and to furnish our readers with answers to many of their questions, we submitted the following questions directly to the FCC. Mr. Curtis B. Plummer, Chief of the Safety and Special Radio Services Bureau of the FCC, was good enough to supply us with these official answers.*

Here are the official answers to some very important questions on the new Class D Citizens Radio Service.

You MAY use the Citizens Band for:

- Private short-distance radio communications for personal or business use, limited to the minimum practicable transmission time.

You MAY NOT use the Citizens Band for:

- A hobby-type operation in itself as opposed to its use, for example, for controlling models.
- Experimental use of radio on the air.
- Amateur operation. Calling "CQ", attempting to contact unknown Citizens Radio stations, trying to contact stations in as many states as possible is not permitted.
- DX operation. Attempting long-distance contacts with unknown stations is not permitted.
- Contacting amateurs and stations in other radio services, except in emergency.
- Recreational activity in and of itself, for the pleasure to be derived from such operation.

REMEMBER:

- A station license *is* required.
- An operator's license *is not* required.
- You *may* construct equipment, and adjust circuits with a non-radiating dummy load *without* a license.
- You *may not* make any adjustments that could cause improper operation when the unit is connected to an antenna without a commercial radio operator's license.

QUESTION 1/ *Just what is the purpose of the new Class D Citizens Band Service and what does the FCC hope to accomplish in setting this service up?*

ANSWER/ The Commission in 1946 established the Citizens Radio Service to provide private short-distance radio communication service with a minimum of restrictions and regulations, utilizing inexpensive, low-power portable equipment in connection with personal or business activities. It was the Commission's intention that it would accommodate three groups of potential users of the radio spectrum not previously accommodated. First, it was intended for those ineligible in other services. Second, it was to include the remote control of objects or devices. Third, it was planned for the individual citizen's use of radio—radio that could be used as a tool of convenience in his business or for his pleasure. The possible uses of this Service are as broad as the imagination of the public and the ingenuity of equipment manufacturers can devise. However, during the 1950's it became apparent that there was little or no development with respect to the third category of users previously mentioned. This was due, in part, to a general lack of low-cost, low-power equipment for use in the 460-470 mc. band. It also became evident that amateurs were making very little use of the 27 mc. band, even though the advance of the technical art made it clear that it was possible to produce low-cost, compact, efficiently operating equipment for this portion of the spectrum. Accordingly, in 1958 the Commission re-allocated frequencies in the 27 mc. ISM band from the Amateur Radio Service to the Citizens Radio Service and established a new Class D station for voice communication in this band.

QUESTION 2/ *How does the Class D Citizens Service compare with other mobile services?*

ANSWER/ The Citizens Radio stations generally, and Class D stations in particular, are low-power stations. The maximum plate power input to the final radio-frequency stage permitted for a Class D station is 5 watts. This is slight compared to the 60-600 watts generally used in other mobile services and the 2000 watts permitted on certain frequencies found in the Public Safety Radio Services.

A licensee of a Class D station can expect a consistent range of only 5 to 10 miles. However, range limitations here, as in other services, vary with the power input, height and location of the antenna, nature of the surrounding terrain, and other factors affecting radio communications. The antenna of a Class D station, operating at fixed locations, cannot exceed by more than 20 feet the height of any man-made structure or natural formation on which it is mounted, except that when mounted on an existing antenna structure, it shall not exceed the height of that structure.

Class D stations, as all other stations in the Citizens Radio Service, are subject to fewer restrictions on use than are generally applicable to other Safety and Special Radio Services. Thus, Class D stations may routinely be used for point-to-point communications and a licensed operator is not required at transmitters operated at fixed locations.

QUESTION 3/ *Can the band be used for business or commercial purposes?*

ANSWER/ The Citizens Radio Service including Class D stations may be employed for business as well as for personal communications, an advantage it possesses over other services. In the other services, communications must not only relate to a business activity, but in most cases are tied down to the particular activity which forms the basis of eligibility.

In addition to this greater flexibility of use, the licensee of a Class D station is not limited to an assigned frequency and may operate on any of the 23 specific frequencies available to that class station. Therefore, any interference problems resulting from someone else operating on the same frequency may be alleviated without prior Commission approval.

Other factors that might persuade a business to apply in the Citizens Radio Service rather than some other service are the relatively low cost of equipment, less restriction on use, the permissibility of point-to-point communications, and the lack of operator requirements.

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Direct-Coupled Transistor Amplifier

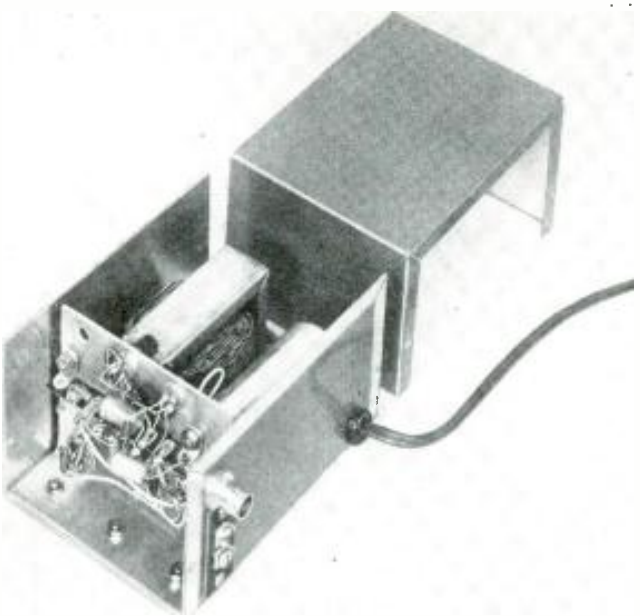

Fig. 1. Amplifier is built inside 5" x 4" x 3" closed box.

By **RICHARD S. BURWEN**
Minneapolis-Honeywell Regulator Co.
Boston Division

Compact, simple but high-quality amplifier delivers 0.9 watt. Costs about $23 to build; may be battery operated.

ELIMINATION of the costly and often distortion-producing output transformer has been the goal of many audio enthusiasts. This problem has been solved in the compact power amplifier shown in Fig. 1 by using a direct-coupled transistor circuit. The amplifier uses only three transistors and a half-wave transistor rectifier. The circuit is simple and inexpensive, delivers a high-quality signal at 0.9 watt output, and requires 0.8 volt r.m.s. input. When feeding a reasonably efficient speaker system, the amplifier will produce surprisingly loud room volume—about all anyone with close neighbors will want to use.

A single amplifier costs about $23.00 net to build. Two of these units built on a common chassis and using a single higher current power supply would make an excellent low-cost stereo amplifier. Operation from a 6- or 12-volt battery in an automobile or boat is another possibility.

The Circuit

In the schematic of Fig. 3, the output stage V_3 is a single common-emitter p-n-p power transistor. An 8- or 16-ohm speaker is connected directly in series with its collector. Since the output stage is class A-operated, its no-signal d.c. collector current of 0.5 ampere flows through the voice coil of the speaker. This current produces some heat and cone displacement, but the magnitudes are low enough to be of no consequence in 8-inch or larger speakers.

The driver stage is a p-n-p emitter-follower, V_2. To protect this transistor from excessive dissipation, its collector is connected to the output stage collector. When a signal increases the driver stage collector current, the output stage collector current also increases, thereby reducing the supply voltage for the driver and the power dissipated in it. The first stage, V_1, is a common-emitter n-p-n transistor with R_7 connected in series with its collector to protect it against exeessive dissipation.

Since the collector currents in all three stages have large swings, each stage, even V_1, generates appreciable distortion. This distortion is largely cancelled by the arrangement of stages and the selection of operating points.

In the power transistor, V_3, current gain, h_{fe}, decreases at high collector currents. V_1 and V_2 have more transconductance at high collector currents. The combined effect is fairly constant total gain as the signal varies, which means linear operation. Negative voltage feedback around the three stages, amounting to 29 db at audio frequencies and 39 db at d.c., reduces distortion and hum so that very high quality performance results.

This feedback voltage is developed across R_7 and C_3 from the emitter of V_1 to ground by feeding the output voltage through R_8 to this circuit. At d.c. C_3 is an open circuit allowing the entire output voltage to appear in series with the emitter of V_1, reducing the voltage gain to unity. The low d.c. gain and 39 db of d.c. feedback virtually eliminate temperature drift in all three stages. With unity gain the d.c. output voltage is nearly the same as the d.c. input voltage determined by R_2 and R_3, irrespective of the characteristics of the transistors and values of other components.

Capacitor C_3, acting as an a.c. bypass on the feedback circuit, increases the voltage gain from unity at d.c. to 10 db at audio frequencies. C_2 is a bypass on the reference voltage which serves three purposes at once. It filters power-supply hum out of the input circuit by grounding the junction of R_2 and R_3 through the low impedance of R_3 plus C_3; it provides positive feedback from the junction of R_7 and R_8 to the input circuit for the purpose of raising the input impedance to 500,000 ohms in order to prevent the loading due to the amplifier from deteriorating the performance of the source; and finally C_2 feeds some ripple current into the emitter of V_1 so as to partially cancel hum at the output. Low hum output is also a result of the basic design of the amplifier in which the constant-current output characteristic of each stage minimizes the effect of power-supply ripple.

The power supply uses an inexpensive power transistor, with its base tied

to its collector, as a half-wave rectifier which feeds a single capacitor for filtering. It delivers 8.4 volts d.c. at 0.5 ampere. Although the "B+" ripple is high, about 0.4 volt r.m.s., the amplifier output contains little hum.

Performance

Measurements were made across a 6-ohm resistance load, using a low-impedance source. Hum at the output terminals is 68 db below 1 watt. Other noises are negligible.

The frequency response shown by the lower curve in Fig. 6 is flat within ± 1 db from 5 to 100,000 cps. Confirming this response, the square-wave output shown in Fig. 2 exhibits little tilt at 50 cps (top) and practically no ringing at 5000 cps (bottom). The maximum output voltage *versus* frequency at 2% total harmonic distortion is shown by the upper curve in Fig. 6 when using a high-quality woofer-tweeter combination as a load and by the middle curve for a 6-ohm resistance load. When feeding the speaker system, full output with ± 1 db is obtained from 15 to 20,000 cps. With a resistive load, the power output falls off at 6 db per octave above 5000 cps because of the limitation on the speed at which the output transistor collector current can be cut off. This limitation is counteracted when using the speaker system as a load because its impedance rises at high frequencies due to the voice-coil inductance and reduces the necessary current swing.

Since a speaker system has an a.c. impedance greater than its d.c. resistance, a proper test of the power output would use a load having this property. The operating point of the output stage has been optimized to take advantage of this difference between a.c. and d.c. impedances in order to deliver the maximum power to a speaker. The typical load was assumed to have 6 ohms d.c. resistance and 8 ohms impedance at 400 cycles. With this type of load an overload signal causes the output stage to limit the positive and negative peaks at the same voltage. Using a resistive load, the negative peaks are limited at a lower voltage, resulting in less undistorted power output. The maximum mid-range power output to a 6-ohm resistive load is 0.75 watt at 0.8% total harmonic distortion, whereas the maximum power output to an 8-ohm speaker load having 6 ohms resistance is 0.9 watt.

At 0.5 watt into the resistive load, the distortion is only 0.4%. The distortion does not increase at low frequencies, as it does in transformer-coupled amplifiers, except below 20 cycles where the maximum power output falls off due to the reduction in power-sup-

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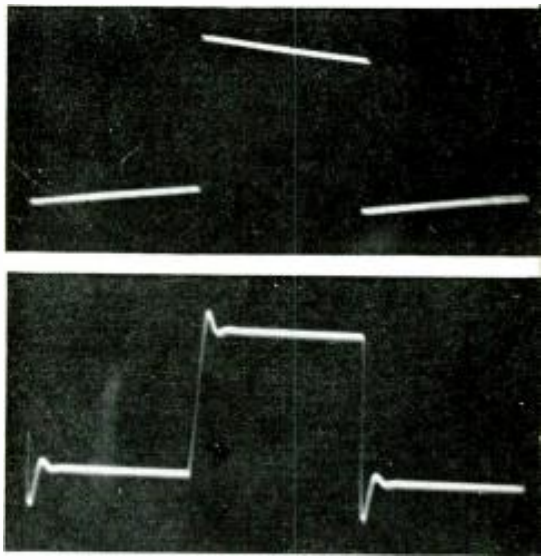
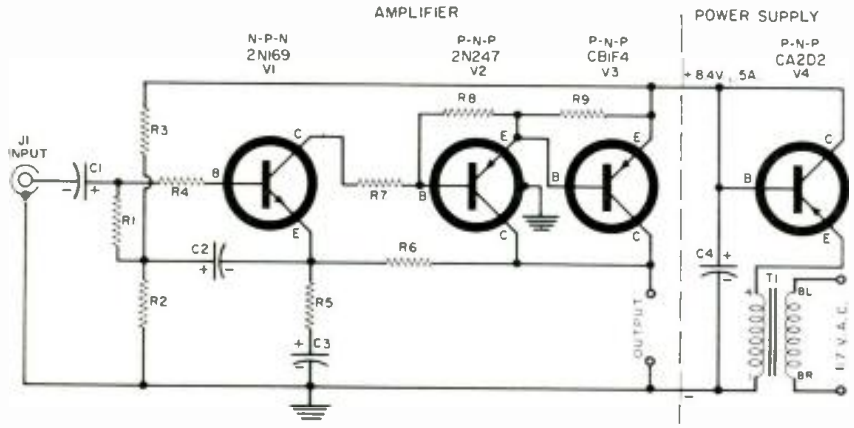


Fig. 2. Square-wave response at (top) 50 cycles and (bottom) 5000 cycles.



R_1—33,000 ohm, ½ w. res. ± 10%
R_2—22,000 ohm, ½ w. res. ± 5%
R_4—33,000 ohm, ½ w. res. ± 5%
R_5, R_7—2200 ohm, ½ w. res. ± 10%
R_6—120 ohm, ½ w. res. ± 5%
R_8—270 ohm, ½ w. res. ± 5%
R_9—10,000 ohm, ½ w. res. ± 10%
R_9—150 ohm, ½ w. res. ± 10%
C_1—5 μfd., 25 v. elec. capacitor
C_2—25 μfd., 10 v. elec. capacitor
C_3—200 μfd., 3 v. elec. capacitor
C_4—3000 μfd., 15 v. elec. capacitor
T_1—Universal line-to-voice-coil trans. 2000 ohm pri. to 16 ohm sec. (Thordarson T22S83 or equiv.)
J_1—Input jack
V_1—"n-p-n" transistor (G-E 2N169)
V_2—"p-n-p" transistor (RCA 2N247)
V_3—"p-n-p" transistor (Minneapolis-Honeywell CB1F4)
V_4—"p-n-p" transistor (Minneapolis-Honeywell CA2D2)

Fig. 3. Complete schematic diagram of the amplifier and a.c. power-supply circuit.

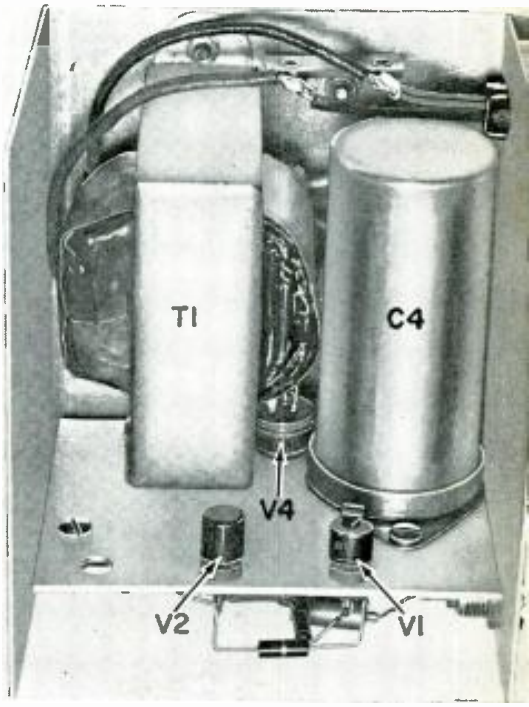
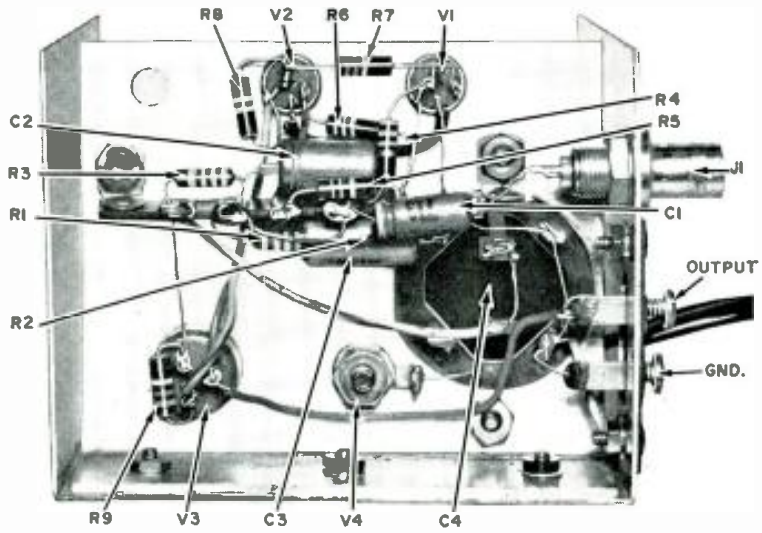


Fig. 4. This view shows the power-supply components along with 3 of the transistors.

Fig. 5. Bottom-chassis view of the transistorized amplifier is shown in this photo.



COVER STORY

COMPACT TWO-TUBE STEREO AMPLIFIER

Over-all view of the two-tube stereophonic amplifier covered below.

By J. AUGERI and D. CHRISTIANSEN, CBS Electronics

Complete stereo amplifier uses only 2 tubes, requires no power transformer. Delivers 3.5 watts per channel, and incorporates volume, balance, and tone controls.

THIS compact, lightweight (less than four pounds) stereo amplifier uses just two tubes and is built on a chassis measuring only 5" x 7" x 2". With the proper choice of stereo cartridge it provides on the order of 3.5 watts per channel. Although the unit should not be compared with higher power, hi-fi amplifiers, it does do a good job where simplicity and compactness are required. Versatile controls include "on-off" and master volume, balance, bass, and treble controls.

The key to the unit's compactness is in the use of the *CBS*-Simplex circuit developed by *CBS Laboratories* of Stamford, Conn. This circuit saves money as well as space. Thus, in addition to the two tubes already mentioned, the builder needs only a pair of inexpensive output transformers and a handful of resistors, capacitors, and miscellaneous parts.

Although the *CBS*-Simplex circuit has been adequately described elsewhere,[1, 2] the reader may find the following review of its operation interesting and helpful. The schematic diagram shows the basic push-pull circuit with an additional output transformer (T_2) connected in series with the "B+" centertap of the push-pull transformer (T_1). This second transformer, plus the symmetrical connection of the speakers with respect to the *transformer combination*, are the important features of the circuit.

What the circuit accomplishes, in effect, is the selective amplification of two separate components of the total stereo signal—the "major" component by push-pull action and the "minor" component by single-ended action. Beyond the stylus itself, the total signal does not exist as a single measurable entity. It does exist, however, at the grids of V_1 and V_2, as two separate signals proportional to the right- and left-channel information picked up by the stylus and, as we shall see, at the output transformers in somewhat different form.

If the instantaneous values of the signals at the input grids are R (right) and −L (left), respectively, then a signal proportional to R *plus* L is amplified *via* the push-pull action of the circuit and a signal proportional to R *minus* L is amplified by its single-ended action. Herein lies the secret of the circuit. With proper phasing of the cartridge terminal voltages, the "R plus L" signal is directly related to the lateral component of stylus motion. Because this lateral component determines the main qualities and power of both channels, it is logically the component we want to amplify *via* push-pull action.

The other ("R minus L") component, although important, is less critical by virtue of its being related to the vertical component of stylus motion and it is amplified "single-endedly." This selective amplification of the two portions of the stereo signal, incidentally, enables the builder to use a parallel or single-ended transformer (T_2) that is even smaller and less expensive than the push-pull transformer (T_1).

The individual channel information is recovered at the speakers by connecting them as shown. Thus, if the voltages at the secondaries of T_1 and T_2 are, for example, 10 (R+L) and 5 (R−L), respectively, the actual outputs can be computed by tracing the connections to each speaker. They would be, for the right channel: 5 (R−L) + ½ × 10 (R+L) or 10R and for the left channel: 5 (R−L) − ½ × 10 (R+L) or −10L.

Thus we note that the right and left channels are completely symmetrical

with respect to both quality and power. The minus sign at the left channel output simply indicates opposite phase, as did the minus sign at the left channel input. It means that the leads to one speaker must be reversed in order to get the two speakers to operate in-phase.

The cartridge used by the authors is the *Columbia* SC-2. This commercially available cartridge is manufactured specifically for use with the *CBS*-Simplex circuit. It is identical to the *Columbia* SC-1 except for phasing of terminal voltages. Although other 3-terminal cartridges *cannot be used* with this circuit, 4-terminal cartridges having a sufficiently high output can be used by properly phasing their output voltages externally (reversing leads to one side).

Construction Details

The amplifier is built around a pair of newly introduced audio tubes (*CBS* 50FY8's). Each combines a high-mu triode and a power pentode in a single envelope. Plate and screen voltage required is only about 125 volts and thus a single silicon rectifier can be used for the d.c. supply.

The builder will find it convenient to first mount all the components with the exception of the controls. The 1N1081 silicon diode is mounted in a diode holder which is screwed to the side of the chassis. The heaters should be wired first, with the d.c. supply next. For low hum, care should be taken to wire the heaters so that pin 4 of each tube is toward the ground side and the heaters are on the ground side of R_{16}, the 120-ohm, 4-watt resistor. Incidentally, C_8, C_9, C_{10}, and C_{11} can be a multiple-section electrolytic, but in the amplifier shown in the photographs, C_{10} and C_{11} are actually separate capacitors.

Other connections are then completed and finally the controls are mounted and wired. Shielded wire is used between the input jacks and the controls. The shielded wire should be grounded to the chassis at the input jack end only to minimize hum pickup.

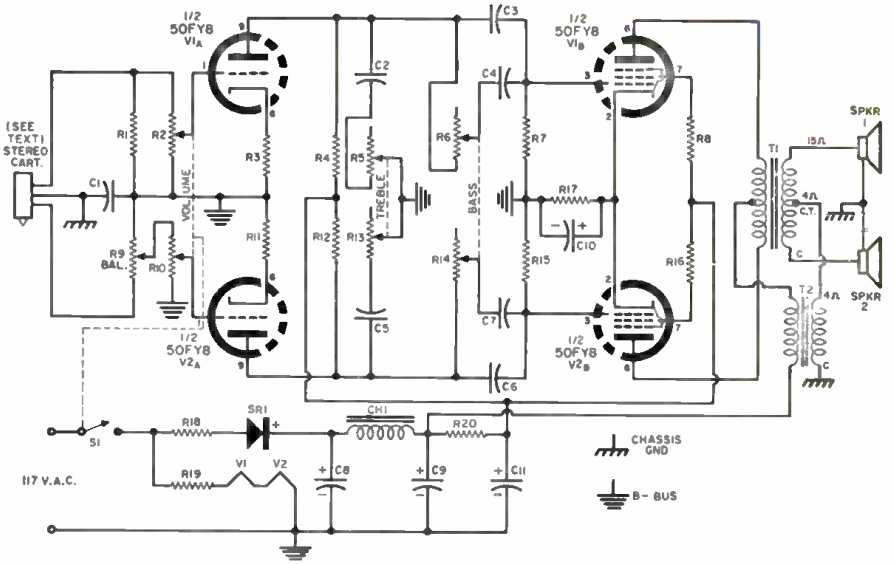
The balance control, R_9, is a single 2-megohm audio-taper pot on one side of the amplifier only. This was done in order not to sacrifice any gain and means that the tubes may have to be swapped, initially, so that the stronger tube is on the same side as the balance control. Master volume, bass, and treble controls are dual half-watt pots and the "on-off" switch is ganged to the master volume control.

The builder will probably want to experiment with various speakers. Of course, they should be of the conventional high-efficiency type. For best results they should be identical and should have a voice-coil impedance of 3-4 ohms. The authors used a pair of *Columbia* AX130's, each having a 12-inch woofer and two 4-inch tweeters in a 4.5 cubic foot cabinet.

One speaker is connected to the common (black) lead and the other to the 15-ohm tap (green lead) of the push-pull transformer secondary. One side of the parallel transformer secondary is grounded to the chassis and the other is connected to the center tap (brown lead) of the push-pull transformer.

Speakers must be connected to operate in-phase. Phasing can be checked just as it is with conventional separate-channel stereo amplifiers. Note that this check should be made with signals applied to the input of the amplifier. If the speaker phasing is checked at the loudspeakers themselves, connections should be made in such a way that they are oppositely phased. This is required since the polarity of the signals applied to the speakers in normal operation is of opposite phase.

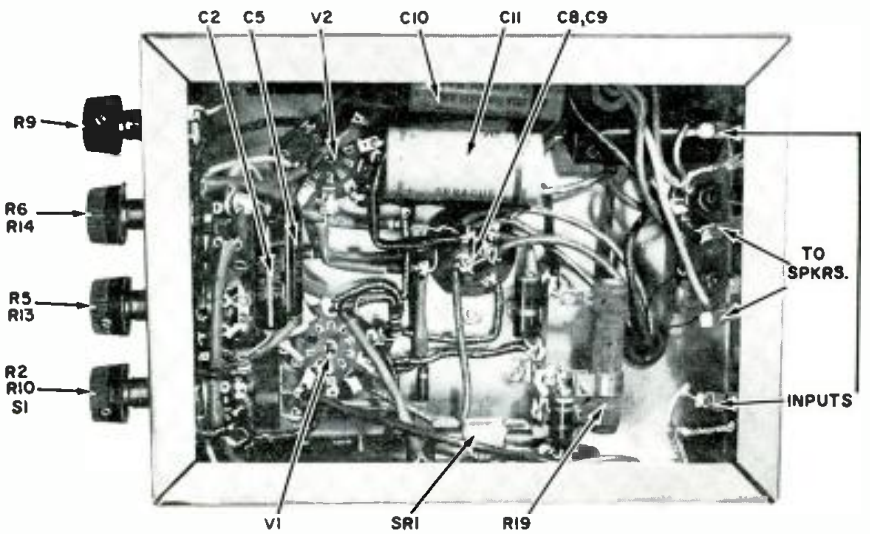
The system will provide amazingly good quality stereophonic sound at power levels entirely adequate for the average-size living room or den.



R_1—2 megohm, ½ w. res.
R_2, R_{10}—2 megohm, ½ w. dual audio-taper pot
R_3, R_{11}—1800 ohm, ½ w. res.
R_4, R_{12}—220,000 ohm, ½ w. res.
R_5, R_{13}—500,000 ohm, ½ w. dual linear-taper pot
R_6, R_{14}—1 megohm, ½ w. dual audio-taper pot
R_7, R_{15}—470,000 ohm, ½ w. res.
R_8, R_{16}—1200 ohm, ½ w. res.
R_9—2 megohm, ½ w. audio-taper pot
R_{17}—75 ohm, 2 w. res.
R_{18}—22 ohm, 2 w. res.
R_{19}—120 ohm, 4 w. res.
R_{20}—200 ohm, 1 w. res.
C_1—.1 μf. paper capacitor
C_2, C_5—.005 μf. paper capacitor
C_3, C_6—.0005 μf. paper capacitor
C_4, C_7—.1 μf. paper capacitor
C_8—100 μf., 150 v. elec. capacitor
C_9—80 μf., 150 v. elec. capacitor
C_{10}—100 μf., 25 v. elec. capacitor
C_{11}—60 μf., 150 v. elec. capacitor
CH_1—1.5 hy., 200 ma. filter choke
S_1—S.p.s.t. switch (ganged to R_2, R_{10})
SR_1—Silicon diode (1N1081)
Stereo Cart.—Columbia SC-2 stereo cartridge or equiv. (see text)
Spkr.1, Spkr.2—High-efficiency type speaker, 4-ohm v.c.
T_1—Output trans. 5000 ohms to 15, 8, 4 ohms @ 18 w. (Stancor A-3872 or equiv.)
T_2—Output trans. 2000 ohms to 4 ohms @ 5 w. (Stancor A-3876 or equiv.)
V_1, V_2—50FY8 tube (CBS)
4—Phono input jacks (RCA type)
1—5" x 7" x 2" chassis

Complete schematic diagram and parts listing for the two-tube stereo amplifier.

Under-chassis view of the amplifier showing wiring and layout of the components.



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1. Crowhurst, N. H.: "Single Push-Pull Stage for Both Stereo Channels," Radio & TV News, January 1959.
2. Bauer, Hollywood & Maerkle: "A Two-Way Stereophonic Amplifier," Audio, October 1958.

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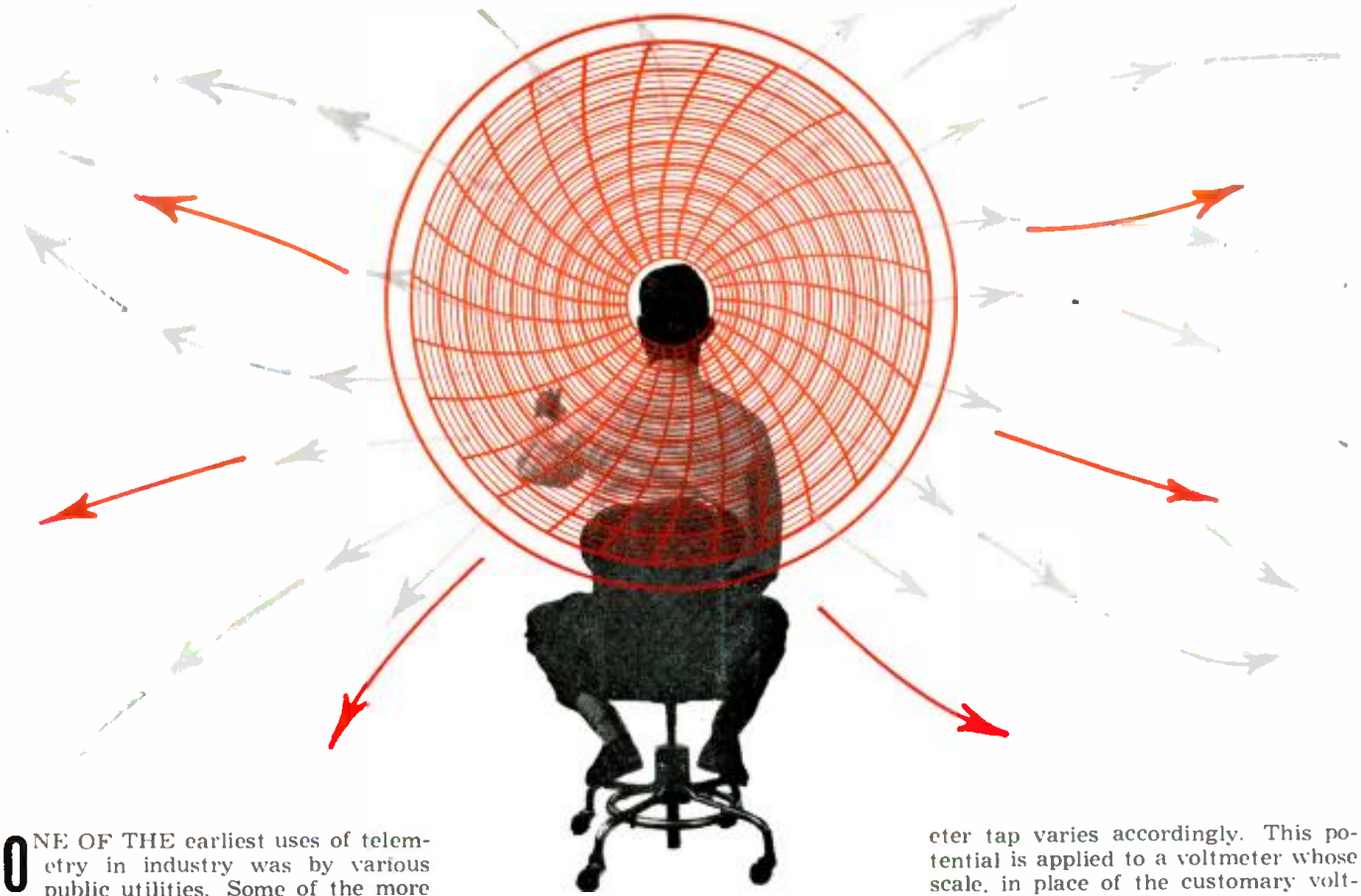


Industrial Telemetry for Technicians

By MARVIN TEPPER

Author of "Fundamentals of Radio Telemetry"

How readings are taken at one point and transferred to another, remote point.

ONE OF THE earliest uses of telemetry in industry was by various public utilities. Some of the more obvious applications in these utilities and in other industries include: reading of footage in remotely located water reservoirs; remote reading, enabling subsequent control, of pressure in gas tanks or pipelines; remote readings and storage control of oil tanks; and measurement of electric power at remote points.

A basic telemetering circuit, used by millions of people who probably do not realize as much, is the gasoline-tank gauge in an automobile. While it is true that the tank itself is actually not a great distance from the driver, the tank is nevertheless so located that it cannot be conveniently viewed to see whether it is full or empty. The simple device shown in Fig. 5 most often consists of a pivoted float with one end connected to the tap of a potentiometer. As the float rises or falls, the voltage at the potentiometer tap varies accordingly. This potential is applied to a voltmeter whose scale, in place of the customary voltage markings, is calibrated to read one-quarter, one-half, three-quarters, and full, or other quantities of fuel capacity.

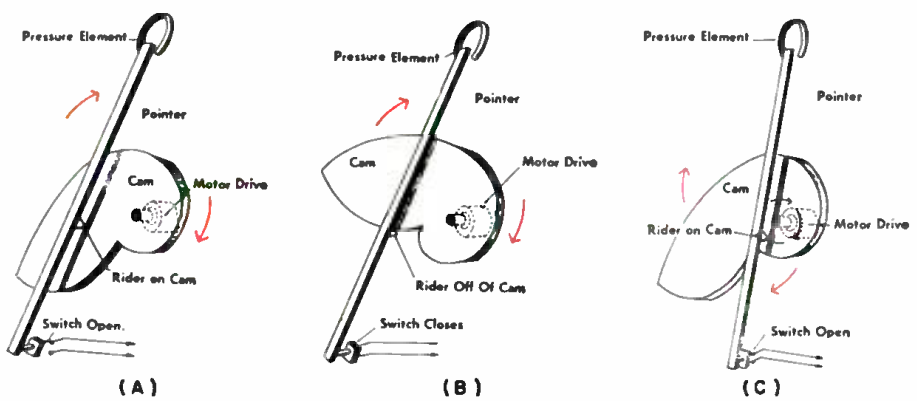
The telemetric device that does the actual measuring is most often called the *transmitter*, while the distant recording device is most often called the *receiver*. A simple arrangment in which these two elements are interconnected by wires need involve no other devices.

One of the simplest methods of measuring any quantity is to convert it to a code, where the quantity is transmitted as a function of time. For example, to indicate 10 pounds-per-square-inch of pressure, a switch may be closed for 10 seconds.

The basic mechanism of an impulse-duration transmitter, made by the *Bristol Co.*, is shown in Fig. 1A. The method used converts a value of pressure to a variable-duration signal. A spiral cam is revolved at a steady rate of one revolution each 15 seconds in this case. Tracking on the cam is a pointer with a special rider. At the bottom end of the pointer is a shorting device that opens or closes a switch. When the rider is on the cam, the switch is open; when the rider is off the cam (Fig. 1B) the switch is closed. The normal period of time during which the switch is closed may be 10 seconds, while the time during which it is open is five seconds.

At its top, the pointer is connected to a pressure-sensing element called a Bourdon gauge. This is a thin, hollow, elliptical tube, sealed at one end. When pressure is applied to the open

Fig. 1. The basic operation of an impulse-duration type of transmitter.



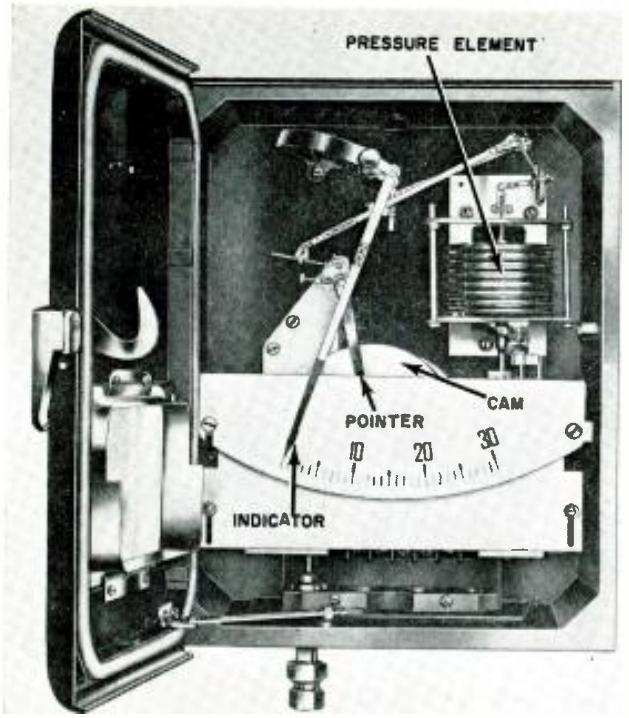


Fig. 2. Actual transmitter of the type diagrammed in Fig. 1.

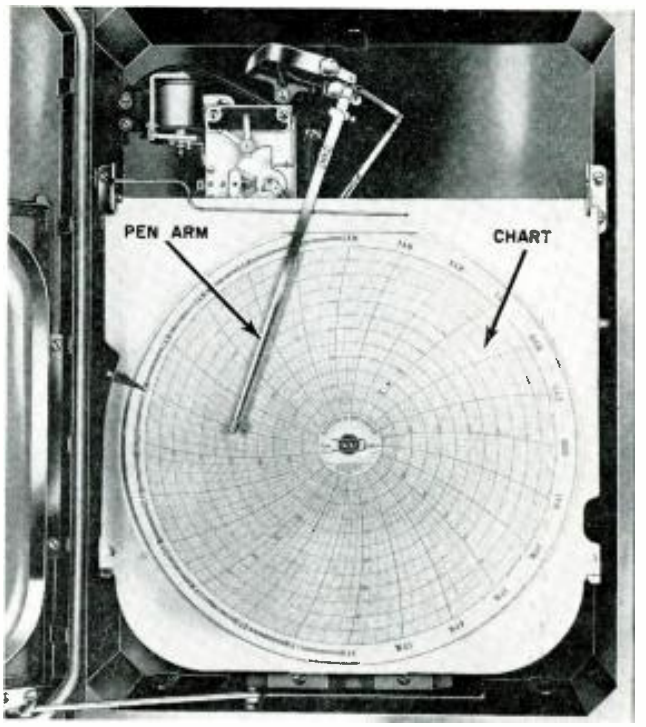


Fig. 3. This Bristol receiver records distant readings.

end, the tube attempts to straighten out. Assuming that maximum pressure is applied to the Bourdon tube in Fig. 1, a 10-second-on, 5-second-off period is provided. With reduced pressure applied to the Bourdon gauge, the pointer swings to the right and the rider now rides on the cam in a higher position.

With the rider on the cam in a higher position, the switch is left open for a longer duration of time and is closed for a shorter duration. Assuming the pressure has dropped to one-quarter of its original value, the time the switch will now be closed is reduced to approximately five seconds, although the rate of rotation of the cam remains the same.

A complete transmitter unit is shown in Fig. 2. In addition to the pointer riding on the cam, another pointer is used as an indicator. The bellows in the upper right corner is the pressure indicating device used to vary the time the rider is on the cam. A portion of the cam shows behind the dial scale.

The basic receiver designed to accept the output of the type of transmitter just described is shown in Fig. 4A. The "on-off" circuit of the transmitter switch (Fig. 1) is applied to a brake coil in the receiver (Fig. 4A). During the time that no signal is received, rotating gear *A* engages the pen arm, moving it in one direction. Upon application of a signal, the brake coil is energized, pulling gear *B* into mesh with motor-driven gear *M* while disengaging gear *A* (Fig. 4B). An arm of gear *B* then engages the pen arm, moving it in the opposite direction. A complete receiver unit is shown in Fig. 3.

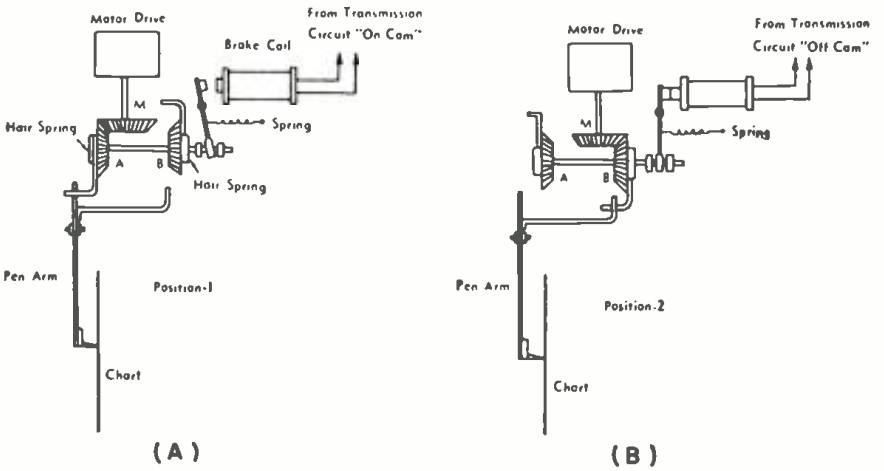


Fig. 4. Receiver mechanism without (A) and with (B) incoming signal.

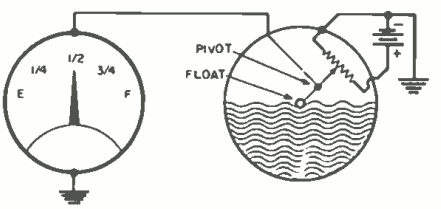


Fig. 5. The gasoline gauge in an automobile is a basic telemetering device.

The use of a transmitter and receiver for monitoring only a single value in a remote location is, of course, limited. Many schemes and devices are available to monitor multiple positions and values. One typical system, whereby the output signals of many receivers may be sent along a single wire

(*Continued on page* 105)

Fig. 7. When separated points are monitored in the same system, location of the transmission line is important.

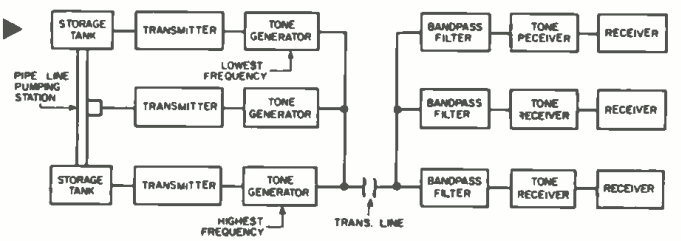
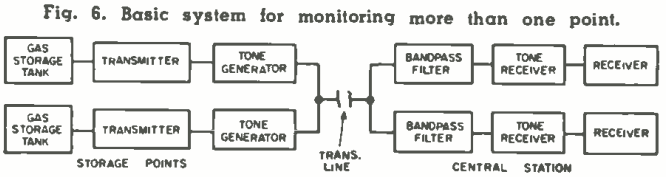
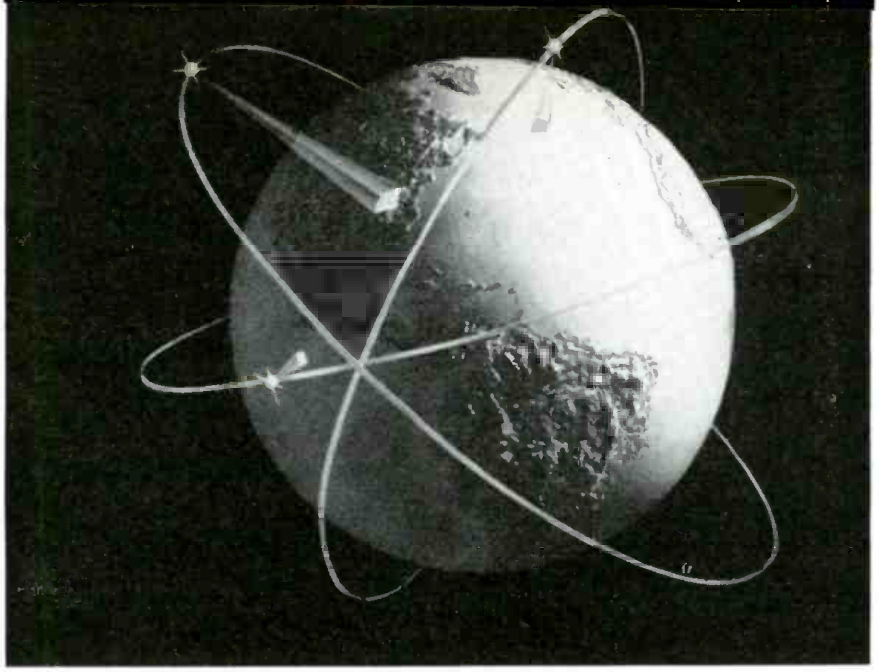


Fig. 6. Basic system for monitoring more than one point.





METEOROLOGICAL SATELLITES-

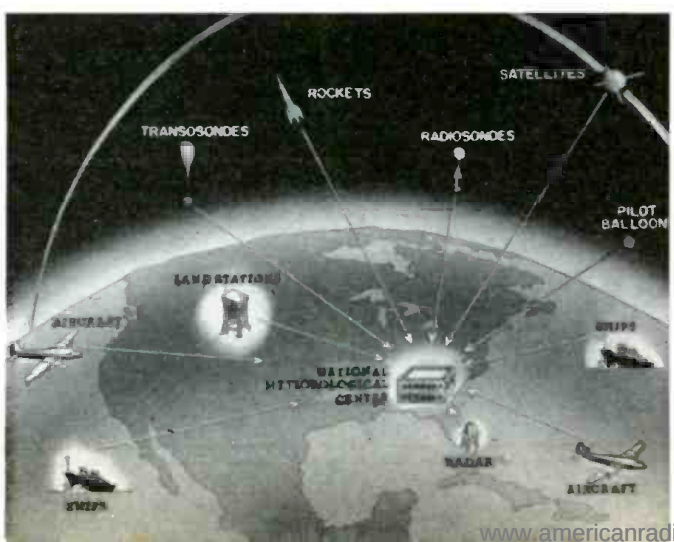
GLOBAL WEATHER OBSERVERS

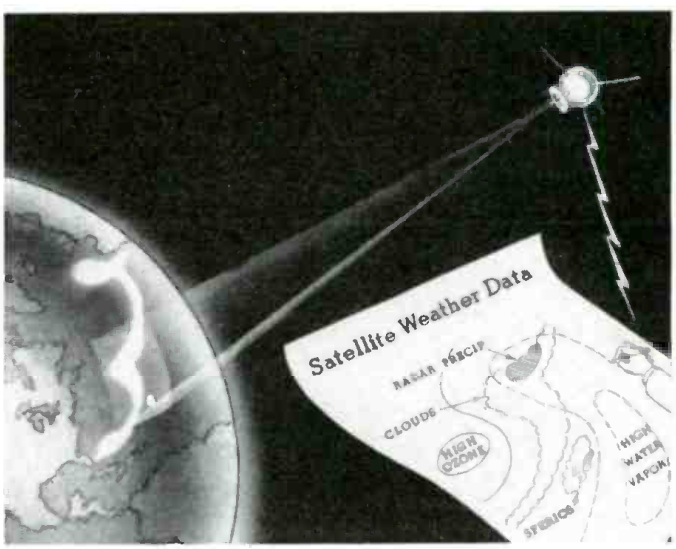
Weather information is now available from only a small part of the total atmosphere and it is possible for large storms to go undetected for days in isolated areas. Satellites orbiting the earth can provide constant surveillance of all storms, noting births of new ones, deaths of old ones.

Editor's Note: The following material was obtained from a U. S. Weather Bureau publication of the same name that had an extremely limited distribution, mainly to meteorologists. Because of the important part played by electronics in the instrumentation of satellites, we feel that our readers will be interested in this important application.

The Collection of Observational Data

Meteorological observations are made by the Weather Bureau in order to: (*a*) forecast weather and flood conditions, (*b*) determine the climatology of the United States and adjacent oceans, (*c*) provide informational service direct to public interests, and (*d*) do research leading to the discovery of natural laws governing the behavior of the atmosphere. The integration of satellite weather data with existing data will give man a more comprehensive picture of existing weather conditions. ▼





Meteorological Observations from Satellites

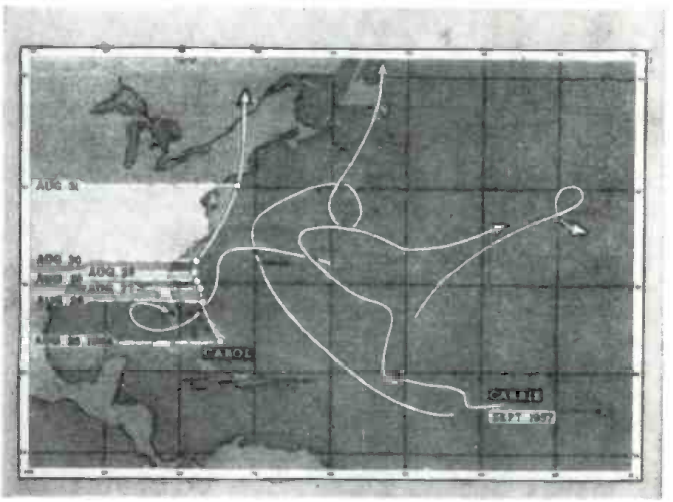
Experiments scheduled for satellite launchings in the near future include: 1. Cloud cover pictures from television cameras and 2. incoming and outgoing radiation (heat budget). Future satellite experiments may include: 1. Radar measurements of precipitation; 2. infrared measurements to obtain information about water vapor, ozone, carbon dioxide, and temperature; 3. detailed measurements of the solar spectrum; 4. thunderstorm distribution by visual and static (sferics) observations; 5. investigations of the optical properties of the atmosphere; 6. sampling of meteoric dust to test the theory that these particles may serve as cloud seeding agents; 7. measurement of surface atmospheric pressure. Also, the establishment of a network of communications satellites will make possible the speedy world-wide dissemination of weather data.

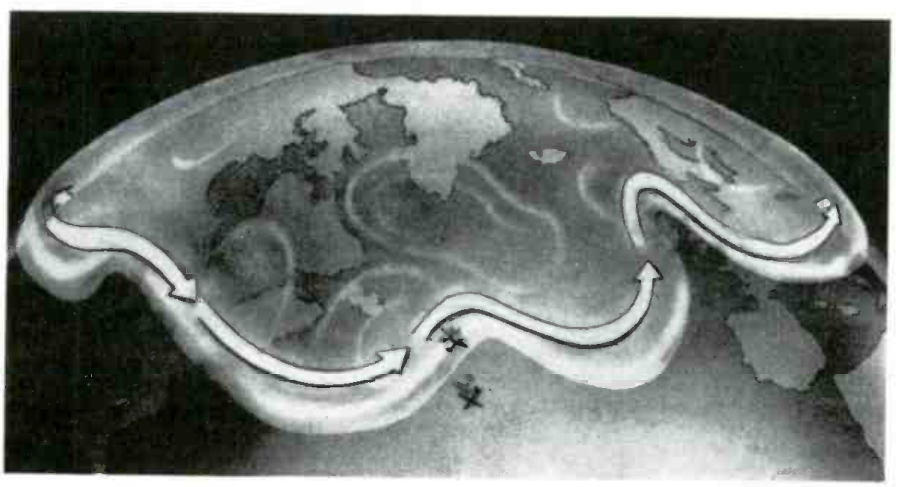
A Major Problem—Sparse Data Areas

The birth or intensification of storms in areas of sparse observational data is a major problem to the meteorologist. Numerous hurricanes have formed undetected off the west coast of Central America and their presence become known only when surface vessels encountered them without warning. Destructive storms have reached the Hawaiian Islands and the Aleutian Islands virtually without advance warning. In the tropical Atlantic, storms have reached full hurricane intensity before they were discovered by aircraft reconnaisance. The rocket photo (left), taken from an altitude of about 100 miles, shows two distinct weather systems which were not detected by the meteorological analysis made at the corresponding time. In the upper portion, just to the left of center, are clouds spiraling into an old tropical storm which produced over six inches of rain in three hours at Brownsville, Tex. and flooding in the Roswell, N. M. area. The storm in the lower right portion of the photo produced much lighter precipitation.

The Erratic Movement of Storms

Hurricane "Carol" was responsible for 60 deaths and almost 500 million dollars in property damage as it moved up the east coast of the United States, through New England, and into Canada. The track of "Carol" is one of the classic examples of record in that it shows deceleration, stagnation, and finally, rapid acceleration. Besides changes in rate of movement, storms occasionally will make radical changes in course, also shown in the illustration (right). The unusual track of hurricane "Carrie" was reported to be responsible for the sinking of the German windjammer "Pamir" with the loss of approximately 80 persons. Meteorological satellites, orbiting the earth at frequent intervals, will provide valuable information which will enable the meteorologist to make earlier detection of the irregular movements of severe storms. Also, it is conceivable that several important forecasting techniques might be developed from the studies of high cloud formations as viewed from the satellite.





Location of Jet Streams

Jet streams are considered significant features of the general atmosphere circulation and have an important influence on the development and movement of storms. Also, a knowledge of the location of jet streams is essential to efficient flight-planning operations for high-altitude aircraft. High cloud formations, as viewed over broad areas by television cameras aboard the satellite, will indicate regions of maximum cloud speed which can be directly associated with the position of jet streams. Also, the use of infrared sensors on board the satellite may enable the meteorologist to detect strong temperature gradients which are associated with jet streams.

The Atmospheric Heat Engine

Special instruments on board meteorological satellites will record and transmit to ground receiving stations radiation from the sun, atmosphere, and earth. Since "weather" results from winds attempting to equalize the non-uniform distribution of net radiant energy, it is important to keep an accurate account of the global distribution of this energy. The energy budget, when measured over long periods of time, will not only be useful in interpreting basic knowledge of the atmosphere but might assist in formulating a new system of long-range forecasts and in anticipating climatic changes.

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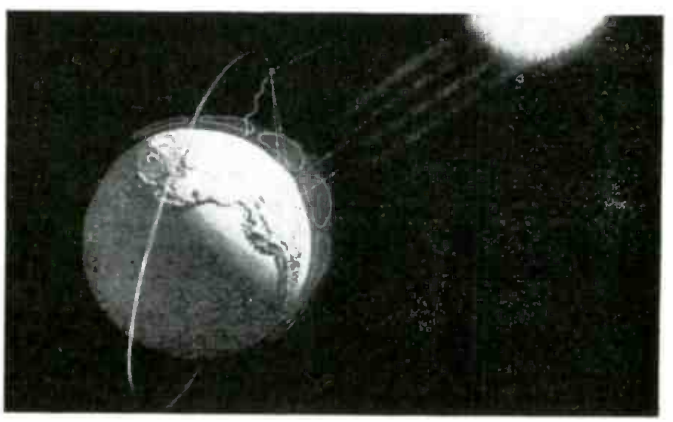


TELEPHONE INTERCOMS

For Home or Shop

One of the intercoms, clipped to television technician's belt, is being used here to help to orient a television antenna properly.

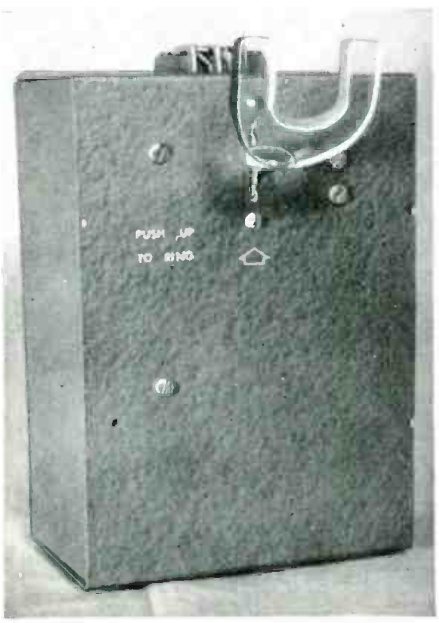
The construction of two simple "landline" systems that provide high quality reliable communication between two locations.

By **CHARLES CARINGELLA** and **RICHARD CLARK**

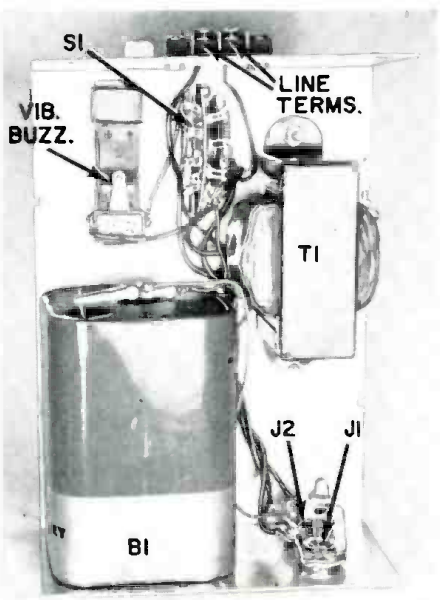
THE authors—in common with many others—have long been plagued by the problem of communicating around the house or shop. An intercom system is a handy device in the home if the shop is out of convenient "shouting range." Several systems were considered but proved to be too expensive or complex. A possible solution to this problem was a telephone-type intercom system. This idea was stimulated by the experience of one of the authors with G.I. field phones. Handsets have been available on the surplus market for some time. It was found that new handsets could be purchased for less than seven dollars a pair.

Several circuits were breadboarded using mike transformers, output transformers, etc., but all turned out badly. It became apparent that a transformer with three windings was needed. It was assumed that the line impedance would be approximately equal to that of the earphone unit. Two of the windings would have to have an approximate turns ratio of 1:1 with the third winding providing a voltage gain for the microphone element. A search of transformer catalogues turned up no suitable audio transformer, but it appeared that a small instrument power transformer might provide the needed windings. The transformers considered had a 117-volt primary, 135-volt second-

Over-all view of intercom using buzzer.



Interior view of this same intercom unit.



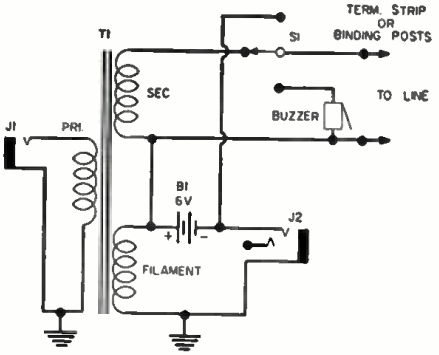
ary, and a 6.3-volt filament winding. These windings appeared to have the ratios required. The transformer picked was a *Triad* R-30X, though an equivalent type would have been OK.

The circuit shown in Fig. 1 was breadboarded and found to work exceptionally well. The response of the transformer to voice frequencies seemed to be quite good. A more accurate check proved it to be essentially flat from 60 to 10,000 cycles at the low levels required for this type of system.

All that was needed now to complete the telephone system was a "ringer." The selection of a suitable buzzer proved to be nearly as much of a problem as the transformer. A modified doorbell buzzer was tried but found to be unsatisfactory due to excessive current drain. The same results were obtained with a 6-volt relay wired as a vibrator. A common four-pin non-synchronous vibrator was tried. The vibrator assembly was removed from its case and bolted securely to the chassis. The noise produced was satisfactory for all practical purposes but the current drain was still excessive. The current drain was on the order of 1 ampere. This was due to the shorting action of the vibrator contacts. See Fig. 3A. Rewiring the vibrator according to Fig. 3B produced reliable action with a current drain of only 50 ma. This modification provided "make-break" rather than "shorting" operation of the vibrator. The contacts used had to be bent into a "normally closed" position.

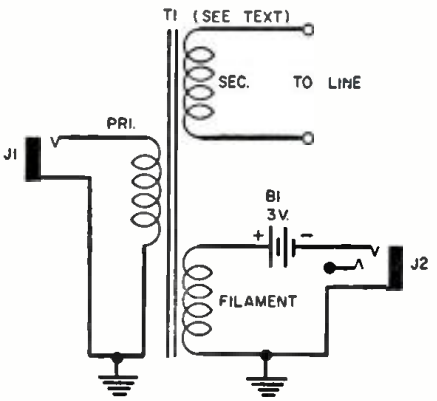
It was considered desirable to use a two-wire system in order that any common two-conductor cable such as TV twin-lead, lamp cord, etc. would serve as the "line." The two-line system presented a problem if semi-automatic switching was to be used. The buzzers would have to be across the line when in "standby" position and then switched out when in operation. Switching was accomplished by modifying a spring-loaded, lever-action switch to function as a "hanger switch." A handset hook was fashioned from plastic and attached to the arm of the lever switch. With the handset in place, the switch is pulled down, connecting the buzzer across the line. Lifting the handset allows the switch to return to the neutral or "talk" position. To ring the other station, the switch is pushed upward.

The units were constructed in 7" x 5" x 3" *LMB* box chassis. This size provided ample room for the transformer, buzzer, switch, and 6-volt lantern battery used for power. The lantern battery should have excellent service life. Placement of parts can be seen in the accompanying photographs. The schematic diagram of the complete unit is shown in Fig. 1. The handsets are Type H-94/U which are later versions of the TS-13. These handsets are equipped with a thumb-operated switch which must be depressed to talk. Mike current flows only when this switch is activated, therefore there is no battery drain when the units are in "standby."



J1—Two-conductor phone jack
J2—Three-conductor mike jack
S1—D.p. 3-pos. lever switch (Centralab 1455)
B1—6-volt lantern battery
T1—Instrument power trans. 135 v. @ 50 ma.; 6.3 v. @ 1.5 amps (Triad R-30X or equiv.)
Buzzer—Non-synchronous 6-volt vibrator (Radiart 5506 or equiv.)
1—H-94/handset
1—Box chassis (LMB No. 145 or equiv.)

Fig. 1. Complete circuit employed.



J1—Two-conductor phone jack
J2—Three-conductor mike jack
T1—See text
B1—3-volt battery (two 1.5-volt penlite cells in series)
1—H-94/U handset
1—Box chassis (LMB No. 650 or equiv.)

Fig. 2. Simpler circuit without buzzer.

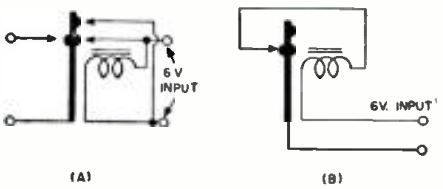
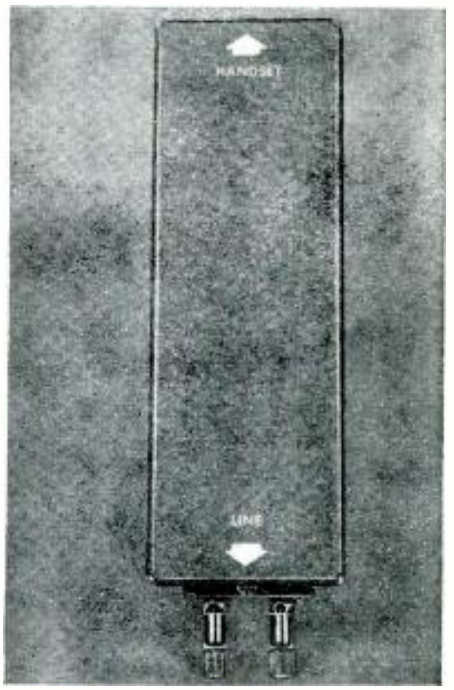


Fig. 3. Here is vibrator modification.

Some handsets are available without these "push-to-talk" switches. The specified hanger switch has an extra set of contacts which can be used to perform this function. For convenience, the components were mounted on what is normally the back side of the chassis box. The front side is then used for a wall bracket. The handset hooks can be made in several ways. The hook shown in the photos was made from ¼-inch sheet plastic. Sheet metal or coathanger wire could also be used.

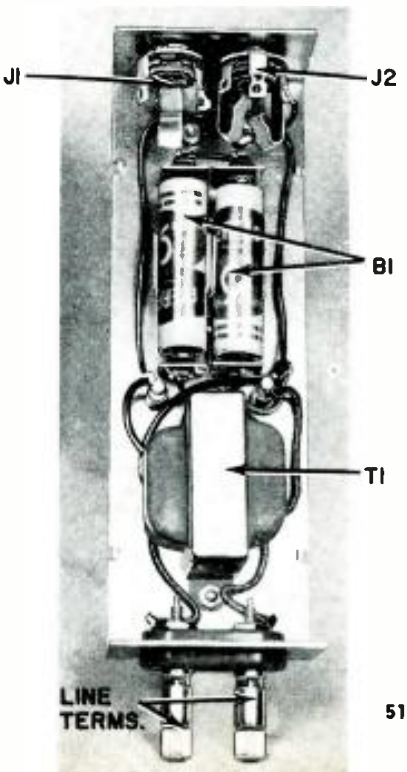
The circuit of Fig. 2 was the basis for a compact, portable telephone. These units have proved valuable for ham or TV antenna adjustments and other jobs requiring short-range, two-way communications. These units were constructed in 6"x2"x2" *LMB* box chassis. Belt hooks were made from sheet metal and attached to the back side of these boxes. The boxes were then clipped to the belt as shown in the lead illustration. The transformers used were miniature instrument power types frequently offered as "specials" by mail-order houses. Power is supplied by two penlite batteries in series. Battery clips are used to facilitate replacement.

Both systems are relatively inexpensive to construct. They should provide reliable communication for distances of up to a mile or more. Two or more units may be used "party-line fashion" by connecting them in parallel. –30–



Outside view of one of the intercoms.

Inside view of this same unit is shown.



IMPROVING THE Rainbow Generator

▶ Fig. 1. The author's altered unit, showing added switch.

By SOL LIBES
Westinghouse Electric Corp.

Two changes increase the jobs this type of unit can perform in both color and monochrome service.

WHEN any new area opens up in electronics, it brings with it requirements for suitable types of associated instrumentation. Thus when color TV came upon the scene, it created the need for new types of test equipment. Among the new "tools" that came into being were the various types of generators that could produce a color-signal output, including the kind that produces rainbow patterns.

While other color-signal generators produce output signals that are more broadly useful, the rainbow generator has satisfied the need, at moderate cost, for a source that provides a basic check for operation of the chroma section of the color set when no transmitted color signal is available. More recent versions of rainbow-type generators have had their versatility increased by the addition of a luminance signal for checking the operation of the monochrome circuits of the color set as well. If this function is not present in a rainbow generator, it can be added with very little trouble indeed, as will be noted later. However, another change can enhance the value of the instrument a great deal.

The addition of crystal control—a simple and inexpensive modification—can make the rainbow generator much more versatile in color work. After such an alteration the instrument becomes a dependable aid for checking and aligning a goodly portion of the chroma circuits and others. For example, the burst transformer, the color-reference oscillator and buffer transformers, and also the 3.58-mc. trap circuits located in the luminance channel may then be aligned reliably.

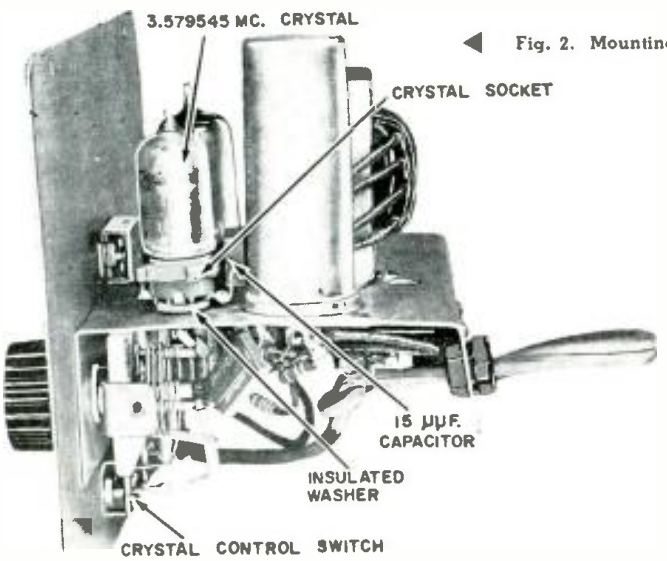
An accurate source of a 3.58-mc. signal, such as this revision provides, is essential for alignment purposes. Many a technician has, in the past, attempted to align a color receiver with the output of a rainbow generator, only to find that the set would not then work properly when receiving transmitted color programs. The reason, of course, is incorrect frequency output from the instrument.

As described here, the procedure for adding the crystal was worked out for the *Win-Tronix* Rainbow Generator, Model 150. The principle is so simple that a similar revision can be made to any generator producing this type of signal from the information given. Only three circuit components are added, plus a socket or holder for the crystal. A s.p.s.t. slide switch, a 15-$\mu\mu$f. capacitor, and the crystal itself make up the added circuit, which is shown inside the dashed box in Fig. 3.

A very accurate crystal (3.579545 mc.) is required. In this case, a unit made by *Midland* was chosen. Since it is enclosed in a miniature tube envelope, a 7-pin miniature tube socket was used for mounting. The advantage of this combination lay in the fact that it permitted simple mounting. (See Fig. 2.) A bolt through the center of the tube socket and an insulated washer were used. Thus only a single hole, to accommodate the bolt, had to be drilled in the steel chassis. A conventional cartridge type of crystal in a matching holder could also be used.

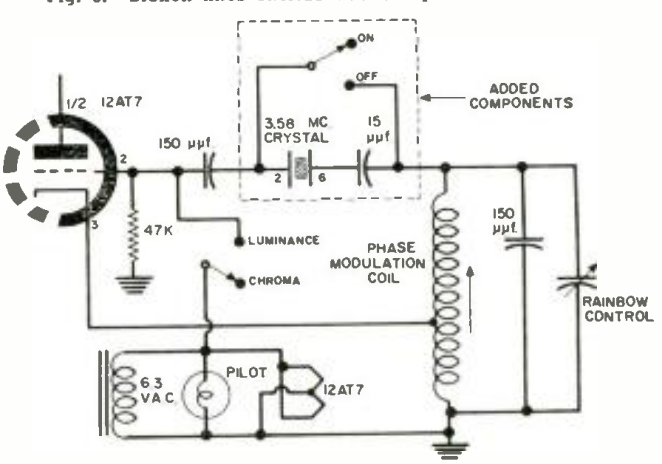
The slide switch was mounted on the front panel next to the "on-off" switch. It was located in such a way (Fig. 1) that only one nut and bolt were needed to mount the switch on one side only. On the other side, the switch can be held by one of the bolts securing the

(*Continued on page* 100)



◀ Fig. 2. Mounting of the crystal on an available spot on the chassis.

Fig. 3. Broken lines enclose added crystal-control circuit.

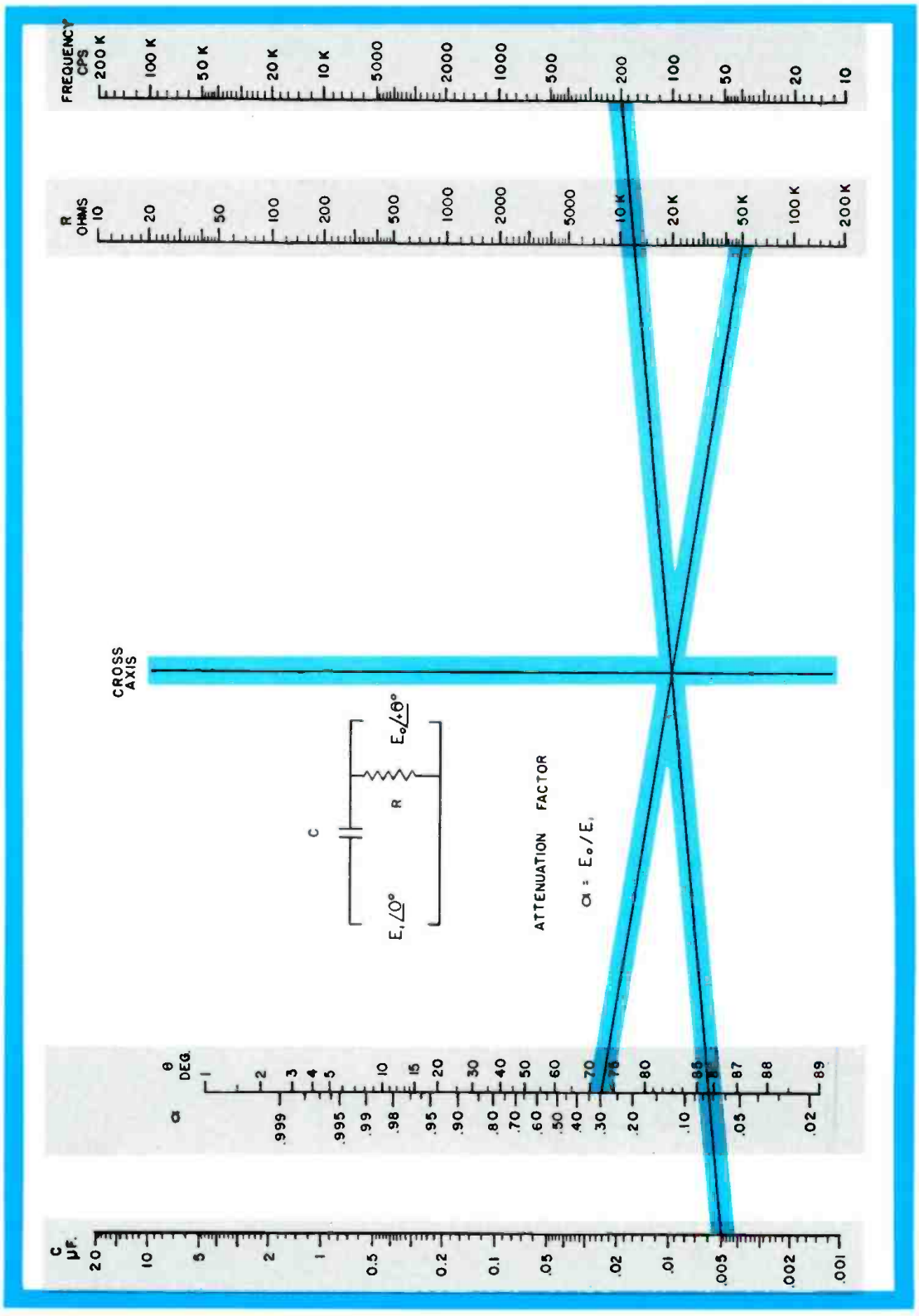


RC COUPLING NETWORKS

By GILMORE BOWERS

This nomogram provides an easy method of calculating phase shift and attenuation in RC coupling networks.

DRAW a line between the value of C on the capacity scale and the operating frequency on the frequency scale. Draw another line from the point where the first line intersects the "cross axis" to the value of *R* on the resistance scale. Extend this line to the attenuation and phase shift scale and then read the values of attenuation and phase shift.

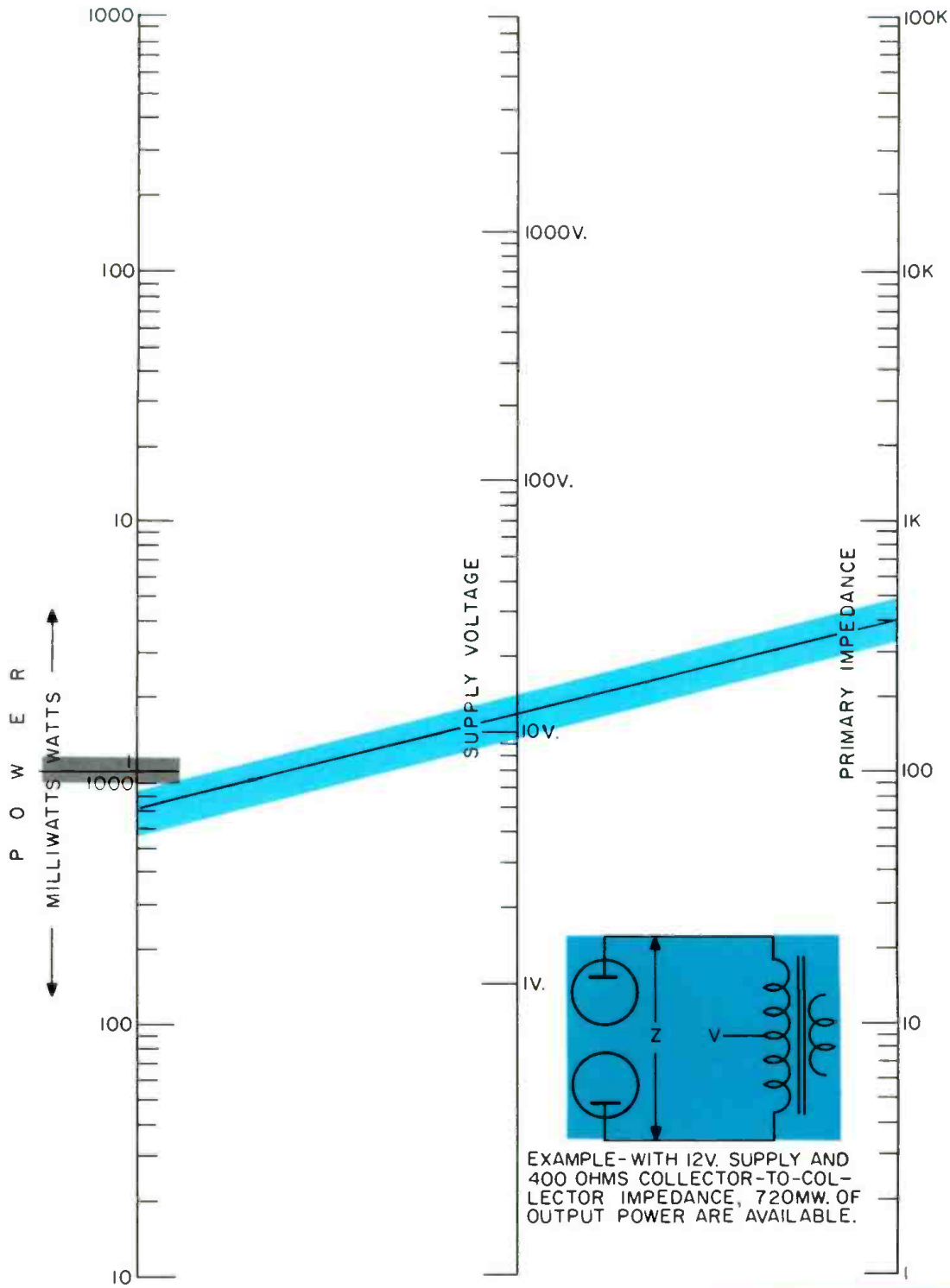


Output Power From Class B Push-Pull Stage

(Vacuum Tube or Transistor)

By D.D. BRIGLIA, D.D. McKIBBIN, and C.S. SEARING
Lockheed Aircraft Corp., Missile Systems Div.

This graph allows one to make rapid determinations of the available power from the output of class B vacuum-tube or transistor push-pull stages. The graph has been constructed for a circuit operating under the following conditions: The output is a sine wave; the collector or plate swings twice the supply voltage; and the available power is given by $(\sqrt{2}\,V)^2/Z = P$, where P = power in watts, V = supply voltage, and Z = impedance of the primary circuit.



Problems with Spurious Oscillation

By SOL HELLER

The many-headed monster is hard to recognize. Use this analysis of causes, symptoms, and remedies.

SPURIOUS oscillation is one of the more troublesome of a TV service technician's problems. Difficulty is frequently encountered in recognizing its existence and locating the stage and component at fault, as well as in eliminating the source of trouble. A tired bench man summing up the difference between oscillation and spurious oscillation, once said that the first condition made currents go round and round, while the second made his head do likewise.

Spurious oscillation may be more precisely defined as a state of *undesired* oscillation. It may affect an amplifier or oscillator stage. In the case of an oscillator, the spurious phenomenon occurs at a frequency other than the desired one.

Undesired oscillations may be grouped into six chief categories, depending on how they make a living: 1. Barkhausen oscillation. 2. Parasitic oscillation. 3. Oscillation due to feedback between two stages through a common impedance in the power supply. 4. Oscillation due to feedback between two stages through a common impedance in some other circuit such as an a.g.c. line. 5. Oscillation due to coupling of two stages through the filament circuit. 6. Oscillation due to feedback between the tuned plate and tuned grid of an amplifier.

Barkhausen oscillations tend to be generated in the horizontal output tube when the plate voltage drops sharply from a positive to a negative peak with the onset of the horizontal retrace. The screen grid remains substantially positive at this time, attracting electrons that originally intended to go to the plate. The electrons turn back from the plate toward the screen. With the end of the retrace a short time later, the plate goes positive and electrons travel from the screen back again to the plate. The back-and-forth movement constitutes an oscillation. The oscillatory signal is radiated, and tends to get into the front end, where it heterodynes with the r.f. signal generated by the local oscillator. Spurious beat frequencies are formed as a result of the beating the Barkhausen signal and its harmonics get. Some of the beat frequencies fall into the band-pass of the video i.f. section, and thus get through the receiver in the same way as the desired intermediate frequencies. The detected Barkhausen signals form pulses that are reproduced as vertical grey or black lines at the left-hand side of the picture screen.

The vertical lines produced by Barkhausen oscillation may be differentiated from somewhat similar lines resulting from other conditions by the following characteristics:

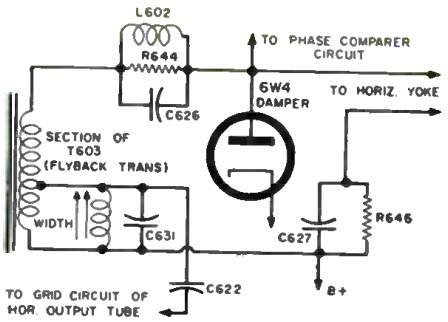


Fig. 1. Plate network in this Philco damper keeps oscillation out of yoke.

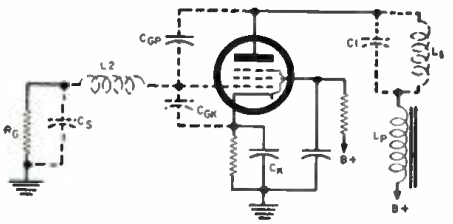


Fig. 2. Hidden stage reactances include plate (L_1) and grid (L_2) circuit inductance; plate (C_1), grid (C_2), and cathode (C_K) circuit capacitance; and tube interelectrode capacitance, such as C_{GP}, C_{GK}.

Fig. 3. Parasitics on part of sine wave.

The lines, which may be one or more in number, are dark, never white. They have sharply defined edges. They tend to vary in width and intensity when channels are switched. Barkhausen lines are commonly more noticeable on the higher-frequency channels and when the brightness setting is low. Severe cases can cause horizontal synchronization to be upset since the Barkhausen pulses, when their amplitude is high enough, may be treated as sync pulses by the sync stages.

The first logical step in dealing with a case of Barkhausen is to reduce the horizontal-drive setting slightly. Excessive drive promotes visible Barkhausen trouble. If this doesn't do the trick, the familiar second step is replacement of the horizontal amplifier tube. The original tube will often function normally in some other receiver. Mounting an ion-trap magnet on the original tube may provide a cure and make a replacement unnecessary. The magnet's position is shifted until visible signs of Barkhausen are eliminated.

When the Barkhausen oscillation is not cleared up by the remedies just described, tests should be made to determine whether the transmission line, the strip of twin-lead commonly used to couple this lead-in to the tuner input, or the built-in or other indoor antenna (if one such is being used) is responsible for the trouble.

A built-in or other indoor antenna is often responsible for excessive pickup of Barkhausen signal because it is positioned close to components that may radiate Barkhausen signals—the horizontal-output tube and its associated leads, or the yoke and its leads. If the antenna is an indoor type, but not a built-in one, moving it farther from the set and noting the effects will serve as a test. If the antenna is a built-in type, substitution of an indoor unit that has been properly separated from the receiver will serve as a check. If these procedures don't completely eliminate the trouble, try using a piece of shielded lead-in from the receiver input terminals to the input of the front end.

Other remedies that have been successfully used to clear up stubborn cases of Barkhausen include: Substitu-

Fig. 4. Parasitics in the filament line may produce this effect on some TV sets.

tion of a coaxial or shielded line in place of a twin-lead line; placement of shields over unshielded front-end tubes; and enclosure of the front end in a shield box, if such a shield is not present. In some cases, the positioning of a filament choke in the tuner has been responsible for Barkhausen symptoms. Turn filament chokes to a position at right angles with their original ones and note results, to test for this possibility. Heater wiring in the tuner may also be picking up Barkhausen signals. Try changing the position of the heater wiring, and note results. Use of additinnal capacitance in the a.g.c. line has proved helpful in cases where Barkhausen is entering by way of this circuit.

When two chassis are used in a TV receiver, placing a metal plate (preferably copper) so that it sits under both chassis, and thus bonds them, has proven helpful in certain instances. In some sets, a network intended to filter out Barkhausen signal is present between the plate of the damper tube and the flyback transformer. Fnr example, C_{con}, L_{con}, and R_{con} in Fig. 1 serve this purpose. A check of the compnnents in this network will reveal whether a defect in one of them may be responsible for the Barkhausen symptoms.

Parasitic oscillation: The leads connected to the electrodes of a vacuum tube have a certain amount of inductance. Capacitance is also present between leads. The stray inductances and capacitances form tuned plate and grid circuits (See Fig. 2) at some high frequency—high with respect to the frequency of the normal signal passing through the tube. When conditions are "favorable," feedback from the tuned plate circuit to the tuned grid, through the interelectrode plate-to-grid capacitance, causes oscillation to take place. The oscillation is called *parasitic*. Parasitic oscillation is encountered most frequently in audio power amplifiers, horizontal-output tubes, and r. f. oscillators.

Parasitic oscillation in an audio power amplifier may be the cause of a continuous "frying" noise; or it may be responsible for an annoying buzz that is heard only on loud portions of a musical program, or it may manifest itself in reduced and distorted sound output. A rattle in the loudspeaker may also be due to parasitic oscillation. A common symptom is a high-pitched whistle that is not affected by a change in volume-control setting.

Less common is a high-frequency oscillation well above the audible range, but whose amplitude is large enough to cause grid blocking, cutting off the tube and causing the sound to disappear momentarily. When enough of the charge on the grid has leaked off to permit business as usual, the audio signals are heard nnce more.

Another possible symptom is a high-pitched howl resembling a microphnnic-induced noise. Tapping the

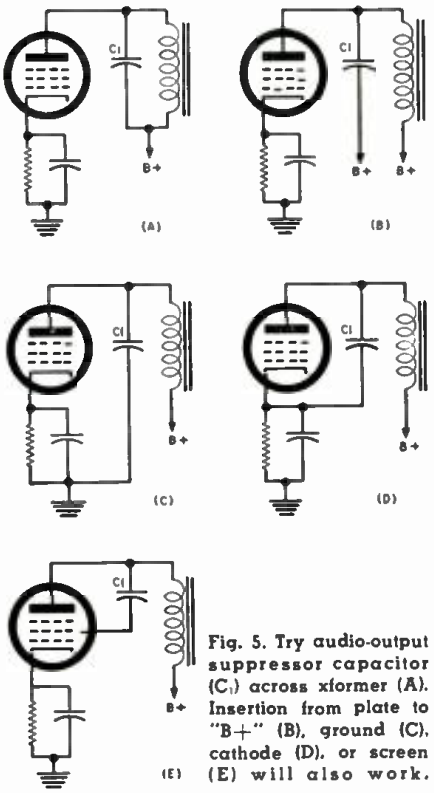


Fig. 5. Try audio-output suppressor capacitor (C_1) across xformer (A). Insertion from plate to "B+" (B), ground (C), cathode (D), or screen (E) will also work.

chassis or receiver components does not affect the oscillation-caused howl, permitting a differentiation to be made between these two kinds of noise.

When any of the symptnms just described are encountered, parasitic oscillation should be checked fnr, providing likelier sources of trouble are not evident. An oscilloscope and audio-signal generator nffer the best means of hunting for parasitic oscillatinn in the power amplifier (or any other audio-amplifier stage). The audio generator is applied to the input of the stage; the scope is connected to the output. The generator is tuned to different frequencies in the audio bandpass. The output nf the signal generator is simultaneously varied from zero to overload. The overload point will be indicated by a flattening of the peaks of the waveforms seen on the scope. If parasitic oscillation is present, the waveforms will shnw a thickening of the trace over the entire cycle, or a portion of it; or else a signal of higher frequency will be seen superimposed over the normal signal, as is indicated in Fig. 3. Actually, the thickening of the trace is also caused by another signal, but it is so much higher in frequency than the desired signal that it is blurred.

Conditions favorable to parasitic oscillation in the power-amplifier stage include: presence of an output transformer with substantial leakage inductance; long leads, particularly in the grid and plate circuits; grid-current flow; and a loss of capacitance or an open circuit in a plate bypass capacitor. The capacitor has an anti-parasitic function.

Remedies for parasitic oscillation in the audio power amplifier include: Relocation of the plate bypass capacitnr (C_1) in one of the ways indicated in Fig. 5 (use whichever one works); shortening the leads connecting to the electrodes of the power amplifier, particularly the plate and grid leads; improved lead dress (which means right-angling of leads) including adequate separatinn of plate and grid leads; and good ground connections. Insertion of an anti-parasitic resistor—100 to 500 ohms in value—in series with the control grid is often helpful. One side nf the resistor should be connected directly to the socket contact going to the grid. The resistor lowers the "*Q*" of the parasitic tuned circuit. A resistor of the same value may be connected in a similar fashion to the plate and/or screen electrode, if necessary. Replacement of the output transformer with one that has a lower value of leakage inductance, *i.e.*, a better-grade transformer, generally speaking, is a last-resort remedy.

Parasitic oscillation in the horizontal-output tube may be the cause of one of the following symptoms: Loss of width, due to the excessive grid-leak bias produced by the oscillation; "segmentation" of the picture, *i.e.*, breaking up of a portion of the picture into small, regularly spaced segments that are displaced some distance away from the main body of the picture; double image in the horizontal direction; jagged, pie-crust effect in the picture; vertical white lines or streaks on the right-hand side of the picture; and picture twist.

The presence of oscillation in the horizontal-output tube can be detected with an oscilloscope or v.t.v.m. The scope will show a signal at the grid, even when the output of the horizontal oscillator has been prevented from reaching the horizontal amplifier—say, by removing or otherwise disabling the horizontal-oscillator tube. When the oscillation is checked for at the horizontal-amplifier grid with a normal drive signal coming in, the symptom may show up as a thickening or "fuzz" on the sweep-signal waveform. The v.t.v.m. will reveal a substantial grid-leak voltage between grid of the horizontal amplifier and ground, with normal drive removed from the tube to avoid confusion. (It is assumed no fixed bias is present in the grid circuit.) It should be kept in mind, incidentally, that connecting a scope or v.t.v.m. lead to an electrode at which an oscillatory signal is present will affect the frequency and amplitude of the oscillation and may, in some cases, remove it al-

together. Watch for this possibility.

Another test for parasitic oscillation in the horizontal-output tube is to remove the preceding oscillator tube and note whether some horizontal deflection and/or high voltage continue to exist. If either or both are present, parasitic oscillation is indicated.

Remedies for parasitic oscillation in the horizontal-output tube circuit include: Changing the horizontal-output tube itself; insertion of an anti-parasitic 50- or 100-ohm, ½ watt carbon or composition resistor in series with the control grid, screen grid, and/or plate electrode (making sure one end of the resistor is attached directly to the socket contact to which the electrode connects); and decoupling of the heater circuit through the addition of an r.f. bypass capacitor (say, 100 or 200 $\mu\mu$f.) from the high side of the horizontal-output tube heater to ground.

On some *Sears-Roebuck* and other chasssis, a parasitic-suppressor coil, grounded at one end and floating at the other, is wrapped around the plate lead of the horizontal-output tube. If the coil's position shifts, a parasitic oscillation that produces a pie-crust effect in the picture is likely to result.

Parasitic oscillation in vertical circuits is sometimes encountered. When the resistor across the primary of a blocking-oscillator transformer opencircuits, parasitic oscillation will result in some cases. The oscillation may produce a white horizontal bar at the top of the raster, more readily noticeable when the brightness is turned up. It can also cause critical vertical sync.

Intermittent vertical collapse of the raster also may be due to parasitic oscillation in the vertical-oscillator stage. Changing the tube, or insertion of an anti-parasitic resistor of 50 or 100 ohms in series with the control grid, plate, and/or screen electrode, will generally eliminate the trouble.

Parasitic oscillation in r.f. oscillator circuits generally manifests itself by sudden changes in the frequency of the oscillator during tuning over a broad range of frequencies, or "dead" spots in the oscillator tuning range. Such oscillation is made more likely by any defect or condition that causes the oscillator's output to become excessive. If an anti-parasitic resistor has lost value or been removed, parasitic oscillation may occur. In some oscillators, a considerable reduction in the resistance of the plate dropping resistor may promote parasitic oscillation. The presence of parasitic oscillation may be determined with a wavemeter (or similar "absorption-type" instrument, like some grid dippers) having a suitable frequency range and a v.t.v.m. If the wavemeter produces a dip in the v.t.v.m. grid voltage reading of the oscillator at some frequency other than the one at which the oscillator is supposed to be working, parasitic oscillation is present.

Oscillation due to feedback between two stages through a common impedance in the power supply, or in the a.g.c. line, is possible when a filter or decoupling capacitor loses value. The tests for and cure of such conditions need no elaboration.

Oscillation due to coupling of two stages via the filament circuit is commonly prevented (and in rare cases, caused!) by filament chokes and filament bypass capacitors. Tests of these components are in order only when no other reason for parasitic oscillation can be found. Symptoms produced by oscillation that occurs *via* the filament supply include: horizontal sync instability and also white horizontal streaks at the left-hand side of the picture on high channel settings, as in Fig. 4. Many other symptoms are no doubt possible, but these two are the most common.

In some *Westinghouse* receivers—H640T17, for instance—an 800-$\mu\mu$f. capacitor is connected between the heater of the first video i.f. amplifier and ground. If video i.f. oscillation occurs in such a circuit, the capacitor should be disconnected to determine whether it is serving as a means of promoting the oscillation.

Oscillation due to tuned-plate to tuned-grid feedback: Oscillation can occur in an amplifier stage when plate and grid circuits are tuned to the same frequency: the necessary feedback takes place *via* the plate-to-grid interelectrode capacitance. The trouble is likely to appear in a video i.f. stage when an alignment is being performed. Stagger-tuned video i.f. stages are especially susceptible to this condition if alignment is off. A substantial d.c. voltage output at the video detector, with no signal input to the receiver, indicates that oscillation in the video i.f. section is indeed present. Receiver manufacturers' alignment notes generally list procedures that may be used to eliminate such oscillation. Slightly tuning the adjustments of successive i.f. coils in opposite directions until the oscillation has stopped, then going on with the alignment, is one procedure that is used.

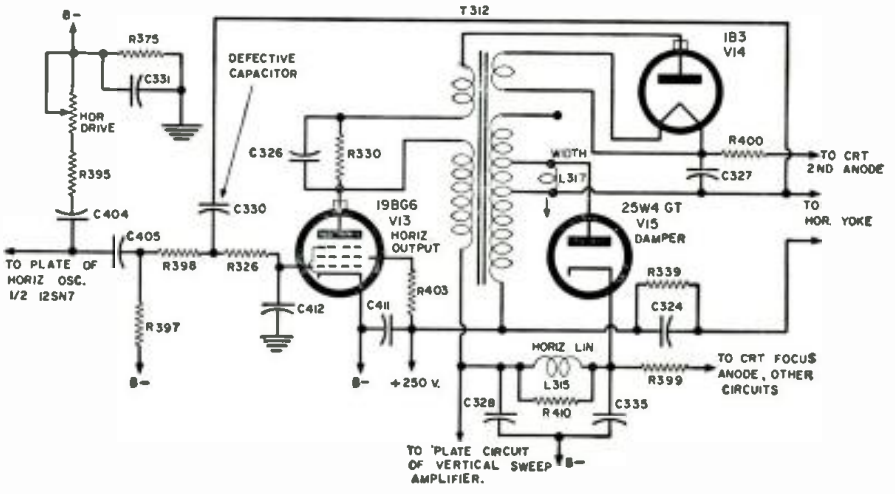
Causes of oscillation in the video i.f. section, other than misalignment, include: defective capacitor in the a.g.c. line; defect in a trap component; missing tube shield; improper lead dress or lead length; improper ground (too far from tube-socket ground connections); and video i.f. tube (usually one that has just been installed as a replacement) has too high a transconductance.

Oscillation in sound i.f. stages tends to occur for the same basic reason as video i.f. oscillation. Symptoms that may be produced by oscillation in sound i.f. stages include: whistle; "hash" in sound; and separation of sound and picture, particularly on high channels. The presence of oscillation in a sound i.f. stage is established by the measurement of a substantial d.c. voltage between ground and the half-load point of a discriminator, or the full-load point of a ratio detector, with no signal applied at the input of the sound i.f. section.

Possible causes of sound i.f. oscillation are: misalignment; improper lead dress; leads too long; ground connection of some component at wrong point; open condition or large increase in the value of the resistor in parallel with a sound i.f. tuned circuit. Suggested remedies are: re-alignment, if needed; lead-dress changes, if necessary; shortening of leads, particularly grid and plate leads; relocation of bypass capacitors, use of bus-bar wire between socket contacts that should connect to chassis and the chassis itself; addition of a tube shield, if none is present; and replacement of defective tube or other component. Addition of a ceramic cathode-bypass capacitor, between .001 and .005 μf. in value, works like magic in some cases. The capacitor is connected across the one already present in the circuit.

Oscillation due to excessive feedback of signal *via* a normal feedback path is possible. In the circuit shown in Fig. 6, a partial breakdown in C_{330} may, due to the peculiar construction of the capacitor type used in such circuits, cause its capacitance to *rise* from, say, 6 $\mu\mu$f. to more than 200 $\mu\mu$f. The excessive feedback through the capacitor to the horizontal-output tube will cause the tube to oscillate under such conditions. —30—

Fig. 6. Section of horizontal-sweep and h.v. circuit in some G-E TV sets.



By JOHN T. FRYE

MAC'S service shop

A Little Soul-Searching

THE complete personnel of Mac's Service Shop was assembled in solemn conclave around the desk of Miss Perkins, the "office force." That meant Matilda occupied her usual chair in front of the desk and Mac and Barney were perched on opposite corners.

"The thing I want us to think about," Mac announced, "is whether or not we should raise our service charges. Since this decision affects your bread and butter as well as my own, I think it's only fair you two should have a hand in making the decision. Now here's the way I see it:

"On the *pro* side, we have the fact that other prices are gradually creeping up. Rent, utility bills, insurance rates, laundry, service instruments, tools—in short, all the factors that determine our cost of doing business are steadily rising and narrowing the gap between these costs and our gross income. That dwindling gap represents our net income from which all three of us draw our salaries and from which I hope to get a reasonable return on the money I have invested. Worse yet, creeping inflation is constantly chipping away at the purchasing power of that net income. I don't need to tell you that your paycheck dollar doesn't buy as much now as it did five years ago. I just had a rude illustration of that.

"Five years ago we had two rooms papered at our house for a total cost of thirty-five dollars. The same two rooms were papered again this year and the bill was eighty-two dollars.

"But now let's look at the arguments against raising our charges. First, I've maintained all along that fighting inflation is an individual as well as a collective scrap. Keeping prices down starts with holding the line on charges for individual work. Ignore this simple but hard-to-swallow fact, and income and prices keep leap-frogging over each other until the devaluated dollar renders both meaningless. But until such time as a reasonable percentage of the people are willing to accept this, refusing to adjust charges to the rising cost of living works a hardship on the businessman and those who work for him without accomplishing much else.

"Also to be considered is the possibility that increasing the charges will not increase gross income. Instead, it may actually lower it through loss of business. There are some service technicians in town who, because of the lower overhead of their part-time operation, their poor business sense, or just maybe their better business sense, charge less than we do. Quite a few other shops charge more. As our charges go up, we are bound to lose some business to competitors who have lower charges."

Barney hesitated a minute and then blurted. "I haven't meant to tell you just yet, for I wanted to surprise you; but I've been attending math classes at night school for a couple of weeks now. I decided my electronic-savvy ceiling was going to be pretty low unless I took more math than I have and understand the math I have already taken better. We've just started studying calculus and we're working with problems dealing with maximum and minimum. Last night we had a problem I think bears directly on what we're talking about:

"A man has 120 apartments, all of which he can keep rented if he charges $80 each. For every $2 he jacks the rent, one apartment becomes empty. Each rented apartment requires an average of $12 worth of repairs per month. How much rent should he charge to realize the most profit?

"Before starting to work on the problem, I felt confident the man would secure the most income when a very high percentage of the apartments were rented; but when you express his income as a function of the number of apartments standing empty and differentiate the function to locate the maximum value, you discover his income is greatest when the apartment rental is $166, 77 apartments are rented, and 43 are vacant.

"Now if we just knew how much business we'd lose for, say, every 10¢ we boost our hourly rate, we could set up an expression and solve it the same way to discover the hourly charge that would bring us the greatest income; and I'd not be at all surprised if it worked out much the same way. We have just so many working hours a year. By making our charges low enough, we could be working hard every one of those hours. But this problem has shown me that the charge that brings the most business is not necessarily the one that produces the most income. In the case of the joker who owned the apartments, he was ahead more than $4000 by allowing 43 of his apartments to stand idle. And don't forget that means 43 fewer tenants to argue and wrestle with!"

Matilda gave him a suspicious look as she said. "Are you sure it's increased income and not less work you're thinking about?"

"I must admit the same nasty thought crossed my mind," Mac said with a chuckle; "but let's give the boy the benefit of the doubt. What he says makes sense. It's mighty easy to confuse 'being busy' with 'making money' in the service game, especially if you fail to keep, study, or understand good business records. Actually, I doubt we'll lose much business because of a moderate increase in prices. Our aim has always been to be the 'best' shop in town, not the 'cheapest.' I like to think most of our customers call us because they have confidence in our ability and our honesty. They know income must keep step with the cost of living because they have the same problem themselves. So how about it? Shall we boost our charges?"

"Aye!" Barney and Matilda chorused enthusiastically.

"Good! Matilda, you get together the figures on our business during the year immediately following our last setting of charges and for the last twelve months. Here is a chart showing the decline in the purchasing power of the dollar for the past ten years. Then we'll get together and figure out how much of an increase will yield the same income in purchasing power that we enjoyed before. Since we have always had just about all the business we could handle, we'll figure things will continue that way in setting the charges. This doesn't disappoint you, does it, Flamehead?"

"Nope, for if I read you right you're figuring on a little something extra in our paychecks. Say, not to change the subject, but I just had a nasty shock this morning. I stopped in at the drugstore for a Coke; and there, big as life and twice as ugly, was a do-it-yourself tube-checker. I really gave the druggist a hard time. I told him we were trying to figure whether we should put in comic books or liquor and asked him to tell me confidentially which brought in the most profit. He got the point all right. I sure think he's got a lot of nerve trying to muscle into our racket."

"Call it 'nerve' or 'a shrewd head for business'," Mac drawled. "We left him an opening and he stepped into it.

(*Continued on page* 90)

Service Plans and the Independent Dealer

By **WILLIAM LEONARD**

Multi-product service clubs and similar systems may be an important factor in the dealer's future.

ONE THING every businessman knows for sure is that the quickening tempo of living has accelerated the rate of change in the character of all commercial operations. And, as the credit craze moves on to engulf all categories of business, a decided change may be brought about in the economics of all consumer service activities.

The total annual national service and maintenance bill is such a large, lush-looking melon, it has watered the mouths of financial interests that must keep money working at a profit. The U. S. Department of Commerce figures show that the public is spending seventeen billion dollars annually on home additions, maintenance, repairs, and services. That is *big* business. It is about double the total annual income of all concerns engaged in manufacturing and assembling electronic components and products, including the military market.

Modern living is built around a maze of complex electrical and mechanical devices. When emergency service is needed, the home owner usually finds himself in a dilemma over whom to call to make the needed repairs. This situation has set the stage for a number of developments which, if they are successful, could completely change the character of all consumer service businesses.

The TV receiver, around which our present national network of independent electronic service businesses was built, has lost the romantic appeal that once gave it special identity and consideration. It is now universally accepted as one of the numerous appliances that are standard equipment in every modern home. The average TV set owner, who once felt it important enough to keep the name of his favorite TV service shop listed with other numbers to be called in an emergency, now buys "catch-as-catch-can" service whenever he needs it. The result has been a high mortality rate in the "regular customer" lists of established service shops.

EDITOR'S NOTE: Whether plans of the type described here will, in the long run, work to the benefit or disadvantage of independent service cannot be answered now. Much may depend on the nature of the plan. In any case, every dealer and technician should be alerted to the possibilities, for these systems, one way or another, loom large in his future. There is one interesting potential on the "pro" side not mentioned in the article: since owner resistance to TV service fees is often based on nothing more than the lack of available funds when an unexpected repair bill comes up, "revolving-charge" plans may help pave the way to sensible service fees.

The rapid development of home-service clubs during the past year may be a straw in the wind indicating the trend most service businesses will follow. In Chicago, the "Mr. Service" Club set up by Eddie Richmond, a real-estate and insurance man, now numbers more than 5000 members who pay a $7.00-per-year membership fee. The "Mr. Service" Club acts as the liaison agent between the customer and the service technician or contractor. In discussing the need for a single point of contact for any type of service required in the home, Mr. Richmond said:

"You need the services of about 70 different types of contractors for the various things that go into a home. The yellow pages of the telephone book aren't much help when it comes to finding the right one. First, you have to locate the right category of service business. Then you have to find one in your neighborhood. Finally, you have to find one that will do the job right and at a fair price. With us," he said, "you have only to call one number—ours. We do the rest."

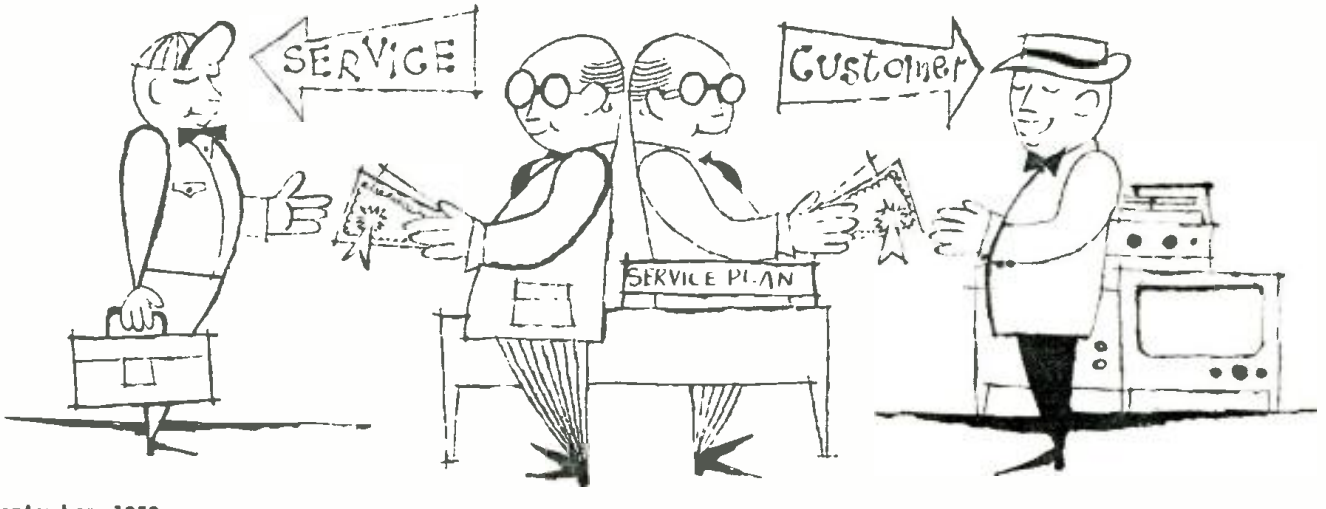
The Chicago "Mr. Service" Club is said to have 880 contractors and service businessmen participating in its plan. There is no charge to the contractor but each one is checked closely to make sure his work and prices are acceptable. The club offers 24-hour-a-day service to give subscribers immediate help in certain emergencies, such as a heating-system breakdown.

A new idea in the home-service-club plan was recently inaugurated by the Morris Plan Bank of Indianapolis, Indiana. The firm announced that its home services program, similar to those already in operation in other major cities, will provide fast, reliable, and guaranteed service to home owners and tenants on any of more than 100 different repair and maintenance services. Overhead costs of the system will be shouldered by Morris Plan's existing charge-account department, which will eliminate the need for charging users' fees, according to Robert D. Hammer, vice-president of the finance firm. Here is how the plan will work:

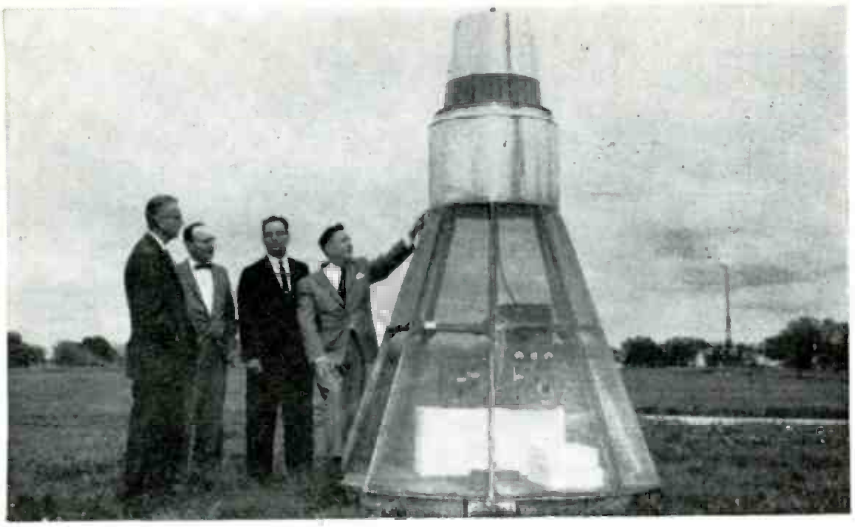
Several hundred reliable, established, service contractors in all fields and in all areas of the city will be affiliated to participate in the plan. A resident with repair troubles can call Morris Plan's "Home Service." It, in turn, alerts the appropriate service contractor nearest to the caller's home and the latter handles the service call. Home owners can pay cash directly to the repairman or ask for a bill, which will be mailed to them by the Morris Plan.

Contractors will pay a 6% fee to Morris Plan and will be re-imbursed weekly for all repairs charged by their customers. The system will relieve them of billing home service customers and all credit losses, according to the

(*Continued on page 84*)



Recent Developments in Electronics



Space Capsule Antenna Mockup

A full-scale antenna test mockup of a Project Mercury manned space capsule is being examined here by *Collins Radio Co.* officials. *Collins* is providing the communications system for the capsule. All design work on the antennas is completed and the company is now in the process of testing and evaluating the designs.

Experimental 1000-mc. Transistor

Fabrication and measurements on some experimental drift transistors that operate at frequencies above 1000 mc. have been reported recently by *IBM*. The units are diffused-base types with minimized bulk resistances and junction capacitances. An oscillator has even been described in which the transistors operated up to 1550 mc.

Car Radio in Rear-view Mirror

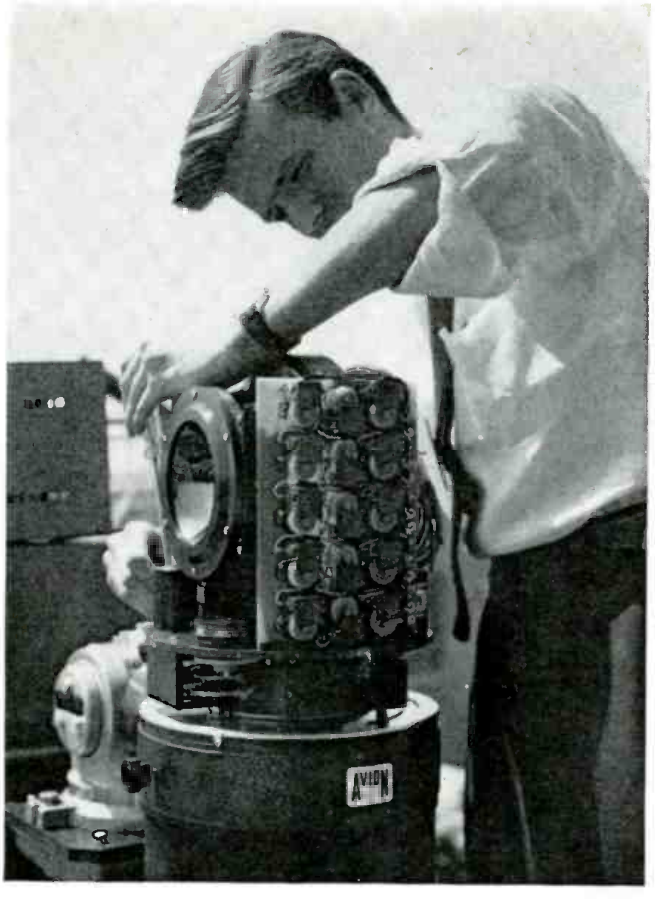
An Italian manufacturer (*Fabrica Apparecchi Radio E Televisione*) has combined a 5-transistor, 2-diode superhet with a rear-view mirror for automobile use. The receiver, which tunes the standard broadcast band, draws .5 amp. from the 12-v. battery supply and has an output of 2.5 watts.

On-the-Spot TV Instruction

A maintenance specialist works on a jet fighter plane under the watchful "eye" of a television camera at the Lowry Air Force Base, Denver. The TV picture is relayed over an *RCA* closed-circuit system to classrooms at the Training Center.

Infrared Satellite Detector

◀ Scanning mirror and cell arrangement is shown here in uncovered CODES (Commutating Detection System) infrared receiver developed for Air Force Cambridge Research Center program for studying possibilities of detecting satellites by infrared techniques. Developed by *Avion* division of *ACF Industries*, the unit is a multi-channel wide-field receiver that demonstrates the feasibility of low-level storage and sampling for achieving high sensitivity and fast coverage with single-channel electronics.



Hi-Fi Exhibit in Moscow

Designer's concept of hi-fi stereo exhibit at American National Exposition in Moscow. Arranged by the Institute of High Fidelity Manufacturers, the exhibit is part of the $3.6-million presentation "to show the true image of America to the people of the Soviet Union." The exhibit features the latest stereo hi-fi components including record players, tuners and amplifiers, loudspeakers and tape decks. This "cube" will serve as the nerve center of all hi-fi music in the Moscow exposition.

▼

Transportable SSB Station

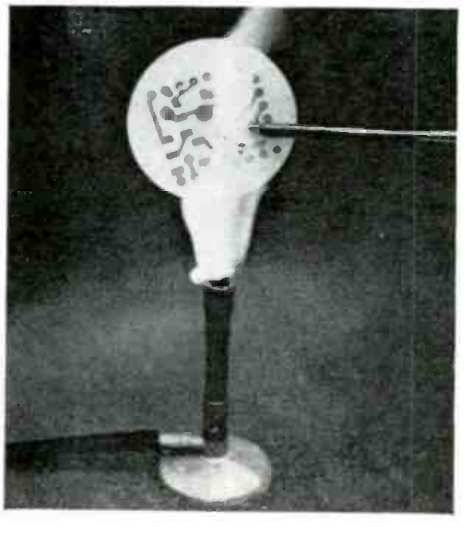
A new Army Signal Corps SSB communication station, built by *Collins Radio*, is shown here. Each station weighs less than 2000 pounds and measures 5 x 5 x 6 feet. Commercial or motor generator power may be used for the station, which requires only one non-technical operator. The unit may be transported by helicopter or ¾-ton truck, and can be completely set up within a half hour.

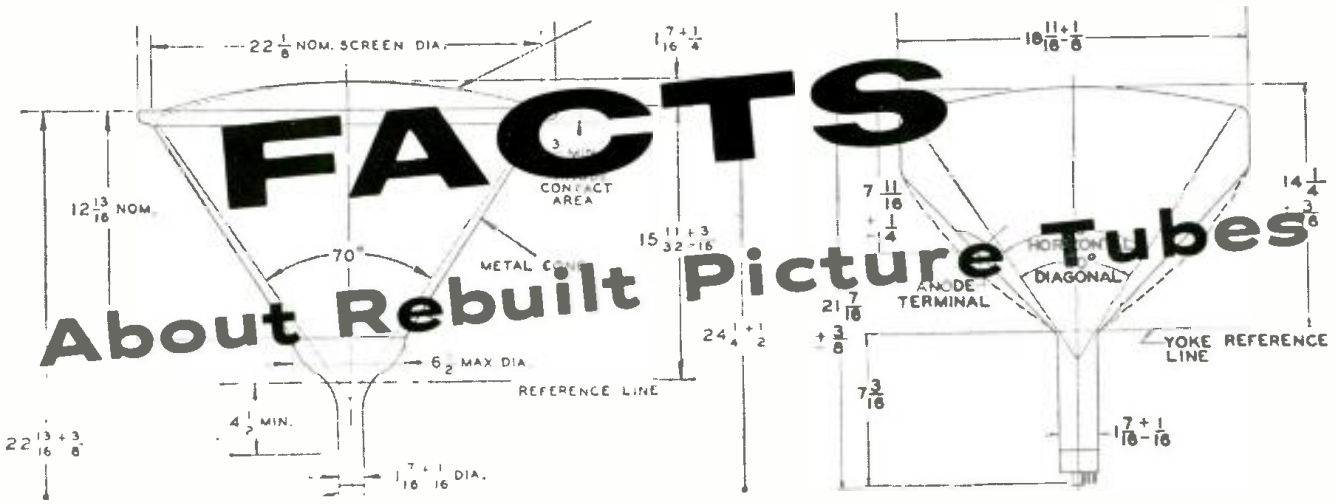
▼

High-Temperature Printed Circuit

Molymanganese printed circuit developed by *Advanced Vacuum Products* can withstand temperatures up to 1300° F. and high current overloads. Circuit cannot be torn or shaken from its alumina board, and is unaffected by water, arcing, and corrosive chemicals.

▼





FACTS About Rebuilt Picture Tubes

By LEE SCOTT / **What they are, how they're made, where they differ from new ones, and how to check up on a "retread."**

EDITOR'S NOTE: The entrance of name-brand CRT manufacturers into the rebuilt market has given new pertinence to some old questions. Set owners and many service dealers have always wanted more information about rebuilt tubes. Today they are asking for the facts more insistently than ever. The author, familiar with the manufacture of both all-new and rebuilt tubes, is in a position to satisfy them.

IN 1958, of somewhat more than six-million picture tubes sold in the replacement market, about 65 per-cent are estimated to have been so-called rebuilt or reprocessed units. For 1957, this figure was about 55 per-cent. For 1956, it was 50 per-cent. The importance of rebuilts can scarcely be ignored.

What is a rebuilt anyway? To answer, we must first know what an all-new tube is. A new CRT is one for which all the constituent parts used in its manufacture are new, including the electron gun mount (or gun), stem, phosphor, screen material, conductive graphite coating (*Aquadag* or "dag"), and base. Most important of all, the glass envelope is new. In a rebuilt CRT, every one of these may be new—except the glass envelope. (There are some cases, not too frequent, in which the original phosphor screen is re-used. More on this later.)

The transparent shell of the picture tube is a more complicated item than many people realize. The glass used at various points in it must meet special requirements. The glass at the screen, for example, must have certain minimum optical properties to transmit a clear, undistorted picture. All of the glass, especially the portion along the flare, must be thick enough and strong enough to withstand a high vacuum. The vulnerable, protruding neck should be strong enough to withstand some accidental strain and to support the weight of deflection components. Combining all these properties and others in a single unit isn't easy or cheap. In fact the glass envelope, which is the most important single item in a new tube, accounts for a good portion of its cost. Hence, the reason for the rebuilt.

There are, however, other differences between new and rebuilt tubes. Specifications for the all-new tubes are generally set by the TV receiver manufacturers who will buy them for use in their sets. Sometimes the CRT maker sets the specifications himself but, even so, he must adhere to certain limits if he hopes to sell to set makers. As for the rebuilt, it will be put on the replacement market exclusively, since receiver manufacturers do not use it. Thus the rebuilder has some flexibility in establishing in-plant specifications.

At this point, an important distinction should be made. Often a CRT sold as all-new shows signs of having been renecked. This occurs when a tube made in a new-tube plant has failed to pass a production test, but the envelope is perfectly good. The latter is then re-used, but the resultant CRT is considered to be all-new because the rejected tube was never sold and put into use.

New tubes are made by well-known name-brand manufacturers referred to as "majors." Rebuilt units are generally made in smaller plants under less well-known names—although some rebuilding operations are owned by majors. Among the large number of

Fig. 1. A new neck is being inserted on a salvaged bulb.

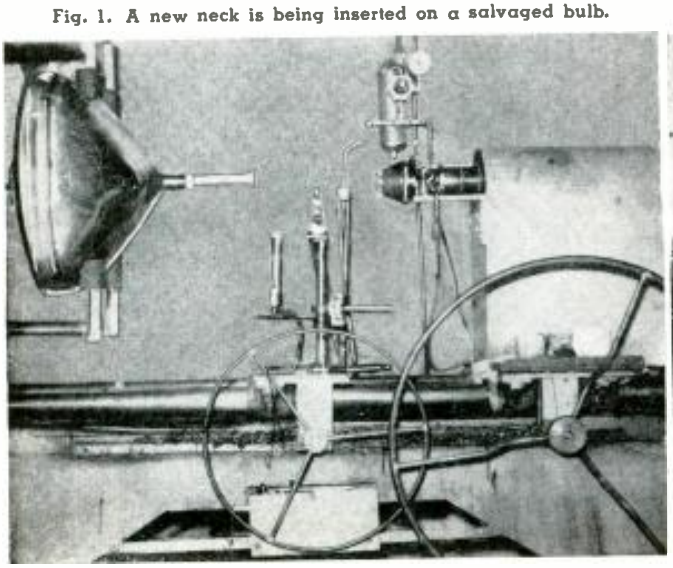
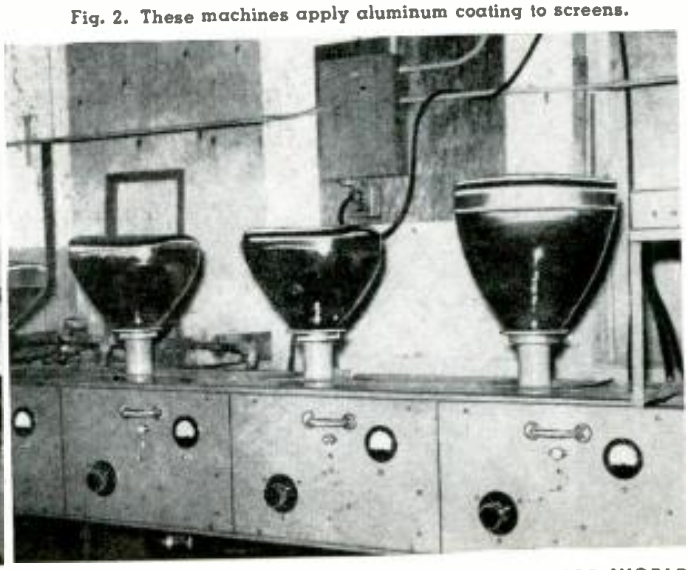


Fig. 2. These machines apply aluminum coating to screens.



rebuilders throughout the country, over 100 are located in the east (New York, New Jersey, and Pennsylvania, principally), with smaller percentages in the midwest (Ohio, Michigan, Illinois, and Kansas), in the southwest (Texas and Louisiana), and the west (California). There are a few others in other states.

Rebuilding factories range from so-called "garage" operations with just a few workers including an owner who may also be manager, accountant, and extra hand, among other things, with an output of as little as 50 to 100 finished tubes a week, to an ultra-modern plant, well equipped and well staffed, that can produce over 3000 units a week.

In essence, the same manufacturing processes are involved in making new and rebuilt units, but the majors, with their greater output (which may be 5000 a day), are more likely to use such mass-production, automated techniques as conveyors and the like than would be practical for a producer whose production is limited. To get an idea of what is involved, it will help to go through the stages of manufacture of a rebuilt briefly, as they would occur in a reliable concern of fair size.

When a replacement picture tube is bought, the old one or "dud," which has definite cash value, is returned and eventually winds up in the hands of a rebuilder. For all practical purposes, the bulb of this dud is comparable to a new one. Some of these do have so-called cord marks that may exist on the face plate. These are ripples or irregularities that ordinarily cannot be seen when a picture is viewed on the screen. However they may show up when the inoperative CRT is viewed from a certain angle under certain light conditions. A reliable rebuilder may nevertheless sell as seconds, at a bargain price, rebuilts made from such bulbs. Corded ware is not ordinarily used in making new tubes.

The neck of the dud is carefully cut open, the gun mount is removed and discarded, and the bulb is cleaned and buffed. The inside of the bulb is scrubbed and washed with chemically pure water. Removed in this process are the old screen (in most cases), the inner and outer "dag" coatings, the aluminum coating (if any), and all other foreign material. A new neck is then spliced onto the old bulb. Such necks are usually obtained with flared ends (see Fig. 1) to facilitate insertion of the gun mounts. Sometimes they are simply made from long lengths of suitable glass tubing.

The tube then goes to a special tilting table, where a solution of phosphor and other chemicals is poured into it. After a settling period, the screen coating is sealed to the inner surface of the face and the remaining solution may be poured off. A drying period follows.

In the next step, the tube is revolved in a machine while a special brush applies a graphite conductive coating (the "dag") to the inside of the anode button and part of the inner surface of the bulb and neck. Then this coating must be dried. If the tube is to be aluminized, the screen is now lacquered to promote the deposition of a uniform aluminum layer, there is another period of drying, and the next step is insertion in special aluminizing equipment, shown in Fig. 2. After these stages, a check is made for screen imperfections. If the tube passes this inspection, it is baked in an oven to seal on the coatings that have already been applied. The baking also drives out gases given off by the coatings.

The bulb is now ready to have a gun mount, including the stem, inserted (Fig. 3). These guns have been stored in an adequately cool, possibly air-conditioned area until ready for use. This prevents harmful moisture from accumulating on them. However, just prior to actual use, the guns are preheated to the temperature at which the ring of the glass stem will be sealed to the neck. For this latter operation a machine called a "head sealer" (Fig. 4) is used. However, this sealing does not yet close off the inside of the tube completely, as the tubular stem is still open.

Final evacuation and closing off of the picture tube takes place in an "exhaust oven," whose temperature exceeds 400°C (more than 750°F), but this is only one of several operations performed while the CRT-to-be is in the oven. In another a "bomber," which is a unit for generating a high voltage, is used to burn out any foreign particles that may still be inside the picture tube. In addition, the cathode is "broken down" to release gases. To accomplish this, the cathode is heated by the application of a specifically timed cycle of elevated filament voltage. Finally, the stem tube is sealed off, maintaining the tube under vacuum. Sometimes a tube, due to some otherwise undetected fault, implodes under the severe treatment to which it is subjected during these final operations. If it comes through in one piece however, as is the case with all-new tubes, the likelihood of subsequent, spontaneous implosion is quite remote.

After exhaust, the getter of the tube is "flashed" (again using the bomber) so that it will remove any gas that may still be inside the CRT. A base is now put on the tube. This involves cementing of the base and soldering of element wires into the base pins.

Essentially, the picture tube could be put into use now, but another step is added: the aging of the cathode. In order to bring this electrode up to the desired emission capability, the rebuilt is placed under actual operating voltages and conditions, except for the heater. The latter is again subjected to a definite cycle of elevated voltage (12 volts is typical) to overheat the cathode so that the latter will provide adequate emission quickly.

If the picture tube were put directly into an operating TV receiver without this aging, it would age itself over an extended period of time. Until it did however, the set owner would be annoyed by the same characteristics produced by poor emission that appear

(*Continued on page* 141)

Fig. 3. Insertion of gun, including glass stem, in neck.

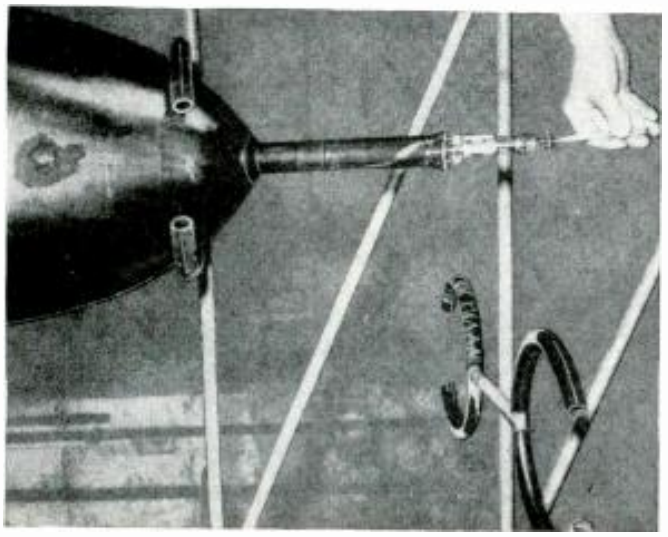
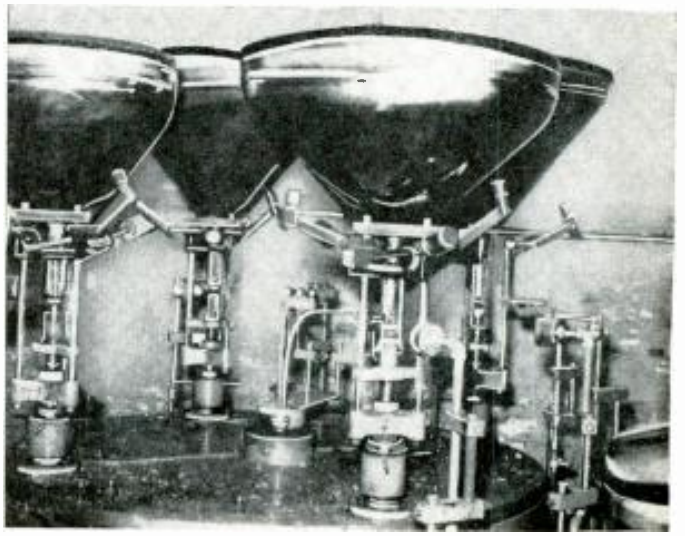


Fig. 4. Head sealer fuses ring of glass stem to CRT neck.



Servicing With Your Eyes

By **KENNETH BRAMHAM**

The time for orthodox fault-finding methods can be shortened if you know what to look for and where.

HAVE YOU ever worked on what seemed to be a really tough service problem, finally pinning down the trouble to a broken tube? It happens. Of course, for weeks afterwards broken tubes are "number one" on the suspect list. What about other visible faults that may occur, faults that can be seen without the aid of scope or v.t.-v.m., requiring just one "service instrument"—a pair of eyes? The only good answer to that is a visual inspection of the chassis before any digging with solder gun and cutters is started. This inspection should be a part of the bench routine.

While a thorough examination of every component, lead, and tie-point may be practical in a four-tube radio, it is much too time-consuming in a twenty-tube TV receiver, and virtually impossible in a modern portable TV set. However, this should not rule out the use of visual inspection as a service tool. It can still be time-saving and effective—if you have some idea of where to look and what to look for. In practice, it is equally important to know where *not* to look. For instance, in the case of a TV set with good raster but neither sound nor video, it would be a waste of time to spend fifteen minutes peering into the innards of the vertical circuit.

Every service routine should start with a look at the TV screen: this will usually give some indication of the part of the chassis in which the fault may lie. The most obvious information given by the screen is the presence or absence of a raster. More subtle information includes indications of frequency response and of sync clipping shown in the blanking bar. Height, width, and linearity should all be scrutinized to provide a possible clue to the trouble source. In the case of a sync problem, for example, the raster may show reduced width, suggesting trouble in the horizontal-output stage or feedback loop and contributing directly to the sync trouble.

Once all possible information has been extracted from the screen, it is time to take a look at the chassis. We should by now have some sort of clue regarding where to look or where not to look. The next question is, "What shall we look for?" A little service history will be a help at this point. Has the set ever worked? If it is new and defective we can generally assume that it left the factory in good shape after a series of tests. From then on it is better to assume the worst. The set was, therefore, hurled into a box car (with square wheels), and given a "super shake" test to its final destination, by way of Alaska.

Under these conditions the most likely fault is that vibration has caused some component to part company with its moorings. This could be and has been known to be almost anything from the power transformer to the picture tube. While a power transformer is not going to damage itself very much when sliding around under the chassis, it can and will carry away any minor components with which it comes into contact. However, a power transformer on the loose is going to be pretty obvious, if unusual; the more frequent forms of transit damage are not so obvious.

Large, unsupported capacitors mounted on long leads are always a potential trouble spot, as they are particularly vulnerable to vibration. Other components with lengthy leads, tubes covered by metal shields, coils and small components supported by stiff wire connections to other components that are free to move—all should be the object of a close scrutiny and a prod with the solder pick or screwdriver. Once a lead has broken, the component may return to its original position: thus, the break will not be seen easily until it is moved in this way.

Printed boards are also, at times, affected by vibration, particularly when used to support heavy components. However, a far more prevalent condition likely to give trouble in a brand-new printed board is a lack of solder in the right places. Printed boards should therefore be examined carefully for dry joints, cracks (particularly around heavy components) and breaks in the printing. Suspected joints should be reheated and carefully pressed together. Breaks in the printing should be joined with copper wire and a liberal quantity of solder to provide a repair that will stand up physically as well as electrically.

So much for the new set and transit damage. What do we look for in the older set? Again service history may supply the answer. "It hasn't worked right since the last tube was changed," or, "It has not been really good since the last time it was taken to the shop," the owner may claim. This sort of remark plus a check on which tube or parts were changed may provide valuable information. The complaint should not be brushed aside lightly as the inane droolings of a customer trying for some free service until it has been checked. If the trouble has followed a tube replacement, a glance at the components in circuit with that tube may reveal a discolored resistor, possibly overheated by the failure of the previous tube. If sufficient heat was generated to change the color, it is possible that a change in value may also have occurred and improper operation of the new tube may be the result. Also take a good look at the tube itself—there is a difference between a 6BQ7, a 4BQ7, and a 6BK7 for example. The best of us may occasionally err.

If other components have been replaced, they too are eligible for a good, close look. And check them against the schematic too; mistakes in reading the color code or converting micromicrofarads to microfarads are possible. It might be an exaggeration to say that as many wrong components are installed as are correct ones. It certainly does not happen in *your* shop—but take a good look anyway.

A service history of one fault recurring is always indicative of a possible service mistake. Technicians working on the set previously may have failed to see a visible intermittent condition. A good, long look for dry joints, intermittent ground connections, cracked printed wiring and such is in order. Again, the solder pick should be used to reveal trouble not visible at first glance. If a component just happens to fall apart after a prod with the solder pick, it was not very good in the first place! Grounded control and tube-socket lugs presumed to be soldered to the chassis should always be regarded as fair game for the solder pick, as it is often quite impossible to see clearly whether this type of connection is good or fractured.

Discolored resistors, burned or melted insulation, and pin-head sized burns in high-voltage transformers, are all visible indications of trouble. Even a gassy tube may sometimes be spotted by the absence of any mirror-like gettering inside the glass. Your eyes are your best service instrument and, as with all instruments and tools, only practice and concentration will enable you to use them to the best advantage.

—30—

Fig. 1. Here is an over-all view of the dual preamplifier described below.

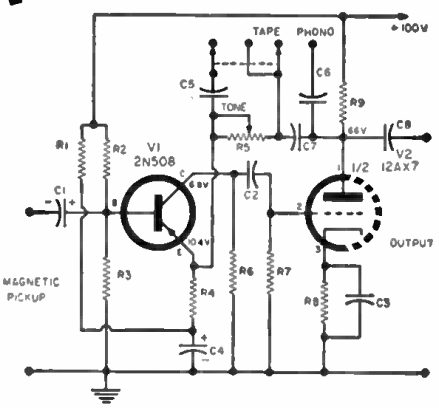
Rebuild the UPX-003 Preamp for Stereo

By DWIGHT V. JONES
Semiconductor Products Dept.
General Electric Company

A simple dual preamplifier for both stereo discs and tapes utilizes a pair of inexpensive transistors and a single vacuum tube.

THIS is the year of the breakthrough in stereophonic sound! According to the record companies almost all of the new disc releases will be available in stereophonic versions. Thus, we find much interest and activity in building the necessary equipment. You can modernize your high-fidelity sound system for stereo without discarding or duplicating your present preamp if you are using the popular *G-E* UPX-003 unit.

This preamp has been rebuilt by the author as shown in Fig. 1. The existing power supply of the UPX-003 was used, with a minor change, to supply the reconstructed dual preamplifier. This minor change involved the substitution of a 10,000-ohm resistor for each of the two 22,000-ohm resistors used in the filter network. See Fig. 5. The existing input was used for channel #1 and the second input was added, as shown in Fig. 1, for the #2 channel. It was also necessary to add a second output cable which was used for channel #2.



R_1—150,000 ohm, ½ w. res.
R_2—3.9 megohm, ½ w. res.
R_3—330,000 ohm, ½ w. res.
R_4—27 ohm, ½ w. res.
R_5—25,000 ohm linear taper pot
R_6—10,000 ohm, ½ w. res.
R_7—2.2 megohm, ½ w. res.
R_8—2700 ohm, ½ w. res.
R_9—220,000 ohm, ½ w. res.
C_1—20 μfd., 20 v. elec. capacitor
C_2, C_8—.05 μfd., 200 v. capacitor
C_3—.01 μfd., 200 v. capacitor
C_4—100 μfd., 15 v. elec. capacitor
C_5—.001 μfd., 200 v. capacitor ± 10%
C_6—.02 μfd., 200 v. capacitor ± 10%
C_7—.01 μfd., 200 v. capacitor ± 10%
V_1—"p-n-p" transistor (G-E 2N508)
V_2—½ 12AX7 tube

Fig. 2. Schematic diagram of one of the two identical channels that are required.

The two preamplifiers are identical, each using the circuit of Fig. 2 and the common power supply diagrammed in Fig. 5.

The 2N508 transistor in Fig. 2 is biased from a constant-current source through R_1 for good current stability with temperature and transistor interchangeability. R_2 and R_3 bias the base for the desired V_{CE} of about 3½ volts. This voltage varies slightly with leakage current of C_1 and with h_{FE} (d.c. current gain) for different transistors. R_4, in conjunction with C_4, improves the signal-to-noise ratio of the transistor stage by reducing the gain through increased degeneration below 50 cycles.

The required equalization of the in-

(Continued on page 130)

Fig. 3. Frequency response from a standard recorded disc.

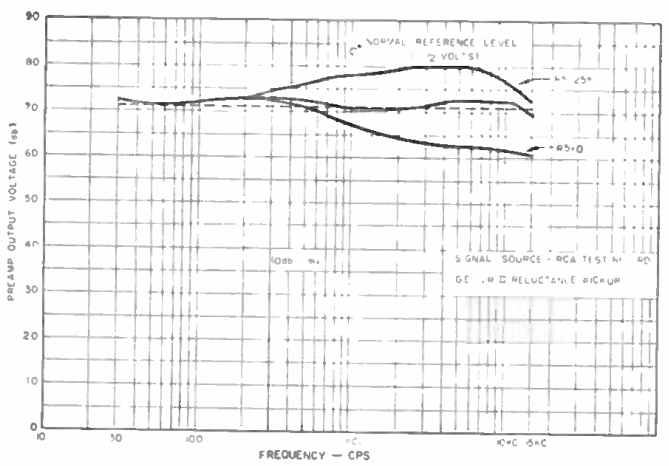
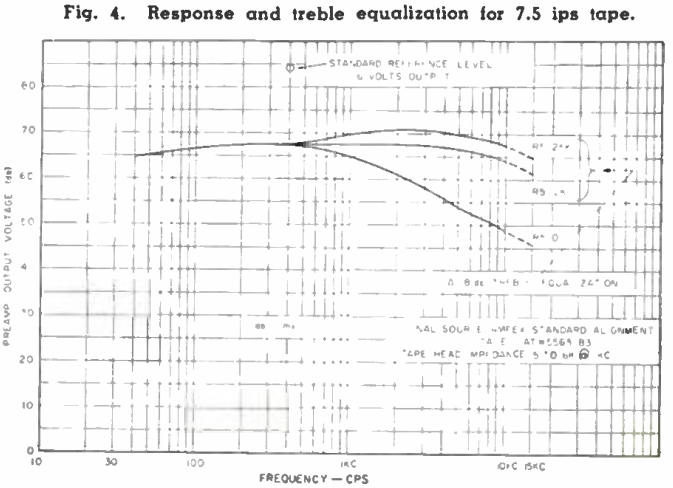
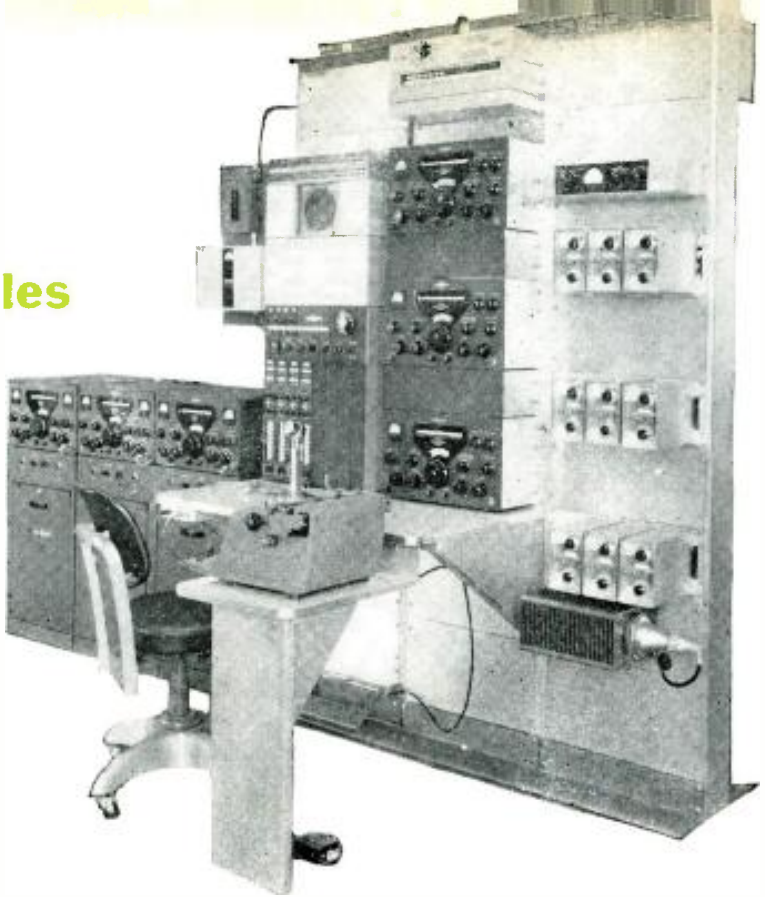


Fig. 4. Response and treble equalization for 7.5 ips tape.



PART 1

General Principles



One of the operating positions at the global single-sideband equipment that is maintained by the Strategic Air Command. Collins equipment is employed.

Single-Sideband Transmission

By ALAN ANDREWS

Advantages of SSB along with description of the basic system and methods of suppressing the carrier signal

SINGLE-SIDEBAND and suppressed-carrier transmission have been in limited use since the 1920's, but were not employed extensively until after World War II. Basically this method of transmission suppresses the carrier signal and one of the sidebands of a conventional amplitude-modulated wave, then only the remaining sideband is radiated. In the receiver the carrier is re-inserted so that normal detection can take place to reproduce the audio signal in the output of the receiver.

Several advantages are obtained with such a system. First, as long as the carrier is not transmitted, there is a substantial reduction in power requirements. Second, as only a portion of the total signal is transmitted, required bandwidth is decreased. The first advantage naturally is a saving in costs, the second allows more stations to operate within a given frequency band. This is especially important now, considering the crowding which exists in some bands and which can be expected to become worse unless some remedy is forthcoming.

Although its basic principles were known for many years, the system could not be utilized to the fullest until individual components and circuits had been sufficiently improved. With the tremendous strides made by electronics during the war years and those immediately following, single-sideband, on a practical basis, became not only a possibility, but a reality.

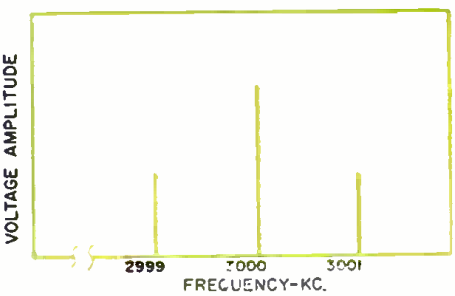
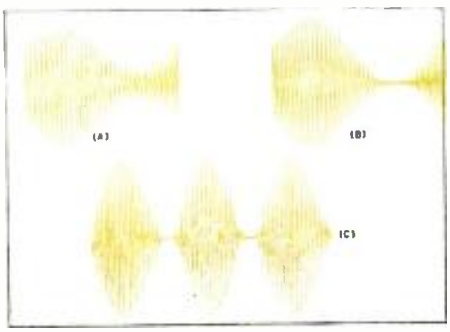


Fig. 1. Carrier and sideband arrangement.

Fig. 2. The carrier is modulated 50% in (A), 100% in (B), and overmodulated in (C).



Radio amateurs have been using it for some time and they have done much to further its usefulness. Many commercial two-way systems are rapidly changing to single-sideband and the armed forces are also beginning to make use of it. Recently it was estimated that within five years virtually all government services would be using this type of transmission instead of conventional AM.

Radio services of the Strategic Air Command have used single-sideband for several years with remarkable results. In January 1957 three B-52 bombers circled the globe and were in almost constant communication with SAC headquarters near Omaha, Nebraska. At times when conventional AM was not usable due to interference, single-sideband reception was loud and clear.

Double-Sideband

A brief description of conventional double-sideband transmission may help in understanding the operation of a single-sideband system. In amplitude modulation the audio signal is used to modulate a carrier whose frequency and amplitude remain constant. Modulation consists of heterodyning the audio and r.f. across a non-linear impedance. Two sidebands are created for each frequency present in the

modulating signal. For example, assuming a carrier frequency of 3000 kc. modulated 100% by a 1 kc. signal, two sidebands are produced. Fig. 1 illustrates this. Carrier signal is shown at 3000 kc. at a certain amplitude. Sidebands are at 2999 and 3001 kc., each having half the voltage amplitude of the carrier.

This means that each sideband contains one-fourth as much power as the carrier when modulating 100% with a single sine-wave tone. Expressed in another way, each sideband contains one-sixth of the total power. Carrier plus audio frequency is called the "upper sideband," carrier minus audio the "lower sideband." In conventional AM both sidebands have the same amplitude and are in-phase in terms of audio variations.

When using voice modulation a set of sidebands is created for each audio frequency. And each sideband is separated from the carrier by an amount equal to the audio signal causing it. In the example of Fig. 1 the modulating signal is 1 kc., and the graph shows that each sideband is 1 kc. from the carrier, for a total bandwidth of 2 kc. If we assume a maximum audio frequency of 3 kc. (typical for voice communications), a total bandwidth of 6 kc. is required to adequately pass the entire signal.

In the receiver second detector, the carrier and the two sidebands are heterodyned and, through this rectification and filtering, two separate audio components are obtained. These are identical, both in amplitude and phase, and add together as applied to the first stage of audio amplification. The r.f. components are eliminated through filtering, most often by use of r.f. bypass capacitors.

Maximum audio amplitude is obtained when the carrier is modulated 100%, as illustrated in Fig. 2B which shows a "modulation envelope." This composite signal is obtained by adding together a carrier and a set of sidebands. Fig. 2A shows modulation of 50%, resulting in less audio. Fig. 2C shows overmodulation, with greater total amplitude, but a distorted signal.

In a 100-watt transmitter, maximum audio power is available when there are 25 watts in each sideband. This occurs at 100% modulation. Utilizing both sidebands, this gives 50 watts of effective audio power at the receiver. This is poor efficiency, only 50 watts of usable power from 150 watts which were transmitted, not even considering the losses in the transmitter stages due to plate dissipation. This 50 watts of audio occurs only at maximum modulation, less power results with smaller signals. For example at 50% modulation, shown in Fig. 2A, there are only 12.5 watts of audio for 100 watts of carrier power.

The carrier is needed only for modulation and demodulation as a reference frequency and is not necessary otherwise because it, in itself, carries no intelligence when voice or tone modulated. Audio signals do not radiate effectively, so modulation is still necessary, but the sidebands are r.f. and can be effectively propagated through space without the carrier.

Johnson Viking "Pacemaker" transmitter.

Globe "Sidebander" double-sideband rig.

Gonset GSB-100 SSB transmitter unit.

Hallicrafters Model HT-32 transmitter.

Single-Sideband

If we eliminate the carrier, once modulation has taken place, then a substantial savings in transmitted power results. But if the modulation takes place in the final stage of the transmitter the high-level carrier still must be produced even though not transmitted. This offers no real savings.

On the other hand, if a form of low-level modulation is used, modulation can take place using only small amounts of carrier and audio power. Eliminating the carrier before further amplification would then give a substantial reduction in operating cost. Then only the sidebands are amplified by the succeeding stages in the transmitter. Such a system is known as double-sideband suppressed-carrier (DSSC) and is often used. There is as much audio signal available at the receiver as when the carrier is transmitted along with the two sidebands. Transmitted power, however, is decreased to one-third at full modulation, even more for lower amplitude audio signals. This alone represents considerable savings.

The advantages however do not stop here. A reduction of bandwidth can be obtained by eliminating one sideband. As shown before, a maximum modulating signal of 3 kc. requires a bandwidth of 6 kc. for both sidebands. By eliminating one, either one, the bandwidth requirement is cut in half. Vestigial-sideband transmission used in TV is a form of single-sideband. In this case the lower frequency video signals are transmitted double-sideband with full carrier. For the higher frequency modulating signals the lower sideband is attenuated, only the upper sideband is transmitted.

Elimination of one sideband cuts the audio power at the receiver in half, seemingly a loss in useful power. But if low-level modulation is used, the losses incurred by eliminating a sideband are not great. If all the available power is concentrated in the remaining sideband the same audio power as is available in a double-sideband system is present at the receiver.

Still another advantage is also noticed. As bandwidth is reduced, so is noise and interference, thus making even better use of the radiated power. Average increase of useful signal is about 6 to 9 db, the equivalent of using about 4 to 8 times more power with conventional AM.

Use of single-sideband suppressed-carrier (SSSC) also reduces the possibility of various carrier signals heterodyning in some of the more crowded bands. In addition, because this is true, two-way systems can operate as "simplex" systems, without cutting off the transmitter when receiving. At one end of the system the lower sideband could be transmitted, at the other end the upper sideband, both using the same carrier, even simultaneously, without interference. The term single-sideband (abbreviated SSB) is now taken to indicate use of only one sideband with the carrier suppressed. The SSSC abbreviation is not used to any extent.

Suppressing the Carrier

The carrier can be suppressed by a very sharp filter, or else by use of a balanced modulator, the latter method being the one most often used. A filter for this application must, of necessity, be extremely sharp so as not to also attenuate sidebands close to the carrier frequency. In some equipment both the carrier and one sideband are eliminated by a single filter, but the sharp cut-off characteristic is still very necessary.

One example of a balanced modula-

B & W Model 51SB single-sideband generator.

Central Electronics Model 100V transmitter. ▶

P & H Electronics LA-400B linear amplifier.

tor is shown in Fig. 3, using two tubes V_1 and V_2. An r.f. signal, generated by the transmitter oscillator, is applied to the control grids of the two tubes. These grids are connected together, so are driven in-phase. The plates are connected in push-pull and, as the tubes are driven in-phase, plate currents for both tubes are identical in magnitude and in phase. However, being in push-pull, the plate currents are in opposite directions through the primary of transformer T_2. This opposing action means that there is no carrier frequency induced into the secondary of T_2.

The audio modulating signal is applied across the primary of transformer T_1. Screen grids of V_1 and V_2 are fed 180° out-of-phase from opposite ends of the T_1 secondary. Tube conduction is changed at an audio rate as determined by the audio voltage induced in series with "$B+2$". For example, if the V_1 end of the T_1 primary is positive, V_1 plate current increases. The screen of V_2 is negative at that time so the V_2 plate current decreases. So in the primary of transformer T_2 the signal currents are of opposite phase inducing the signal into the secondary.

However, modulation still occurs even though the carrier is eliminated from the output. As a result the output of the circuit (T_2 secondary) consists of two sidebands, one equal to carrier plus the audio frequency, the other equal to the difference between them.

In Fig. 3 screen-grid modulation is shown. However, the same arrangement could be used for any other type, such as grid or plate modulation using triodes, tetrodes, or pentodes. Also, it is possible to achieve the same result by connecting the grids and the audio input in push-pull and the plates in parallel. Several other arrangements of balanced modulators are used, most of them similar to the one shown.

Another possibility, often used commercially, is that shown in Fig. 4. The circuit uses four diodes connected in a "bridge" arrangement. It looks entirely different from Fig. 3 but the end result is the same.

Audio is applied to terminals 1 and

2 through transformer T_1 as shown, r.f. is applied to terminals 3 and 4 through T_2. Output occurs across transformer T_3. All of the diodes are the same type so the bridge is balanced except when a signal unbalances it. With no audio applied and an r.f. signal fed in at points 3 and 4, there is no carrier output since the potentials at terminals 1 and 2 are the same. All four diodes conduct on one r.f. polarity, all four are non-conductive on the other. This action supplies the non-linearity necessary for modulation.

An audio input disturbs this condition of balance at terminals 1 and 2 at the audio rate. The audio is applied at these points, so for the audio signal, points 1 and 2 are always of opposite polarity. The r.f. is modulated by the audio but with the carrier balanced out by diode action only the two sidebands appear in the output.

A variation of the diode circuit is called the ring modulator and is shown in Fig. 5. Audio is applied across T_1, r.f. across T_2, and the output is from T_3, the same as in Fig. 4. However, the diodes are arranged differently. Diodes CR_1 and CR_4 conduct on one polarity of r.f., CR_2 and CR_3 on the other to achieve the non-linearity necessary so that modulation can occur. R_1 is a balancing control, used to compensate for any differences in diode characteristics.

Almost any type of diode could be used in these circuits including germanium, copper oxide, silicon, or selenium. Diode tubes are usually not used because of their heater requirements. Germanium diodes are available in mounted units, with four closely matched diodes each with its own terminal connections. Increased application of SSB no doubt will increase the availability of such units as well as other "packaged" equipment for ready use in other parts of the system.

The methods of carrier suppression given here illustrate the basic function performed by all of the various types. The others are, for the most part, merely variations of these. One exception is the single-ended type which is sometimes used. However, this type is more critical as to design and adjustment. If desired, each sideband could be modulated with separate audio signals, transmitting two messages at once using only a single carrier, which is suppressed. The telephone company has used this method, sending several messages on each sideband, through multiplexing. The government is sending teletype messages on one sideband, voice communications on the other.

For single-sideband however, one sideband should be removed before amplification takes place in the transmitter. Methods of sideband suppression as well as a description of the reception process will be discussed in the concluding article of this series.

(To be concluded)

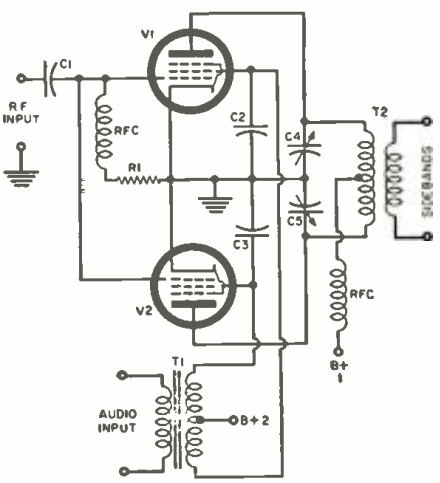


Fig. 3. Example of balanced modulator.

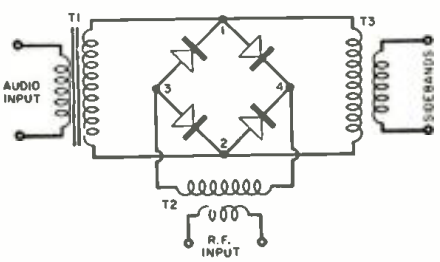
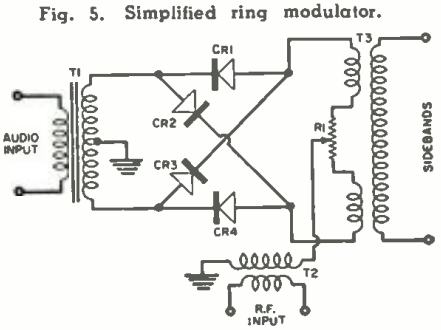
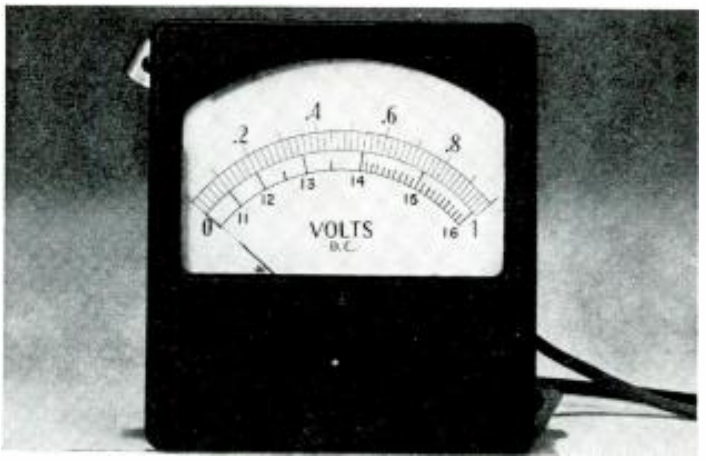


Fig. 4. Simplified bridge modulator.

Fig. 5. Simplified ring modulator.





This meter was modified to produce a wide scale between 14 and 16 volts for the adjustment of automotive voltage regulators. The meter starts to read at about 10 v.

Meter Zero Suppression with Zener Diodes

By **M. L. SNEDEKER**
Project Manager
Designers for Industry

Simple method for expanding the range of any d.c. microammeter or low-range milliammeter with a diode.

THE occasion frequently arises for the accurate reading of voltages over a limited range. Zero-suppressed instruments are used for this purpose; all voltages below a certain value applied to the meter will cause no movement of the pointer, and the scale is calibrated so that the lowest voltage value takes the place of the conventional zero. Such meters usually employ specially shaped pole pieces and are relatively expensive. By using a silicon-junction diode of the zener type a conventional meter can be used to provide zero suppression over a wide range of voltages.

The uni-directional characteristics of germanium and silicon diodes are well-known. The ratio of back resistance to forward resistance is quite high, varying with the type diode and operating voltage.

If a potential of "opposing" polarity and sufficient magnitude is applied to a conventional germanium diode, a very small reverse current will flow. Reference to the characteristic charts will show it to be limited to an extremely small value. If this value is exceeded, the diode will be destroyed. The reverse current so caused tends to be erratic, varying greatly from diode to diode. Note also, in Fig. 1, that the reverse current increases gradually as the reverse voltage is increased. In contrast, the silicon-junction diode provides a repeatable, stable, reverse-current characteristic with a definite conducting voltage.

As used in voltage-regulator applications, a zener diode is normally connected as shown in Fig. 2. This is the familiar voltage-regulator circuit used with conventional VR tubes and functions in much the same manner; the voltage across the diode remains almost constant over wide variations in the unregulated supply voltage. Zener diodes with a breakdown voltage held within 5% of rating are available; power handling capabilities range from 250 milliwatts up to 10 watts. This type of diode has an extremely high back resistance and, of additional importance, is its property of conducting "all at once"; a relatively sharp breakdown voltage value exists below which very little current flows.

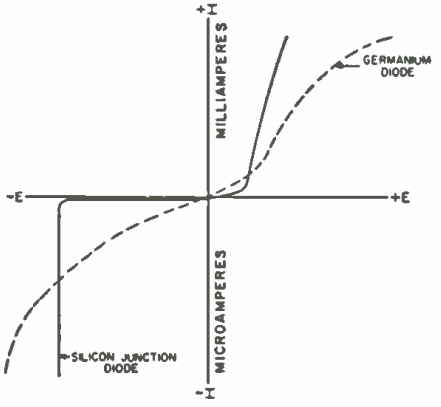


Fig. 1. Reverse-current characteristics.

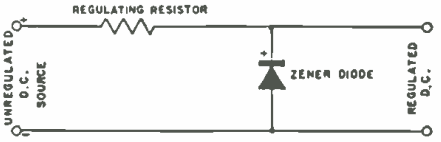


Fig. 2. Zener diode employed as regulator.

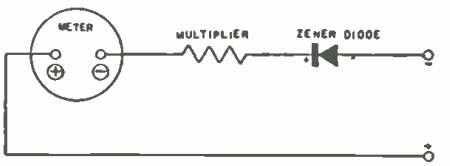


Fig. 3. Diode used to suppress meter zero.

Table 1. Typical voltage ranges obtained.

ZENER DIODE	VOLTAGE RANGE 0-100 μa. METER	VOLTAGE RANGE 0-1.5 ma. METER
International 1N470	3.5-10	6-15
Transitron SV 818	17.5-32	20-32
Hoffman 1N1789	24-65	46-100

Note: All diodes rated 750 milliwatts.

This sharply defined breakdown-voltage characteristic can be utilized by connecting the diode in a straight series arrangement as shown in Fig. 3. In the conducting condition, the resistance of the zener diode is relatively low. However, at voltages below breakdown, its resistance is very high and little current flows through it. Consequently, no indication will appear on the meter and, by using a diode having the proper breakdown voltage, we can cause the meter to begin to read at almost any desired value. We thus have available the entire scale for the reading of voltages over the range in which we are interested. Two or more diodes can be placed in series to produce the desired breakdown voltage. This suppressed-zero feature can be obtained with any d.c. microammeter or low-range milliammeter.

The scale must be calibrated for the range desired, using a known accurate standard. The series multiplier will have to be determined by experiment. Some typical voltage ranges, the regulator diodes, and d.c. meters used are shown in Table 1. It will be noticed that the "threshold" voltage is higher when the less sensitive meter is used; the very small current flowing just below the zener breakdown is not perceptible on this meter scale.

In the meter illustrated, an open scale was desired in the 14-16 volt range for the testing and adjustment of automotive voltage regulators. Two 1N470 diodes were connected in series. The full-scale sensitivity of this meter is 100 microamperes; its internal resistance is 540 ohms.

This simple method of obtaining the suppressed-zero feature makes possible the construction of a most useful instrument with a minimum of expense.

—30—

ELECTRONICS IN OUTER SPACE

By JORDAN McQUAY

PART 2

The equipment that sends information back to earth from our far-ranging satellites and space probes. Data transmitters, sensing, and memory units are covered.

IN Part 1 of this series we discussed the electronics payload in general and the radio tracking transmitters. Now we will cover some of the other specific equipment which has been flown into outer space.

Radio: Data Transmitters

These radio transmitters vary widely—in size, weight, and complexity—in accordance with the nature and volume of the telemetered signals to be broadcast.

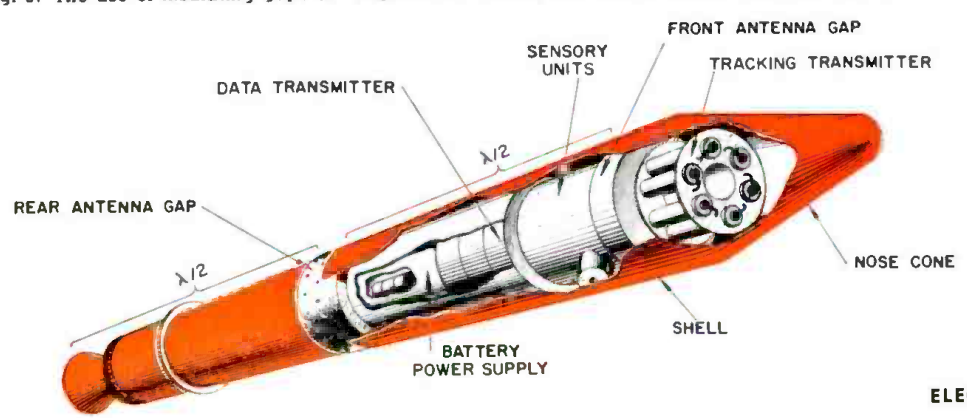
The data transmitter used aboard the "Vanguard I"—which is still in orbit—consists of a crystal-controlled transistor oscillator powered by solar cells. Since this transmitter was intended to broadcast indications of internal temperature within the satellite, an AT-cut crystal is mounted remotely from the transmitter on the inside shell of the spherical satellite. Operating on its fifth overtone, the crystal responds to frequency changes to provide a linear frequency shift. In this way, the data transmitter is modulated to provide a telemetry signal output of about five milliwatts on a nominal frequency of 108.03 mc. Required input power is provided by solar cells; and after a year of operation, it has survived environmental hazards in space and is still broadcasting data signals from the orbiting "Vanguard I."

Much more sophisticated data transmitters are required for payloads with physically larger and electronically more complex instrumentation.

The transmitter aboard the "Explorer I" was a crystal-controlled transistor-type oscillator operating at a frequency of 108.03 mc. with an output of about 60 milliwatts. Its various components—with sensory units and power supply—are shown in Fig. 9. After launching of the satellite, the transmitter functioned continuously to relay data on cosmic rays, micrometeorites, and temperature. Due to continuous operation, its battery power supply was exhausted in about two weeks. Much of the transmitter's effort was dissipated when the satellite traveled over uninhabited areas and the oceans.

A similar type of data transmitter was used aboard the "Explorer III," but was turned on and off as required by control signals from a tiny command receiver which was also added to

Fig. 8. The use of insulating gaps on "Explorer IV" makes the vehicle itself a radiating dipole antenna.



the payload. In addition, a magnetic tape recorder was linked with the data transmitter. When the transmitter was not in operation, collected data was fed directly to the recorder. On receipt of a command signal from a ground control station, the transmitter was turned on and the tape recorder modulated the data transmitter with a "burst" of compressed data. Then the transmitter was turned off and the tape recorder allowed to again store scientific data until interrogated from the ground. This conservation of battery power prolonged the life of the data transmitter to more than two months.

Also part of the payload of the "Explorer III" was an ingenious system for coding the time so that it was possible, during brief periods of data transmission, to tell where the satellite was in its orbit at the time when it

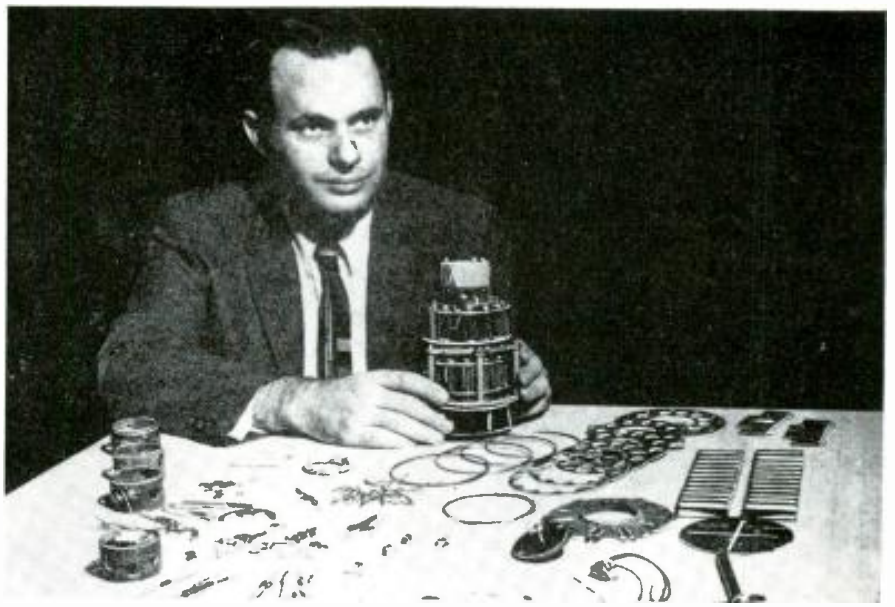


Fig. 9. Components of data transmitter employed in "Explorer I" and "Explorer III."

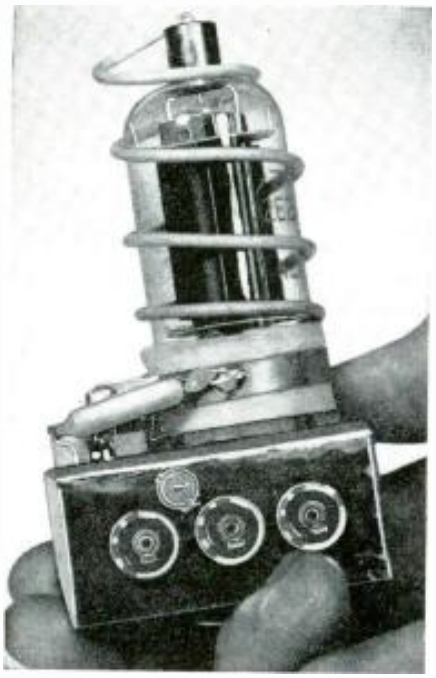


Fig. 10. Data transmitter in "Pioneer III."

collected specific cosmic-ray data. A diminutive tuning fork was used as the internal time standard.

The entire payload of "Explorer IV" was devoted to measuring the intensity of cosmic-ray particles in space. Sensory units provided five separate channels of data, which were combined by the telemetry converter and broadcast by both the data transmitter and the tracking transmitter.

Aboard the "Pioneer I," the data transmitter operated at a frequency of 108.06 mc. with an output power of about a half watt.

A much higher frequency of 960.05 mc. was used by the data transmitter of "Pioneer III." It broadcast a phase-modulated signal with a power of 180 milliwatts during the short, one-day life of this space probe (Fig. 10).

A similar transmitter, operating on 960.05 mc., was used aboard the "Pioneer IV." In addition to data on radiation and micrometeorites, it also broadcast an indication of the effective radiated power of the transmitter. This was done because during the flight of the previous "Pioneer III," there was an unexplained power drop of the data transmitter at altitudes of about 50,000 miles. This measurement of output power will be repeated during future space probes in an effort to identify and locate some unknown phenomenon affecting space communication.

Another future satellite will be equipped with a data transmitter about the size of a loaf of bread, weighing forty pounds. Known as DOVAP (Doppler, Velocity, and Position) equipment, it broadcasts data on the trajectory and velocity of early stages of a missile during actual launching and flight.

The command receivers, used to trigger the data transmitters and control other operations of the payload, are essentially sensitive u.h.f. transistor-type receivers operating on a frequency separate from that of the data and tracking transmitters. In most cases, the command signals are encoded to prevent unauthorized operation of the electronics payload. Command receivers operate continuously, but draw negligible current from the power supply.

Radio: Antennas

A separate antenna is used for each transmitter aboard a satellite or space probe. Each antenna is constructed so that it is electrically and mechanically symmetrical with the main axis of rotation of the space vehicle.

The spherical shells of all "Vanguard" satellites are equipped with six long rigid elements of radial. Four of these constitute a turnstile antenna for the tracking transmitter and are circularly polarized. The remaining opposite two are a dipole antenna for the data transmitter and are linearly polarized. All radiating elements are ⅛ wavelength.

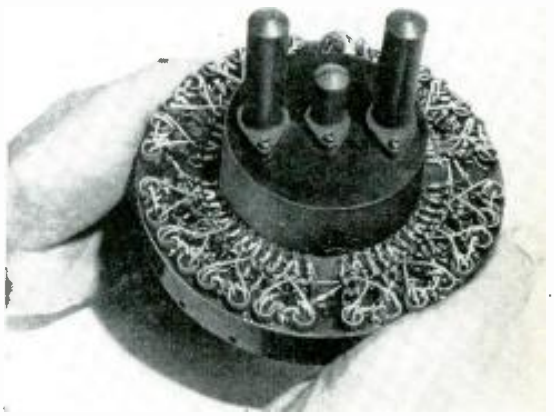
A turnstile antenna was used for the data transmitter on "Explorer I," consisting of four whip-like wires extending ¼ wavelength from the midsection of the space vehicle. These flexible dipoles caused the satellite to revolve like a propeller while in orbit, however, and were replaced by stubs on the "Explorer III."

For "Explorer IV" even these were eliminated and the satellite itself used as a dipole antenna. As shown in Fig. 8, a Fiberglas insulating ring (rear antenna gap) in the midsection of the vehicle divides the housing shell electronically in two parts—so that each half functions as one pole of an antenna. Imbedded in the same insulating ring is a single circular wire that serves as the antenna for the command receiver.

A similar insulating gap in the forward part of "Explorer IV" isolates the antenna used by the tracking transmitter (Fig. 8).

After its introduction, this type of antenna system has become common and is now generally used on most satellites and space probes. One excep-

Fig. 11. Radiation sensory unit in "Pioneer III" consists of 2 large G-M tubes and small voltage supply tube.



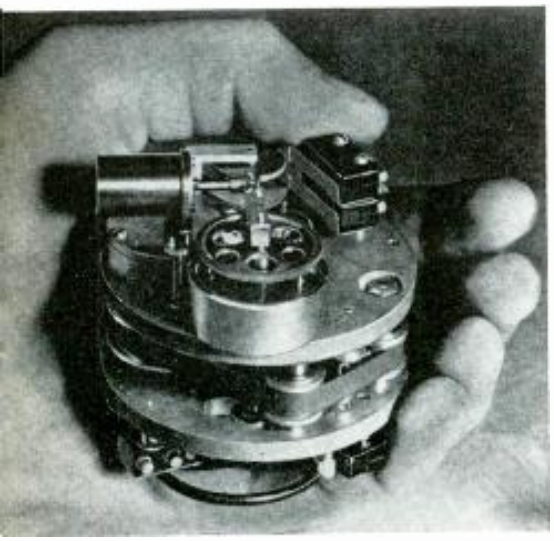


Fig. 12. Magnetic tape recorder that was employed aboard "Explorer III." This miniature instrument is used to record data during the satellite's orbit and, when triggered from the ground, to play it back through a transmitter.

tion was the antenna for the data transmitter aboard the "Pioneer III" satellite, which consisted of a gold foil or flashing over the nose cone of the space probe.

The radiation pattern of antennas for space vehicles always has rotational symmetry. The radiation pattern of the vehicle itself is similar to that of a dipole. When the vehicle is long with numerous rocket stages, the antenna lobes tend to bend toward the rear with a pronounced increase in antenna gain.

The record for long-range transmission of radio signals belongs, at the present, to "Pioneer IV." Signals were received on earth from this space probe over a distance of more than 400,000 miles. Never before was a radio signal of this type received from so far out in space.

Sensory Units: General

A satellite or space probe is ideally suited for measuring certain scientific data that can *only* be measured outside or beyond the absorbing atmosphere of the earth. Such data is obtained by sensory units or active detectors. The number and type of sensory units will vary according to the type of data to be collected and measured.

Sensory units have a signal output between zero and about five volts. Potentiometer-type units are usually preferred over inductance devices and other cumbersome and heavy equipment.

Relatively simple sensory units are used to measure internal and external temperatures, air pressure, and the impact of meteorites and micrometeorites. More complex devices are used to detect and measure radiation in the ultraviolet range from the sun, cosmic rays, and magnetic fields in the atmosphere.

Temperature within the electronics payload is measured simply by means of a bead thermistor. Similarly, the temperature at several spots on the housing shell is measured with a number of thermistors. The output may be used directly to modulate a tracking transmitter or it may be fed with other signals to a telemetry converter and then broadcast by a data transmitter.

Air pressure within the electronics payload—always in a sealed air-tight chamber or container—is measured by a simple pressure-recording detector.

Meteorite erosion effects on the housing shell of a space vehicle are measured at a number of different points by means of thin resistance strips connected to a small cadmium-sulfide cell. Increases in resistance, due to erosion or actual collision with meteorites, produce a proportionately increased signal output.

The number of micrometeorites, or atmospheric "dust" particles, is measured either with a tiny crystal microphone mounted against the interior shell, or with a delicate wire-screen gauge detector whose electrical constancy is affected by the bombardment of micrometeorites.

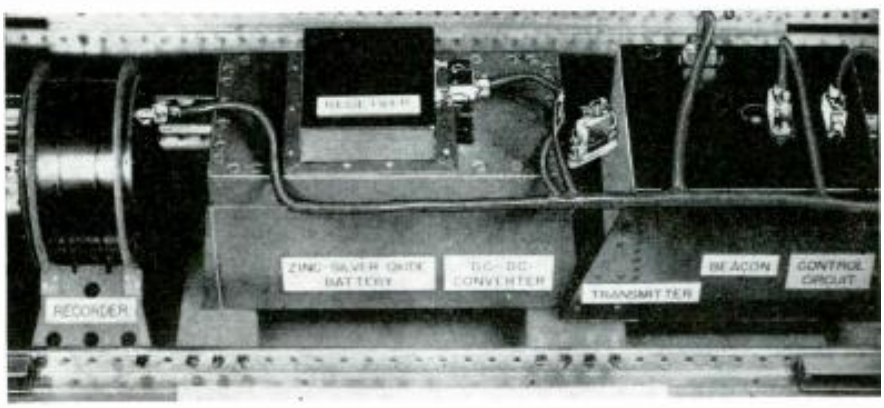


Fig. 13. Electronics payload for "Score," communications relay satellite. Total transmitter produces 8 watts of power and uses zinc-silver oxide batteries. Total weight of the entire communications payload is about one-hundred-fifty pounds.

Sensory Units: Radiation

Outer-space radiation particles — such as cosmic rays, *gamma* rays, and others—are of scientific importance. These high-energy particles come from the sun and from the universe beyond the sun. In sufficient concentrations, these rays are dangerous to human beings because they produce mutations by knocking electrons off the molecules in human cells.

To explore and define dense concentrations of these particles, almost all space vehicles are equipped with some type of radiation sensory unit. Important initial measurements of radiation were made by "Explorer I" and "III." The entire electronics payload of "Explorer IV" was devoted to this study and measurement.

Radiation is measured basically with some form of G-M (Geiger-Mueller) counter. This is a tiny ion chamber enclosed by a metal tube, containing an inert gas: argon. When high-energy cosmic particles penetrate the walls of the tube, they knock off electrons and ionize the gas. This allows the tube to conduct electricity. A microammeter recorder connected in series with the tube indicates a measure of ionization and, consequently, a measure of the density of radiation particles in the immediate vicinity of the particular space vehicle.

A G-M counter aboard the "Explorer I" first detected the existence of a dense radiation band from about one to two thousand miles above earth. In fact, the radiation was so intense that the G-M counter was frequently overloaded and inoperative.

This led to the development of an improved G-M counter with a wider recording range, which was part of the payload of "Pioneer III" (Fig. 11). One of these G-M counters plus two scintillation counters were carried aboard the "Explorer IV" space vehicle.

A scintillation counter consists of a translucent crystal of cesium iodide or sodium iodide, which is mounted in front of a photo-multiplier tube. When cosmic particles of sufficient energy strike the scintillator, a minute flash of light is produced and recorded by the unit.

The volume of radiation data collected and transmitted by "Explorer IV" proved so extensive as to require more than a year of complete analysis. But, in general, the results showed a pronounced density band of cosmic particles above the earth—with the greatest density at about 1500 miles altitude.

In such an area, an unprotected human would be exposed to the equivalent of a year's dose of radiation in less than an hour. This will have a pronounced effect on space travel by humans, requiring future space travellers to be suitably protected. Similarly, protection must be afforded photographic films, transistors, insulators, and other electronic components. Even radio communication may be influenced by this intense concentration of cosmic particles. There will be further exploration and measurement of cosmic radiation by future space vehicles.

Fully developed but not yet proven aboard a space vehicle is a special type of radiation detector that measures

(*Continued on page* 120)

SAVE 1/2 THE TIME

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SIGNAL INJECTION
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WAY

MODEL 1075 B&K TELEVISION ANALYST

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MODEL 1075 TELEVISION ANALYST. Complete with standard test pattern, white dot, white line, and color-bar slide transparencies, and one clear acetate. Net, **$259.95**

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Saves many hours of service work. Provides vertical and horizontal sync and driving pulses that enable you more easily and quickly to check out every stage in the sync and sweep sections of a television receiver.

Tracks down troubles in the horizontal and vertical output circuit including defective output transformer and yoke; checks for shorted turns, leakage, opens, short circuits, and continuity. Includes unique high-voltage indication. Eliminates trial and error replacements.

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ANOTHER FIRST FOR HEATHKIT
. . . amplifier power rating standards

Heathkit is accustomed to pioneering . . . to leading the way. We led the way into the kit field of electronic equipment. Now, we are leading the way to audio amplifier power rating standards . . . standards clearly defined to assure you of Heathkit quality . . . to enable you to compare before you buy.

The Heathkit amplifier standards have been established upon these following beliefs after reviewing over one hundred published treatises on the subject:

WE BELIEVE any amplifier should be rated for its intended use . . .

PROFESSIONAL amplifiers must be so nearly perfect that no audible change occurs in the program material.

HIGH FIDELITY amplifiers must be almost as perfect, almost as efficient.

UTILITY amplifiers can be less perfect and still fulfill their practical job.

WE BELIEVE the rated power of an amplifier in any of the above "use" categories should be that power which satisfies all requirements in that category.

Each of the three "use" categories we have chosen has requirements which can be translated into performance specifications with rather definite limits . . . limits established by recognized authorities. The Heath requirements and their limits for each of the categories are as follows:

PROFESSIONAL RATING

The professional power rating shall be that power which satisfies the following five tests:

1. Maximum power at which total harmonic distortion (THD) does not exceed 0.3% at 1000 CPS.
2. Maximum power at which total harmonic distortion (THD) does not exceed 2.0% at 20 CPS.
3. Maximum power at which total harmonic distortion (THD) does not exceed 2.0% at 20,000 CPS.
4. Maximum power at which response does not deviate by more than ±1 db between 20 and 20,000 CPS.
5. Maximum equivalent single-frequency power at which intermodulation distortion does not exceed 1.0% (60 and 6000 CPS. 4:1).

HIGH FIDELITY RATING

The high fidelity power rating shall be that power which satisfies the following five tests:

1. Maximum power at which total harmonic distortion (THD) does not exceed 0.7% at 1000 CPS.
2. Maximum power at which total harmonic distortion (THD) does not exceed 2.0% at 30 CPS.
3. Maximum power at which total harmonic distortion (THD) does not exceed 2.0% at 15,000 CPS.
4. Maximum power at which response does not deviate by more than ±1 db between 30 and 15,000 CPS.
5. Maximum equivalent single-frequency power at which intermodulation distortion does not exceed 2.0% (60 and 6000 CPS. 4:1).

UTILITY RATING

The utility power rating shall be that power which satisfies the following five tests:

1. Maximum power at which total harmonic distortion (THD) does not exceed 1.0% at 1000 CPS.
2. Maximum power at which total harmonic distortion (THD) does not exceed 3.0% at 60 CPS.
3. Maximum power at which total harmonic distortion (THD) does not exceed 3.0% at 7000 CPS.
4. Maximum power at which response does not deviate by more than ±1 db between 60 and 7000 CPS.
5. Maximum equivalent single-frequency power at which intermodulation distortion does not exceed 3.0% (60 and 6000 CPS. 4:1).

We at the Heath Company are now rating all our amplifiers to these standards. To show you just how this rating system works, let's look at the Heathkit EA-3 amplifier:

As a professional amplifier—

1. Maximum Power at which T.H.D. does not exceed 0.3% at 1000 CPS: 15.1 watts
2. Maximum Power at which T.H.D. does not exceed 2.0% at 20 CPS: 13.9 watts
3. Maximum Power at which T.H.D. does not exceed 2.0% at 20,000 CPS: 15.3 watts
4. Maximum power at which response does not deviate more than ±1 db between 20 and 20,000 CPS: 17.6 watts.
5. Maximum equivalent single-frequency power at which intermodulation distortion (60 and 6000 CPS. 4:1) does not exceed 1%: 18.0 watts.

Taking that power which satisfies all five tests, we could rate the EA-3 for professional use, at 13.9 watts. Its advertised professional rating is a conservative 12 watts.

A review of the chart below shows why the EA-3 is rated at 14 watts for high fidelity applications, and 16 watts as a utility amplifier.

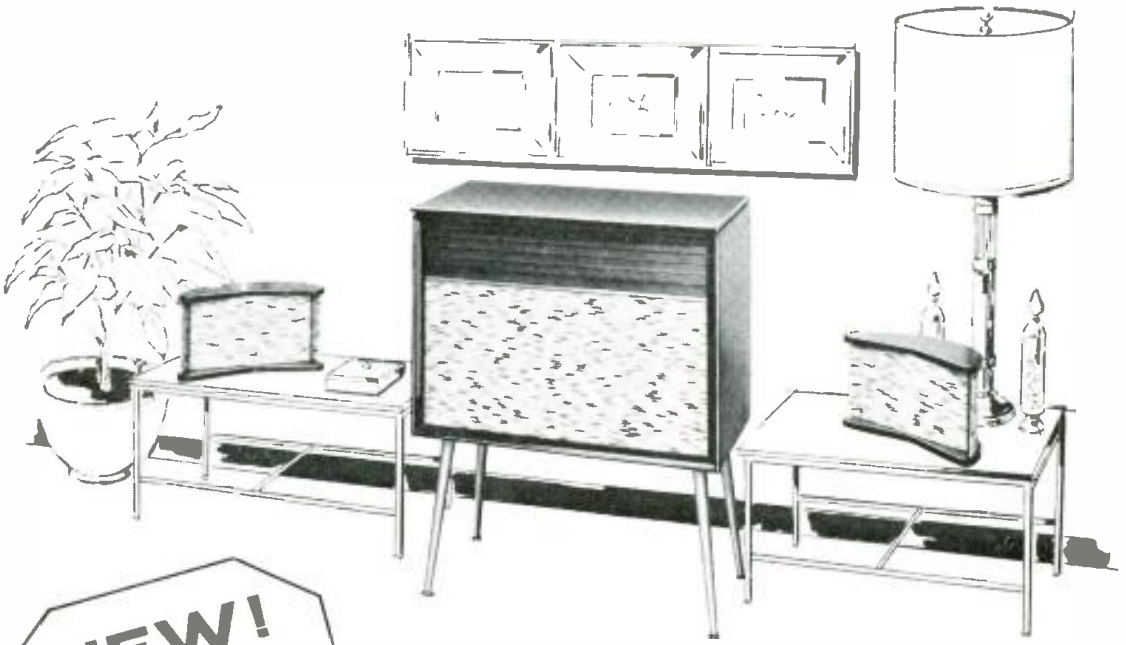
Notice that our specifications are set at rated power for one or more classifications (when our customers need an amplifier for a particular use, we believe thay want it to deliver its rated power under those particular conditions). Observe that our distortion figures are specified at the limits of the amplifier frequency range as well as at the traditional 1000 CPS (the common practice of rating distortion only at 1000 CPS does not tell you what happens throughout the full range of the amplifier).

As an example of how these standards work on several competitive amplifiers, we have prepared the following chart. Notice that if the amplifiers did not meet standards at rated output power, we have determined the power output where they do meet the standards set up under the three categories.

AMPLIFIER COMPARISON CHART

Amplifier Description and Price	Heath Standard Rating		Maximum Power Output Satisfying:				
	Classification	Power (watts)	Power Rating at Test 1 Stds.	Power Rating at Test 2 Stds.	Power Rating at Test 3 Stds.	Power Rating at Test 4 Stds.	Power Rating at Test 5 Stds.
Kit "A" "12 w. HI FI" $23.90	Professional	Disqualified	8.4 watts	0.02 watts	0.65 watts	Disqualified	3.9 watts
	High Fidelity	Disqualified	9.1	1.3	1.67	Disqualified	5.9
	Utility	8.6 watts	9.8	8.9	8.6	12.3 watts	11.6
Assembled Amp. "B" "14 w. HI FI" $39.50	Professional	0.3	4.7	0.3	4.8	1.2	4.0
	High Fidelity	1.1	12.1	1.1	5.7	5.3	8.2
	Utility	7.8	13.2	7.8	12.9	15.8	13.9
Kit "C" "12 w. HI FI" $34.95	Professional	3.6	11.0	3.6	7.5	7.5	6.5
	High Fidelity	8.0	11.8	8.0	11.2	13.4	14.3
	Utility	11.9	12.0	12.0	11.9	15.0	14.9
Assembled Amp. "D" "15 w. HI FI" $64.50	Professional	3.8	13.2	3.8	14.5	12.0	14.6
	High Fidelity	10.6	14.3	10.6	14.5	18.3	16.3
	Utility	14.7	14.7	14.7	15.0	23.7	17.0
Heathkit EA-3 "14 w. HI FI" $29.95	Professional	13.9	15.1	13.9	15.3	17.6	18.0
	High Fidelity	15.5	16.2	15.8	15.5	18.3	18.9
	Utility	16.4	16.5	16.6	16.4	19.0	19.5

The Heathkit amplifier power rating standards have been established as further assurance to you of the high quality of our products. We will live by these standards until industry-wide standards are established.



NEW! from the HEATHKIT AUDIO LABS

BRAND NEW!

a complete Heathkit Stereo "Package"

THRILL TO A NEW DIMENSION IN STEREO SOUND

HEATHKIT SD-1 B (birch or SD-1 M (mahogany)

$179.95

(cabinet legs included; end tables not included)

HI-FI STEREO SYSTEM KIT

For the first time anywhere . . . a stereo-kit package, ready-to-play after only a few hours assembly time and complete with cabinet, stereo amplifier, stereo record changer, bass woofer and stereo speaker wings. And the unbelievably low price sets an unprecedented record for stereophonic systems of this quality anywhere on the market. One of the factors behind this phenomenal achievement is the introduction of the revolutionary stereophonic "sum and difference" amplifier used in this kit—licensed in kit form exclusively by Heath Company from CBS Laboratories. This unique development in audio science employs a new principle of stereophonic reproduction. The single chassis amplifier separates the individual stereo channels by utilizing the sum and difference of the total signal and directing the sound to the appropriate right and left channels, reproduced by the stereo wing speakers. The centrally located woofer reproduces the non-directional bass frequencies. The result of this modern stereo reproduction is a breath-taking experience of sound coming to you with depth and direction seldom achieved by conventional stereophonic methods. The beautifully styled console cabinet houses the stereo amplifier, stereo record changer and low-frequency woofer. Controls on the handsome black and gold amplifier panel consist of: on-off switch, bass and treble tone controls, input selector switch and level balancing control. The new CBS sum-and-difference or matrix-type circuit employs only four tubes and is extremely easy to assemble. The woofer, mounted behind the attractive grille cloth, is a high compliance 8" speaker capable of 30 cycle response when housed in the acoustically designed ducted-port enclosure. The specially designed crossover employs a dual bass-mixing 250 cycle network. The twin stereo speakers are 6" x 9" extended range dual cone oval speakers. The completely automatic, four speed record changer employs a ceramic stereo cartridge with micro-groove diamond stylus capable of obtaining the best from the latest stereo or LP monophonic recordings. A 45 RPM spindle is also included for 45 RPM monophonic or stereo records. Separate inputs are provided for AM/FM tuners or multiplex. Both in styling and performance, the all-new SD-1 Stereo offers you the greatest Heathkit value in years. Ship. Wt. 88 lbs.

- 9 Watt High Fidelity Rating (monophonic)
- Complete—No "Extras" to Buy
- Revolutionary Stereo Amplifier
- Assemble in Just a Few Hours From Easy Step-By-Step Instructions
- Beautifully Styled Cabinetry
- Stereo Sound With Such Impact You'll Find It Hard to Believe!

SPECIFICATIONS—Overall System Frequency Response: ±5 db, 30-16,000 cps. Amplifier: (push-pull conditions except where specified) Power versus Distortion, 10 watts, less than 3% THD from 30-16,000 cps. 9 watts, less than 2% THD from 30-16,000 cps. 1 watt, less than 0.7% from 30-16,000 cps. Peak Power: 20 watts. Mid-range individual channel power, 5 watts. Frequency Response: Tuner input, tone controls in mid-position, 1 watt level, ±1 db, 30-16,000 cps. Ceramic cartridge input—equalized for RIAA characteristic. Input Sensitivity: 0.1 volt at 1000 cps to each tuner input for 10 watt output. Hum and Noise: 70 db below 10 watt level with inputs shorted. Channel Separation at Significant Frequencies: (9 watt level on operating side). 250 cps—29.0 db. 1 kc—31.0 db. 2 kc—35.0 db. 3 kc—35.0 db. 5 kc—36.0 db. 8 kc—37.0 db. 12 kc—35.0 db. 16 kc—29.0 db. Overall Channel Separation using RCA test record #1427-1, cartridge supplied, 1000 cps. 20 db. Bass Tone Control: 50 cps, ±16 db attenuation 8 db. Attenuation 9 db. Treble Tone Control: 10 kc, ±16 db attenuation 9 db. Attenuation 7 db. Power Requirements: 117 volts, AC, 60 cycles, 75 watts. Crossover Network: crossover freq.—250 cps. Attenuation rate 12 db per octave. Power rating—5 watts per channel. Changer: speeds—16, 33⅓, 45, 78 rpm. Cartridge: ceramic stereo, out of phase connected (.0008" diamond stylus). Cabinet: dimensions—main cabinet, 30" wide x 34½" high x 15" deep. Satellite speaker: 14¼" wide x 8" high x 6" deep.

EASY TIME PAYMENTS

The thrills of stereo sound from this New Heathkit Stereo System can be yours NOW . . . while you pay in easy installments.

a complete line of stereophonic and monophonic

NEW! from the HEATHKIT AUDIO LABS

HEATHKIT

Tape Recorders

Field Tested for One Year

SPECIFICATIONS—Tape Speed: 7.5 and 3.75" per second. Maximum reel size: 7". Frequency response: (record-playback). ±2.5 db 30-12,000 cps at 7.5 IPS, ±2.5 db, 30-6,500 cps at 3.75 IPS. Harmonic distortion: 1% or less at normal recording level. 3% or less at peak recording level. Signal-to-noise ratio: 50 db or better, referred to normal recording level. Flutter and wow: 0.3% RMS at 7.5 IPS, 0.35% RMS at 3.75 IPS. Heads (3): erase, record, and in-line stereo playback. Playback equalization: NARTB curve, within ±2 db. Inputs (2): microphone and line. Input impedance: 1 megohm. Outputs (2): A and B stereo channels. Output levels, approximately 2 volts maximum. Output impedance: Approximately 600 ohms (cathode followers). Recording level indicator: professional type db meter. Bias-erase frequency: 60 kc. Timing accuracy: ±2%. Power requirements: 105-125 volts AC, 60 cycles, 32 watts. Dimensions, 15½" W. x 13¾" D, total height 10¾". Mounting: requires minimum of 8½" below and 1½" above mounting surface. May be operated in either horizontal or vertical position.

NEW PROFESSIONAL-TYPE TAPE RECORDER KITS

Designed to take their place in the finest of hi-fi systems, the new models TR-1C and TR-1D Tape Recorders will provide superb performance for years to come. These completely field tested, precision engineered instruments provide monophonic record and playback in the TR-1C or monophonic record and playback plus stereo playback in the TR-1D.

The mechanical assembly, with fast forward and rewind, is completely finished and adjusted—you build only the tape amplifier. Easy to assemble, the amplifier features two circuit boards which virtually eliminate wiring errors and assure the high stability necessary for consistently good results.

Low noise EF-86 tubes in input stage and push-pull bias erase oscillator assure maximum freedom from hum and noise in recording and playback.

Two inputs are provided (mike and high level line) for recording from microphone, preamplifier, tuner, phono, or TV. In the TR-1D, a separate playback channel with cathode follower output is provided for each stereo track—one of the stereo channels is used for monophonic playback.

Separate record and playback heads and amplifiers allow monitoring from tape while recording. Built-in sound level meter indicates proper recording level and bias for top quality recordings. A pause control allows instant starting and stopping of tape for accurate cueing and tape editing. Kit includes counter for cueing and editing ease.

The precision tape mechanism features heavy duty fan cooled motor, balanced flywheel, long-life bearings, and positive acting braking system. Push button provides instant selection of 3¾ or 7½ IPS tape speed. Safety interlock on record switch minimizes the possibility of accidental erasing. The handsome styling includes plastic escutcheon in soft gold mounted on semi-gloss black panel with black knobs with gold inserts. Complete instructions provided for assembly and operation. This outstanding kit offers a combination of features found only in higher priced professional tape decks selling for $350 to $400.

MODEL TR-1C Monaural Tape Deck: Has all features of model TR-1D with the exception of stereo playback. Shpg. Wt. 30 lbs. **$159.95**

MODEL TR-1D Stereo Tape Deck: Provides monaural record and playback and stereophonic playback of the pre-recorded tapes (stacked). Shpg. Wt. 30 lbs. **$169.95**

MODEL C-TR-1C Conversion Kit: Converts model TR-1C to include stereo function of model TR-1D. **$19.95**

NOW! TWO NEW STEREO-MONO TAPE RECORDERS IN THE TR-1A SERIES

Our most versatile tape recorder kit, the model TR-1A now can be purchased in any one of three versions. You can buy the new half-track (TR-1AH) or quarter-track (TR-1AQ) versions which record and play back stereo and monophonic programming, or you can buy the original monaural version (TR-1A) and add either half-track or quarter-track stereo provisions later using the MK-4 or MK-5 Conversion kits. The tape deck is extremely simple to assemble and uses precision bearings throughout the rugged mechanism assuring long and faithful service. One control lever selects all tape handling functions on the deck, greatly simplifying operation. Speeds of 7.5 or 3.75 IPS are available. Flutter and wow are held to less than 0.35%. Each tape preamplifier features NARTB playback equalization, separate record and playback gain control, cathode follower output and provision for mike or line input. Record level is indicated on "magic eye" tube. A safety interlock is provided to minimize accidental erasure of tape. Filament balance control allows adjustment for minimum hum level. Cathode follower output from playback channel is approximately 600 ohms impedance. Two circuit boards are used for easy assembly. Supplied with attractive vinyl-clad steel cover in black leather texture, with inlaid gold design. Templates and instructions provided for panel mounting or equipment enclosure installation.

NOW AVAILABLE IN THREE MODELS!

MODEL TR-1A: Monaural record/playback with fast forward and rewind functions. Shpg. Wt. 24 lbs **$99.95**

TR-1A SPECIFICATIONS—Frequency Response: 7.5 IPS ±3 db 50-12,000 cps. 3.75 IPS ±3 db 50-7,000 cps. Signal to Noise Ratio: Better than 45 db below full output of 1.25 volts channel. Harmonic Distortion: Less than 2% at full output. Bias Erase Frequency 60 kc (push-pull oscillator).

MODEL TR-1AH: Monaural and half-track stereo record/playback with fast forward and rewind functions. Shpg. Wt. 35 lbs. **$149.95**

TR-1AH SPECIFICATIONS—Frequency Response: 7.5 IPS ±3 db 40-15,000 cps. 3.75 IPS ±3 db 40-10,000 cps. Signal to Noise Ratio: 45 db below full output of 1 volt channel. Harmonic Distortion: Less than 2% at full output. Bias Erase Frequency: 55 kc (push-pull oscillator).

MODEL TR-1AQ: Monaural and quarter track stereo with record/playback fast forward and rewind functions. Shpg. Wt. 35 lbs. **$149.95**

TR-1AQ SPECIFICATIONS—Frequency Response: 7.5 IPS ±3 db 40-15,000 cps. 3.75 IPS ±3 db 40-10,000 cps. Signal to Noise Ratio: 40 db below full output 75 volts/channel. Harmonic Distortion: Less than 2% at full output. Bias Erase: 55 kc (push pull oscillator).

NOW! FULL STEREO CONVERSION FOR TR-1A OWNERS

MK-4 Half-Track Stereo Conversion Kit: Modifies TR-1A monaural tape recorder to include function of record and playback of half track stereo program material. Consists of a TE-1 tape preamplifier, a stereo head array plus components and instruction to convert TR-1A to TR-1AH. **$62.95**

MK-5 Quarter-Track Stereo Conversion Kit: Modifies TR-1A monaural tape recorder to include function of record and playback of quarter-track stereo. Allows playing stereo both ways on standard tape for twice the playing time or four times playing time with monophonic recordings. Consists of a TE-1 tape preamplifier, a stereo head array plus component and instructions to convert TR-1A to TR-1AQ. **$62.95**

HEATHKIT

monophonic or stereo Hi-Fi

HEATHKIT Program Sources

NEW

MODEL FM-4

$34.95

SPECIFICATIONS—Tuning Range: 88—108 mc. Quieting Sensitivity: 2.5 uv for 20 db of quieting, 3.5 uv for 30 db of quieting, 25 uv for maximum quieting (45 db). IF Frequency: 10.7 mc. Image Ratio: 45 db. AFC Correction Factor: 75 kc per volt. AM Suppression: 25 db. Frequency Response: ±2 db 20-20,000 cps. Harmonic Distortion: Less than 1.5%, 1100 uv, 400 cycles 100 modulation. Intermodulation Distortion: Less than 1%, 60 cycle and 6 kc mixed 4:1 1100 uv, 30% modulation. Antenna: 300 ohms unbalanced. Output Impedance: 600 ohms (cathode follower). Output Voltage: nominal .5 volt (with 30% modulation, 20 uv signal). Power Requirements: 105-125 volts 50/60 cycle AC at 25 watts. Overall Dimensions: 4¼" H. x 13¼" W. x 5½" D.

MODEL PT-1

$89.95

MODEL BC-1A

$26.95

HIGH FIDELITY AM TUNER KIT (BC-1A)

Delivers AM broadcast reception comparable to FM quality. Features a special detector using crystal diodes and broad-band IF circuits for low signal distortion. Prealigned RF and IF coils eliminate the need for special alignment equipment. Sensitivity better than 3 microvolts for one volt output. Two output levels provided. Built-in power supply. Special antenna supplied, also provision for outside antenna. Shpg. Wt. 9 lbs.

MODEL FM-3A

$26.95

HIGH FIDELITY FM TUNER KIT (FM-3A)

Featuring broad-banded circuits for full fidelity and better than 10 microvolt sensitivity for 20 db of quieting, the FM-3A pulls in stations with clarity and full volume. Incorporates stabilized temperature compensated oscillator, built-in power supply, prealigned IF transformers and ratio detector. The pre-assembled tuning unit is pre-aligned. Two output levels provided. Shpg. Wt. 8 lbs.

NEW HIGH FIDELITY FM TUNER KIT (FM-4)

This superbly designed unit incorporates advancements in circuit design with features asked for by hi-fi fans everywhere. Better than 2.5 microvolt sensitivity, automatic frequency control (AFC) with defeat switch, flywheel tuning and prewired, pre-aligned and pretested tuning unit . . . bring you the finest in FM listening entertainment. The exceptionally clean chassis layout, pre-aligned IF transformers and the prewired, pre-aligned tuning unit insure ease of construction with no further need of alignment after the unit is completed. The five tube circuit features a generous power supply utilizing a silicon diode rectifier for cool running operation and low power consumption. The attractive styling of the FM-4 features a vinyl-clad steel cover with leather-like texture, soft black front panel, set off with brushed-gold trim and new soft evenly-lit dial scale. A multiplex adapter output is provided. Feature for feature the FM-4 offers the most outstanding dollar value in FM entertainment available today. Shpg. Wt. 8 lbs.

MONOPHONIC-STEREO AM-FM TUNER KIT (PT-1)

Outstanding features in both styling and circuitry are combined in this 16-tube deluxe stereo AM-FM combination tuner to bring you the very finest of program sources for your listening enjoyment. Features include three printed circuit boards for easy construction and high stability—wired, pre-aligned 3-tube FM tuning unit—built-in AM rod antenna—tuning meter—automatic frequency control (AFC) with on-off switch—and flywheel tuning. Other features include variable AM bandwidth, 10 kc whistle filter, tuned-cascode FM front end, FM AGC and amplified AVC for AM. AM and FM circuits are separate and individually tuned so they can be used simultaneously for stereo applications. Cathode follower outputs with individual level controls are provided for both AM and FM, with a multiplex adapter output provided. A tuning meter and flywheel tuning combined with two edge-lit slide rule scales provide effortless tuning. Styling features vinyl-clad steel cover in black with inlaid gold design and soft black, rigid die-cast panel set off by brushed gold trim, black knobs with gold inserts. Shpg. Wt. 24 lbs.

AUTOMATIC HI-FI RECORD CHANGER KIT (RP-3)

Combining automatic convenience with turntable quality through unique and simple design the Heathkit RP-3 handles your records with the finest of care for full fidelity reproduction. The unique "turntable pause" feature during change cycle and smooth friction clutch start prevents record damage. Proper weight distribution and low pivot point friction of the tone arm minimize arm resonance, tracking error, and record wear. All record changer kits come equipped with changer base, stylus pressure gauge, 45 RPM spindle, and necessary wire.

STEREO MODEL RP-3S: Equipped with Shure diamond stylus magnetic cartridge providing frequency response of ±4 db from 30 to 14,000 CPS. Shpg. Wt. 19 lbs. **$74.95**

MONAURAL MODEL RP-3-LP: (monaural microgroove recordings only): Equipped with Fairchild Magnetic diamond stylus cartridge. Shpg. Wt. 19 lbs. **$74.95**

MONAURAL MODEL RP-3: Features a GE VRII magnetic cartridge with diamond LP and sapphire 78 stylus. Shpg. Wt. 19 lbs. **$64.95**

SPECIFICATIONS—Operates from: 105-130 volts 60 cycle. Wow and Flutter: Less than 0.18% peak at 33 1/3 RPM Turntable Speed. Accurate within ±2%. Change Cycle: Complete in 9 seconds. Dimensions: 13" wide x 12" deep, 5" above and 3" below mounting board. Motor Type: 4 Pole hum shielded. Type of Drive: Friction. Record Speeds: 4 speeds. Automatic and manual 33 1/3, 45, 78 RPM. Manual only—16 RPM. Variation in Tracking Force: Less than 0.9 gram from first record to tenth record. Controls: "ON-OFF" switch, Manual Reject, "Speedminder" (automatic speed selection and indexing). Manual speed selector (4 speed). Finish: Midnight Gray. Base: Maple (unfinished). Mounting Board: Birch (unfinished).

NEW from the HEATHKIT AUDIO LABS

a complete line of monophonic and stereo

HEATHKIT

Hi-Fi Amplifiers

MODEL SA-3

NEW

$29.95

NEW "ECONOMY" STEREO AMPLIFIER KIT (SA-3)

The all-new Heathkit SA-3 Stereo Amplifier has all the convenience of complete dual channel control at a fraction of the cost of comparable equipment. High level preamplifier section of the SA-3 provides complete control for both channels. Ganged tone controls provide "boost" and "cut" for bass and treble. Dual concentric volume controls make possible precise channel balancing. A channel reversing switch and a speaker phasing switch allows optimum performance. Two separate inputs are provided for each channel to accommodate ceramic cartridge phonographs, AM-FM tuners, or tape recorder. Program source may be reproduced in either monophonic or stereo form. A really big package of stereo performance for the small investment! Shpg. Wt. 13 lbs.

SPECIFICATIONS: Power Output: 3 watts [illegible] **Power Response:** ± 1 db [illegible] **Total Harmonic Distortion:** [illegible] **Intermodulation Distortion:** [illegible] **Hum and Noise:** (5 db [illegible]) **Controls:** [illegible] **Inputs:** ([illegible]) phono **Outputs:** ([illegible]) and 16 ohms **Finish:** [illegible] **Dimensions:** 12" [illegible] D [illegible] H

MODEL EA-1

NEW

$15.95

NEW "ECONOMY" 3 WATT AMPLIFIER KIT (EA-1)

More than enough for room filling volume . . . ideal for getting started on a low cost individual component system. Designed for use with ceramic cartridge record players, tuners, tape recorders, etc. Built-in pre-amplifier provides you with all the necessary tone and volume controls for adjusting the sound reproduction to your personal taste. Smart appearance, quality components, assemble it in a few hours for years of trouble-free enjoyment. Shpg. Wt. 7 lbs.

SPECIFICATIONS: Power Output: 3 watt [illegible] **Power Response:** ± 1 db [illegible] **Total Harmonic Distortion:** [illegible] watts output **Intermodulation Distortion:** [illegible] **Hum and Noise:** 70 db [illegible] **Power Supply:** [illegible] **Inputs:** ([illegible] crystal, ceramic phono cartridge) **Input Sensitivity:** [illegible] **Output Impedance:** [illegible] **Dimensions:** 3" [illegible] D

MODEL EA-3

NEW

$29.95

NEW 14-WATT HI-FI AMPLIFIER (EA-3)

From HEATHKIT audio labs comes an exciting new kit . . . New Styling, New Features, Brilliant Performance! Designed to function as the "heart" of your hi-fi system, the EA-3 combines the preamplifier and amplifier into one compact package. Providing a full 14 watts of high fidelity power, more than adequate for operating the average system, the EA-3 provides all the controls necessary for precise blending of musical reproduction to your individual taste. Clearly marked controls give you finger-tip command of bass and treble "boost" and "cut" action, switch selection of three separate inputs, "on-off" and volume control. A hum balance control is also provided.

NOTE THESE OUTSTANDING SPECIFICATIONS: Power Output: [illegible] watts [illegible] **Power Response:** ± [illegible] **Total Harmonic Distortion:** [illegible] **Intermodulation Distortion:** [illegible] **Hum and Noise:** [illegible] input, 47 db [illegible] crystal phono [illegible]

PREAMPLIFIERS

Model WA-P2 "Master Control" hi-fi pre-amplifier kit, 7 lbs. **$19.75**

Model SP-2 Mono-Stereo (2 channel mixer) Preamplifier kit, 15 lbs. **$56.95**

Model SP-1 Single Channel version of SP-2, 13 lbs. **$37.95**

Model C-SP-1 Converts SP-1 to SP-2, 5 lbs. **$21.95**

HEATHKIT

POWER AMPLIFIERS

Model UA-1 "Universal" hi-fi 12-watt amplifier kit, 13 lbs. **$21.95**

Model W-4AM Single Chassis 20-watt hi-fi amplifier kit, 28 lbs. **$39.75**

Model W-3AM Dual Chassis hi-fi 20-watt amplifier kit, 29 lbs. **$49.75**

Model W-7M "Extra Performance" hi-fi 55-watt amplifier kit, 28 lbs. **$54.95**

Model W-5M high fidelity 25-watt amplifier kit, 31 lbs. **$59.75**

Model W-6M high fidelity 70-watt amplifier kit, 52 lbs. **$109.95**

SPEAKER SYSTEMS

Model SS-3 "Basic" for hi-fi speaker system kit, 26 lbs. **$34.95**

Model SS-2 "Basic Range" hi-fi speaker system kit, 26 lbs. **$39.95**

Model SS-1B "Range Extending" hi-fi speaker system kit, 80 lbs. **$99.95**

Model HH-1 "Legato" hi-fi speaker system kit, 195 lbs. **$299.95**

HEATH COMPANY, Benton Harbor, Michigan

a subsidiary of Daystrom, Inc.

NEW: Heath Now Puts 2-Way Radiotelephone Communications in Reach of Everyone

Citizen's Band Transceiver Kit

NEW: No Radio Operators License Necessary!

NEW from the HEATHKIT COMMUNICATIONS LABORATORIES

- Designed to meet all FCC requirements for new 11-meter "Citizens Band" class D operation.
- Any U.S. citizen 18 or older eligible for license.
- No theory to study—no tests to take.
- Hundreds of uses in business or pleasure.
- Top quality components—proven performance—easy to build.

SPECIFY FREQUENCY CHOICE

CLASS D CITIZEN'S BAND FREQUENCIES

26.965 mc	27.035 mc	27.115 mc	27.185 mc
26.975 mc	27.055 mc	27.125 mc	27.205 mc
26.985 mc	27.065 mc	27.135 mc	27.215 mc
27.005 mc	27.075 mc	27.155 mc	27.225 mc
27.015 mc	27.085 mc	27.165 mc	*27.255 mc
27.025 mc	27.105 mc	27.175 mc	

*This channel shared with Class C Radio Control.

NEW

MODEL CB-1

Includes transceiver, microphone, and special power cords.

$42.95

First and only kit of its kind . . . designed to meet all FCC requirements for two-way radio telephone communication on new class D 11-meter "citizens band" . . . any U.S. citizen eighteen or older eligible for license . . . no code test, no radio theory exams, no knowledge of specialized operating procedures required . . . just fill out simple form included with kit and mail to FCC for registration. The Heathkit CB-1 Transceiver is light, compact, simple to assemble, easy to use. Buy two or more units, have your own communications system . . . talk with family, friends, associates from your car, home, boat or office . . . cover distances from one to ten miles depending on location and type of installation (extensively field tested). A flick of a switch selects "transmit" or "receive" while single receiver tuning control selects any of 23 assigned channels . . . third knob controls volume and turns set on and off. With separate vibrator power supply available from Heath, along with two special power cords included with kit, you can convert transceiver from fixed location at home or office to mobile operation in cars, boats, etc., in minutes, after initial installation, with no tools or adjustments. There's a Heathkit accessory antenna for any application, mobile or fixed. Kit comes complete with microphone, station identification card which fits in plastic window at end of cabinet, all pertinent FCC regulations and application forms, a sheet of adhesive-back letters and numbers to affix call letters in space provided on front panel, and crystal for one channel. Specify your frequency choice or we will supply crystal of appropriate frequency. The famous Heathkit quality coupled with the market-shattering low price of this kit make it truly a value of a lifetime. Shpg. Wt. 10 lbs.

SPECIFICATIONS—Receiver Type: Superregenerative detector w/rf stage. Power Input: 5 watts to plate of final RF amplifier (FCC maximum). Transmitter Frequency Control: Third overtone type quartz crystal operating within 0.005% of marked channel frequency between 32 F and 140 F. Modulation: AM plate modulation automatically limited to less than 100% (FCC requirements). Power Supply: 117 V 50/60 cycle, AC. 6 V battery using Model VP-1-6 Vibrator Power Supply or 12 V battery using Heathkit VP-1-12. Power Requirements: 117 volts 50/60 cycle AC 35 watts, 6 V battery w/VP-1-6, 6.5 amps., 12 V battery w/VP-1-12, 4.0 amps. Total B + requirements, 260 volts at 60 ma, total heater requirements, 6.3 volts at 1.8 amps. or 12.6 volts at 0.9 amps. Power Rectifier: 2 silicon diodes in full wave voltage doubler circuit. Microphone: Combination hand-held and desk type, ceramic element, plastic case, with cord and connector. RF Output Impedance: 50 ohms. Speaker Size: 4 inch (round). Undistorted Audio Power Output: Approximately 1 watt. Line Cords: Two supplied, one for AC operation, one for battery operation. Power circuits automatically switched when appropriate line cord is plugged in. Cabinet Dimensions: 8" H. x 6" D. x 9¾" W.

ANTENNAS

MODEL CBU-1 "UTILITY" ANTENNA

Low cost, portable antenna for CB-1 Transceiver for temporary installations, mobile or fixed, where maximum coverage is not required. Rugged clip for mounting on eaves-trough of house or rain gutters of cars, trucks, etc. Bracket supplied for mounting on transceiver or any flat surface. 45½" base-loaded, antenna with 12' connecting cable comes complete, ready to use. Shpg. Wt. 3 lbs.

$9.95

MODEL CBM-1 "MOBILE" ANTENNA

For CB-1 Transceiver permanent mobile installations where greatest coverage is desired. Easy to install double chain-type bumper mount spring base—no cutting or drilling. Easily adapted to boats, etc. ¼ wave whip antenna approximately 9' from mounting surface to tip—supplied with clip for securing in semi-horizontal position to clear obstructions. Kit is complete with 102" whip in 2 sections, 15' connecting cable and all necessary hardware. Shpg. Wt. 7 lbs.

$19.95

MODEL CBF-1 "FIXED LOCATION" ANTENNA

A ¼ wave "ground plane" type antenna for CB-1 Transceiver using 4 radial elements as the "ground plane" and 1 vertical element as the radiator. Excellent coverage, essentially non-directional, making it ideal for communications between fixed and mobile units. Antenna measures 9' 4" from bottom of mounting bracket to top of vertical radiator. Radial length 9'. Kit is complete with 50' connecting cable and easy to install mounting clamp. Shpg. Wt. 7 lbs. **$19.95**

POWER SUPPLIES FOR MOBILE USE OF CB-1:

MODEL VP-1-6 Vibrator Power Supply kit for 6 volt batteries. Shpg. Wt. 4 lbs.

$7.95

Model VP-1-12 Vibrator Power Supply kit for 12 volt batteries. Shpg. Wt. 4 lbs.

$7.95

NEW

MODEL CO-1

$7.95

(batteries included)

NEW TRANSISTOR CODE PRACTICE OSCILLATOR KIT (CO-1)

Your best buy in a high quality code oscillator, the CO-1 is ideal for Boy Scouts or beginning radio hams. Practice code by authentic CW tone or blinker light. Switch selects built-in speaker or light. Contactor provided for practice keying or any standard key can be connected. Completely transistorized for long battery life. Powered by two standard flashlight batteries. Batteries included. Shpg. Wt. 3 lbs.

TRANSISTOR PORTABLES

. . . and other Do-It-Yourself Hobby Kits

Model XR-1P Transistor Portable Radio kit. .6 lbs. **$29.95**
Model CR-1 Crystal Radio kit. . .3 lbs. **$7.95**
Model BT-1 Battery Tester kit. . .2 lbs. **$8.50**
Model ET-1 Enlarger Timer kit. . .3 lbs. **$11.50**
Model BR-2 Broadcast-Band Receiver kit. . .10 lbs. . . (less cab.). . **$18.95**
Model RC-1 Professional Radiation Counter kit. . .8 lbs. **$79.95**

MODEL XR-1P

MARINE KITS . . .

For Fun and Safety Afloat

Model DF-2 Two Band Transistor Radio Direction Finder kit 9 lbs. **$69.95**
Model FD-1-6 Fuel Vapor Detector kit (6 v.). . .4 lbs. **$35.95**
Model FD-1-12 Fuel Vapor Detector kit (12 v.). . .4 lbs. **$35.95**
Model MC-1 Marine Battery Charge kit. . .16 lbs. **$39.95**
Model PC-1 Power Converter kit. . .8 lbs. **$24.95**

MODEL DF-2

New—Electronic Ignition Analyzer Kit—IA-1A

NEW from Heath Test Equipment Labs

MODEL IA-1A
$59.95

- A Fraction of the Cost of Comparable Instruments
- Shows "Picture" of Entire Ignition System Performance on Cathode Ray Screen
- Shows Primary or Secondary Circuit Patterns
- "Trouble-Shoot" Complicated Ignition Faults in Minutes

A revolutionary development in the automotive tune-up field. Heathkit offers the small garage owner, service station operator or hobbyist an ignition analyzer with qualities and features of scopes costing several times as much (comparable to instruments costing as much as $750.00). The savings you realize through do-it-yourself kit assembly are only part of the story. Heath engineering know-how and tremendous buying power play an important role in keeping prices at rock bottom. Yet, this scope, as with all Heathkits, is designed to be "beginner built". A few hours of your spare time . . . and you're in business. The IA-1A lets you check the complete ignition system of an automobile in operation by merely connecting two leads to observe the tell-tale spark pattern of the cylinders. Can be used with the car under load and in motion by adding a vibrator power supply. Shows condition of coil, condenser, points, plugs and ignition wiring. A switch selects either primary or secondary circuit patterns; or alternately provides choice of parade or superimposed secondary patterns. It will also indicate coil reserve, a poor spark plug, defective wiring and will even identify the offending plug or wire. Also detects breaker point bounce, a defective condenser, or will allow setting of the dwell-time of the points. The IA-1A is simple to use, with a minimum of controls, yet is completely flexible for all types of internal combustion engines with coil ignition and accessible breaker points. Shows complete engine cycle or just one cylinder at a time. Test leads and comprehensive instruction manuals are supplied with kit. Shpg. Wt. 20 lbs.

NEW MODIFICATION KIT FOR OWNERS OF MODEL IA-1 IGNITION ANALYZERS:
Gives you switch selection of either primary or secondary circuit patterns; or alternately provides choice of parade or superimposed secondary patterns. Kit includes test lead modification parts and comprehensive instructions for modification and use. Shpg. Wt. 2 lbs. Heathkit MK-6. **$4.95.**

A COMPLETE LINE OF INSTRUMENT KITS

OSCILLOSCOPES

Model OM-3 "General Purpose" 5" oscilloscope kit. 22 lbs. **$39.95**
Model O-12 "Extra Duty" 5" oscilloscope kit. .22 lbs. **$65.95**
Model OP-1 "Professional" 5" DC oscilloscope kit. . .34 lbs. **$179.95**

METERS

Model V-7A Etched Circuit VTVM kit. . .7 lbs. **$25.95**
Model AV-3 Audio VTVM kit. . .6 lbs. **$29.95**
Model MM-1 20,000 ohms/volt VOM kit. . .6 lbs. **$29.95**
Model AW-1 Audio Wattmeter kit. .7 lbs. **$29.50**
Model M-1 Handitester kit. . .3 lbs. **$17.95**

GENERATORS

Model TS-4A TV Alignment Generator kit. . .16 lbs. **$49.50**
Model CD-1 Color Bar and Dot Generator kit. .13 lbs. **$59.95**
Model SG-8 RF Signal Generator kit. . .8 lbs. **$19.50**
Model TO-1 RF Test Oscillator kit .4 lbs. **$16.95**
Model LG-1 Laboratory RF Generator kit. . 16 lbs. **$48.95**
Model AG-9A Audio Generator kit . 10 lbs. **$34.50**
Model AG-10 Sine-Square Generator kit. . .12 lbs. **$49.95**
Model AA-1 Audio Analyzer kit. . .13 lbs. **$49.95**

TEST INSTRUMENTS

Model TC-3 Tube Checker kit . .12 lbs. **$39.95**
Model CC-1 Cathode Ray Tube Checker kit. .10 lbs. **$24.95**
Model T-4 Visual-Aural Signal Tracer kit. . .5 lbs. **$19.95**
Model C-3 Condenser Checker kit. . 7 lbs. **$19.50**
Model CM-1 Direct Reading Capacity Meter kit. . 7 lbs. **$29.50**
Model CT-1 In-Circuit Capaci-Tester kit. . .5 lbs. **$7.95**

Plus many more quality instruments for every need!

A COMPLETE LINE OF HAM GEAR

FIXED STATION

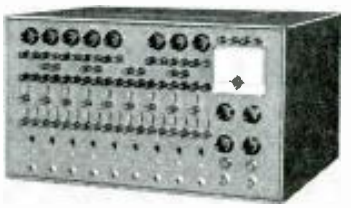
Model DX-20 CW Transmitter kit 19 lbs. . **$35.95**
Model DX-40 Phone and CW Transmitter kit 25 lbs **$64.95**
Model DX-100-B Phone and CW Transmitter kit . . .107 lbs **$189.50**
Model VHF-1 "Seneca" VHF Ham Transmitter kit 56 lbs **$159.95**
Model TX-1 "Apache" Ham Transmitter kit . . .110 lbs **$234.95**
Model RX-1 "Mohawk" Ham Receiver kit 66 lbs **$274.95**

MOBILE

Model MT-1 "Cheyenne" Mobile Ham Transmitter kit 19 lbs **$99.95**
Model MR-1 "Comanche" Mobile Ham Receiver kit 19 lbs **$119.95**
Model MP-1 Mobile Power Supply kit 8 lbs **$44.95**
Model PM-2 Power Meter kit 2 lbs **$12.95**
Model AK-7 Mobile Speaker kit 4 lbs. . . **$5.95**

NEW EDUCATIONAL ELECTRONIC ANALOG COMPUTER KIT (EC-1)

- 9 DC operational amplifiers—3 initial condition power supplies
- 5 coefficient potentiometers—repetitive solution oscillator
- Electronically regulated power supply



NEW from the HEATHKIT INSTRUMENT LABORATORIES

HEATHKIT EC-1

$199.95

Filling a multitude of needs in the fields of education and electronics, the model EC-1 puts advanced engineering techniques within easy reach of the average individual or institution. An assortment of precision components and patch cords are provided for setting up many complex problems. Solutions are read directly on the panel mounted meter or on an external read-out device such as the Heathkit OR-1 DC Oscilloscope. An informative manual is provided, illustrating operating procedures and basic computer information as well as showing how to set up and solve typical problems. Shpg. Wt. 43 lbs.

NEW 5" DC OSCILLOSCOPE KIT (OR-1)

- Identical DC coupled vertical and horizontal amplifiers
- 5ADP2 flat-face CRT—edge-lit graticule
- Transformer operated silicon diode power supply

HEATHKIT OR-1

$119.95

Offering all the features of a high quality DC oscilloscope, the model OR-1 is ideal as a read-out indicator in computer applications as well as many types of testing and development work. Features DC to 200 kc (1 db point) bandwidth, 0.1 V (peak-to-peak) per CM sensitivity (uncalibrated). Normal frequency coverage is from 5 to 50 kc in four overlapping ranges. Critical voltages are regulated with gas-filled VR tubes. Coupling may be either AC or DC as selected by the input attenuator switch. Many uses in industrial, educational and medical fields. Shpg. Wt. 21 lbs.

Free Catalog

Over 100 easy-to-build kits are illustrated and described in the latest Heathkit catalog. If you are among the thousands interested in saving one-half or more on hi-fi, test, marine, or ham radio instruments, send for your free copy today.

COMING SOON! ELECTRONIC ORGAN KIT...

. . . an instrument that will excite the entire musical world. Engineered to familiar Heathkit perfection, and styled for the most discriminating taste . . . yet simple to assemble and priced for the average home. Interested? Send your name and address, we'll rush information as soon as available. No obligation.

HEATHKIT

ORDER BLANK

NOTE: all prices and specifications subject to change without notice.

Enclosed find ( ) check ( ) money order. Please ship C.O.D. ( )

On Express orders do not include transportation charges—they will be collected by the express agency at time of delivery.

On Parcel Post Orders include postage for weight shown. All prices are NET F.O.B. Benton Harbor, Michigan, and apply to Continental U.S. and Possessions only. 20% Deposit required on all C.O.D. orders.

HEATH COMPANY BENTON HARBOR 15, MICH.

a subsidiary of Daystrom, Inc.

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Address _____

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SHIP VIA

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QUANTITY	ITEM	MODEL NO.	PRICE
		POSTAGE	
		TOTAL	

☐ SEND FREE HEATHKIT CATALOG

HEATHKITS are also available at your Dealer see listing on next page

Service Plans & the Dealer

(Continued from page 61)

bank. The 30,000 customers who now subscribe to the Morris Plan charge-account system are expected to form the nucleus of the customers for the firm's new Home Service Plan.

Since all calls for service will have to be made directly to the bank, it will probably eliminate the major criticism of dealers who participated in the bank's original credit-plan program. The bank assumed no liability for credit given to card-holders who had exhausted their credit funds if the dealer had failed to get prior credit approval on the transaction from the bank. Under the Home Service Plan, the bank will check the customer's credit standing before relaying the call on to a service contractor.

Undoubtedly, the progress and effectiveness of the Indianapolis bank's home service plan will be studied by banks in all parts of the country that are using the revolving check-credit system, which has become a "red hot item" in banking circles. Many dealers have been critical of these check-credit plans because the banks assume no liability when a bank credit check bounces. If, however, all calls for service are handled by a department of the bank, the condition of a customer's account could be checked before the call was passed on to a service contractor.

These plans need not be inimical to the best interests of independent service, as an industry, if properly managed. Regardless of the type of plan, the service must be handled by a reliable, competent service operator or contractor. The degree of the success these systems achieve will be determined by the quality and character of the service that is provided by the affiliated service shops. Under conscientious and alert management, such plans could help to create a higher degree of respect and acceptance for independent service shops by the general public.

To the independent dealer who does not participate in them, these service plans constitute a new type of competition, aggravating the already serious problem of maintaining an adequate volume of business.

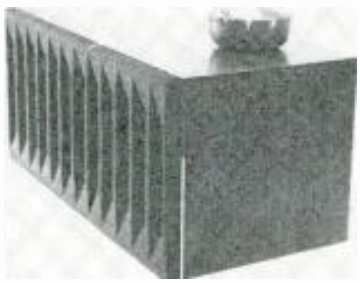
Long-range, the dealer must find ways to get business against competition with more promotional resources than he has. Becoming a contractor in a club plan is one way. Another is to offset losses in consumer service by entering the growing commercial and industrial electronics fields. A third is to develop a sales-promotion plan that will keep old customers and win new ones despite competition.

Much as some small business operators would like it, there is no chance to maintain the *status quo* in any type of business activity. A business either keeps moving forward or it falls behind to finally drop by the wayside from sheer financial exhaustion. —30—

Hi-Fi-Audio Product Review

AUDAX HI-FI SPEAKERS

The *Audax Division* of *Rek-O-Kut Company*, 38-19 108th St., Corona 68, N. Y. is currently offering a new line of high-fidelity speakers which have



been especially designed by George Nelson, a leading furniture and industrial designer.

The new units are individually crafted from oiled walnut and finished on all four sides. Each model has detachable legs and a completely new type of speaker grille—a "three-dimensional acoustic screen."

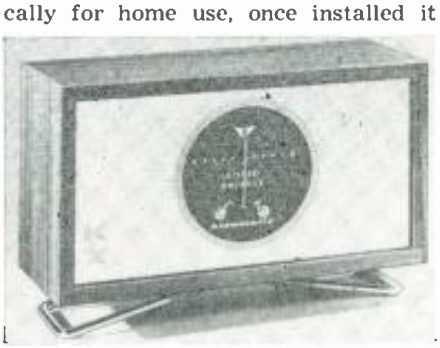
The Model CA-80 houses two 8" extended-range speakers while the Model CA-100 has two 10" woofers plus two special cone tweeters for augmenting high-frequency response. Both units are intended for bookshelf placement and may also be used as floor speakers.

The enclosure measures 12"x12"x24". The decorative metallic edging serves as a trim between the overlapping fabric grille and the cabinet surface. For more complete information and prices on these new models, write the manufacturer direct.

STEREO BALANCE METER

Kinematix, Incorporated, 1616 N. Damen Ave., Chicago 22, Ill. has recently introduced a sound balance meter for stereophonic system applications.

Since the unit was designed specifically for home use, once installed it



requires no adjustment or manual operation. The instrument is housed in a natural wood enclosure and incorporates a single, easy-to-read meter which is connected to the speaker output terminals. The user simply adjusts his volume controls until the needle is centered. The circuit also incorporates a control panel with two simple volume controls which permit the user to make the two channels of his sound system unequal in volume to compensate for acoustic environmental problems or off-center seating arrangements.

Cabinets in blonde, mahogany, or walnut finishes are available.

STEREO AMPLIFIER KIT

Heath Company, Benton Harbor, Michigan is now offering a budget-priced stereo amplifier kit, the Model SA-3.

A high-level preamp section provides complete control for both channels. Ganged tone controls provide convenient "boost" and "cut" action for bass and treble while dual concentric volume controls facilitate channel balanc-

ing. A channel reversing switch and speaker phasing switch permit the user to select his own mode of listening. Two separate inputs are provided for each channel to accomodate ceramic cartridge phonographs, AM-FM tuners, or tape recorder.

Power output is 3 watts per channel. Frequency is ±1 db from 50 to 20,000 cps at 3 watts output. Each channel offers 4-, 8-, and 16-ohm outputs. The unit, when assembled in the black, gold-trimmed cabinet, measures 12½" x 6¾" x 3¼".

"ELIPTOFLEX" ENCLOSURE

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y. has introduced a new bookshelf enclosure designed to promote maximum performance from any 12" wide-range speaker or 12" woofer, separate tweeter, and dividing network.

Although the design is basically that of "reflex" or "ported" types, this new enclosure incorporates two unique features—an elliptical port and a triangular shaped diffracting ring mounted on the front of the baffle board. According to the company these features serve to broaden the frequency response, improve transient response, and create a "lens" effect, changing relative particle velocities and thus

phase relationships so as to produce a smooth transition from front to rear radiation.

For further information on the "Eliptoflex" enclosure, including full mechanical specifications, write the company direct.

WIDE-RANGE MICROPHONE

Tandberg of America, Inc., 8 Third Ave., Pelham, N. Y. is now merchandising the new Type DP4 dynamic microphone made by *Grampian Reproducers Limited* of England.

The DP4 is a high-pressure type unit which achieves uniform, wide-range frequency response extending from 50 to 15,000 cps. The unit weighs less than one-half pound and can be used as a hand-held or desk microphone. The holder which comes with the microphone can be easily removed when desired. The microphone itself is $8\frac{1}{4}$" long and $1\frac{5}{16}$" in diameter. It is finished in black and chrome.

The Type DP4 dynamic mike is available in 25-ohm, 600-ohm, and 50,000-ohm impedance models. These models may be selected with push-button or slide-switch operation.

The U. S. distributor will supply full specifications on request.

EICO AM TUNER

Electronic Instrument Co., Inc. (EICO), 33-00 Northern Boulevard, Long Island City 1, N. Y. is now offering a matching AM tuner, the HFT94, as a companion piece to its Model HFT90 FM tuner.

Available in both kit and factory-wired versions, the new tuner features a choice of "hi-fi" wide bandpass to 14,000 cps or narrow bandpass to 7000 cps for weaker or distant stations; tuned r.f. stage for high selectivity and sensitivity; pre-aligned r.f. and i.f. coils; built-in ferrite loop; and pre-

wired precision "eye-tronic" tuning with the traveling DM-70 indicator that contracts into an "exclamation point" at exact center of each channel.

A high-"Q" filter eliminates 10-kc. whistle while reducing response by no more than 3 db at 9000 cps. Typical sensitivity is 3μv. at 30% modulation for 1 volt output, 20 db signal-to-noise ratio. No alignment or test instru-

ments are required to build the kit, according to the company.

The HFT94, which matches the HFT90 FM tuner in appearance, measures 3⅝" x 12" x 8¼".

STEREO TURNTABLE AND ARM

Alliance Manufacturing Company, Alliance, Ohio is now in production on an aluminum stereo turntable and companion stereo arm.

The new turntable incorporates a statically balanced arm which en-

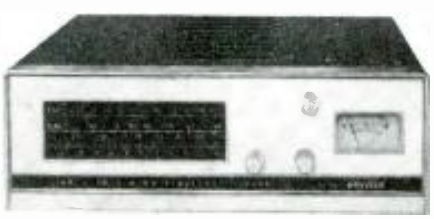
tirely eliminates the need for critical levelling of the unit. The entire assembly can be tilted 45 degrees or more without interfering with accurate tracking. The turntable features a heavy-duty, 4-pole motor; a Teflon thrust bearing to provide vertical vibration damping; single-speed belt-drive operation; slip clutch for accurate cueing; precision ground spindle to reduce wow; and 8-pound anodized aluminum turntable. Noise level is −50 db and wow and flutter is less than .2%.

The stereo arm of die-cast aluminum combines low mass and rigidity. Stylus pressure, independent of gravity, is adjusted by a screw-lock leaf-spring device. Any size cartridge can be accommodated in the arm, according to the company.

PRECISE'S AM-FM TUNER

Precise Development Corp., Oceanside, N. Y. has added an AM-FM tuner to its line of audio equipment.

Marketed as the "Perfecta," the new instrument features an unusual dual-limiter circuit which has been designed to provide increased selectivity. FM coverage from 88 to 108 mc. and AM coverage from 500 to 1600 kc. are provided along with variable automatic



frequency control. Coupled with the dual-limiter circuit, the a.f.c. feature affords sensitive tuning, pull-in of weak stations, and station lock-in. An output meter facilitates tuning by providing a visual indication in both FM and AM modes.

The "Perfecta" has inputs for TV and phono and a selector switch permits the listener to choose AM, FM, phono, or TV. The circuit incorporates cathode-follower output, Foster-Seeley discriminator, flywheel tuning, ferrite loop antenna, and three-gang variable capacitor.

A white and gold front panel harmonizes with the charcoal grey case.

FM TUNER FOR STEREO

Fisher Radio Corporation, 21-21 44th Drive, Long Island City 1, N. Y. recently introduced its FM-100 tuner which has been designed with complete facilities for handling all types of stereophonic broadcasts.

The new FM tuner is equipped with space and power connections on the chassis to accommodate the company's plug-in multiplex adapter (MPX-20) and with two output channels enabling the unit to receive FM multiplex stereo broadcasts transmitted under the *Crosby* system. In addition, feedthrough connections permit an external tuner to be connected to the FM-100 for listening to FM-AM or FM-FM stereo broadcasts.

The circuitry includes the company's "MicroGap" cascode r.f. stage, a bridge-connected mixer and oscillator,

four wideband i.f. stages with limiters, and a wideband ratio detector. A new and exclusive muting control eliminates sideband response, interstation noise, and unwanted weak signals.

12-WATT STEREO KIT

Arkay Radio Kits, Inc., 88-06 Van Wyck Expressway, Richmond Hill 18, N. Y. is marketing a 12-watt stereo amplifier-preamp in kit form at a price the budget-minded audio fan will welcome.

The CS-12 will select and control all stereo or monophonic program material. It can be driven by either a ceramic or crystal phono cartridge or by high-output tape decks, tuners, and other auxiliary equipment. All inputs are of the dual variety for rendering full stereo reproduction.

Power output is 12 watts with 20 watts peak, push-pull outputs for each channel. Frequency response is 20 to 20,000 cps, ±1 db. Speaker impedances of 4, 8, and 16 ohms can be handled.

The kit comes complete with step-by-step instructions for easy assembly.

SMALL SPEAKER FROM G-E

The Audio Components Section of *General Electric Company,* Auburn, N. Y. is now offering a new, compact speaker system, the G-501, which has been especially designed for high-fidel-

ity applications where space is limited.

Termed a "stereo-compact" speaker system, the G-501 will deliver a full range of sound despite its 22" x 13" x 9" bookshelf dimensions. The new system

is based on the company's extended-bass design and has a self-contained woofer, tweeter, and electrical cross-over network.

The one-cubic-foot, two-way speaker system is currently being offered in four genuine wood veneer finishes.

STEREO TAPE RECORDER

Bogen-Presto Company, a division of *The Siegler Corporation*, Paramus, N. J. is now in production on a competitively priced, professional stereophonic tape recorder that can be instantly converted from one-half inch to one-quarter inch tape.

The Model 850 is a three-track, one-half-inch tape version of the firm's *Presto* 800 series. It is equipped with three *Presto* A-908 amplifiers and is available console mounted, in portable cases, or unmounted for rack installation.

With a guaranteed speed accuracy of ±3 seconds per 30 minutes, the tape recorder at maximum speed will rewind a 10½" diameter reel in about 55 seconds. Three erase heads permit individual track erasing. Frequency response extends from 40 to 15,000 cps, flutter is below .15%, and signal-to-noise ratio is −55 db.

AUDIO CATALOGUES

JENSEN SPEAKER CATALOGUE

Jensen Mfg. Co., 6601 S. Laramie St., Chicago 38, Ill. has issued a 16-page catalogue which fully illustrates and describes its line of high-fidelity loudspeaker systems for mono and stereo.

Complete specifications on the new tube-vented "Bass-Superflex" enclosures with "Flair" line styling, for high-compliance "Flexair" woofers are included. "Stereo Director" units are also covered in some detail along with monophonic and "Stereo Director" kits for those who wish to build their own cabinets or built-in speaker systems.

Copies of Catalogue 165-C are available without charge from the manufacturer. —30—

Mac's Service Shop

(Continued from page 60)

There's no use getting mad at him. We really ought to be mad at ourselves and I'm just as guilty as the rest. You know how we felt when a fellow brought in a whole basket of tubes out of his TV set for us to test. We resented it. We felt it was pretty much a waste of time—both his and ours—for we knew from experience indiscriminate testing of tubes is a most inefficient way to locate trouble. We also knew that a tube tester cannot be relied on to spot certain tube defects. This feeling showed in our attitude. The customer was made to feel he was imposing on us. Some technicians began making a small charge to test tubes.

"We forgot the lesson of the filling stations. For many years they have been multiplying and thriving while offering a whole list of free commodities and services: free air; free water; free checks of radiator, battery, and oil level; free tire inflation; free windshield cleaning; etc. All of these services consume time; and some of them, such as purchasing and maintaining an air-compressor, represents a considerable outlay of cash; yet all service stations gladly and cheerfully provide the services. Obviously it pays to do so.

"And it paid us to check tubes cheerfully without charge, too, no matter what anyone says to the contrary. Tubes are among the most profitable items a technician sells. Still more important is the contact that testing tubes provides with the customer. If no bad tubes are found, almost invariably we get the service job. Where we missed the boat was by not keeping this lucrative tube business for ourselves by being *eager* to test tubes free and possibly by setting up a do-it-yourself tester right in the shop."

"Do you think the drugstore testers will really hurt us?"

"Sure they will. Let's not kid ourselves about that. People go there and buy a lot of new tubes to replace the old ones that test marginal. When this does not restore the set to operation, we get it for repair; but we've already lost the profit on replacing the weak tubes?"

"Do you think the average customer can do a good job of testing his own tubes?"

"No, at least not the kind of job we do in which we test for emission, gas, leakage, noise, loose elements, and mutual conductance. The do-it-yourself testers vary considerably in their complexity; but, in general, the more automatic they are the less thorough is the test; and the greater the number of tests provided, the more complex the tester and the greater chance for error by an inexperienced operator. A school teacher was here just yesterday to have some tubes checked. She admitted rather shamefacedly that she had just come from a drugstore tester

that showed four bad tubes out of nine; but she was a little dubious and wanted me to test them. None of the tubes was bad."

"Crooked tester, huh?"

"Not necessarily. She may have set it up wrong. The point is that if she had depended on her own testing she would have bought four new tubes she didn't need."

"What can we do to fight the drugstore testers?"

"For one thing we can do an about-face and persuade the customer we *want* to have him bring his tubes to our shop to be tested. I intend to set up a do-it-yourself tester out here in the office and put a sign on the door reading: *Test Your Own Tubes Free—Help If You Need It.* That do-it-yourself enthusiasm goes just so far. Supermarkets know this. They let you push your cart around and select your own groceries, but then they provide a boy to carry the groceries out and put them in your car. I think women especially will let us do the testing.

"Another thing: let's replace every tube that does not come up into the green in every set we service, no matter what was wrong with the receiver. That is what the customer will do if he takes the tubes to the drugstore; so let's provide him with fully guaranteed standard brand tubes."

"Check and double-check!" Barney said with mounting enthusiasm. "I was feeling pretty low when I came out of the drugstore, but I feel lots better now. We'll give them a real scrap for the tube business." —30—

HARVEY RADIO OPENS PROFESSIONAL AUDIO ROOM

DESIGNED primarily to serve the needs of broadcast and recording engineers, a new operating display of professional audio equipment has been opened in New York by Harvey Radio Co. Known as the Professional Audio Room, the display will be maintained on a permanent basis, with new items being added and obsolete ones replaced as the art advances.

On exhibit and in operation are such diverse items as Ampex professional three-track tape recorders and duplicators, the new Fairchild stereo limiter and cutter, Pultec program equalizers, microphones, amplifiers, booms, monitors, etc. —30—

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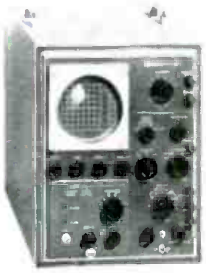

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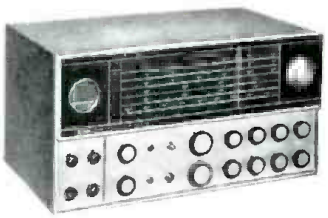

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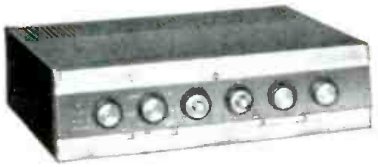

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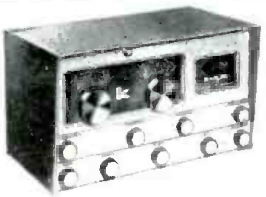

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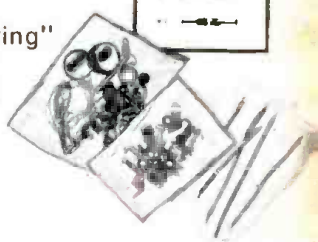

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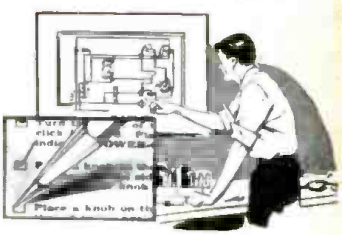

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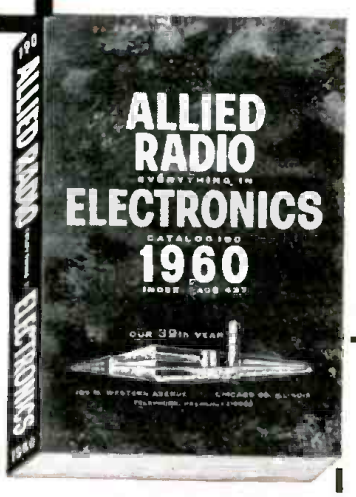

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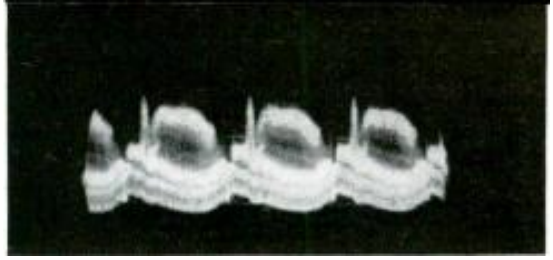


Fig. 1. Fairly light 60-cps hum superimposed on video signal, as it appears on the scope.

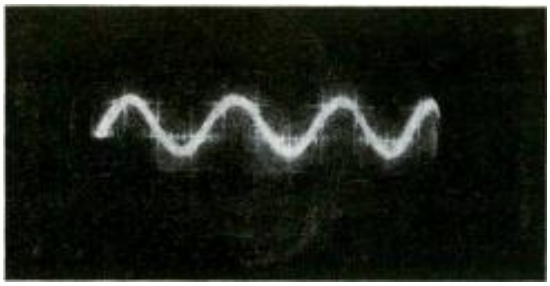


Fig. 2. A weak sine wave with superimposed spikes is typical of heater-cathode leakage.

Fig. 3. This distorted 60-cps sine wave indicates hum pickup at a poor ground connection.

The Aspects of Hum

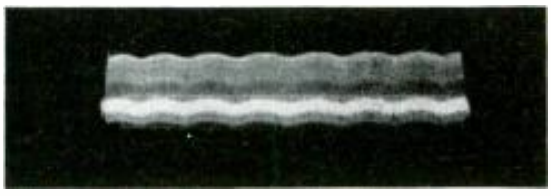


Fig. 4. Hum on the horizontal-sweep signal. Moving spikes interrupt the sine wave faintly.

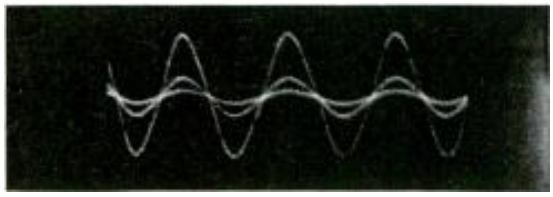


Fig. 5. Unstable waveform obtained by tapping tube with intermittent heater-cathode leakage.

By ROBERT GARY

Some hum effects are not obvious, and most are hard to track down. A scope provides quick recognition.

"I GET a dark bar across the screen." "There's a buzzing sound in my TV set." "My record player hums." These and many similar complaints tell the service technician that once again he has to deal with some sort of hum problem. Because hum occurs not only in TV sets but in AM broadcast, FM, and hi-fi equipment as well, the symptom should be classified according to its type and origin. However, before we can decide what kind of hum it is and from what part of the equipment it originates, we have to track it down in the set. We must determine the point at which the hum signal enters the circuit, in other words, before we deal with the reason for its entering at that point.

All hum is a type of interference. It is caused by a low-frequency signal entering the system chain somewhere and being progressively amplified until the hum becomes apparent either on the TV screen or through a loudspeaker. Hum is not usually due to a short circuit or a weak tube, nor does it occur if the "B+" or filament power is missing. In equipment that has previously operated without trouble, the appearance of hum indicates the failure of some component in such a way that it does not prevent the set from operating altogether. This component may be a wire, a tube, a capacitor, or any defective part. Newly built kits or combinations of separate hi-fi components are often subject to hum due to insufficient or improper grounding. For this reason it is worthwhile to check and double-check all ground connections in hi-fi systems before trying to determine the exact source of the hum.

Which Type of Hum?

To determine the type of hum and its point of entry, an oscilloscope is invaluable. Since hum is low in frequency, nearly any high-gain instrument will do. It should first be synchronized to the 60-cps line voltage. The first thing to determine is the exact nature of the hum, since this will give a clue to its origin. The most frequent types of hum signals are the 60-cps sine waves due to line voltage, the 120-cps ripple due to full-wave rectifiers, and, in the case of TV sets, the 60-cps saw-tooth or sync-pulse signals. By locking scope sync to the a.c. line or using heater voltage for comparison, the nature of the hum signal can be checked.

First connect the scope probe to the output of the stage immediately preceding the point where we already know the symptom exists. If the hum is visible on the screen of a TV set, for example, the scope is connected to the plate of the video amplifier. In the case of audible hum, connect to the plate of the audio-output stage. By comparing its frequency with the 60-cps filament voltage, it is possible to determine at once if the hum is 60 cps or 120 cps. A typical case of 60-cps video hum, as it appears on the TV screen, is shown in Fig. 6.

When the scope is connected to the video amplifier, it will become apparent that the video signal has a "peak-and-valley" pattern superimposed on each field. Since the field frequency is 60 cps, the scope picture shows that the interfering hum signal must be 60 cps. This is also clear from the TV screen, since 120-cps hum interference would produce *two* dark bars on the screen. (Note, however, that what may look like two dark bars, one at the top of the raster and one at the bottom, may actually be one bar that is split up. Rotate the vertical-hold control, making the bar or bars roll, to check this.) Fig. 1 shows how light 60-cps interference appears superimposed on the video signal.

Where hum is found in the sound, the scope picture will tell not only its frequency but also its waveshape. The waveshape may be an invaluable clue as to the source of the interference and should, therefore, be carefully noted. Basically the 120-cps interference is almost invariably a clipped sine wave, since it originates at the full-wave rectifier—if one is present. The 60-cps interference can be a sine wave, a saw-tooth, or some other shape. The saw-tooth would originate at the vertical-sweep circuit of the TV set. If the pulse shows any similarity to the vertical synchronizing and blanking pulse, then that is the most likely source, but sometimes the interference consists of a weak sine wave with sharp and irregular spikes riding over it. This may be due to interference from a fluorescent or neon light system or, occasionally, to interference from a high-voltage power-line transformer. Fig. 2 shows a typical 60-cps sine wave interference which was caused by heater-to-cathode leakage. This is quite different from some of the 60-cps signals found due to poor

grounding. One such is shown in Fig. 3.

60-cps Sine-Wave Hum

If it has been determined that the hum is a 60-cps sine wave, then the possible causes can be enumerated quickly. If the equipment uses a full-wave rectifier, the 60-cps sine-wave hum cannot be attributed to the "B+," but if either a single diode or a half-wave voltage-doubler circuit is used, the "B+" will contain some 60-cps ripple that could cause the hum. The simplest way to check if the hum is due to insufficient filtering of the power supply is to temporarily connect a large electrolytic capacitor across each bus from the supply in turn. Be sure to use a capacitor having a high enough voltage rating and connect the negative and positive terminals to the correct points in the set.

In many receivers which use half-wave rectifiers and voltage-doubler circuits, the chassis is not the ground for the "B" supply and the correct tie-points in the set must be located before the capacitor is connected. If it is determined by this method that the hum is not due to the "B" supply, the most likely culprit will be the filament circuit.

Leakage from the heater to the cathode inside a tube occurs occasionally and can appear either as a permanent defect or else as an intermittent after warm-up or when the set is vibrated. This intermittent condition is due to the filament wire sagging after warm-up and tending to touch the cathode structure. For the permanent defect, tube replacement is the simplest remedy. If the hum occurs in only one section of a TV set, only the tubes in that portion need be suspected. A typical case of hum superimposed on the horizontal-sweep signal is shown in Fig. 4. This will cause a "waxy" edge and some distortion on the TV screen.

Frequently heater-to-cathode leakage is found in the tuner or i.f. stages and appears both in the sound and on the screen. In this case it is quickest to start replacing the last i.f. stage and, if no change appears, to go back step-by-step to the tuner until the defective tube is found. Intermittent heater-to-cathode leakage is usually found simply by tapping each tube in turn. If the scope is connected to the second detector and the defective i.f. stage is tapped, a trace like that of Fig. 5 will appear.

In addition to tube failure, the filament voltage is, in rare cases, coupled to the grid of a stage either by accidental contact or by magnetic pickup. Long grid wires which pass close to a.c. wires can pick up enough 60-cps signal to cause noticeable hum. Lead dressing and visual inspection of all filament and a.c. wires in the set usually take care of this type of defect.

Another cause of 60-cps sine-wave hum is very often poor grounding. In the case of poor grounding the hum voltage usually looks like Fig. 3, being a ragged rather than a smooth sine wave. This type of defect is sometimes the most exasperating since it is quite difficult, in a crowded set, to determine the quality of all ground points. Many experienced technicians simply use a heavy soldering iron and heat up all ground points in the set. Before doing this, however, one should check whether the set has a resistor-and-capacitor combination going from the a.c. ground to the chassis and whether or not this network is defective.

Often the hum is caused by an ungrounded outer conductor or a shielded lead and resultant grid pickup. Similarly, if the grid return of an amplifier is not properly grounded, hum pickup can occur. This is often the case in audio equipment where a large grid resistor is used and a lead breaks off or where the resistor itself opens up.

Still another, although rarer, type of 60-cps hum can occur. This is usually found in audio equipment or in home-built electronic gear and originates with the power transformer. Magnetic pickup due to the field set up by the transformer is the problem. We know of several such cases that occurred in home-designed oscilloscopes where the power transformer was mounted under the CRT socket. When the transformer was remounted the hum was substantially reduced. Routing grid leads over or close to the power transformer can cause sufficient pickup to be audible or visible, even if the leads are shielded. The shielding protects against electrostatic but not against magnetic fields.

A very rare defect would be the opening of the copper band which goes around most transformers or the loss of a ground connection to the electrostatic shield which is used inside some of the more expensive transformers in hi-fi gear. Occasionally the hum is mechanical, resulting from vibration of the laminations in the transformer itself. The mounting bolts should be tightened and, in extreme cases, the laminations can be re-sealed.

120-cps Hum

Hum at 120-cps is quite frequent but relatively simple to troubleshoot. Its presence is confirmed by the picture on the screen or the scope and, once diagnosed, the procedure for connecting a capacitor across the various "B+" and "B−" points is sufficient to locate the defect. Among the various "B+" connections, the decoupled and separately filtered points, such as the i.f. "B+," should not be neglected. In many TV sets, the i.f. "B+" is obtained by passing a higher d.c. voltage through the audio-output stage, and separate filtering is then provided at the cathode of that stage. Be sure to check that point carefully.

Such 120-cps hum could also be due to poor filtering in the negative supply. Many of the older TV receivers used a separate system of bleeder resistors and filter capacitors to provide various negative voltages for grid bias and other purposes. If one of these electrolytic capacitors has dried up and a fair amount of 120-cps ripple exists on the negative bus, this could modulate the grid sufficiently to produce annoying hum. In bypassing each bias point with a good electrolytic capacitor, the correct polarity must be observed. The outer portion of an electrolytic is always negative.

A much rarer source of 120-cps interference is pickup from the full-wave rectifier. This can occur where a long grid lead passes close to the cathode of the rectifier or, in sets where a filter choke is used, where magnetic pickup from the choke is involved. In general, however, it is safe to assume that 120-cps hum is more likely due to poor filters.

Miscellaneous Hum

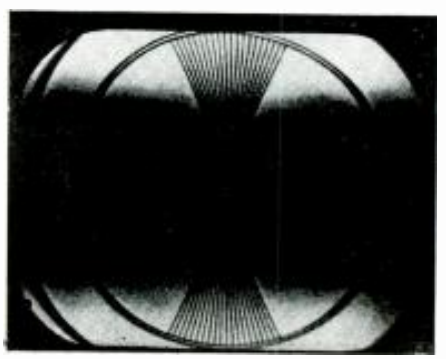
We must also consider 60-cps hum that is not in the nature of a sine wave. In TV receivers, this usually takes the form of audio buzzing: a low-frequency, rasping noise. In other equipment, such varied causes as interference from fluorescent fixtures, neon signs, and power-line equipment can be found to produce this symptom.

Audio buzzing in TV receivers is easily identified by connecting the scope to the grid of the output stage and observing the interfering signal. To make sure that this buzz is not caused by pickup from the vertical-sweep circuit, the vertical saw-tooth oscillator tube can be removed. If the buzzing persists, it is probably due to vertical-sync pulses passing into the audio section. The first step should be to carefully re-align the FM detector transformer. If this does not correct the trouble, re-alignment of the entire sound channel and eventually the entire i.f. section, if necessary, is indicated.

In some intercarrier receivers, sync buzz is often very difficult to eliminate, and special care should be taken in aligning the sound i.f. traps, 4.5-mc. coils, and the FM detector itself. Occasionally, this type of buzz is made worse by grid clipping in one of the video amplifiers. Be sure to check the operation of the video amplifier as well as the a.g.c. voltage with the scope. Poor filtering of the a.g.c. bias could be responsible. As a last resort, sync buzz can be minimized by inserting a 100-$\mu\mu$f. capacitor in series with the

(*Continued on page* 106)

Fig. 6. A case of 60-cps video hum as it appears in a television picture.



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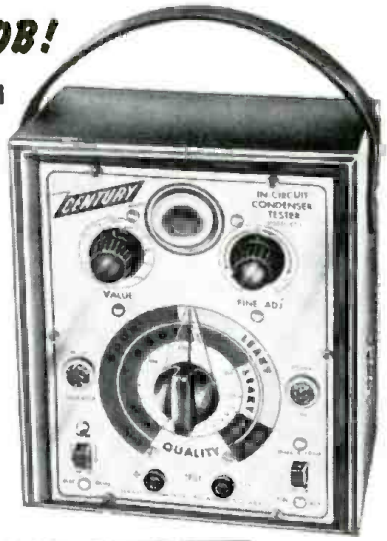

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- Quality of all electrolytic condensers (the ability to hold a charge)
- Transformer, socket and wiring leakage capacity

out-of-circuit checks:

- Quality of 100% of all condensers . . . (This includes leakage, shorts, opens and intermittents)
- Value of all condensers from 50 mmfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
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- Cannot damage circuit components
- Electronic eye balance indicator for even greater accuracy
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WHY THE CT-1 SURPASSES ALL OTHERS IN THE FIELD

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	Leakage	Value	Open	Short	Electrolytics	
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Advertised Instrument A	Yes	No	No	Yes	No	$79.95
Advertised Instrument B	No	No	Yes	Yes	No	$92.50
Advertised Instrument C	No	No	Yes	Yes	No	$34.50
Advertised Instrument D	Yes	No	No	No	No	$44.95
Advertised Instrument E	No	Yes	No	No	No	$69.95

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- Separate meter scales for in-circuit and out-of-circuit tests.
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SIMPLE TO OPERATE Just clip SRT-1 test leads across rectifier under test right in the circuit without disconnecting rectifier from circuit. Press test switch and get an instant indication on the easy-to-read three-color meter scales. . . .

TRANSISTOR TESTER Model TT-2

AN INEXPENSIVE QUALITY INSTRUMENT DESIGNED FOR ACCURATE AND DEPENDABLE TESTS OF ALL TRANSISTORS AND DIODES QUICKLY AND ACCURATELY

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SPECIFICATIONS

● Checks all transistors, including car radio, power output, triode, tetrode and unijunction types for current gain, leakage, opens, shorts, cut-off current ● Checks all diodes for forward to reverse current gain ● All tests can be made even if manufacturers' rated gain is not available ● Less than half a minute required for tests of either transistors or diodes ● Large 3" meter is extremely sensitive yet rugged . . . with multi-color scales designed for quick easy readings ● Power is supplied by an easy to replace 6-volt battery — current drain so small, service life almost equal to shelf life. Battery cannot be drained due to accidental shorting of test leads ● Cannot burn-out its own meter or damage transistor or diode under test ● Long test leads and insulated test clips enable tests without entirely removing transistor from circuit ● Test leads are identified by E.I.A. color code so that connection to the correct terminal is assured ● Comes complete with replaceable transistor set-up chart that fits into a special rear compartment.

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IMPORTANT FEATURE: The TT-2 cannot become obsolete as the circuitry is engineered to enable you to check all new type transistors as they are introduced. New listings will be furnished periodically at no cost.

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- Ohms — 0 to a billion ohms, 10 ohms center scale — Rx1/10/100/1K/10K/100K/1M
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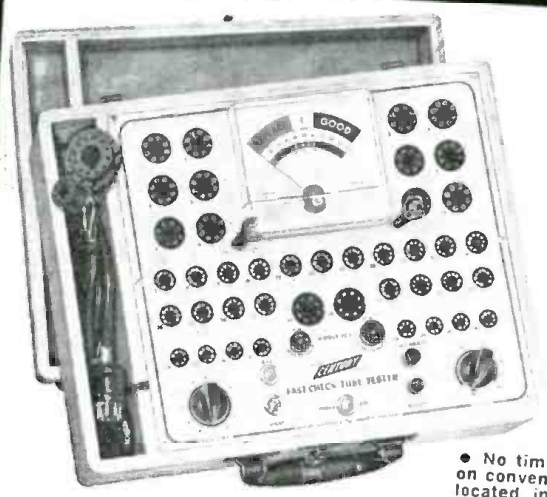

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Transatlantic TV via Phone Cable

News film taken in London shown to U.S. viewers just a little over 2 hours later in experimental telecast.

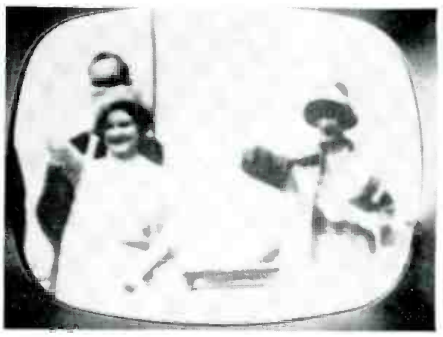
THE ERA of transatlantic television newscasting was opened recently with a special program on the *NBC-TV* network showing news films of Great Britain's royal family a little more than two hours after it was taken at London Airport. About two minutes of film, including scenes of the Queen departing for her Canadian tour, were transmitted on the transatlantic telephone cable and telecast on the special experimental program. For U. S. viewers the program originated in the Montreal studios of the *Canadian Broadcasting Corp.* and was fed to the *NBC-TV* network at Buffalo.

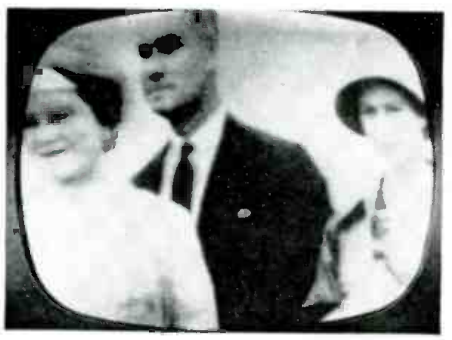
In watching the telecast, we were reminded of the quality of some of the early movies that are being televised. Motion was slightly jerky, and some of the pictures were a little streaky and ocassionally marred by quick black-outs. When it was considered, however, that a good deal of the video information was able to be compressed into the narrow confines of a telephone cable (which would only handle video signals up to 4500 cps), the feat represented a remarkable technical achievement. Entire credit for devising the system must go to the *BBC's* Engineering Division. The British General Post Office, the *Canadian Overseas Telecommunications Corp.*, and the *American Telephone and Telegraph Co.* cooperated in putting the transatlantic cable circuits at the disposal of the *BBC* for the experiments.

The new system makes it possible to transmit facsimiles of newsreel sequences in much less time than it would take to fly them across the Atlantic. The speed of transmission of each film frame is about 75 times faster than previous methods of sending still pictures by facsimile transmission. It is interesting to note that for east-to-west transmissions it will be possible to broadcast an item at a time which is earlier by the clock than the time at which the actual event occurred.

The process employs a slow-speed flying-spot film scanner, the video signal from which is used to modulate a carrier for transmission over the cable. Vestigial sideband transmission is used with a special form of negative-going amplitude modulation. The carrier frequency is 5 kc., and substantially the whole of the lower sideband is transmitted. At the receiving end the signals are demodulated and used to operate slow-speed film telerecording equipment. To squeeze as much of the video signal into the 4500-cps bandwidth of the telephone cable it was necessary to: (1) restrict the horizontal definition to that corresponding to a bandwidth of 1.75 mc. in the original 405-line television system; (2) reduce the number of scanning lines to 200; and (3) scan at the transmitting end every other film frame with each frame-scan reproduced on two adjacent film frames at the receiving end.

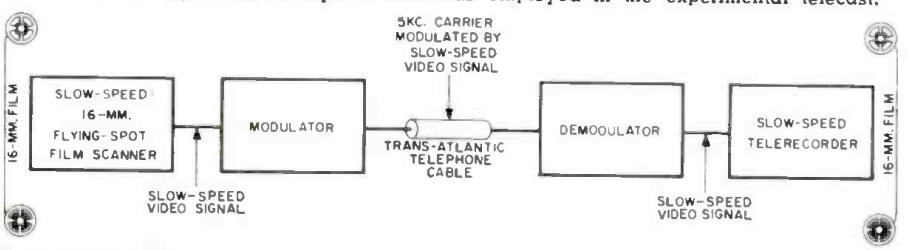
These measures reduced the required bandwidth to 450 kc. In order to reduce this by a factor of 100 (to the 4500 cps required) it was necessary to slow down the film as it was being scanned by 100 times. Hence, a half minute news item takes about 50 minutes to transmit. —30—





Off-the-air photos taken from TV monitors in New York show Queen Mother and Princess Margaret seeing Queen Elizabeth and Prince Philip off at the London Airport.

Basic block diagram of the system that was employed in the experimental telecast.



The Rainbow Generator

(*Continued from page 52*)

adjacent "on-off" or "power" switch.

The addition of the new parts will change the distributed capacity of the rainbow circuit, thus causing a corresponding change in the frequency of the oscillator. It will therefore be necessary to recalibrate the "Rainbow Control" after the change. This may be done with a properly operating color TV receiver and an oscilloscope. First an air signal is used to make certain that the receiver's horizontal-hold control is correctly set. Then the antenna is removed from the color set and the output of the rainbow generator is connected to the receiver's antenna terminals instead.

The front-panel "Rainbow Control" is set to indicate one rainbow pattern, without regard to the actual pattern seen on the face of the CRT, which is not likely to correspond to this indication. The phase-modulation coil of the generator is adjusted until a single rainbow pattern, showing the correct sequence of colors, is produced. This sequence should be red, blue, and green from left to right.

As a further check, the scope is connected to the *R-Y* or other suitable test point in the color receiver, to see whether the signal waveform is the correct one for this circuit with the generator signal being fed in. The receiver's hue control is normally set at the center of its range for this observation. As a final check, the "Rainbow Control" may be turned to its zero setting. The evidence of a zero-beat condition should be seen on the scope.

Where rainbow generators lack the luminance test signal mentioned earlier, modification to incorporate this feature is even easier than the procedure for adding crystal control. A s.p.s.t. slide switch is the only item needed. A 6.3-volt a.c. signal is taken from the hot side of the filament transformer and injected at the grid of the modulator tube, as shown in Fig. 3. The new "Luminance-Chroma" switch may be mounted on the front panel of the instrument, as shown in Fig. 1. —30—

A quick and easy method of filing those ELECTRONICS WORLD articles you want to save has been suggested by M. C. Anderson of Arlington, Va. Use spring-back notebook covers like that shown in the photo. No punching of holes—no fuss. Just clip the pages, spring the covers apart, and insert. It is just as easy to add to or change the file. Try it for your reference shelf.

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A few years ago, Lincoln E. Kitchin had no formal degree and knew nothing about electronic computers.

He still doesn't have a degree, yet today, he is a Field Engineer on one of America's biggest electronics projects. He helps maintain one of the largest computers in the world. He's doing work ordinarily done by engineers—an opportunity usually denied to men without a degree. This is a story of unusual significance to every technician who feels himself handicapped by lack of a formal degree.

"It all started back at the Base," Link Kitchin recalls, "about two years ago. We were having lunch. One of my fellow Aircrewmen described an interview he had just had—with IBM.

"It sounded good to me—particularly the field engineering aspects. I wasn't anxious to start my civilian electronics career stuck in a corner of some plant. Here was a chance to work in the field—with all the advantages of a permanent location. I made a note to add IBM to the companies I was considering for civilian work."

Taking notes in IBM Field Engineering class | Discussing a SAGE display console | Front view of computer frame

Interviewed by IBM

A month later, Link Kitchin sat across the desk from an IBM interviewer. "Frankly," he confesses,"I was scared at the thought of this interview. I didn't know the difference between an analog and a digital computer. I didn't expect to get the job."

The interviewer put him quickly at his ease. A check of his background revealed his Service training—28 weeks of Class "A" aviation electronics plus Class "C" schooling in LORAN, RADAR and SONAR. He took a test which indicated excellent aptitude for computer work.

Then he learned how IBM would train him in electronics—for 20 weeks at full salary—to become a Field Engineer on the SAGE program. He learned about SAGE, part of our nation's radar defense net, which is built around giant IBM computers. He heard about IBM's excellent company benefits, especially interesting to Link Kitchin who had a wife and child. By the time the interview was over, he had decided that IBM and the SAGE program were what he was looking for. He decided then and there that he wanted to come with IBM.

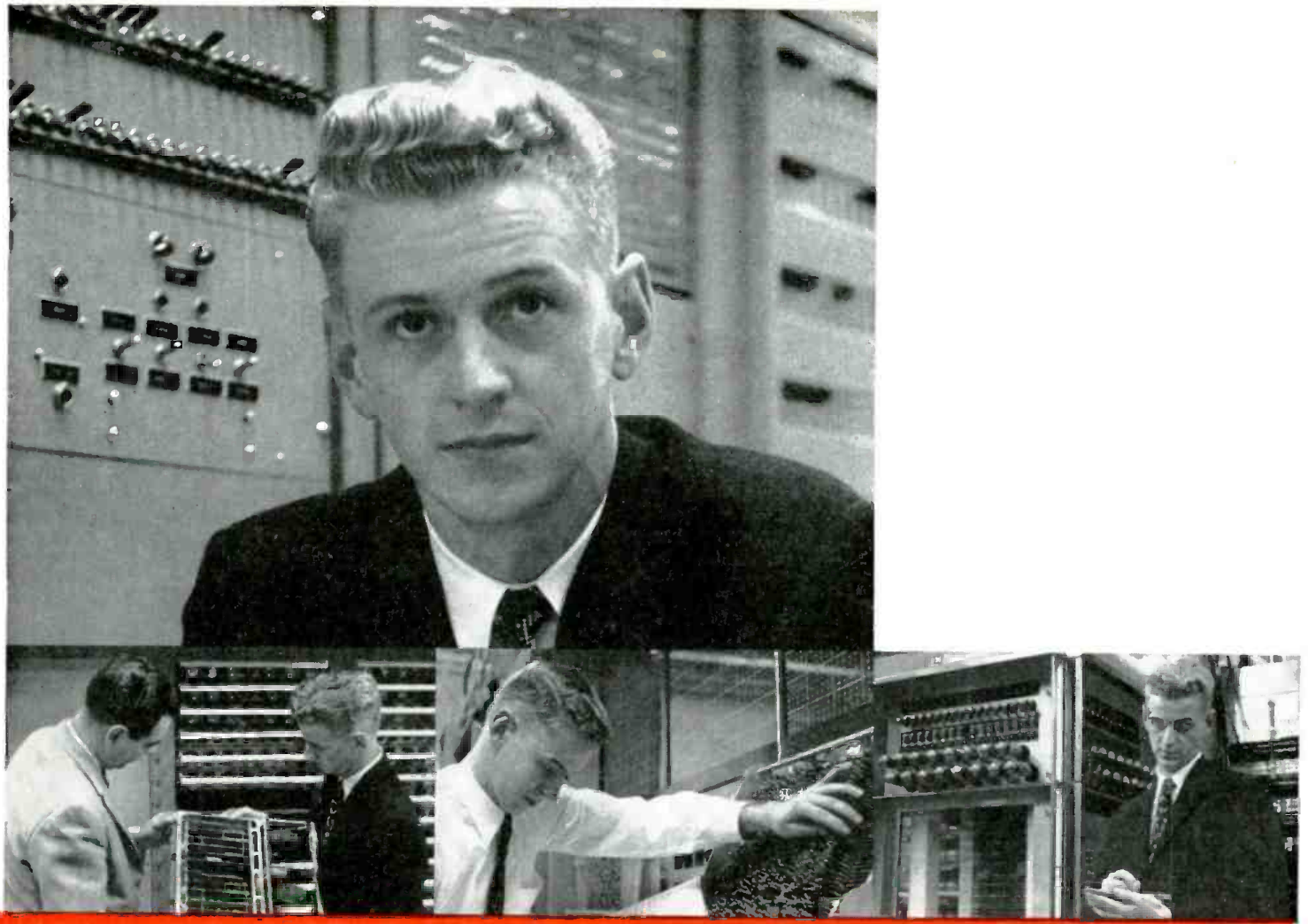
Receives 20 weeks' training

Link Kitchin reported to Kingston, N. Y., for training. In the IBM "school," he studied basic computer circuits, computer logic and programming, card punch machines—all part of the twenty week course a Computer Units Field Engineer takes. "The instruction was excellent," he recalls. "Our teachers, experienced field men, often made points not in the textbook." Formal classroom lectures accounted for half his time, the other half being spent in the laboratories, where he worked on actual computer equipment for SAGE. During his training period, he received a living allowance in addition to his salary and overtime pay.

Assigned to site in home state

His twenty weeks' training completed, he was assigned to the SAGE site at Topsham, Maine. "IBM makes every effort to assign you to a location of your choice wherever possible," Link Kitchin, who is a native State-o'-Mainer, points out.

At Topsham, he has completed the installation phase of the computer. Now his work consists of preventive maintenance and "keeping the customer happy"—the customer, in this case, being the Air Force personnel who man and operate the computer. "Installing this giant computer was a significant engineering feat. First we ran 2,509 cables from 4 to 300 feet long. Then we bolted the computer sections together and hooked up the cables. Next came the testing phase in anticipation of Air Force acceptance tests.



A problem in pluggable units | Working on manual input board of SAGE computer | Recording data on main core memory unit

"I'm in the Display Group which has responsibility for over one hundred display consoles," Link Kitchin continues. "Each of these has a 19-inch and a 5-inch cathode ray tube (similar to a TV tube) plus associated circuits. The knowledge of complex circuitry which we learned in the IBM school is essential for this work. We also maintain our own test equipment—oscilloscopes, meters, signal generators and specially designed pluggable unit test equipment."

What does the future hold?

Link Kitchin looks forward to a rewarding career as a Computer Units Field Engineer. Promotion-wise, he could become, with further training, a Computer Systems Field Engineer, a Group Supervisor or Group Manager. Most important, however, he believes, is the excellent electronics background he's acquiring for the years ahead. 'I've had a new engineering dimension added to my career —thanks to IBM's willingness to spend time and money training technicians to assume engineering responsibilities."

A career for you with IBM?

Since Link Kitchin joined IBM and the SAGE program, opportunities are more promising than ever. IBM will invest thousands of dollars in the right men to insure the success of the SAGE program.

If you have a minimum of 3 years' technical schooling—or equivalent experience—you may be eligible for advanced training for 20 weeks as a Computer Units Field Engineer. While training, you receive full salary and overtime pay plus living allowance before assignment to a permanent location.

From then on, you can go as far as your abilities and ambition will take you. IBM is the leader in a field that offers you unlimited horizons. And, as you may already know, at IBM you receive company-paid benefits that set standards for industry today.

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You will receive a prompt reply. Personal interviews arranged in all areas of the U. S.

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Rechargeable Flashlight Battery

Nickel-cadmium cartridge with built-in recharger replaces conventional complement of two "D" cells.

PRACTICAL, extra-long-life, nickel-cadmium batteries that are physically and electrically interchangeable with conventional dry cells of the type used in flashlights, toys, and other consumer products are now on the market. The *Sonotone Corp.* of Elmsford, N. Y. offers a complete range of small, sealed, sintered-plate units, including those to replace all standard dry-cell types and sizes. Of particular note is the power cartridge (Fig. 1) for standard flashlights, exactly the size of two "D" cells in series, listing for $7.95. A built-in recharger, permitting insertion in any a.c. outlet for renewal, uses a miniature stepdown transformer and rectifier.

Each nickel-cadmium cell provides 1.25 volts, with batteries available in standard ratings up to 32 volts. The rugged, shockproof construction (Fig. 2) is similar to that used in military nickel-cadmium units.

The two special cells used in the flashlight cartridge resemble the regularly available "½ C" units, but have somewhat greater size and capacity. The discharge curve for the "½ C" in Fig. 3 approximates the useful life (nominally, one hour) of a single charge with a standard flashlight bulb.

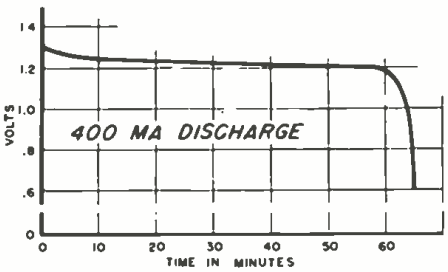


Fig. 3. Discharge curve for "½ C" cell.

Note the relatively constant output voltage up to the cut-off point.

The built-in charger meets the requirement of a constant-current source below 1.5 volts per cell. Within these limits, cells may be recharged safely for thousands of cycles even from the completely discharged state or when left in the charge circuit indefinitely. Recommended renewal period for the flashlight cartridge is 16 hours.

The nickel-cadmium cells will withstand vacuum, pressure, and temperature extremes (−40 to +160°F) and continue to operate. An emergency flashlight kept in the car could be relied upon in abnormally low winter temperatures. —30—

Fig. 1. (Above) The flashlight cartridge is exactly the size of two "D" cells in series, with its cap in place. Screwing off the cap exposes a plug that may be inserted in any a.c. wall outlet to activate the recharger.

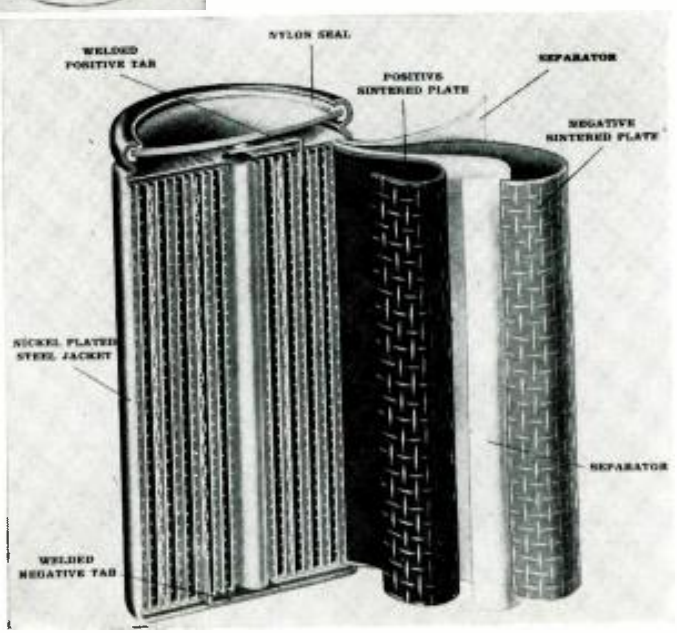


Fig. 2. (Right) The cutaway diagram highlights the internal construction of a typical rechargeable nickel-cadmium cell.

Industrial Telemetry

(*Continued from page 47*)

or transmitted by microwave transmitters and receivers, operates as follows:

Low-frequency (audio) oscillators, called *tone generators*, are used. These generators are switched on and off by the transmitters that are monitoring the units to be read. At the receiving end of the transmission line, bandpass filters are used to separate each tone frequency and apply each to its own *tone receiver*. The receivers are units tuned to the various oscillator frequencies. When the correct signal is passed through the bandpass filter and applied to its own tone receiver, it causes a relay to be tripped. The contacts of the relay may be wired either to open or to close, permitting any type of operation.

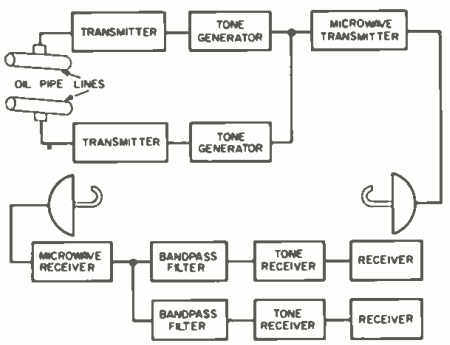
A basic, single system for monitoring two units simultaneously is shown in Fig. 6. The outputs of two transmitters are applied to two tone generators, each developing its own audio frequency. These are mixed together and sent along a single transmission line to the central station. At the latter point, the two frequencies are separated by bandpass filters and applied to individual tone receivers. The relays operated by the tone receivers will, in turn, operate the indicating receivers.

The same system may be used with radio transmission by including a microwave transmitter and receiver, as shown in Fig. 8. In terrain where foul weather may make the use of exposed transmission lines hazardous, unattended microwave-operated systems are often used.

Quite often the units to be measured are at widely separated distances. Nevertheless, monitoring three units at different locations may still be accomplished with a single transmission line. The only precaution necessary is use of the lowest-frequency tone generator at the unit farthest from the central receiving location, as in Fig. 7. This is done because the higher frequencies will have a larger signal loss over long transmission-line lengths. They are therefore placed closest to the central receiving location to avoid such losses.

—30—

Fig. 8. Instead of a direct wire, microwave transmission is sometimes used.



The Aspects of Hum

(Continued from page 95)

sound take-off coil. This coil then has to be re-aligned.

If removal of the vertical saw-tooth oscillator tube corrects the buzz, the most likely source of trouble is pickup from the vertical-output amplifier and transformer. This pickup usually occurs in the volume-control leads or other wires going to the high-gain audio-amplifier grid. It is sometimes necessary to run such wires on top of the chassis or completely re-route them in some other way to avoid this type of interference. Shielding braid may not prove adequate.

Still another cause of sync interference is the rare case where a local station signal is so strong that it overloads one of the i.f. or other stages, causing grid-leak detection. Where this defect occurs, excessive contrast and loss of picture detail usually accompanies the audible hum. Removing one side or all of the antenna lead-in from the TV set usually shows up this defect at once since the symptom will then be reduced or eliminated. Where overload is due to a defective a.g.c. circuit, the symptoms would be similar, but a quick measurement of d.c. bias would show up this cause.

Properly operating fluorescent fixtures and neon signs should not interfere with TV reception, but it frequently happens that internal arcing in these devices generates a modulated r.f. signal that may enter the TV set. Interference filters for almost all frequency bands are available commercially and they can sometimes be very helpful in this sort of trouble, especially where entry is through the antenna input. Where the interference enters through the a.c. power line, a power-line filter will do the trick.

In rare cases, the interference originates in defective power-line equipment itself. High-voltage transformers located in the vicinity of the receiver may have internal arcing, which will result in 60-cps hum. The local power company will be interested to learn of such interference and will usually remedy it quickly. In very rare instances, overhead high-voltage power lines cause unavoidable 60-cycle interference. Relocating the antenna is often the only solution to this type of trouble.

Conclusion

While we have tried to enumerate all the known types of hum interference, we will not be surprised to hear from readers who know of instances where hum was caused by some completely novel and unusual circumstances. The types described represent those that can normally be expected, but the thing that makes servicing an art is the fact that, from time to time, completely unexpected and unusual troubles require all of the ingenuity and understanding we can muster. —30—

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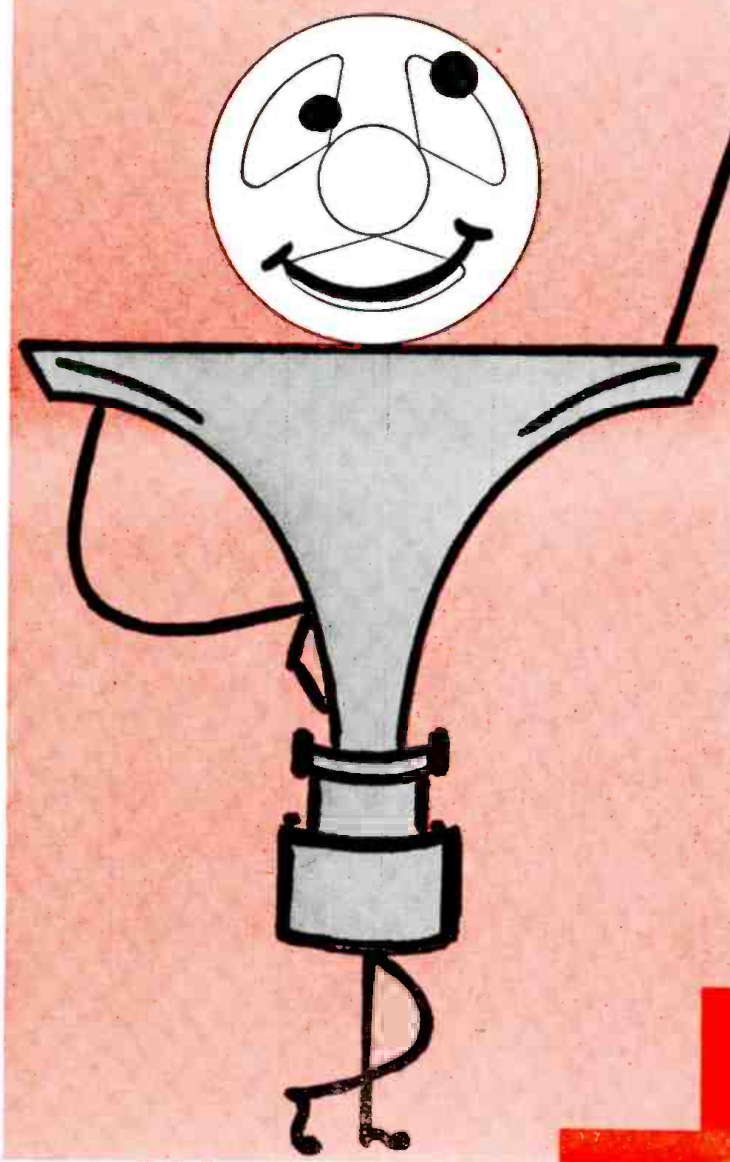

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SUPERIOR'S NEW MODEL TW-11

STANDARD PROFESSIONAL TUBE TESTER

★ Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.

★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary.

★ The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

★ Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.

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

Model TW-11—TUBE TESTER . . . Total Price $47.50—Terms: $11.50 after 10 day trial, then $6.00 per month for 6 months if satisfactory. Otherwise return, no explanation necessary!

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

The Model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

$47.50 NET

SUPERIOR'S NEW MODEL 83

C.R.T. TESTER

TESTS and REJUVENATES ALL PICTURE TUBES

ALL BLACK AND WHITE TUBES

From 50 degree to 110 degree types—from 8" to 30" types.

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

ALL COLOR TUBES

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

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

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

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

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7 Signal Generators in One!

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

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

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

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

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

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

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

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

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

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

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

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

- ✓ Model 77 completely wired and calibrated with *all* accessories (including even portable carrying case) sells for only $42.50.
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- ✓ Model 77 uses new improved SICO printed circuitry.
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- ✓ Model 77 uses a selenium-rectified power supply resulting in less heat and thus reducing possibility of damage or value changes of delicate components.
- ✓ Model 77 meter is virtually burn-out proof. The sensitive 400 microampere meter is isolated from the measuring circuit by a balanced push-pull amplifier.
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- ✓ AS AN AC VOLTMETER: The old-fashioned laboratory AC V.T.V.M. was cumbersome, erratic and required several dial manipulations to arrive at a reading. The Model 77 when connected to a circuit will quickly and simply measure its RMS value if sine wave, and its peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers, sync. pulses and saw tooth voltages are easily read with the Model 77.
- ✓ AS AN ELECTRONIC OHMMETER: Because of its wide range of measurement in the resistance range (from .2 ohms to 1,000 megohms) the Model 77 will be your most frequently used resistance meter. Leaky capacitors which may not show up on other resistance meters, show up glaringly when tested with the new model 77. Because of its sensitivity and low loading, intermittents are more easily found, isolated and repaired.

Model 77—Vacuum Tube Voltmeter
Total Price $42.50

Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

Traditionally, the V. T. V. M. has been the one instrument used for voltage measurements where low-drain or wide frequency response is essential. And now, the Model 77 V. T. V. M. by taking advantage of new developments including modern balanced push-pull circuit design, etched circuitry, an extra large meter and other improvements provides such measurements quicker, with a higher degree of accuracy and with better readability.

The Model 77 will measure DC with negligible loading AC of ANY FORM WAVE; whether sine wave, pulse wave, spike wave, square wave or other complex wave forms. It will measure all AC from 30 cycles to over 5 megacycles and will do so without additional accessories or cables.

SPECIFICATIONS

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

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

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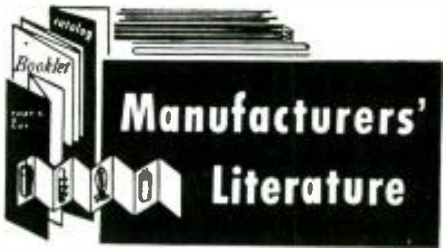

TRANSFORMER DESIGN NOTES

CBS Electronics has issued a new, four-page bulletin which gives formulas for designing transformers for use in transistorized power supplies.

The bulletin can be obtained by writing to the firm's Advertising Service, Parker Street, Newburyport, Mass. and requesting Bulletin E-285.

The brochure offers a handy guide to selecting the proper transistors, choosing operating frequencies, and determining the values of biasing resistors.

NEW EIA STANDARDS

Electronic Industries Association has released four new recommended Standards and one addendum. They are:

RS-209-1, "Standards for Electron Tubes" (addendum #1 to RS-209). For information on obtaining this, contact the EIA.

RS-218, "Metal Encased Fixed Paper Dielectric Capacitors for DC Applications," price $2.50.

RS-219, "Audio Facilities for Radio Broadcasting Systems," price 70¢.

RS-220, "Continuous Tone-Controlled Squelch Systems," price $1.20.

RS-21, "Polarization or Phasing of Broadcast Microphones," price 60¢.

These Standards are available from the Association's Engineering Dept., 11 W. 42nd Street, New York 36, N. Y.

STORAGE BATTERY TIPS

Exide Automotive Division, The Electric Storage Battery Co., P. O. Box QD 6266, Cleveland 1, Ohio, is offering an interesting booklet entitled, "Facts About Storage Batteries." Free copies are available from the company.

The 32-page brochure offers facts on preventing corrosion, testing batteries, installing, removing, and recharging batteries, and storing batteries, among other items. Also included is data on "Your Car Battery—How to Get the Most from It," "Your Tractor Battery—How to Get the Most from It," and "Your Boat Battery—How to Get the Most from It," as well as information on battery chemistry and construction.

The booklet will be of great interest to car, tractor, and boat owners, teachers, and those who buy, specify, or work with storage batteries.

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Kaar Engineering Corporation, 2995 Middlefield Road, Palo Alto, Calif., is offering a free interpretation of the FCC Rules and Regulations affecting mobile communications effective September, 1958.

In a three-fold brochure suitable for loose-leaf binding, all frequencies available to Business Radio. Manufacturer's

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...and enjoy top performance from your hi-fi system!

Special to our readers for only...

Now we know what the Gold Rush must have been like! The past month has brought an unprecedented landslide of orders for this new, trouble-shooting test record from readers of ELECTRONICS WORLD. We're still counting and filling them by the thousands! But the supply is practically depleted. So unless your order is already in the mail, we urge you to fill in and return the coupon below—*right now!*

Special Features of ELECTRONICS WORLD 7" Stereo-Monophonic Test Record

- Four bands for stereo checks only—plus three bands for checking stereo or monophonic equipment!
- Made of top-quality virgin vinyl for long wear!
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Here are some of the questions this record will answer for you!

- ✔ *How good is my stylus? Is it worn? Will it damage my records?*
- ✔ *What about my stereo cartridge? Does it have enough vertical compliance so that it won't ruin my expensive stereo records?*
- ✔ *Is my turntable running at the right speed? Is it free of rumble, wow, and flutter?*
- ✔ *What sort of standing waves do I get in my listening room?*
- ✔ *Are my speakers hooked up correctly? Are they phased properly, and is the correct speaker connected to the right stereo channel?*
- ✔ *How perfectly is my system equalized?*
- ✔ *What about separation? Is it adequate?*

You'll get on-the-spot-answers to these and many other questions when you use this Stereo-Monophonic Test Record. It's the *most complete test record* of its kind—contains the widest range of essential check-points ever incorporated into *one* test disc! And, best of all, you need no expensive test equipment when you use this record! Just listen and get the thorough results you want—*all checks can be made by ear!*

As a man who is seriously interested in hi-fi, you can immediately see the extraordinary 2-way value you get from this special test record. First, it guides you in evaluating the quality of reproduction your equipment now produces. Second, it specifies the adjustments necessary to get the best recorded sound you have ever heard! Add up the advantages! Check the special low price! This is easily the best value of the year for everyone who owns a hi-fi system—either monophonic or stereo!

Don't miss out—Order your Test Record for just $1 now!

This Stereo-Monophonic Test Record has been produced as a service for readers of *Electronics World*. You can be sure that it comes as close to perfection as is humanly possible, because the editors have poured their accumulated know-how into this project for a period of many, many months. You may obtain a copy at the special reader-price of just $1.

But the supply is running out . . . and orders will be filled on a *first-come, first-served* basis. So avoid disappointment—fill in and mail the coupon, together with your check ($1 per record) *today!*

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Please send me_____test records at $1 each. My money order or check for $_____is enclosed. I understand that you will pay the postage and that each record is fully guaranteed.

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Please print

Address_____

City_____ Zone_____ State_____

SORRY—no charges or C.O.D. orders! SEPT.

Radio, Telephone Maintenance Radio, Public Safety Radio, and Citizens Radio are listed with the respective conditions and provisions for their use in an easy-to-read tabulated form.

Write direct to the firm for a free copy.

NEW DIODE CATALOGUE

Silicon Transistor Corp., Carle Place, Long Island, N. Y., has a new four-page catalogue on silicon glass diodes.

The two-color specification sheet lists some of the firm's high-reliability, general purpose and fast switching diodes and includes curves, charts, and other pertinent data.

Known as Form 1895, the catalogue may be obtained by writing to the company.

IRC ENGINEERING HANDBOOK

International Rectifier Corporation, El Segundo, Calif., has issued its "Engineering Handbook", edited by J. T. Cataldo.

This attractive, 130-page book sells for $1.50 and features material on application data of selenium, silicon, and germanium rectifiers, zener voltage regulators, photocells and sun batteries, and an index to the firm's semiconductor types.

The booklet also contains reprints of articles from leading electronic publications, including ELECTRONICS WORLD.

"VIKING" EQUIPMENT

E. F. Johnson Company, Waseca, Minnesota, is offering an attractive, 4-color catalogue covering its amateur radio line.

This catalogue, No. 959, describes such products as the firm's "Adventurer," "Challenger," "Navigator," and "Pacemaker" units, as well as many others.

Also covered in this 26-page brochure are details on the manufacturer's station accessories and keys and practice sets.

TV PICTURE TUBE GUIDE

Sylvania Electric Products Inc., 1100 Main Street, Buffalo, N. Y. (a subsidiary of *General Telephone & Electronics Corporation*), has released a wall size television picture tube comparison chart and a pocket picture tube selector guide.

Each guide lists the physical and electrical characteristics of over 350 types. In addition to information on the latest 110-degree tube types, the new guides list characteristics of the company's 53-degree, 90-degree, and 110-degree television check tubes. The wall chart also includes basic diagrams for all picture tubes listed.

Copies of the new guides may be obtained direct from the company.

NEW OHMITE CATALOGUE

Ohmite Manufacturing Company, 3630 Howard Street, Skokie, Illinois, is currently offering its catalogue No. 30. Write direct to the firm for a free copy.

Attractively illustrated and printed in two-colors, this 32-page brochure describes the company's line of rheostats,

potentiometers, resistors, relays, variable transformers, tap switches, chokes, capacitors, and miscellaneous items.

MILLER REPLACEMENT GUIDE

J. W. Miller Company, 5917 South Main Street, Los Angeles 3, Calif., is offering a new 88-page TV coil replacement guide which cross-references thousands of original parts to the firm's equivalents and contains 300 new chassis listings.

A copy of this catalogue, No. 160, can be obtained at any of the company's distributors or by writing direct to the organization.

Compiled as a service aid for TV service technicians, the brochure gives complete coverage of television coils used in the industry and provides a quick reference source for replacements.

NEW HARRISON CATALOGUE

Harrison Radio Corp., 225 Greenwich Street, New York 7, N. Y., now has available the 34th edition of its catalogue.

This 274-page brochure lists information on such products as high-fidelity components, batteries, books, capacitors, resistors, transistors, tubes, test equipment, tools, and amateur equipment, among many others. Also included is a handy order blank.

For extra convenience, the catalogue also contains an index to manufacturers.

TRANSISTOR SUPPLEMENT

CBS Electronics, Danvers, Mass., has available an up-to-date supplement of its original 1957-1958 "Transistor Home-Study Course". It may be obtained by sending a check or money order for one dollar to the company, Dept. TC.

Included in the supplement are 14 pages of additional projects and circuit descriptions for lessons 2 through 8, and 10. Also given are equivalent vacuum-tube circuits for the various transistor configurations, as well as transistor circuits for preamplifiers, a simple broadcast receiver, monostable and bistable multivibrators, a vertical deflection system, a Colpitts oscillator, and a complementary multivibrator.

DIODES AND RECTIFIERS

U. S. Semiconductor Products, Inc., 3540 W. Osborn Road, Phoenix, Arizona, has published a new "Short Form Catalogue". Copies may be obtained by writing to the firm, attention of J. G. Worth, Jr., vice-president-sales.

Specifications on most of the firm's diodes have been compressed to fit on one folded sheet of paper for ready reference. This new catalogue contains the basic information wanted by engineers, together with 1N numbers and brief descriptions of the various lines. Also listed are temperature-compensated voltage regulating diodes, alloyed junction low-power zener diodes, diffused junction medium-power zener diodes among other subjects. —30—

GET BEHIND THE SYLVANIA $2. Combination

America's biggest magazines deliver this business-building offer to over 100 million readers!

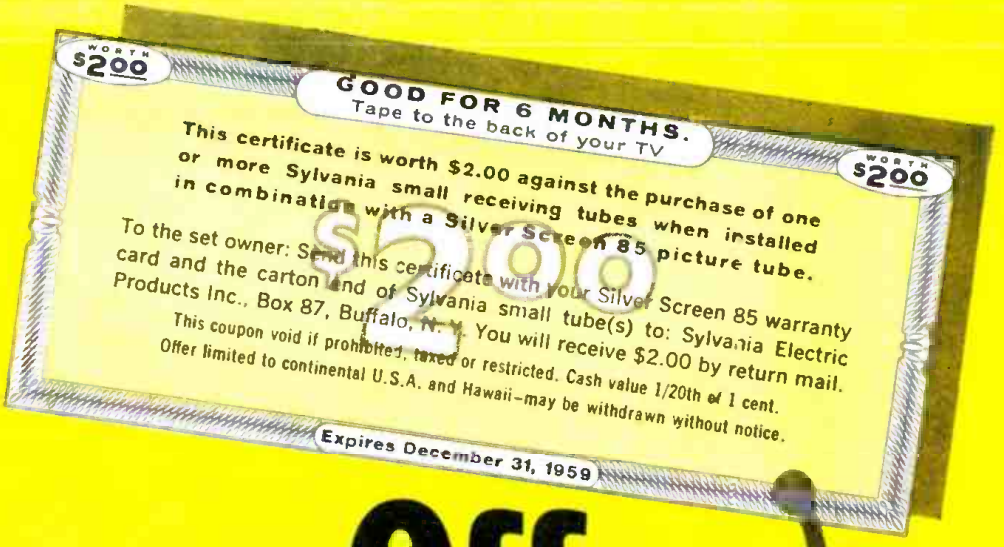
Look for this ad in these leading national magazines.

On June 20th Sylvania launched the dramatic combination coupon offer appearing in America's biggest weekly magazine, *TV Guide*, and America's biggest monthly magazine, *Reader's Digest*—plus *Sunday* and *Parade* newspaper supplement magazines.

Your Service shares the spotlight with top-quality Sylvania picture tubes and receiving tubes in a three-point program to make your customer's old TV set *better than when it was new.*

Month after month, more set owners will be saving the $2.00 coupon. Many will attach it to the back of their TV set so it's there for you to see.

You can identify yourself with this program by featuring Silver Screen 85 and Sylvania receiving tubes. Get behind the biggest, most practical, business-building offer ever made to the Service industry.



Coupon Offer

Sells your service and Sylvania receiving tubes in combination with every Silver Screen 85 you install

Here's an action-packed offer that can add an average of $3.00 to $6.00 in receiving tube business every time you install a Silver Screen 85 picture tube.

Sylvania urges your customers to have their receiving tubes checked to make sure they get full performance from their new Silver Screen 85. And, to emphasize the importance of replacing weak tubes, Sylvania offers to pay $2.00 toward the cost of Sylvania receiving tubes installed in combination with a Silver Screen 85.

Your customers mail the $2.00 certificate directly to Sylvania with the picture-tube warranty card and receiving-tube carton end. Nothing for you to sign or send.

Stock up on Sylvania. Be prepared for greater-than-ever consumer demand for America's Number One picture tube and receiving tubes.

SYLVANIA
Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

By
BERT WHYTE

CERTIFIED RECORD REVUE

WITH this issue this department begins its seventh year! No wonder I am beginning to feel old! Events in the hi-fi world move swiftly and just for fun I thumbed through some of the earlier issues to see what I was spouting from my soap box. There were earnest pleas for pre-recorded tape (monaural, yet!), laments for failure to standardize on equalization, the big tub-thumping for pre-recorded stereo tape, numerous blasts and dire predictions about the cheapening of equipment beyond a certain point wherein the term "high fidelity" was degraded to the position of being virtually meaningless (a prediction which has unfortunately been fulfilled). And there was a great deal more . . . the development of the three-channel techniques for tape masters and one of the great hi-fi thrills and musical experiences when I first heard these tapes and my prediction . . . which still stands . . . that the ultimate form of stereo, at least for the high-quality market will be true three-channel tape.

There was the first faint glimmer of hope, that a stereo disc was possible (with the early *Sugden* system) and then finally the bombshell of the *London* and *Westrex* demonstrations and the rest is history.

It has been a wonderful experience and great fun reporting to you all these years and I have been deeply gratified by your kind reception of my efforts as evidenced by your many welcome letters. Here I ask my readers' forgiveness, as time is ever short with me and it is not always possible to answer every letter. But keep those letters coming! Your ideas and opinions are highly valued and I can assure you that more than a few columns have been the result of numerous letters which have indicated certain trends and changes in your hi-fi attitudes. Once again, thank you for your support and I hope I shall be able to report to you on the happenings of the hi-fi and record world for a long time to come.

Now on to matters of moment . . . as expected, the National Association of Music Merchants Show in New York broke all previous records for attendance, betokening a return to health of the somewhat ailing record business. What I saw at the Show bore out what I reported during the summer . . . the "package boys" are all set for the biggest merchandising blitz on stereo this fall. In sheer variety of stereo goods and weight of promotional money behind them, the public is destined to become stereo conscious. Whether they will become stereo-oriented remains to be seen. The trend in equipment displayed at the Show was not very encouraging, as far as I was concerned. For one thing there was still further degradation of components used in the very cheap portable type of equipment, to the point where if any stereo effects were discernible, they would have a difficult time overriding the hum and rumble and numerous other distortions.

One of the strangest stories to come out of the Show is this . . . a well-known trade publication conducted a survey of its dealer-readers and one of the questions asked was, "What type or form of stereo equipment would you most like the manufacturers make available, based on the preferences expressed by your customers?" Well, believe it or not, the results were quite heavily in favor of the "two-piece" stereo units. In other words the public indicated that they wanted, above all, the speakers and other components in separate cabinets with which optimum placement for best stereo results could be obtained in any given room.

This result was, of course, absolutely contrary to the crystal-ball revelations of the sales and merchandising managers of the big companies. And in an astonishing disregard for the public's preference, now more than ever they have adopted the single cabinet or console approach. To make matters worse, they have further ignored good stereo practice by placing speakers so close together as to negate all of stereo's benefits. This naturally makes for neat and eye-appealing consoles, which is fortunate for them, because any merchandising effort on behalf of their alleged stereo qualities can only be successful with the most grossly uninformed people.

Happily the console situation is not a totally black picture. There are several companies who have made an honest attempt to correct the shortcomings of this form of stereo. *Stromberg Carlson* for one, has put a great deal of thought and effort towards the elimination of acoustic feedback in their units. From a necessarily brief audition I would say that they had succeeded well enough so that a reasonably clean, low bass response is at last possible in console type units. Among other manufacturers of console units, *Fisher Radio* deserves credit for its nice amalgam of styling and the use of high-quality components integrated and planned for reasonably spacious stereo reproduction.

Of strictly hi-fi component people, old friend *Bozak* was there, showing his regular line of high-quality speakers, in addition to the new "Spinet" model, a small unit designed especially for stereo use and which impressed with its smooth treble and bass response in spite of the cubic limitations. *Ampex* was there with its expensive hut top quality units and naturally was in there pitching for 4-channel reel-to-reel tape. Some weeks before the Show, in a move to strengthen the role of the 4-channel tape, *Ampex* formed what is, in essence, a distributing company called *United Stereo Tapes*. This company will act as sort of a master distributor for the products of quite a number of record and tape manufacturers and the list of well-known

companies who have joined *United* is quite impressive.

There were other tape people at the Show and in the tape column you can read about the beginnings of the "tape comeback." Before leaving the Show, I must comment once again on the razzle-dazzle misleading advertising that is being used with so many stereo units. Now comes along one company (whom I'll be kind enough to leave nameless) which is using an advertising catch-phrase which purports that their wonderful console brings you, at last, the glories of *three-channel stereo!!* Boy, this really burns me . . . three-channel stereo, the *bona fide* stuff, is glorious all right as any who have had the good fortune to hear it will testify. But although I still feel that we will ultimately come to this form of stereo, I'll also be the first to admit that its realization is a long way off. So here is an outfit demeaning the whole idea of three-channel sound even before it's off the ground. The marvel in this console is, of course, nothing but a derived third channel from the left and right channels. There is nothing wrong with this idea of itself and in fact properly done can yield laudable improvements. In this particular case, it didn't even make good sense . . . here are three speakers disposed within a total console width of less than four feet. Except for the most ping-pong "gimmicky" type of widespread stereophony, natural sounding directional effects didn't exist and, in fact, the entire impression was essentially monophonic. The idea is sound, but it is a pity that it was not used more intelligently. In closing let me say that if any of the engineers on this project have ever heard real three-channel stereo, they should hang their heads in shame every time they see their company's advertising. Let us hope that not too many people will get their fingers burned on this deal.

Record releases are still on the lean side, but next month the summer "drought" should be over and we can get more meatier releases. In the meanwhile what we have is quite choice.

MOZART
CONCERTO FOR PIANO AND ORCHESTRA IN C MINOR (K.491)
SONATA IN B FLAT (K.333)
Denis Matthews, pianist, with Vienna State Opera Orchestra conducted by Hans Swarowsky. Vanguard Stereo VSO-2025. Price $5.95.

This is a beautifully recorded "C Minor" concerto, with superb playing from the Vienna Philharmonic in its recording guise. Matthews is an artist of considerable perception and his playing is consistently good, especially in matters of tempi and phrasing. If he is not yet of the stature of other Mozart specialists, it is more a matter of youth and inexperience rather than anything basically lacking in his pianistic ability. The sound is notable for its smooth clean contours and the fine balance between piano and orchestra. Piano stays centered and all directional effects are discreetly in evidence. The "Sonata" is well played and recorded but is of lesser moment here.

MENDELSSOHN
SYMPHONY #4 ("ITALIAN")
SCHUBERT
SYMPHONY #5
Israel Philharmonic Orchestra conducted by George Solti. London Stereo CS6065. Price $5.95.

Here is a delightful record for late summer listening. The infectious gaiety of the opening movement of the Mendelssohn has never been more effectively realized than in this superb stereo recording. Solti has done an extremely good job and one which must rate near the top although his inclination here is more to the rhythmic side of the music

somewhat at the expense of lyricism. But rather this than the draggy tempi afflicted on us by so many others! The Schubert isn't played very frequently which is a shame for there is much to admire in this score even if it is not of the level of inspiration of the great "C Major" symphony. The Israel men play well for Solti and I feel that the only thing that prevents this orchestra from reaching the very top is lack of strong continuing leadership. The *London* stereo sound is magnificent . . . a close-up pickup is very revealing of inner detail yet hall acoustics have been utilized for a softening of contours and added stereo spaciousness. The volume level is quite high here, but without apparent distortion. Directionality is good without being overdone and the sense of depth quite striking.

KATCHATURIAN
CONCERTO FOR PIANO AND ORCHESTRA

Leonard Pennario, pianist with Concert Arts Orchestra conducted by Felix Slatkin. Capitol Stereo SP 8349. Price $5.95.

Still another stereo tape to stereo disc transfer and this one, to my knowledge, one of the very earliest *Capitol* stereo tapes—which makes this recording all the more remarkable, since it was an original two-channel job and supposedly is not able to compete with the more modern three-channel recordings. This was on tape and is on disc, a real dazzler. It was recorded at an extremely high level and the sound, in general, is exceptional in that it has great brilliance and yet is wonderfully smooth and undistorted. The stereo directionality is well-maintained, there is a fine sense of depth, and with all this there is just a slight suggestion of a "hole-in-the-middle."

Pennario has a real flair for this work and turns in a really rousing performance, ably abetted by the perceptive accompaniment of Mr. Slatkin. The work by now may seem a little dated and even trite to musical sophisticates, but for those whose experience with piano concertos has been confined to Greig, Schumann, etc., or for those who simply enjoy a good display of piano pyrotechnics, this should fill the bill as an item of unusual interest and as a hi-fi spectacular.

ELGAR
ENIGMA VARIATIONS
PURCELL
SUITE FOR STRINGS

Halle Orchestra conducted by Sir John Barbirolli. Mercury Stereo SR90125. Price $5.95.

The Purcell piece is unusual and well done, but the real treasure here is Barbirolli's magnificent reading of the "Enigma Variations." After hearing all the rest I am still impressed with the expressive power and vigor, the exquisite humor of his account of this great score. This was a sensational stereo tape and much the same can be said for the disc. Except for the extreme dynamics at the end of the work, where the disc can't quite cope with the gigantic organ pedal, everything else is clean and distortionless and maintains all of the tape's many stereo virtues.

CHOPIN
PIANO MUSIC (VOLUME ONE)

Wilhelm Kempff, pianist. London Stereo CS6040. Price $5.95.

Solo piano in stereo? Yes, friends, and highly effective too! It has always annoyed me to hear so-called experts pontificating that it is useless to record solo piano in stereo. It all depends on how the job is handled. Done properly, the piano sound is singularly realistic by virtue of contributing reflections and reverberations which must be recorded along with the fundamental sound. A direct comparison with a monaural piano and a

stereo version will show the richer, rounder tonal qualities, and purity of intonation on the stereo disc. The piano has a natural quality to it that is rarely encountered in monaural recording.

This is Volume One of three thus far issued by *London* and I would presume it to be the start of a perusal of the entire Chopin literature. Kempff is a good choice for this, bringing to bear his happy combination of sensitivity and restraint with his exquisite dynamic shading and expressive phrasing.

SCHUMANN
SYMPHONY #1 ("SPRING")
MANFRED OVERTURE
Detroit Symphony Orchestra conducted by Paul Paray. Mercury Stereo SR90198. Price $5.95.

Paray has always had a particular flair with Schumann and his reading of this charming "First Symphony" exemplifies this ability. The attitude of the conductor is essentially lyrical, but the interpretation never lacks vigor and is never rhythmically flaccid. Paray has brought the Detroit men to a fine edge and the luster of their playing is a joy to the ear. *Mercury* has had its problems with the new Ford Civic Auditorium where the recording was made, but from the evidence of this record, these problems have been surmounted . . . and brilliantly. The sound is closely recorded with good detail, with everything quite clean and with wide frequency response. Directional effects were well maintained and center "fill" is entirely adequate. The acoustics are possibly not as resonant as some would prefer, but it is probable that with this type of scoring, any more may have muddied the texture.

MAHLER
SYMPHONY #10
WALTON
PARTITA FOR ORCHESTRA
Cleveland Orchestra conducted by George Szell. Epic Mono LC3568. Price $3.98.

One of the very best monophonic recordings ever issued by *Epic* it features unusual music. The Mahler 10th is an unfinished work, *consisting of but two movements*—all that could be reconstructed from the five Mahler had written when death came to him. It is without doubt the least accessible of any Mahler score and will be of interest only to the most devoted Mahlerites. The Walton score is extremely brilliant and abounds with writing to stimulate the hi-fi boys. Mono sound which can stand with the best!

BEETHOVEN
CONCERTO #4 FOR PIANO AND ORCHESTRA
Wilhelm Backhaus, pianist, with Vienna Philharmonic Orchestra conducted by Hans Schmidt-Isserstedt. London Stereo CS6054. Price $5.95.

Backhaus has made something of a specialty of the Beethoven "4th" and in this recording he has ample opportunity to display his wares. This is a hugely proportioned recording, the sound is big and imposing, even noble. The directionality and fill are such that a wonderful "curtain" of sound is presented across the speakers. Orchestral detail is finely delineated yet we have this spaciousness of acoustics which lends such rich sonorities. The piano tone is equal to the task and is robust, without being clangorous. Backhaus' reading is tremendously powerful and vigorous, yet is elegantly modeled and not heavy-handed. One thing is certain and that is that he, with the able assistance of Schmitt-Isserstedt and the engineers, has come up with a recording which abounds in vitality and excitement. If you are a concerto-fancier this is an item not to be missed! —30—

Electronics in Outer Space

(Continued from page 74)

and records Lyman-*alpha* rays—an obscure type of solar radiation, believed to have an effect on the propagation of radio waves. (See "Receiving U. S. Satellite Signals," RADIO & TV NEWS, March 1958.)

Telemetry Converters

A telemetry converter combines the signal impulses from various sensory units, producing a single encoded or digital signal, which is used to modulate the data transmitter. It is essentially a combining and modulating device.

Any of three systems of telemetry conversion is used in the payload of space vehicles: (1) pulse-position modulation of an AM signal; (2) pulse-width modulation of an FM signal; or (3) frequency modulation of an FM signal.

Systems 1 and 2 both utilize data sampling or time multiplexing of the various input signals. System 3 utilizes frequency multiplexing to provide continuous transmission of each input signal.

System 1 handles large volumes of data at low-frequency response rates. System 2 handles slow-response data. System 3 handles high-frequency signal data inputs. The exact type of system is determined by the nature and complexity of the signals obtained from the various sensory units.

Bandwidths of these input signals range from essentially direct current to 100 cps, the latter frequently used to determine accurately the instantaneous position of the satellite with respect to the sun. Different bandwidth inputs sometimes require a conversion system that combines both time-sharing and frequency-sharing telemetry.

The simplest telemetry converter can accommodate three input signals from sensory units. Input capacity can be expanded up to 48 signals with only a small increase in weight and volume of a converter. Telemetry signal-frequency components are in the audio-frequency range and signals seldom exceed about 12 kc.

Memory Devices

In early types of satellites, the electronics payload was simply designed because of weight and volume limitations. The data transmitter was allowed to broadcast continuously and much data was dissipated when out of range of ground receiving stations.

To effect longer life and more efficient operation of the electronics payload, a memory device was incorporated into the telemetry converter. This permits the storage of data continuously during an orbit and subsequently, when triggered from the ground by a command signal, the broadcast of such data to ground receiving stations. There the "burst" of

transmitted data is recorded, decoded, and analyzed. In this way, power needed for the data transmitter is conserved during periods of no transmission, considerably lengthening the total amount of useful operating time for the entire electronics payload.

First successful use of such a memory device was aboard the "Explorer III," which contained a miniature magnetic tape recorder (Fig. 12). As this satellite circled the earth, omnidirectional cosmic-ray incidences and intensities were detected by sensory units and then fed continuously, as impulse signals, to the tiny tape recorder. These signals were applied through the recording head to the magnetic tape, moving about 0.005 inch per second. Also applied to the tape was a time code to relate the data to points along the orbit of the satellite. The magnetic tape was about 55 inches long, or the equivalent of two hours of flight time.

As the satellite swung over certain areas of North America, a command receiver in the electronics payload was triggered by a coded signal from a ground station. This turned on the data transmitter and activated the playback head of the recorder. Within about five seconds, the entire 55-inch load of the recorder was fed into the data transmitter and broadcast to earth. After each playback, the tape was run over an erase magnet—and then rewound by a spring mechanism controlled by a magnetic brake, consisting of an eddy-current retard system using a silver disc rotating in a magnetic field.

Power requirements of this type of tape recorder are negligible. The recording and playback heads use 5 milliwatts and the advancing coil requires 20 milliwatts. All of the apparatus—reel, heads, switches, and solenoids—can be held in the palm of a hand. About 2.5 inches in diameter, it weighs less than 0.5 pound.

A magnetic tape recorder of much larger size but with less capacity was used in the electronics payload of "Project Score"—the "talking" satellite—during December 1958. The recorder (Fig. 13) has a 4-minute capacity for voice signals or analogue data.

Another type of memory device, utilizing two semi-independent magnetic tape recorders, has been developed for radiation studies by future space vehicles. One recorder receives and stores data during an orbit, while the second recorder plays back data stored during the previous orbit. As the satellite passes from shadow into sunlight during an orbit, the roles of these two recorders are reversed by means of a switch activated by a silicon-boron solar cell. This technique permits continuous transmission of data without extremely large and heavy data storage units.

Our next and final installment will include information on the use of satellites for communications relays and television transmission.

(To be concluded)

Lafayette Superior Quality Hi-Fi Kits

50 WATT INTEGRATED STEREO AMPLIFIER

KT-250
IN KIT FORM
64.50

LA-250
COMPLETELY WIRED
89.50

● 50 WATTS MONAURALLY—25 WATTS EACH STEREO CHANNEL ● RESPONSE 17-21,000 CPS ± 1 DB (at normal listening level) ● UNIQUE "BLEND" CONTROL ● PREMIUM EL86 OUTPUT TUBES ● SEPARATE BASS AND TREBLE CONTROLS ● CLUTCH-OPERATED VOLUME CONTROL ● 3RD CHANNEL OUTPUT

A completely new stereo high fidelity amplifier with a high quality of reproduction, versatility of operation, and distinctive styling. A full range of controls enable you to enjoy the utmost in listening pleasure in any situation. Deluxe features include: unique "Blend" control for continuously variable channel separation—from full monaural to full stereo, 4-position Selector, Mode, Loudpess and Phase switches. Also provided are outputs for 4, 8 and 16 ohm speakers. Hum-free operation is insured by the use of DC on all preamp and tone control tubes. Harmonic distortion, less than 0.25%. IM distortion, less than 1%. Hum and noise, 74 db below full output. Designed with the kit builder in mind, assembly is simple—no special skills or tools required. Complete with deluxe cabinet and legs, all parts, tubes and detailed instruction manual. Shpg. wt., 26 lbs.

KT-250 Stereo Amplifier Kit.....6.45 Down.....Net 64.50
LA-250 Stereo Amplifier, wired.....8.95 Down.....Net 89.50

LAFAYETTE PROFESSIONAL STEREO MASTER AUDIO CONTROL CENTER

Solves Every Stereo/Monaural Control Problem!

KT-600
IN KIT FORM
79.50

LA-600
COMPLETELY WIRED
134.50

- UNIQUE STEREO & MONAURAL CONTROL FEATURES
- AMAZING NEW BRIDGE CIRCUITRY FOR VARIABLE 3d CHANNEL OUTPUT & COSS-CHANNEL FEED
- PRECISE "NULL" BALANCING SYSTEM
- RESPONSE 5-40,000 CPS ± 1 DB
- 6 CONCENTRIC FRONT PANEL CONTROLS

A REVOLUTIONARY DEVELOPMENT IN STEREO HIGH FIDELITY.

Provides such unusual features as a Bridge Control, for variable cross-channel signal feed for elimination of "ping-pong" (exaggerated separation) effects. Also has full input mixing of monaural program sources, special "null" stereo balancing and calibrating system. 24 equalization positions, all-concentric controls, rumble and scratch filters, loudness switch. Clutch type volume controls for balancing or as 1 Master Volume Control. Has channel reverse, electronic phasing, input level controls. Sensitivity 2.2 millivolts for 1 volt out. Dual low-impedance outputs (plate followers), 1500 ohms. Response 5-40,000 cps ± 1 db. Less than .03% IM distortion. Uses 7 new 7025 low-noise dual triodes. Size 14" x 4½" x 10⅛". Shpg. wt., 16 lbs. Complete with printed circuit board, cage, profusely illustrated instructions, all necessary parts.

LAFAYETTE KT-600—Stereo Preamplifier kit .....7.95 Down.....Net 79.50
LAFAYETTE LA-600—Stereo Preamplifier, Wired...13.45 Down....Net 134.50

Outstanding Design—Incomparable Performance

LAFAYETTE STEREO/MONAURAL BASIC POWER AMPLIFIER KIT

KT-310
IN KIT FORM
47.50

LA-310
COMPLETELY WIRED
69.50

- 36-WATT STEREO AMPLIFIER—18-WATTS EACH CHANNEL
- 2 PRINTED CIRCUIT BOARDS FOR NEAT, SIMPLIFIED WIRING
- EMPLOYS 4 NEW PREMIUM-TYPE 7189 OUTPUT TUBES
- RESPONSE BETTER THAN 35-30,000 CPS ± ½ DB AT 18 WATTS ● LESS THAN 1% HARMONIC OR INTERMODULATION DISTORTION

A superbly-performing basic stereo amplifier, in easy-to-build kit form. Dual inputs are provided, each with individual volume control, and the unit may be used with a stereo preamplifier, for 2-18 watt stereo channels, or, at the flick of a switch, as a fine 36-watt monaural amplifier—or, if desired, it may be used as 2 separate monaural 18-watt amplifiers! CONTROLS include 2 input volume controls, channel Reverse switch (AB-BA), Monaural-Stereo switch, DUAL OUTPUT IMPEDANCES are: 4, 8, 16 and 32 ohms permitting parallel (monaural) operation of 2 speaker systems of up to 16 ohms. INPUT SENSITIVITY is 0.45 volts per channel for full output. TUBES are 2-6AN8, 4-7189; GZ-34 rectifier. SIZE 9-3/16" d (10-9/16" with controls) x 5¼" h x 13¼" w. Supplied complete with perforated metal cage, all necessary parts and detailed instructions. Shpg. wt., 22 lbs.

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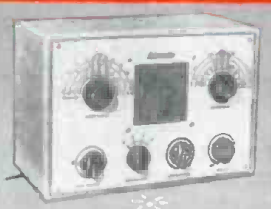

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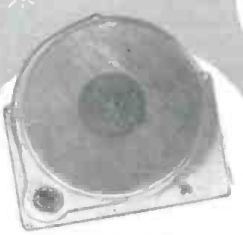

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SOUND ON TAPE

By BERT WHYTE

AS I write this column, it is but a few days since the National Association of Music Merchants convention ended in New York. Here is where the newly proposed 4-channel, 7.5 ips stereo tape got its baptism of fire. This year's NAMM show was one of the most heavily attended in some time. This was because of the tremendous general interest in stereo and, of course, interest in the new tape format has been stimulated by the controversial statements regarding it which have appeared in the trade press.

In any event, this NAMM show saw the four-channel stereo firmly in orbit. It is interesting to compare our new stereo tape format and the furore it is causing . . . with the stereo tape situation in Europe. Having just returned from a European trip of some weeks, I have been astonished by the wide divergence of activity, for example, 4-channel tape is almost completely unknown to the average enthusiast and, in fact, there are few tape companies who are aware of its existence. The old 2-channel stereo tape market there has almost ceased to exist. Tape costs were even higher than ours considering the wage differential of American and European workers. When the stereo disc came along, tape really nosedived. This is especially true in England, which must be regarded as the most nearly like our country as far as hi-fi activity is concerned.

I believe I told you some of these facts when I returned from my last trip, but have repeated them to jiggle memory and also to further report that this situation is practically unchanged. Which is unhappy news for many of you who would liked to have had some of the fine *Angel* and *HMV* recordings on stereo tape. Well, perhaps the stimulus of the 4-channel tape in our country will affect the American representatives of these companies and we will get some action.

In spite of the gloomy picture as far as stereo is concerned, there is plenty of other tape activity. For one thing, taping live programs off the air is very popular in England. The British are now beginning to build up quite a respectable network of FM stations and high-quality tuners, heretofore practically unavailable in England, are now coming on the market from the major hi-fi manufacturers. In the area of live symphonic broadcasts, the Briton fares much better than we do. It is not at all unusual to have as many as 3 live symphonic shows in a night and it is a rare night when there is not at least one live broadcast.

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All this activity has given impetus to their market in monaural tape machines, and a great variety is available. As in our country there are good and bad units and some pretty wild performance claims made. One unit claims response within 3 db from 50 to 12,000 cycles at 3.75 ips, and 60 to 9000 cycles at 1⅞ ips!

In another area of tape activity, the Europeans and especially the British and Germans, seem to be a bit ahead of us. This is in the use of tape synchronized for home movie production. I know we have our Magnastripe and other similar systems and these have undoubted advantages, but now becoming a strong market factor are several units which can be attached to any tape recorder to perform lip sync functions with the movies. Not much bigger than a lady's shoebox and of relatively modest cost, these units function on a carrier basis. Generally a very-high-frequency signal is put on the tape along with the program signals and this is subsequently modulated with a low-frequency signal and on some units there are even motor interlock devices. It all adds up to the fact that at reasonable cost lip sync home movies are becoming very much the thing over in Europe. We have had several such devices in our country which accomplish about the same thing. *Fairchild* made one, *Ranger* still does, *Ampex* once had one and years ago *Magnecord* had a brief fling with an especially effective type. The trouble with all of these was the high cost and so, except for professional use, they sort of fizzled. Surely with our genius for mass production and automation we can come up with a reasonably priced item like this that would seem to have quite a potential considering the ever-growing popularity of home movie making.

One other really intriguing item stems from the Germans who for some time now have been trying to come up with a completely revolutionary idea in magnetic recorders. This is a device in which "tape" is not really tape as we know it, but rather a sheet of oxide coated plastic, roughly equivalent in size to this page you are reading. Inserted in the machine somewhat on the order of paper in a typewriter, the sheet remains stationary, while the magnetic pickup and record heads are on a carriage type of affair which "scans" the oxide sheet back and forth line by line, again analogous to a typewriter. From what I understand there has been a lot of progress made on the device but many problems remain unsolved. The big point of it all is motional stability and a presumably fast and easy method of "tape" sheet duplication and lower material costs. Still in the realm of "blue sky," but so was the atom bomb a few years ago.

As was to be expected, *Ampex* and all the other tape people were going all out for the 4-channel tape and I observed enough reaction by visiting dealers to gain the impression that most of the reaction was favorable. A

number of dealers were still puzzled about the relationship of the cartridge, since *RCA* had announced once again that it was releasing equipment to play these tapes. But the real bombshell was the *Bell Co.* which much to the consternation of many jumped into the cartridge ring with no less than *six* tape cartridge playback machines, all of which were purported to be available for early delivery. In spite of this development, most people were of the opinion that the 4-channel reel-to-reel tape would be the quicker to get off the ground. Very likely both will soon be on the market and it will be up to individual preferences which system will appeal most to the consumer. From a strictly quality viewpoint, for the hi-fi man, the cartridge will just not make the grade. Furthermore at this time I am not even sure whether the four-track reel tape will meet with the unqualified approval of the tape enthusiast. Early reports had the quality of the four-track stuff as at least equal to the old two-channel tape.

I have a number of the first production of four channel tapes now for review and to be quite candid and blunt about it . . . I'm not overly impressed. Of course, it is to be emphasized that this is the very first production run on these tapes and there are undoubted "bugs" that will have to be worked out, but thus far I have been bothered by several things. Layer-to-layer "print-through" is much greater than it should be and, on virtually every tape, I heard cross-modulation between the two sets of stereo tracks during the quieter sections. Probably on the average type of speaker system this might not be noticeable, but it sure is with high-quality units. Noise-wise, the new tapes scored fairly well, but as far as I am concerned there is a lack of brilliance and a diminution of transient impact between the four- and the two-channel. So with this in mind . . . that what I review may not be of optimum 4-track quality . . . here goes!

A MIRACLE IN SOUND

Mercury 4-track demonstration tape. DE MS-3. Price $7.95.

The one side of this tape is devoted to pop selections from the *Mercury* catalogue, the other to classical selections. The pop side was quite cleanly recorded at good volume levels, was well balanced, and stereo directional effects and other stereo aspects were well maintained. Noise level was no higher than 2-channel equivalent. However, I did hear a moderate amount of print-through at the beginning of selections and I also could hear cross-channel modulation.

The classical side was recorded at lower volume levels and there was more noise apparent although still nothing too objectionable. Balance between the two channels had to be adjusted for equal output. There was again print-through and cross-modulation. One of the selections, the Wagner "Siegfried" excerpt, I had available on two track. I set up my machines so

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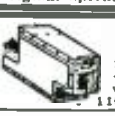

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DM-33A	28V 5A	575V .16A		
	28V 7A	540V .25A	1.95	3.75
DM-34D	12V 2A	220V .080A	4.15	5.25
DM-53A	28V 1.4A	220V .080A	3.75	5.45
DM-64A	12V 5.1A	275V .150A		7.95
PE-73C	28V 20A	1000V .350A	7.95	10.50
PE-86	28V 1.25A	250V .050A	2.75	4.95

that I could A-B from the 4-track to the 2-track at the same volume levels. To me, the 2-track had it over the 4 in terms of brillance and especially in transient response. It seems hard to believe that this could be the case, since the only difference between two- and four-channel is the magnet gap area.

Mercury has some of the most capable technical people in the record business so I cannot entertain the idea that something is amiss from that point. I think further evaluation is necessary, if possible with another copy of the tape. I think it best at this time to attribute the things I hear to sheer newness . . . and lack of familiarity with the medium on everyone's part. It is certainly unjust to draw any definite conclusions regarding the technique at this very early stage of the art.

DANCING AND DREAMING

The Jay Norman Quintet. Concertapes 4-track tape 4T-5001. Price $7.95.

Much the same applies to this tape as to the *Mercury*. This is all pop material and well done for its type. The recorded level is very high and signal-to-noise ratio quite good. Generally the sound is reasonably clean, but there was a certain "coarseness" to the piano I found unpleasant, and it may be once again a matter of transient response. Here, too, I found print-through and cross-modulation was somewhat more severe since the material on both sets of tracks is quite loud and in any quiet passage if the loud is juxtaposed, it rattles through quite audibly. These people have a good reputation in the 2-track field and know what they are doing. Sooooo . . . once again it is either "early production blues" or (perish the thought) an inherent problem with the 4-track medium. Let's hope not . . . but I felt there was no point to be gained in not reporting the phenomenon which I heard.

I will have more 4-track reviews next month, and I'm going to listen very critically and at the same time check my setup thoroughly. Maybe we'll have some nicer things to say!

—30—

TAPE EDITING TIP

By ROBERT E. MONROE

EDITING of tape on Viking FF 75 or Heath TR-1A tape decks is made simpler if the tapelifter-pressure pad assembly is removed. The screw which holds this unit is located just below the record and erase head cover. If the selector switch is in the stop or rewind position, the screw is accessible from the front panel.

After loosening the screw and lifting the pad assembly up and out, turn off the drive motor and place the selector switch in the rewind position. The tape reels may now be easily rotated by hand. In this manner, it is possible to locate sounds precisely enough to remove the "s" at the end of a word. Mark the exact spot to be cut directly over the playback head with a black or yellow glass marking crayon. —30—

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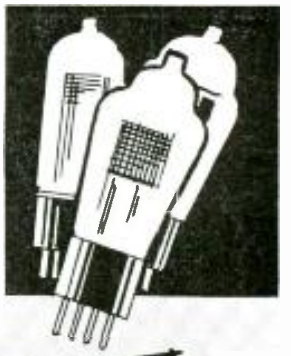

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1A7GT	3BN6	6AC7	6BC5	6CM6	6SA7	7B6	12AU6	12SK7	39/44
1B3GT	3BZ6	6AF4	6BC8	6CM7	6SD7GT	7B7	12AU7	12SN7GT	41
1C6	3CB6	6AG5	6BD6	6CN7	6SF5	7B8	12AV6	12SQ7	42
1C7	3Q4	6AH4GT	6BE6	6CQ8	6SF7	7C4	12AV7	12V6GT	43
1F4	3S4	6AH6	6BF5	6CR6	6SG7	7C5	12AX4GT	12W6GT	45
1F5	3V4	6AK5	6BG6G	6CS6	6SH7	7C6	12AX7	12X4	50A5
1G4	4BQ7A	6AL5	6BH6	6CU5	6SJ7	7C7	12AZ7	14A7/12B7	50B5
1H5GT	4BS8	6AM8	6BJ6	6CU6	6SK7	7E5	12B4	14B6	50C5
1L4	4BZ7	6AN8	6BK5	6D6	6SL7	7E6	12BA6	14Q7	50L6
1L6	4CB6	6AQ5	6BK7	6DE6	6SQ7	7E7	12BA7	19	56
1N5GT	5AM8	6AQ6	6BL7GT	6DG6GT	6SR7	7F7	12BD6	19AU4GT	57
1R5	5AN8	6AQ7	6BN6	6DQ6	6T4	7F8	12BE6	19BG6G	58
1S5	5AT8	6AR5	6BQ6GT	6F5	6U8	7G7	12BF6	19J6	71A
1T4	5AV8	6AS5	6BQ7	6F6	6V6GT	7H7	12BH7	19T8	75
1U4	5AZ4	6AT6	6BR8	6H6	6W6GT	7N7	12BQ6	24A	76
1U5	5BR8	6AU4GT	6BS8	6J4	6X4	7Q7	12BR7	25Z6GT	77
1V2	5J6	6AU5GT	6BY5G	6J5	6X5GT	7S7	12BY7	26	78
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2CY5	5V4G	6AV6	6CB6	6K7	7A5	7Z4	12F5	35B5	
3A4	5V6GT	6AW8	6CD6G	6N7	7A6	12A8	12K7	35C5	
3A5	5X8	6AX4GT	6CF6	6Q7	7A7	12AB5	12L6	35W4	
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Preamp for Stereo

(*Continued from page 67*)

put signal to give a constant output with frequency is the function of R_5, C_5, C_6, and C_7. This network provides negative feedback which is frequency selective to compensate for the standard phono (RIAA) and tape (NAB) recording characteristics. A flat response from a standard recorded disc occurs with R_5 at 6000 to 12,000 ohms, see Fig. 3, depending on the actual values of the capacitors in the network and also the recorded material and response of the magnetic pickup used.

Fig. 4 shows the response and treble equalization for tape at a speed of 7.5 ips. The .01-μfd. capacitor from the 12AX7 cathode to ground provides a small amount of treble boost above 10,000 cps as part of this equalization.

The treble equalization control, which is labeled "Tone" in Fig. 2, enables the operator to correct for deviation in components or recorded material to give the most pleasing response from his particular audio system. A linear taper pot was used for this tone control.

These preamplifiers will give an equalized output with most magnetic pickup impedances and have operated successfully with pickup impedances of 2000 to 6000 ohms at 1000 cps. The input impedance to the preamp increases with frequency because of the frequency selective negative feedback to the emitter of the 2N508. The impedance of the magnetic pickups will also increase with frequency but will be below that of the preamp.

The feedback decreases at low frequencies because of the increasing reactance of the feedback capacitor in series with the tone control. Each of the two feedback networks gives the desired increase in gain at the lower frequencies to accomplish the correct compensation required for tape playback or for disc.

C_5 decreases the amplifier gain at the higher frequencies in accordance with RIAA requirements. This eliminates the need to load a reluctance pickup with the proper resistance for high-frequency compensation.

The noise level in this preamp is 55 db or more below the standard reference level which gives an output of 1½ volts. The total harmonic distortion of this preamplifier at this level is ½ per-cent.

Figs. 1 and 6 show the component placement adopted by the author. Different component arrangements are possible as long as the high-signal-level wiring and components at the two outputs are not in close proximity to either input.

If a UPX-003 is not available, then this stereo preamp may be constructed from scratch and the required 100-volt supply could be obtained by decoupling from a power amplifier voltage supply. The total current required for both preamplifiers is approximately 2 milliamperes. —30—

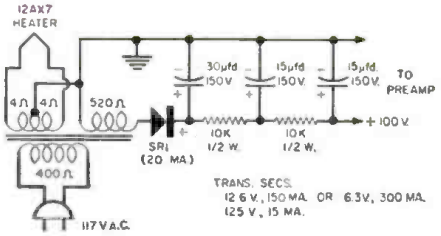
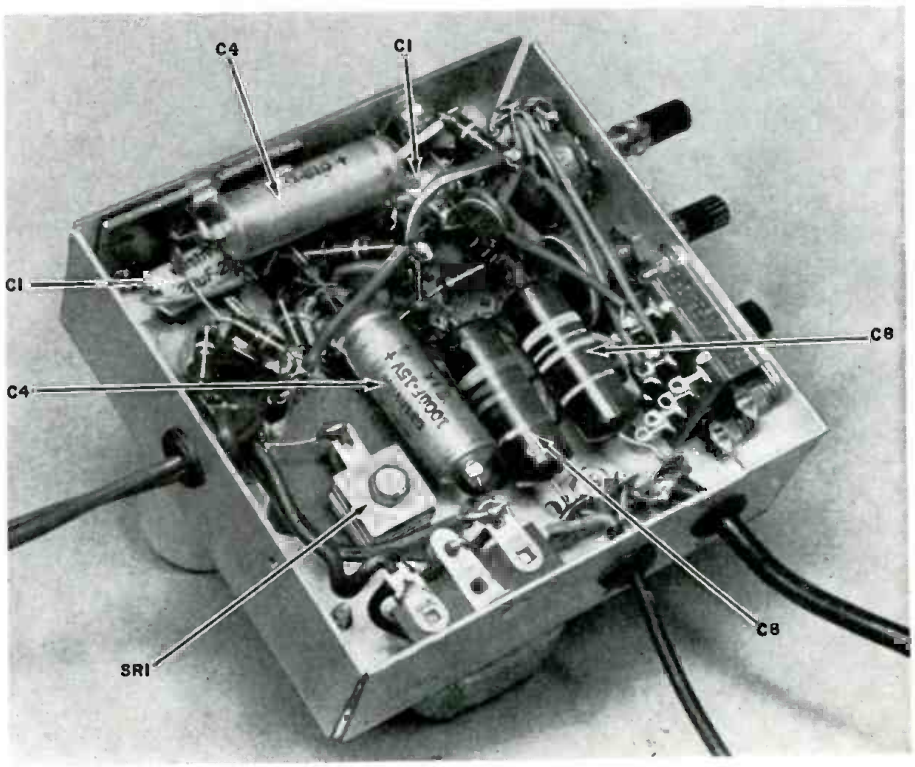
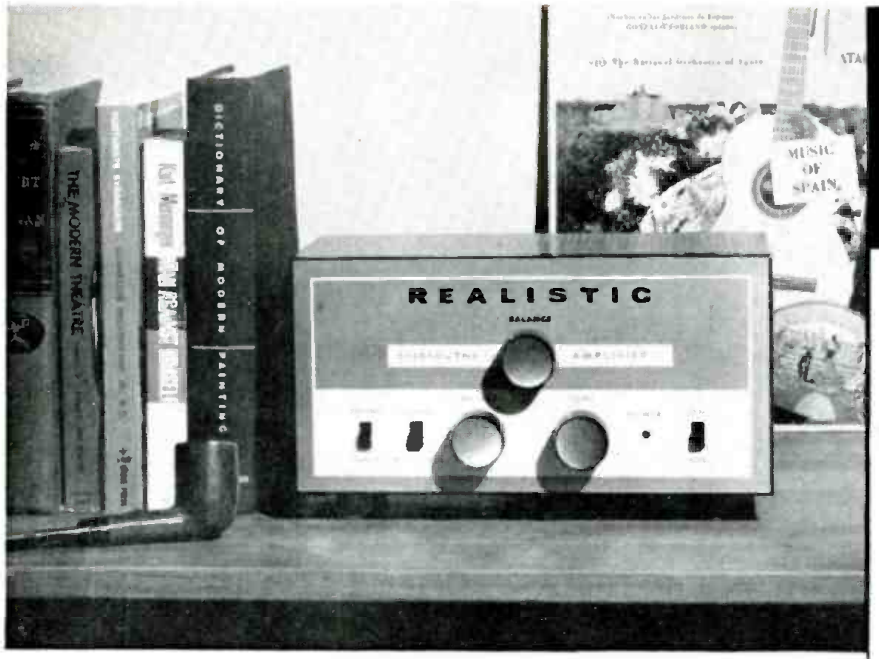


Fig. 5. The common power-supply circuit.

Fig. 6. Under-chassis view showing component layout for the dual preamplifier.





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By **JOSEPH S. JASPER**

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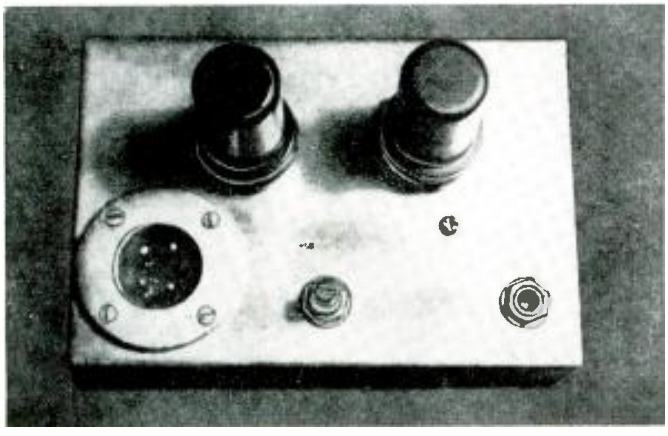
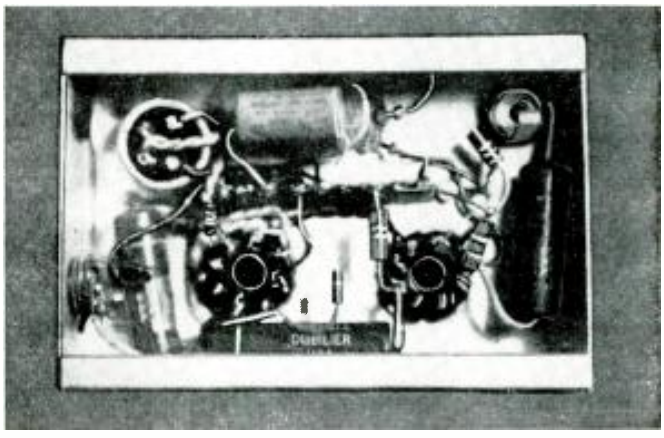


Top view of preamp. Adjustment shown is feedback control.



An 8" x 4" chassis allows plenty of room for components.

THERE are numerous instances when one wishes to measure a.c. voltages that are below the level one may expect to read accurately on a conventional voltmeter. Generally, these will involve readings in decibels in such applications as measuring signal-to-noise ratio, hum level, residual noise, frequency runs on tape recorders or disc equipment (where the level used may be 20 db or more down from normal signal level), and other uses.

A meter that can read, say, 60 db down from a reference level that will itself be within the range of the instrument is a useful adjunct to the array of equipment of any radio-TV or audio technician or experimenter. Such instruments are indeed commercially available, but prices run so high that it scarcely pays to buy a separate instrument when an existing one can be adapted for much less.

Since virtually everyone who does some sort of work in electronics has a voltmeter of one kind or another, unnecessary expense can be avoided by increasing the sensitivity of an existing unit with an accessory that does not require any alteration of the main instrument itself. The author already had a v.t.v.m. with a scale calibrated in decibels that could read down to −20 db below its zero reference level. (Many popular units meet and exceed this range.) Taking this into account, plus the fact that modest amounts of operating power could be tapped off from any of a number of other available instruments, the following requirements for an a.c. preamplifier were projected:

1. It should provide at least 40 db gain after the application of feedback to insure wide frequency response and stability. 2. A control to vary gain a few decibels on either side of the nominal gain should be included to permit accurate calibration and make allowance for tube and component aging, tube changing, power-supply fluctuations, load variations, and the like. 3. Response should be flat ± 1 db for a range from at least 15 to 40,000 cps. 4. It should have low internal noise, including hum. 5. Parts used should be readily available. 6. Good quality should be combined with reasonable cost.

The completed unit described here exceeded these goals. At 40 db gain, it was flat ± 1 db from 15 to 50,000 cps, and down 2 db at 60,000 cps. When adjusted for only 35 db over-all gain, it was flat ± 1 db from 10 to 80,000 cps.

Construction

The chassis used is aluminum and measure 8" x 4" x 1". The two 6SQ7 tubes were chosen for several reasons: they could supply the necessary gain; they used octal sockets, thus providing greater work area and heavier pin lugs for point-to-point wiring of components; they were available; and if necessary, one could be found in almost any old radio set.

The grid resistors, R_1 and R_4 in Fig. 1, were chosen with consideration for Miller effect. This involves the shunting capacitance of the tube itself on high frequencies due to such factors as interelectrode capacitance and tube gain. The resultant cut-off point for high frequencies (where response will be approximately 3 db down) falls at 45-50 kc. for the first stage and 65 kc. for the second stage.

The plate resistor values were also chosen carefully. The voltage gain of the first stage is approximately 48, corresponding to a decibel gain of 34. The gain of the second stage is approximately 75 (38 db). The power ratings of all resistors in the unit are minimum values as far as low-noise operation and current-carrying capacity are concerned.

When the feedback control, R_7, is turned to provide minimum feedback, the gain of the preamp is approximately 55 db. When the control is adjusted for maximum feedhack, gain falls to zero without oscillation. If the gain of the preamp is reduced by 10 db for an over-all gain of 30 db. the frequency response of the unit will he extended to cover from 8 eps to 100 ke., ± 1 db. This reduction in gain can be tolerated if the purpose of the unit is to provide more than normal v.t.v.m measurements where the signal would not fall under −50 db below the reference level.

A slightly restricted frequency range for measurements as low as −65 db can be obtained if R_7 is increased in value to 250,000 ohms. If R_7 is disconnected entirely, levels to −75 db can be read. These sensitivity capabilities are, of course, based on a voltmeter that can read levels as low as −20 db. If the meter has a greater or smaller range. the stated sensitivity readings should be correspondingly increased or decreased. As previously mentioned, the greater the gain, the narrower the frequency response range; however, even at the maximum preamp gain of 55 db, response is still almost flat from 30 cycles to 10 kc.

The coupling capacitors were chosen to provide adequate gain at 20 cycles when loaded with their complementary resistors (C_1 with R_1, C_2 with R_4, C_3 with R_5, C_4 with R_7). These are almost minimum values; therefore if an exact duplicate is not available, choose a unit that has greater capacitance rather than less.

The capacitor voltage ratings are quite adequate; however the constructor may wish to increase the voltage rating of input capacitor C_1. All units should be of high quality and, before installation, each should be tested for a dielectric resistance of at least 1000 megohms. Plastic-encased units are recommended. Outside foil notations should be observed, and chassis layout and lead dress deserve careful attention.

Power Supply

A word concerning the power supply. The d.c. current drawn by this unit is on the order of 2 milliamperes. A supply that can provide this current at a voltage output of 250 to 300 volts d.c. is recommended. The filament voltage to the tubes is a.c. but no hum troubles were encountered because of this. A center-tapped filament supply is both desirable and recommended.

The various ground points should be connected together and then grounded to the chassis of the preamp at a single point. The filament center-tap is grounded at the power supply. Neither side of the filament wiring should be connected to the chassis. The "B+" voltage should be relatively free from ripple; a choke-input filter, followed by a dual 40-μf. capacitor with a 10,000-ohm resistor between the capacitor sections proved satisfactory. In lieu of such a complete filter, however, an *RC* filter could be used inasmuch as a slight amount of ripple could be compensated for when the unit is adjusted initially.

Adjustment

After the completed unit has been checked for wiring errors, etc., power may be applied. Allow the unit to warm up for at least ten minutes. Apply a signal from an audio oscillator directly to the voltmeter. Adjust the generator output control to give a reading of −20 db, or whatever other low calibration in db is desired, on the voltmeter. Without disturbing the level setting of the generator, disconnect the generator output from the voltmeter. Now connect the voltmeter to the output of the accessory preamplifier itself.

With the voltmeter voltage range switch set at the same position as was used to read the original −20 db signal from the oscillator or generator, adjust the "Zero Set" knob of the voltmeter to bring the meter pointer to exactly zero *voltage* (*not* zero db). This will compensate for any residual hum or noise from the preamp itself.

Set the voltage range switch of the voltmeter so that a level of +20 db can be read conveniently. Then connect the generator output to the preamp input, still without changing the generator's output level. Adjust R_7 to produce a reading of exactly +20 db on the voltmeter. The difference between a −20 db input and a +20 db output is the 40-db nominal gain of the preamp. An even greater gain can be secured (up to 55 db), as described earlier. Voltmeter db settings used in this procedure may be changed to suit the particular instrument or the convenience of the user, but the basic procedure is the same.

Limitations

As with many units this one does have its limitations; however they are few and not too serious. For one thing, the preamp was designed to work with a v.t.v.m. which has an input impedance of 200,000 ohms. However, almost any voltmeter with an input impedance as low as 100,000 ohms could be used with satisfactory results. This fact will permit the use of 20,000 ohms-per-volt meters that include decibel scales. Of course, if R_7 is changed to a higher value, such as 250,000 ohms, the input impedance of the voltmeter should be of correspondingly higher value. For best results, a meter input impedance of ten times the value of feedback resistor R_7 is desirable. If the loading of the voltmeter or external circuit is more severe than the minimum recommended, the output waveform from the preamp will be distorted, with attendant error in accuracy of measurements.

Also, the accessory itself has a rather low input impedance (approximately 47,000 ohms); therefore possible loading effects on the equipment under test should be considered in readings obtained. Again, for best results and greater accuracy of measurements, the input impedance of the preamp should be ten times the output impedance of the equipment under test. There is, of course, no loading problem with the low-impedance outputs of conventional amplifiers, with which this accessory will most frequently be used. Finally, maximum input voltage to the preamp should not exceed 0.5 volt a.c.

When sensitive measurements are to be made, with readings directly in decibels, this instrument offers an accuracy and ease of operation that belie its low cost—which was less than ten dollars excluding the optional power supply.

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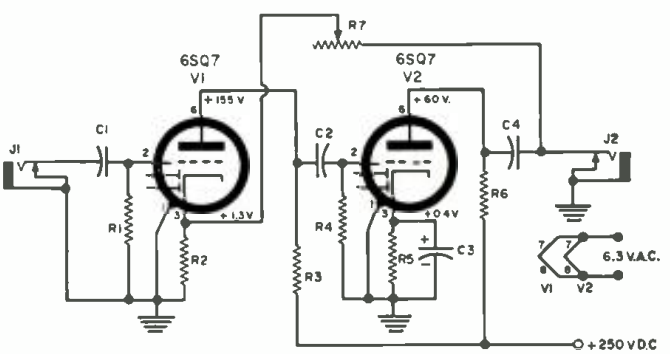

Fig. 1. Author's final circuit for his v.t.v.m. preamplifier balanced gain requirements against such factors as low noise and good frequency response.

R_1—47,000 ohm, 1 w. res.
R_2—1500 ohm, 1 w. res.
R_3—100,000 ohm, 1 w. res.
R_4—33,000 ohm, ½ w. res.
R_5—1000 ohm, ½ w. res.
R_6—330,000 ohm, ½ w. res.
R_7—100,000 ohm pot (see text)
C_1, C_4—.5 μf., 200 v. paper capacitor
C_2—.5 μf., 400 v. paper capacitor
C_3—50 μf., 25 v. elec. capacitor
J_1, J_2—Closed-circuit phone jack
V_1, V_2—6SQ7 tube

Career Opportunities

(Continued from page 40)

courses provide the key to a career in electronics for those who must hold down full-time jobs (often in a field unrelated to electronics) while acquiring their electronics training or for those who live and work in areas removed from the larger cities where such educational opportunities are offered. In connection with correspondence schools a few words of special advice are in order. Because the presence of a teacher and other students is lacking it takes a lot more will-power and "stick-to-it-iveness" to successfully complete a course of study when you are "on your own" than when weekly attendance in the classroom is involved. Frankly, it takes real "drive" and those who acquire their "know-how" in this way deserve respect.

In the writer's opinion, correspondence courses are most valuable to someone who wishes to get a general background in electronics or a person already working in electronics who wants a better understanding of his job. When a person has access to instruments, other technicians, a chance to operate electronic equipment, etc., he can obtain considerable benefit from a correspondence course in a very short time. Basically, any correspondence course requires that the student maintain his interest in electronics and this is usually easiest when he already works in the field. Correspondence schools now supply kits with instructions to let the student build up some equipment and thus familiarize himself with the more practical aspects of his trade. The sooner this "build-as-you-learn" technique is generally adopted, the easier it will be for the average student to acquire a practical and continuing interest in his work.

Probably somewhere between the two-year technical institute and the correspondence course are the many different 3- to 9-month specialized courses offered by trade schools in most large cities. These courses generally start with 3 months of radio fundamentals after which period the student should be able to repair most radios and phonographs. The second term is usually devoted to TV servicing or some other specialty. A final course may go into color-TV servicing and such advanced applications as computers, broadcasting, recording, etc. This type of training is very valuable, especially if the student has a particular vocational goal in mind.

As we mentioned before, technical "know-how" has a way of growing. We know of one young man who took a correspondence course, then worked in a radio factory and, later, through his military service, developed enough background to undergo an eleven-year evening college ordeal which brought him a master's degree and a top position in one of the country's largest electronics concerns.

Some junior colleges offer a two-year course leading to the degree of Associate in Science and there are also some colleges which conduct a major part of the training by mail with a short residence requirement prior to graduation. Most employers do not consider such training as being on the graduate level and hire people from such schools either as technicians or engineering aides.

The electronics training offered by the Armed Services usually provides a sound base, but it is rarely that the particular specialty learned there can be applied in industry. Those who take up maintenance and servicing of electronic equipment during their military careers generally have better preparation for civilian life than those who are trained to operate specialized military equipment. Once a man starts to work in the electronics industry, the fundamentals which give him an understanding of electronics are his most important tool.

Almost all of the larger corporations in our industry offer training programs of some type. These range from full-time, company-paid schools to time off for evening classes and tuition refund. Most companies that are not within easy reach of evening schools offer in-plant training which is usually an important factor in advancement. Even small firms encourage their employees to attend evening schools since they understand the need for continued technical growth.

Once a person is in the electronics field his technical "know-how" must keep pace with the constant rush of new developments. Books and magazines such as the one you are reading now are the main sources of information. Many engineers jokingly refer to the ads in technical magazines as the most important news source they have and there is a great deal of truth in this, but the technical articles usually provide the details of new products, techniques, and new equipment. The tangible value that books and magazines represent to technical personnel can best be realized by visiting one of the special libraries which practically every electronics company maintains for its engineers. Magazines are kept for years and complex systems of indexing are devised to insure efficient referencing of the needed material.

In conclusion, we would like to encourage our readers to apply for jobs in the electronics industry. It is possible that your present work does not make full use of your potential. Most people, after a year or so in one job, are ready to advance to a better position but they usually have too little confidence to apply for the more difficult but more rewarding position. The personnel manager of one well-known electronics firm confided that over 85% of all job applicants *underrate* themselves with regard to their technical ability. The proof of this lies in that company's practice of promoting practically all newly hired people within the first year!

—30—

IN OUR June editorial ("Service Unity at Last?") we saw fit to give prominence to the most promising looking steps toward national service unity that we recall in many a year. The large and powerful Television Service Association of Michigan, often at odds with NATESA, had applied for membership in the latter group. Some groups affiliated with the Texas Electronic Association had also expressed interest along the same lines. Action with respect to Texas did not seem highly probable, even at the time, perhaps becoming a greater possibility if the TSA affiliation could be worked out to the satisfaction of all. TSA entry into NATESA however, to judge by direct statements from principals on both sides made to us and by published material released by both camps, seemed to be well on the way. The latest information on this important matter—one of the biggest news items to come out of the service industry in some time—accordingly came as an unpleasant disappointment, as it will to many others who consider unity of paramount importance.

The TSA application for NATESA membership has been denied. In returning it, Frank Moch, NATESA executive director, said: "Under our constitution we can recognize one state group and only one local affiliate in any one city. Inasmuch as TESA-Michigan (formerly AMETA) has been duly recognized, we cannot recognize TSA-Michigan.

"Further, since ESA of Detroit is the duly recognized local affiliate of TESA-Michigan, and its predecessor group AMETA, we cannot recognize TSA as a Detroit affiliate.

"Under no condition is this action to be interpreted as an act opposed to the rank and file membership of TSA-Michigan. It is the firm conviction of NATESA that all legitimate service people are faced with the same problems and need the same means of sharing in the opportunity of solving their problems. Membership for service business operators in all areas is invited by each of our local affiliates, regardless of what other group they may belong to at present or simultaneously."

TSA-Michigan Reaction

The effect of the rejection on the Michigan group ranged from calm reassurance to the effect that they would no more be impaired in their continuing role as an effective association on both local and national levels than they have been in the past, to angered interpretations concerning the motives behind the NATESA action. The immediate past president of TSA, Karl Heinzman, who is now empowered by the TSA board of directors to handle national affairs for the group, had this to say in part:

"The rejection . . . was anticipated. We have known for some time that Frank Moch does not want harmony and national unity in the independent service industry. Urged by our friends in the Ohio associations, several of whom joined with the Texas Electronic Association and TSA-Michigan in organizing the IDEA program, we submitted our application to NATESA . . . Mr. Moch's action is a direct challenge to the NATESA members in Ohio who sought so diligently to achieve national unity and to breathe some fire into the programs of the national association."

A subsequent statement released by the TSA board of directors made some additional points concerning the situation. We quote some brief excerpts from this rather long document: "We wonder now what powerful forces motivate NATESA leadership . . . Who stands to gain the most from disunity? . . . Our cheek now was completely turned and we were willing to give all of our efforts and facilities to a program of genuine unity. For the record, too, we had previously been invited to join NATESA by Vince Lutz in the March issue of the 'NATESA Scope.'

"We now find a NATESA by law road-block, and our 'rank and file' members are told they can join ESA because ESA is now the NATESA affiliate in Detroit, ESA comprising a membership that is less than 15 percent of TSA's membership, and counting among its members some who are not qualified for membership in TSA . . . If, in applying for membership in NATESA and the subsequent denial of that membership by NATESA, we have proved a point, then perhaps the effort was not wasted.

"It is not our intention to carry on a running word battle with the present leadership of NATESA. To do so would be a reflection on the many fine friends we have among the NATESA membership. Our hope is that somewhere, sometime, the sincere dedicated service dealers of this great industry can find a common ground to meet, and unite in a truly National Voice."

The editors of ELECTRONICS WORLD are not in a position to determine the real motives for the failure of this most promising step toward reconciliation on the national level, nor to affix the blame, if any. However, we cannot conceal our disappointment at the collapse of negotiations toward the solu-

tion of the service industry's most pressing problem.

ARTSD-Columbus Views

John Graham, president of the Associated Radio-Television Service Dealers of Columbus, Ohio, one of the early NATESA affiliates, took a serious view of the rejection of the TSA application. Mr. Graham pointed out that when, at the NATESA Spring convention, he read the telegram stating that the TSA directors had voted to apply for affiliation with the national, the enthusiasm of the delegates was so great that an attempt was made to accept TSA on the spot.

Referring to the active participation of the Columbus association in all efforts to achieve national unity of the service industry, Mr. Graham said that ARTSD is making a thorough study of the national organizational situation. "This action just goes to prove," said Mr. Graham, "that the NATESA constitution needs a complete overhauling so that NATESA can grow into a truly effective and representative national association."

TEA Opinion

In view of reports that the directors of the Texas Electronic Association were considering the matter of applying for NATESA affiliation, contact was made with A. R. Niehaus, of San Antonio, Texas, president of the Texas state association.

"At no time," said Mr. Niehaus, "has the board of directors of the Texas Electronic Association given any consideration to applying for affiliation with NATESA.

"We have absolutely no confidence in the leadership of NATESA as that organization is now constituted. . . . TEA is now and always has been interested in a strong, democratically controlled and managed national association for the service industry. Unfortunately, most of the fine service associations that are affiliated with the present national have been blind to what goes on behind the scenes in that organization. Because of that, the service industry nationally will be mired down in the mud of back-biting and recrimination until they get rid of the men who are responsible for that sad state of affairs."

TSA-Iowa Joins NATESA

The "TSA Beacon" reports that the Iowa State Association voted unanimously to join NATESA at its June meeting. The "Beacon" lists the following benefits its members will gain from this affiliation:

Mutual Benefits. Benefits from this association will be many and mutual. Immediate benefits will be communication between associations in other states and Iowa. Also reduction in the scope of effort of our own association due to elimination of duplication.

Bulletins. Receiving "NATESA Scope" and special bulletins will enable Iowa members to spot troubles and

recognize problems at their source.

Dues Structure. Dues to the national at the present will be absorbed by TSA-Iowa. It is thought that eliminating part of our effort and taking advantage of information from the National will enable us to do this. Many members will save enough from the report on the yellow pages of the phone book to more than pay their NATESA dues for many years.

Durham RTSDA Elects

L. L. Leathers, president of *Leathers Television Service*, was elected president of the Durham Radio & TV Service Dealers Association at the annual election. He succeeds Garland Hoke, president of *Hoke Television & Radio Service*.

Other officers named include Walter P. Cobb, of *Cobb's Television & Sound Service, Inc.*, vice-president; Norman C. Schultz of *Maurlee Electronics Co.*, secretary; and Lewis Ferrell, service manager of *Montgomery & Aldridge Inc.*, treasurer. The association mailing address is P. O. Box 222, East Durham Station, Durham, N. C.

TESA-St. Louis Officers

Ray Wirtel, of *Wellston Electronics Co.*, was elected president of the Television & Electronics Service Association of St. Louis at the recent annual meeting. Fred Reichman of *Teltonics Laboratories*, the retiring president, was elected board chairman.

Other officers selected include Ralph Newberry of *Southampton Electronics Co.*, executive vice-president; Gene Love, of *Gene's Radio & Television*, first vice-president; Morton Singer of *Schweig-Engel Co.*, secretary; Wilma Tompkins of *States Radionic*, treasurer; and Al Wulf, of *Charles Electric*, sergeant-at-arms.

Wally Hirschberg, of *Hirschberg TV Technicians*, was named NATESA director, while the following members were elected to serve on the regular board of directors: Roland Berndt of *Berndt Radio & TV*; John Ford of *Fireside TV*; William Frasure of *Standard TV*; Robert Matteson of *Matteson TV Service*; Clyde Miller, Sr., of *Electronic Clinic*; Vincent Lutz of *Lutz Radio & TV Co.*; and Kenneth Garthe of *Television Service, Inc.* The address of TESA-St. Louis is 1724 South 39th Street, St. Louis, Mo.

State Group Forms in Tennessee

In Tennessee, the representatives of four local associations met recently to form the Television Electronic Association of Tennessee, Inc. Organizations involved in the move to make it the eighteenth state with an active statewide association were: TESA of Memphis, MTTTA of Nashville, TESA of Dickinson County and the Radio & TV Association of Chattanooga. Officers named to head TESA of Tennessee during its first year include Nelson Burns of Memphis, president; Claude Hilton, vice-president; T. R. Nabors, secretary-treasurer; and Charles Grif-

fin, sergeant-at-arms. Address of the association is: Nelson Burns, president, 966 East McLemore Ave., Memphis, Tenn.

Members of the MTTTA recently met with a group of TV technicians from Cookeville and adjacent communities to discuss the formation of a TV service association in the Upper Cumberland area. The group selected a corps of temporary officers to handle the details of developing a formal association. Dewey Wilmouth, of the *Stockton & Binson Hardware & Furniture Co.*, Algood, was elected temporary president; Al Karch of *Al's Radio-TV Sales & Service*, Monterrey, Tenn., was named temporary vice-president; and Odell Chaffin, of *Chaffin Radio & TV*, Cookeville, secretary-treasurer.

Industrial Electronics Course

On September 8, 1959, the Electronics Dept. of the New York Trade School will offer an up-to-date course in industrial electronics, designed to meet the industry's needs by preparing young men to take their places in the many positions now open to electronic technicians. The course was developed by the school in cooperation with an advisory committee of the Electronic Industries Association.

Running for two years, this prototype effort may establish the pattern for similar courses in other technical institutes providing instruction in electricity and electronics. The new course of instruction also involves the publication of a special laboratory manual and instructor's guide. Applicants must be high-school graduates or have equivalent education. Possible careers for graduates include employment as laboratory technicians, field engineers, sales engineers, service engineers, and technicians in the manufacture and installation of industrial electronic equipment. Address of the school is 304 East 67th Street, New York, N. Y.

Indiana Elections

Dean R. Mock, head of *Mock TV Sales & Service*, 1823 North Michigan Street, Elkhart, Ind., was elected president of the Television Bureau of Elkhart at its recent annual convention. Wilbur Wenger was selected for the post of vice-president; Wayne Clem was named secretary; and Harry Carmien was elected treasurer. Members named to serve on the association's board of directors, in addition to the officers, include Floyd Menges, Willis Roberts, and Lamar Zimmerman.

The Television Bureau of Elkhart is affiliated with the Indiana Electronic Service Association.

NATESA Award to CBS

Another award for "outstanding service in creating better customer relations" has been made by NATESA to *CBS Electronics*. A. L. Chapman, president of the latter company, received the plaque from NATESA president, Vincent Lutz, in a presentation ceremony.

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FCC on the Citizens Band Service

(*Continued from page* 41)

On the other hand, the lower permissible power and the comparatively shorter range of this service may be a disadvantage.

QUESTION 4/ *How long does it take to get the necessary forms from the FCC for a Citizens Band license, and how long after that does it take to get the actual license?*

ANSWER/ The FCC Form 505, used in applying for a license in the Citizens Radio Service, was revised in September 1958. There was a subsequent delay in procuring enough copies to fill the widespread demand; however, this has recently been partly corrected. Assuming an available supply of forms, copies should be received within several days after the receipt by the FCC of a request, or they may be obtained in person from the Commission at its Washington, D. C. offices and/or the field offices.

In view of the present backlog and the fact that applications are processed in the order of their receipt by the Commission, the present processing time for Citizens applications is approximately 60 to 65 days. Licenses will be received by the applicants shortly thereafter.

QUESTION 5/ *Since the service is supposed to be "mobile," what about a.c.-operated equipment at a fixed location?*

ANSWER/ Class D stations are classed as "mobile" although they are permitted to operate into antennas at fixed locations, since they may be removed from that location and operated at any other location, including while in motion, without additional authority from the Commission. The only conditions which limit such operation at fixed locations are those which restrict the height of antennas.

QUESTION 6/ *How many licenses have been issued so far for the Class D Citizens Band?*

ANSWER/ The Commission records are not kept in such a manner as to disclose the number of licenses issued to Class D stations or how many have been issued to individuals, corporations, etc. However, the Commission has received approximately 5000 applications for Class D station licenses in the month of May alone.

QUESTION 7/ *Once you get a license, can you change your frequency and change the number of units in use? Can a single transceiver be licensed, or must two be licensed at a time for point-to-point coverage.*

ANSWER/ A licensee of a Class D station may operate on any one of the 23 specific frequencies available to Class D stations and may change frequencies without applying for a modification of license. He may use any number of units so long as he does not exceed the number authorized on the license. If a licensee desires to increase the number of authorized units, he must file an application for modification on FCC Form 505. In this connection, see Section 19.24 of Part 19.

Usually a Class D station license will be issued only for a self-contained system of private radio communication. However, the Commission will authorize a single unit where it appears that pre-arrangements have been made to communicate with another licensee.

It was not intended that Class D stations be operated in a manner similar to amateur stations and the random calling of distant or unknown stations, such as calling "CQ," is not authorized.

With respect to the question of whether a single transceiver or two must be licensed at a time for point-to-point coverage, the licensee in the Citizens Radio Service may communicate with another transceiver operated under his own license, or a unit of another licensee by pre-arrangement. Also, a Citizens Radio station may transmit addressed messages to a receiver for one-way communication. —30—

Facts about Rebuilt CRT's

(Continued from page 65)

when an old tube is nearing the end of its useful life. After aging, nothing remains but final tests. These include a final check of the screen for defects, especially those that show up only at this point, when the tube can be operated to produce a raster; and electrical tests for emission, interelectrode shorts, gas content, and others.

Of the new materials used in rebuilding a CRT, the gun is probably the most important. How good are these? Except for some scattered manufacturers of guns whose output represents an insignificant portion of the total used and whose quality is difficult to assess, there is little more than a handful of gun manufacturers supplying rebuilders, and some of these are themselves name-brand "majors." Although there may be differences in the characteristics of guns supplied by these various makers, all are considered to be of high quality.

One interesting characteristic in which guns may differ is that some manufacturers use a larger G_1 (control grid) aperture than others. This permits greater beam current to pass and promotes longer useful life for the tube. However, the minimum size of the undeflected spot on the screen is somewhat larger as a result, and the best focus that can be obtained in a raster on the CRT is reduced somewhat in sharpness. There is some question as to how noticeable this reduction is to the TV viewer, and whether he is or is not willing to exchange it for the advantages obtained. In all-new tubes, the wide-aperture guns are not used.

Anyone familiar with processing in a new-CRT plant will recognize that it is similar to the rebuilding procedure described here. The big difference, as already noted, is in the more stringent specifications and post-production, quality-control checks. Here are some of the things a major manufacturer will do:

Samples from every run of tubes are placed on a "life" rack, which tests the samples under actual operating voltages and conditions (sometimes even under above-normal voltages) for about 2000 to 2500 hours. This is the equivalent of at least a year of regular use.

The undeflected spot of any tube is checked to make certain that it does not exceed a certain diameter. This spot must also be very close to the physical center of the screen, usually not more than $\pm^1/_8$ inch off-center in any plane.

A check of "rise time" is also used. In picture-tube manufacture, this term refers to the length of time it takes to produce a full raster after the application of typical operating voltages to all electrodes of a cold CRT. A tube may be rejected if rise time exceeds 15 seconds. There are other tests in which light output from the screen,

tube cut-off characteristics, and beam-current density are measured. Uniformity of phosphor distribution is also checked.

As for rebuilders, one should not jump to the conclusion that they dispense with such testing altogether. Nevertheless, it is a fact that the rejection rate in a new-tube plant is higher than that in most rebuilding establishments. This is partly due to marketing economics.

There is also some question as to how important some characteristics are in the long run. Many people believe, for instance, that a somewhat long rise time will not be noticed by the average viewer or, at least, will not be annoying to him. If the undeflected spot is somewhat off-center in a test, it may be simple to compensate for this deviation by adjustment of related deflection components and receiver controls.

Where a rebuilder is conscientious, he will adhere to an extensive in-plant testing program, but his specifications are not likely to be as tight as those of one of the majors. The difference may be roughly summed up as follows: the new-tube plant will tend to use maximum-condition tests, whereas the rebuilding plant tends to use normal-use tests.

In the long run, it is impossible to relieve the set owner or the service technician of their responsibility in deciding whether a replacement CRT should be new or reprocessed, and we shall not attempt to do so. Some set owners are of the type who demand "nothing but the best" and are committed to brand names, with the price consideration secondary.

For the picture-tube purchaser who is interested in the substantial cost saving he can effect by buying a rebuilt tube, the choice has already been made. The only problem is that of making certain his tube comes from a reliable source. Generally the service technician is in a position to make this decision. If rebuilt tubes come from a distributor, the reputation of the latter must be relied upon to some extent. He may not want to jeopardize his reputation by handling an inferior product. However, there is another possibility: most rebuilding plants market in a limited, local area. This helps in keeping the cost to the consumer down, as nation-wide distribution adds to the price. In fact, many rebuilders sell "over the counter," or direct to service dealers.

This means that the rebuilt tubes available in a given area usually come from a manufacturer within a reasonable distance. If he is reputable, he will not only have no objection to an inspection of his facilities by the service dealer, but he may actually welcome it. Much can be learned about the quality of the product in this way.

Generally, the rebuilder should be suspect if he runs one of the smaller, so-called "garage-type" operations. While many of these are reputable, and while some reprocessers who

started out in this way now operate larger, reliable plants, the smaller installation is less likely to have the best facilities for testing.

It should also be noted whether an effort is made to save the old phosphor screens in rebuilding and, if so, what percentage the plant attempts to salvage and what kind. In this connection, there is far less truth than is widely believed to the notion that an old screen may be too "worn out" to use again. However, newer phosphors and other technological improvements in making the screens produce greater efficiency and light output than was formerly possible. If the original tube is not too old and it has an aluminized screen, there may be more justification in attempting to salvage it. However, the rebuilder gives a clue to his attitude on the quality of the product by what he decides in this area. One who tries to save every screen he can get away with is suspect.

The manner in which electron gun mounts are stored prior to use is another good indication. The cool, dry storage condition necessary to prevent deterioration of this important part of the product is most likely to be ignored by a manufacturer who is careless in other important respects. The length of the cycle in the exhaust oven is another clue to general quality. It should take at least a couple of hours from the time that exhaust begins to the time the tube is sealed off.

Examination of the finished tube also helps. The point where the new neck has been spliced on should be checked for smoothness. If the splice is carelessly made, there may be difficulty in mounting the yoke and other external components properly. Sometimes a double splice is seen on the neck. This indicates that the bulb has been "through the mill" twice, but does not necessarily mean that quality has suffered as a result.

At best, a rebuilt tube from a reputable source can match an all-new one in consumer satisfaction and life. —30—

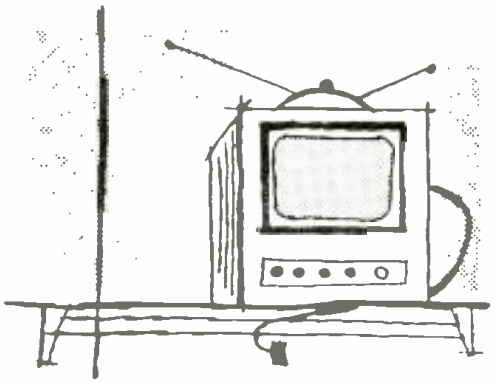
MALLORY "MEXICO CITY" TRIP

P. R. MALLORY'S "Go Places with Mallory" contest for technicians will close at midnight September 1st with all entries to be postmarked before that deadline to qualify.

Official entry blanks are enclosed in each "flight bag kit" which contains an assortment of popular numbers of eight different Mallory lines of replacement parts. The flight bag and its contents are specially priced for the contest period. Contestants are required to tell in 25 words or less which line of the company's components they like best and why.

The winner will receive an all-expense week-end air trip for two to Mexico City, hotel accommodations at the Continental Hilton, sightseeing, and $50 in cash for pocket money.

Entries, on official registered entry blanks, should be mailed to Mallory Contest, P. O. Box 1558, Indianapolis 6, Ind. Winners will be announced approximately six weeks after close of the contest. —30—



Pay-TV Today

By **A. W. BERNSOHN**
Executive Vice-President
National Appliance & Radio-TV Dealers Assn.

Claims, counter-claims, and partisan statements have served to cloud the current status of subscription TV.

PROBABLY the most frustrated of all services presently identified with television is "pay-TV." For years its proponents have been waging an uphill battle to have such a system tested as a prelude to commercial acceptance. It has received less-than-flattering attention from Federal agencies, has been cold-shouldered by some phone companies and other firms whose cooperation would be required for any wide-scale application of the scheme, and it is denounced and denigrated by those whose economic interests might be threatened should such a system be adopted.

As of now, there are only three proponents of any stature in the pay-TV picture. Biggest is *Zenith Radio Corporation*—advocate of the thorny-pathed broadcast method of doing the job. Others are *Paramount's "Telemeter"* and *Skiatron*. These two are hoping to side-step the jurisdiction of Congress and the FCC by making the system a closed-circuit deal.

Zenith does a pretty fair job of rebutting the objections to their version of pay-TV raised by the service fraternity. They have gone on record as divorcing themselves from any operation involving the leasing of sets with built-in decoders and are content to maintain the *status quo* as far as the service industry is concerned.

As for possible jurisdictional disputes between service dealers and decoder attachers, the company advises that in case of doubt the decoder box should be switched off, another channel tried, and if the picture is still bad something other than the decoder is wrong with the TV set. If the picture is good on the other channels, however, the trouble might be in the decoder equipment. This test can be quite definitive since the decoders can be installed or detached without pulling the chassis or tubes.

Zenith has extended another olive branch in the hope of allaying the fears of the service group by pointing out that a technician can install an average of five decoders a day– a nice source of service income for the independent looking for added revenue since the company is frank to admit that they couldn't handle the entire job themselves.

The other two pay-TV firms favor the direct-line approach in order to bypass the FCC and Congressional supervision. Another factor is that the broadcast system proposed by *Zenith* is considerably more difficult to design. The problem is not just one of devising a scrambling system—it must be done well enough to foil the would-be program bootlegger, cheap enough to make it economically feasible, and simple enough to be installed quickly and without disturbing the original circuitry. Running lines to homes all around New York, for instance, would mean that *Consolidated Edison*, which has dedicated its life to the task, would have someone else digging up the streets, too. Such a wired TV system as proposed by *Telemeter* and *Skiatron* would be easier to install in the smaller cities since parabolic reflectors and waveguides could be used to provide service to a central distribution point for amplification and piping to subscriber sets.

Pay-TV has been stymied in Congress largely because Congressman Oren Harris doesn't feel that it ought to be muddying the already far-from-clear waters of channel allocations, etc. Lately, though, the Harris Committee and the FCC have worked out a compromise which would permit the filing of applications for a test operation in one city with four stations. *Zenith* is studying the various possible test locations as well as the other problems connected with conducting a test under conditions outlined by the Federal Communications Commission.

The problems involved mean that such testing will not get underway in the very near future. There is a rather formidable gauntlet to be run, the filing, the appeals, delays in the FCC (expected to run six months or longer), higher courts to be gone through, and equipment to be manufactured and installed. An educated guess puts the start of such tests on the far side of one to two years.

When and if *Zenith* gets a green

light, such tests can run for three years and could involve tens of thousands of sets—depending on the test city selected. It will be the company's gamble, though, not the consumers'. By Commission regulation, *Zenith* will not be permitted to sell the equipment during the test period.

Queried about the program material to be offered, the company envisions first-run pictures, plays from New York (probably telecast live rather than filmed), top sports events, concerts, operas, etc. Since the delays involved have been so long drawn out, *Zenith* is designing equipment that will work equally well in both black-and-white and color.

No outsider has been told what the company has already ploughed into this project but this writer's purely speculative guess is that the figure runs into several millions of dollars. To have access to enough sets to recover even a part of this investment means a good-sized city for the test and more participants than could be reached economically by direct wire.

Probably the first extensive test of the *Zenith* pay-TV system was the one run in Chicago in 1951 when a three-month try was given the service under University of Chicago supervision by the National Opinion Research Center. They picked 300 families on a scientific basis, hooked up their sets, ran what films they could inveigle out of a still-hostile movie industry and did what the company considered a good job. People paid $1.00 a film to see the pictures and averaged $1.73 a week for the service. The researchers found that three out of four of the viewers hadn't seen the old films in theaters, even the good ones!

It took until 1957 for the FCC to come to any conclusions about what the tests showed and that meant plowing through a welter of thousands of comments that had been filed—the largest stack of paper garnered by the Commission on any subject in its history. After all that time, the Commission OKed a larger test but then Congress got into the act.

Paramount's "Telemeter" did some experimenting around 1953 with closed-circuit pay-TV in Palm Springs, relaying a signal from Mount Wilson to the subscribers linked by a community antenna system. They ran into some exhibitor opposition and *Paramount* is, of course, relatively sensitive to criticism from such quarters.

Skiatron hasn't conducted any real public test but has run some technical field tests. The date for public testing has been steadily advanced until, at this writing, the target date has been pushed back to April 1960.

Video Independent Theaters, operating in Oklahoma and the Southwest, got into the picture with community TV antennas and their own Oklahoma City TV station. Because the company owned all the theaters in Bartlesville, Okla. they tried it out there, making a deal with *Southwestern Bell Telephone*

Company. The TV firm constructed and ran lines for the phone company, then leased them for five years.

This test came a-cropper, probably because they didn't let the public buy the service on a per-program basis. The monthly fee started out at $9.75 and was then whittled down to $4.75—but still it didn't work out. Even though the test laid an egg, the company did line up from 800 to 900 subscribers. This service may be re-activated if the promoters can devise a workable, profitable metering device.

K. A. Simons, chief engineer of *Jerrold Electronics Corp.*, in an address before the Society of Motion Picture and Television Engineers, outlined a "program-by-program billing system for pay-TV" which emphasized the advantages of distribution by cable. According to Mr. Simons, "It does not come into conflict with licensed TV broadcasting and it does provide an additional service with its own channel space. It also provides the possibility of a return circuit between the consumer and the program originator. A system is described for using this return circuit to provide billing information. The system records during each program the identity of each receiver accepting it."

The anti-pay-TV forces are spearheaded by the television networks with the movie exhibitors running a close second, and the individual broadcasters lining up in third spot. Pay-TV proponents can't understand opposition from this last group, figuring that the broadcasters would get approximately the same or better revenue from their kind of programming. What they don't consider is the devaluation of left-over time or the loyalty to the networks, or the loss of not the abstract but the specific set-owning audience.

The subscription TV advocates point to a study conducted by the now-defunct "Tide," advertising trade magazine, which showed that agency people, smart public relations experts that they are, insist that what kind of television the public will get depends on the expressed preferences of the people in front of the sets. It is suspected, however, that the fine Machiavellian hand of some of the agency boys is tipping the scales against pay-TV.

It is this author's opinion that *Zenith* is the outfit to watch in the subscription TV struggle. They have the capital to swing such a deal and to wait out the interim setbacks. The company has been mulling over the problem of pay-TV and has been engaged in active work on the project since 1928. Today they have a crack staff, headed by Dr. Alexander Ellett, engaged on perfecting the medium and eliminating the bugs and loopholes.

As of now, there's little definite to report on pay-TV other than the facts that it's been worked on for a long time and it's not dead yet so only time will tell just what subscription service, if any, will be available on our living room screens. —30—

"101 WAYS TO USE YOUR VOM AND VTVM" by Robert G. Middleton. Published by *Howard W. Sams & Co., Inc.*, Indianapolis. 111 pages. Price $2.00. Soft cover.

Since any professional service shop has v.o.m.'s and/or v.t.v.m.'s on its test equipment shelf and many hams, hobbyists, and experimenters count these handy instruments as valuable adjuncts to any electronic project, this book should find wide acceptance with both segments of the electronics "industry."

Most readers of this text will undoubtedly be surprised at the many uses to which such gear can be put. Aside from the standard circuit tracing and voltage and current checks, there are, as the title denotes, 101 ways in which v.o.m.'s and v.t.v.m.'s can work for you. The text is divided into seven sections covering equipment checks, d.c. voltage tests, ohmmeter tests, signal-tracing tests, a.c. voltage tests, d.c. current tests, and alignment applications.

It is a fairly safe bet that even the most experienced "old timer" will find several new applications for these test instruments among the comprehensive listing provided by the author.

* * *

"FUNDAMENTALS OF RADIO TELEMETRY" by Marvin Tepper. Published by *John F. Rider Publisher, Inc.*, New York. 111 pages. Price $2.95. Soft cover.

While most texts on telemetry have been written on an engineering level this technique is beginning to play an increasingly important role in the lives of technicians and laymen, hence, a basic book on the subject was warranted. The author has assumed no prior knowledge of telemetry on the part of his readers and the only prerequisite is a basic background in electronics.

The text material is divided into eight chapters, a bibliography, and two appendices. Topics covered include an introduction to telemetry, telemetry inside the missile, multiplexing, telemetry receiving stations, the recovery and recording of data, digital techniques in telemetry, telemetry data reduction, and satellite telemetry. The appendices cover telemetry standards for guided missiles and magnetic recorder/reproducer standards. An extensive bibliography permits the reader to make further excursions into the subject if desired.

The lavish use of line drawings, cutaway diagrams, charts, tables, and photographs helps to clarify the textual

presentation. For citizens with a well-developed bump of curiosity and eagerness to learn more about the scientific marvels of the space age, this largely non-technical treatment should enable them to get a good over-all picture of the art.

* * *

"BASICS OF MISSILE GUIDANCE AND SPACE TECHNIQUES" by Marvin Hobbs. Published by *John F. Rider Publisher, Inc.*, New York. 142 and 143 pages. Two volumes $3.90 each. Soft cover.

These two volumes have been designed as a "basic course" in the electronics of outer space probes and missiles. The first volume covers the principles of control and guidance, radio and radar command links, guide beams, Doppler and homing methods, fundamentals of gyroscopy, inertial guidance and celestial navigation, computer applications, actuators, and related components.

Volume two in this set covers telemetering, space exploration by optics and electronics, satellite theory and practice, satellite monitoring and tracking, as well as applications of earth satellites.

The presentation is along the lines of this publisher's "picture books" but the extensive pictorial material should not mislead the reader—this is not a "primer." Those who work in some field of space electronics or have a fairly extensive electronics background will derive the most benefit from these volumes. As an up-to-date source for current development work in the field of space electronics, these volumes are highly recommended.

* * *

"STEREO — HOW IT WORKS" by Herman Burstein. Published by *Gernsback Library, Inc.*, New York. 218 pages. Price $2.90, soft cover edition, $5.00 in hard cover.

This handbook could be classed as a primer for the nontechnical audiophile who may have stereo equipment or plans to buy such gear but does not necessarily know all of the "why's" and "wherefore's" involved in the technique.

Although the author has taken it for granted that his audience is familiar with general audio terminology (*i.e.*, amplifiers, preamps, tuners, cartridges, woofers, tweeters, frequency response, etc.) his presentation of the subject of stereo starts from scratch. He defines and illustrates monophonic sound, binaural reproduction, stereophonic reproduction, quasi-stereo, "hole-in-the-middle," phantom channel, etc. as applied to two- and three-channel reproduction techniques. In addition to this introductory material, the author covers the stereo effect, stereo on the air, stereo on discs, stereo on tape, stereo mike techniques, amplifiers and speakers for stereo, and installing a stereo system.

Lavish use of graphs, line drawings, photographs of commercial equipment and installations, as well as partial schematics and block diagrams is helpful in conveying the subject matter. Most readers of this magazine are thoroughly familiar with Mr. Burstein's style and will find that this text is characterized by the same clear and concise presentation technique.

* * *

"SERVICING TRANSISTOR RADIOS" by Sams Staff. Published by *Howard W. Sams & Co., Inc.*, Indianapolis, Ind. 160 pages. Price $2.95. Soft cover. (Vol. 3.)

This is the third volume in this publisher's series on current transistor receivers and covers models from twenty-three different manufacturers. In addition to providing the standard "Photofact" treatment for each of the receivers, the book also carries a section on the techniques of servicing transistor circuits and covers the comparison of such circuits, coupling between a.f. stages, power-output stages, negative feedback, phase inverters, and the public-address amplifier. Another section is devoted to basic information such as standard notation schematics, dial cord stringing arrangements, resistance charts, photographs of cabinets and chassis, alignment instructions, and parts lists and replacement data.

A cumulative index covering all three volumes in this current series is also included to facilitate the location of the correct schematic.

Technicians involved in the servicing of such transistorized equipment will find this manual helpful in speeding repairs and troubleshooting.

* * *

"ELECTRONICS FOR EVERYONE" by Monroe Upton. Published by *The Devin-Adair Company*. New York. 369 pages. Price $6.95. Second revised edition.

When this book first appeared in 1954 it garnered kudoes as a basic and readable text for the uninitiated. This newest edition still serves as a good introduction to the subject of electronics—one which might help the undecided select an interesting and rewarding vocation.

By presenting the "historical background" of the art as well as outlining present-day applications which have evolved from such early discoveries, the author has been able to cover an amazingly wide field including transistors, television, radar, hi-fi, video tape, space electronics, and myriad other applications of electronics.

The style is informal, non-technical, and non-mathematical and there is no reason why anyone interested in electronics (and that should include almost everybody in this day and age) shouldn't be both entertained and instructed by this presentation.

* * *

"MARINE ELECTRONICS HANDBOOK" by Leo G. Sands. Published by *Howard W. Sams & Co., Inc.*, Indianapolis, Ind. 228 pages. Price $3.95. Soft cover.

Since boating has burgeoned as the new "family hobby" marine electronics is a subject of interest to almost 37,000,000 Americans who operate a

total of 7,330,000 craft of all types on the waterways in the U. S.

This volume gives complete service maintenance information on the electronic equipment to be found on both large and small craft. Both boat owner and marine service technician will find this information valuable.

Schematics, service tips, operating regulations and procedures have all been included to make this volume as comprehensive and self-contained as possible. Photographs of commercial equipment and installations amplify the text material. Two special 12-page fold-out maps which chart the location of all shore-based transmitting facilities serving the mariner are especially valuable for the skipper afloat.

Compact enough to be stowed in any boat locker, this handy guide should be part of the standard equipment of all craft boasting electronic gear of any type. —30—

RECORD-SETTING 222-mc. HAM CONTACT

JUNE 22nd was a new milestone in ham radio since on that day two-way radio contact on 222 mc. was made between the Hawaiian Islands and the mainland a record distance of 2540 miles! This surpassed by 1800 miles the previous record of 740 miles set in 1957.

Contact between Palos Verdes, California (near Los Angeles) and Kahuku on the northern tip of Oahu was established on 222 mc. by John Chambers, W6NLZ, and Ralph Thomas, KH6UK.

Attempts at the record were begun on June 18th with Chambers and Thomas using other amateur frequencies for liaison. The contacts lasted for 53 minutes beginning at 9:30 p.m. (PDT). Successful two-way telegraphy communication and one-way SSB were made. Chambers is an engineer employed by Douglas Aircraft at Santa Monica. His home at Palos Verdes Estates is 910 feet above sea level with a clear view out over the Pacific.

In establishing the new record, Chambers transmitted with a 750-watt input while Thomas used the maximum 1000 watts. Special receiving equipment was used at both ends. Special transmitting-receiving antennas were employed for the contacts, with both amateurs constructing much of their own equipment.

According to the ARRL, tropospheric propagation made the record-breaking contact possible. The quality of signals at both ends of the circuit indicated that weather conditions over the Pacific were responsible.

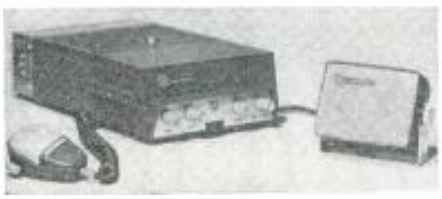
Both men are old-time "record breakers." On July 8, 1957, using telegraphy, these same amateurs made contacts from the same locations on 144 mc., also setting a new world's record. Thomas, as W2UK at Rocky Point, Long Island, was among the leaders in the International DX competitions of the ARRL for several years in a row, back in the 1930's. In 1953, from Brunswick, New Jersey, he embarked on a cooperative program of investigation of the possibilities of 144 mc. communication by means of reflection of signals from meteor trails—a form of communication now being exploited for military and commercial purposes. —30—

What's New in Radio

HIGH-POWER TWO-WAY GEAR

The Communication Products Department, *General Electric Company,* Lynchburg, Va. has unveiled a new line of transistorized two-way radio equipment which features high power, small size, and low battery drain.

The new "Transistorized Progress Line" is being offered in units up to 75 watts. From the 75-watt category the



line ranges downward to 30 and 10 watt units in sizes as small as 8⅝" wide, 12" long, and 4" high.

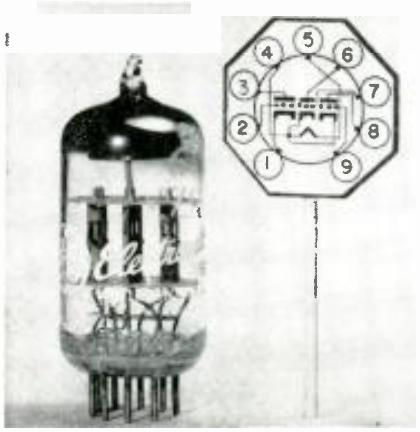
The new equipment uses modular construction which facilitates replacement in the field. Plug-in terminals on all cable connections speed installation and interchange of units. To facilitate troubleshooting, plug-in transistors are easily removed enabling the technician to make circuit tests which usually can't be made with transistors in place. All routine adjustments are accessible from the top of the unit. Plated-through printed circuit boards are completely interchangeable on all units. A heavy-duty circuit breaker replaces the usual fuses.

The first units to be offered will be for the 150-174 mc. band.

Further information on this new line is available from Section P of the department, P.O. Box 4197, Lynchburg, Va.

G-E'S TRIPLE TRIODE

The Receiving Tube Department of *General Electric Company,* Owensboro, Ky. is now in production on what is



said to be the industry's first triple triode receiving tube.

The 6EZ8 can serve as a one-tube tuner for frequencies as high as the FM band. This 9-pin miniature has a cumulative plate dissipation of 5 watts yet is housed in a single T-6½ envelope. The cathodes of two of the three sections have a common connection; the third section's cathode is brought out to a separate pin. Possible applications include r.f. amplifier, oscillator, and mixer; and oscillator, mixer, and a.f.c. tube.

Each triode in the tube is rated for a maximum of 330 plate volts, 50 volts negative d.c. grid, and 2 watts plate dissipation. In typical operation with 125 plate volts and minus 1 grid volt, each section has an amplification factor of 57, transconductance of 4200 micromhos, plate resistance of 13,500 ohms, and draws 4.2 ma.

TRIPLETT AMMETER

The Triplett Electrical Instrument Co., Bluffton, Ohio is now offering a new series of matched, hand-size instruments as its "Little *Triplett*" line.

One of the instruments in the new series is the Model 307 a.c. ammeter. The circuit features a built-in transformer for use on 60-cycle lines and permits measurement of current drawn by electrical appliances and motors, heating elements, lamps, radio receivers, etc.

The instrument has five a.c. ampere ranges: 0-1, 0-2.5, 0-5, 0-10, and 0-25. The circuit is housed in a fully insulated black molded case which measures 2¾" x 4¼" x 1¾₁₆". Posts extend ¾" below the case.

The manufacturer will supply additional details on request.

"SEIZERS"

Xcelite, Incorporated, Orchard Park, N. Y. has developed a new and versatile service tool which is being marketed as the "Seizer."

Curved or straight nose and six-inches long, the tool handles like a scissors. It will hold momentarily or clamp on indefinitely, and release easily. The tool is designed to hold dial cords, pigtails and wires for soldering, act as a heat sink, pick screws or nuts and hold them, or reach remote corners of a chassis.

The "Seizers" are constructed of stainless steel, perfectly tempered with precise box joints. The straight-nose

version is catalogued as No. 42H while the curve-nose type is the No. 43H. Distributors now have these tools in stock.

PORTABLE TUBE TESTER

The Hickok Electrical Instrument Company, 10524 Dupont Avenue, Cleveland, Ohio has developed a new high-speed tube and transistor checker for electronic service applications.

The Model 6000 features a snap-in master socket panel that provides for all tubes and transistors normally encountered in service work. When the plate is removed an 11-pin socket that will accommodate new special tubes is exposed. Alternate socket plates are available to test foreign-made tubes.

Tube quality evaluations are read

directly on the 3-range micromho scale (0-3000,0-6000, and 0-15,000). Five neon lights indicate shorts or leakage between elements and identify which elements are shorted. The line voltage is constantly indicated and can be adjusted very quickly.

The instrument is housed in an attractive red leatherette-covered portable case with detachable lid and measures 16¾" x 11¾" x 7½". The panel is gold anodized with red and black lettering.

Further information on the Model 6000 is available from the manufacturer on request.

"SHAFT-KUT TOOL"

Centralab, a division of *Globe-Union Inc.,* 900 E. Keefe Ave., Milwaukee 1,

Wis. is now offering a technician's tool which permits the precision cutting of control and switch shafts to an accuracy of 1/64".

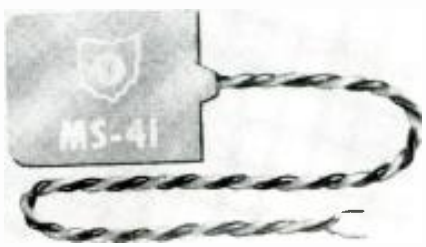
In operation, the control or switch is inserted in the tool, the jig is set at the length desired on a scale, and the excess shaft is sawed off. The design of the "Shaft-Kut Tool" makes it virtually impossible to cut a shaft incorrectly.

The tool is constructed of case-hardened tool steel, designed to withstand the hard usage of a service shop. For price information or details on how this tool can be obtained without charge on the company's special introductory offer with its "Fastatch" FDK-100 dual control kit, write the firm direct.

MAGNETORESISTORS

Ohio Semiconductors, Inc., 1035 W. Third Ave., Columbus 8, Ohio has announced the commercial availability of its recently developed semiconductor device, the "Magnetoresistor."

The Type MS-41 is a semiconductor in which the electrical resistance is a function of an applied magnetic field. It features a 10 to 1 change in resistance with an applied field of 10 kilo-



gauss. Greater changes can be achieved at fields greater than 10 kilogauss with a linear dependency. At lower magnetic field densities the "Magnetoresistor" obeys an approximate square function.

Important features of the MS-41 include low noise, fast response time, and non-inductive design. The unit can be used as a contactless potentiometer, amplifier, voltage and current regulator in computers, squaring devices, modulators, choppers, and transducers.

The company can now supply the units in experimental and production quantities. Write the manufacturer for full details.

MARINE-B.C. RECEIVER

Channel Master Corp. of Ellenville, N. Y. is now offering a two-band marine and standard broadcast portable radio, the Model 6514.

This 8-transistor set receives regular broadcasts from 540 to 1600 kc. in addition to the marine communications band from 1.85 to 4.2 mc. This bandspread includes the 2-3 mc. marine band, some amateur frequencies, plus other communications services.

The circuit is a superheterodyne and features eight matched transistors, two diodes, and one thermistor to provide 10-tube performance. The circuit is powered by four 1½-volt penlite batteries. The receiver measures a compact 3½" x 6¼" x 1¾" and comes with a telescoping external antenna for marine broadcasts, a cowhide carrying case and strap, extension outlet and earphone for private listening, and plug-in external antenna wire.

A brochure on this and other sets in the company's line of receivers is available on request.

CURRENT-SENSITIVE RELAY

Filtors, Inc., Port Washington, N. Y. has announced the availability of a new

current-sensitive relay in its "Powrmite" microminiature relay series.

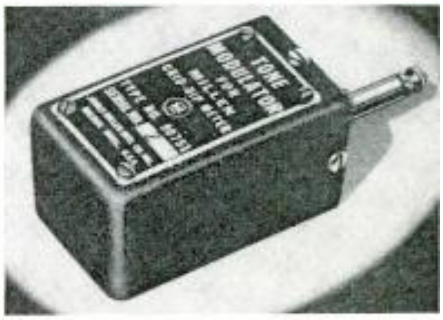
Known as the "S" type, this new unit meets shock tests of 100 *g's* for 11 milliseconds and vibration tests of 10-55 cps @ 0.6 double amplitude, 55-2000 cps @ 30 *g's*. Double-pole, double-throw contact arrangements are available. The relay will operate over an ambient temperature range of —65 to +125 degrees C. Contact rating is 2 amps resistive; maximum pull-in and drop-out times are 5 milliseconds.

Coils resistances from 185 to 10,000 ohms are available as standard values. For further information, write the manufacturer direct.

TONE MODULATOR

James Millen Manufacturing Company, Inc., 150 Exchange St., Malden, Mass. has announced the availability of a new transistor tone modulator, the No. 90751.

A small package containing a transistor oscillator and its mercury battery plugs into the phone jack of a grid-dip meter to modulate the signal at approximately 800 cycles for appli-



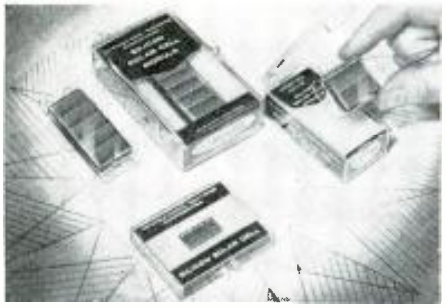
cations requiring a modulated signal. The modulator is turned on automatically when plugged into the grid-dip meter.

For complete details on this new accessory, write the manufacturer direct at the above address.

"PACKAGED" SOLAR CELLS

International Rectifier Corporation, 1521 E. Grand Ave., El Segundo, Calif. has just released a complete line of solar cells and modules for the "do-it-yourself" and hobbyist market.

When mounted in series or parallel configurations, these solar cells will



power small electric motors and relays or can be used to replace drycells in transistorized radios for daylight operation in bright sunlight. The complete line includes a single solar-cell pack, a 2-cell module pack, and a 5-cell module pack. A typical 5-cell module will supply approximately 1.5 volts at 35 ma. output in bright sunlight.

All units are packaged in re-usable plastic boxes and are now available through the company's 88 authorized distributors throughout the U. S. and Canada.

CITIZENS TRANSCEIVER

Dunlap Electronics, Inc., 764 Ninth St., Des Moines, Iowa is currently in production on three models of its Citizens Band transceiver—standard, deluxe, and commercial.

All three models are being offered in both kit and assembled versions. The units feature crystal-controlled transmitter sections and two-stage i.f. crystal-controlled superhet receiver circuitry. The unit has an etched circuit chassis and the receiver includes a built-in squelch and noise limiter circuitry.

The deluxe model provides push-to-talk operation while the commercial version features extra rugged construction for trunk mounting with remote control head. This latter unit comes complete with 25 feet of remote cable, control head, shock-mounted base, and crystal for two channels (16 and 20).

All models include tubes, crystals for one channel (channel 20), microphone, and power cord. The transceivers are

housed in grey wrinkle finish cabinets which measure ¾"x8"x9⅞". The units may be ordered for 117 volt a.c., 12 volt d.c., or 6 volt d.c. operation. —30—

OHIO HAMFEST

The Findlay Radio Club, W8FT, will hold its annual hamfest on Sunday, September 13, at Findlay Riverside Park. Advance registration is $1.00 per family or $1.50 at the park. Information and tickets are available from Fred F. Flowers, W8UGE, 1307 S. Main St., Findlay, Ohio. —30—

Direct-Coupled Amplifier

(*Continued from page 43*)

ply voltage during the current peaks.

Construction Hints

The amplifier is constructed on an aluminum bracket and mounted inside a 5" x 4" x 3" aluminum box. No power switch is used since the total power consumption is only 6 watts and it is economical enough to leave the amplifier on continuously. The power transistor and the rectifier transistor are stud mounted, using mica and fiber washers for insulation, at the bottom of the bracket where the path length for heat flow to the outer case is short.

A "universal" line-to-voice-coil transformer is used instead of a power transformer because it runs cooler. All the a.c. wiring is inside the power-supply compartment to prevent hum pickup in the input circuit, which is entirely within the amplifier compartment.

Any of several types of power transistors can be used in the output stage. The basic requirements are a d.c. current gain, h_{FE}, equal to 60 or more at 0.5 ampere collector current and leakage current, I_{CBO} of less than 4 ma. with 15 volts between the collector and base at 50 degrees centigrade.

The *Honeywell* transistors specified in the parts list are readily available from the company's sales offices throughout the country. The types CA2D2 and CB1F4 are wide-tolerance variations of the 2N1263. For 12-volt operation with a 16-ohm loudspeaker the 2N1263 is to be preferred. The 2N1263 is a $6.15 transistor while the CA2D2 costs only $1.35 and the CB1F4 costs about $3.50. While some of the automobile types such as the *RCA* or *CBS* 2N301A could probably be used in this circuit, these have not been tried so specific recommendations cannot be made.

The only critical transistor is V_3. Practically any power transistor or 0.5 ampere silicon diode can be used for V_4. Use of the automobile-type transistors, suggested before, would require some modification of the circuit layout in order to accommodate the larger physical size of these units.

Connecting the Amplifier

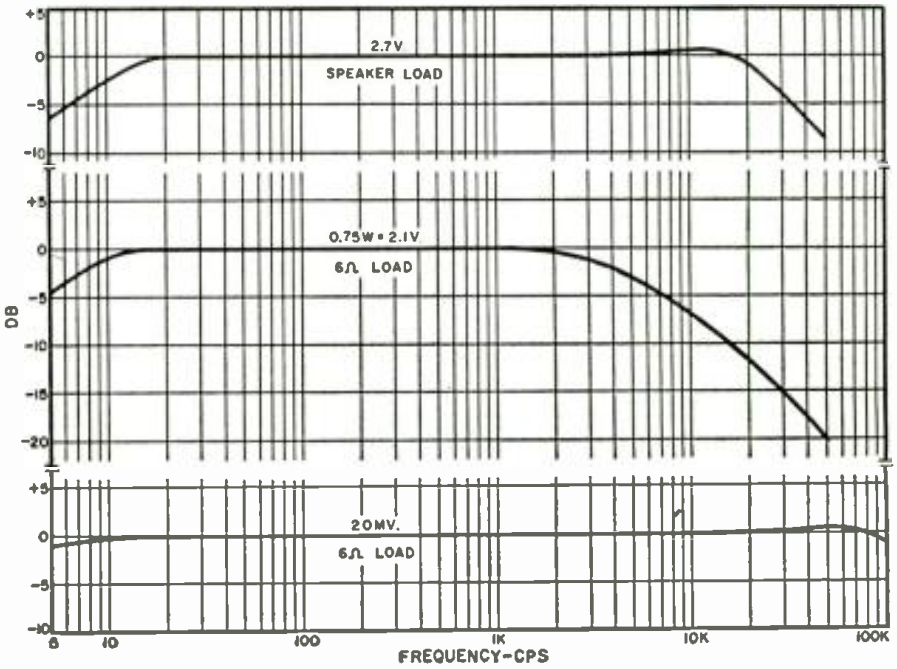
Before plugging in the transistors check all the circuits with an ohmmeter. Then plug in V_1 and V_2 and connect the output to a loudspeaker having at least 6 ohms d.c. resistance. Avoid the use of clip wires as even a momentary short circuit at the output may burn out a transistor, usually V_3.

For satisfactory performance the signal source should have less than 10,000 ohms internal impedance even though the input impedance of the amplifier is 500,000 ohms. The required input voltage for full output is 0.8 volt r.m.s. which may be obtained from a tuner or a preamplifier. A transistor tone-control preamplifier is ideal, but most of the vacuum-tube preamplifiers available have a feedback-type output stage which is suitable for this amplifier.

After applying power, check the d.c. voltage across the speaker. If this voltage is between 2.5 and 3.5 volts d.c., the amplifier can be assumed to be working properly. If the hum output is excessive, it is advisable to change V_2 and possibly V_1 because hum can be caused by a leaky transistor.

The listening quality of this amplifier within its power handling capability should be the same as that of fine vacuum-tube amplifiers, with the added "plus" of greater reliability. —30—

Fig. 6. Top curves shows maximum voltage vs frequency delivered to 2-way speaker system at 2 per-cent total harmonic distortion. Middle curve is with a 6-ohm resistance load. Lower curve is low level response with 6-ohm resistance load.



New Audio Test Report

ELECTRONICS WORLD **LAB TESTED**

NEW G-E VR-227 STEREO CARTRIDGE

ONE of the most uniform stereo cartridges, channel-for-channel, in frequency response and channel separation is *G-E*'s new VR-227. Such uniformity can only be obtained by meticulous production and extreme efforts in quality control.

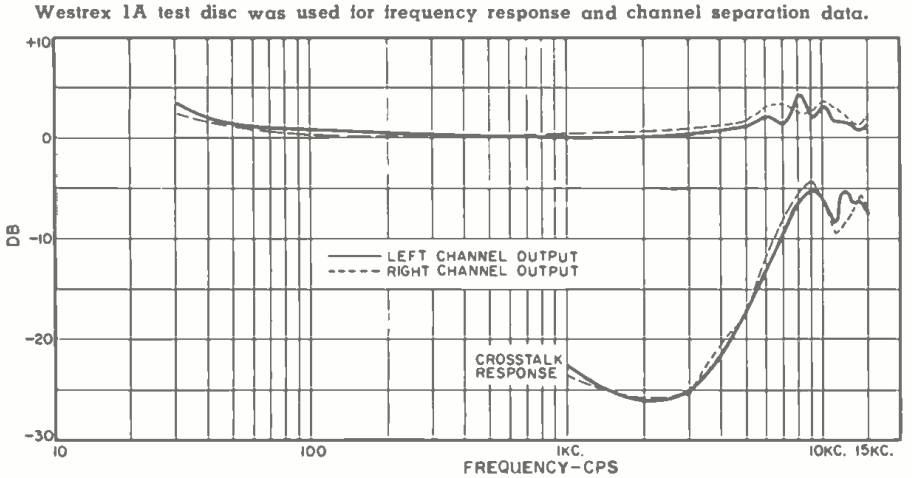
Although basically the same design as its previous model, the VR-227 incorporates many new features, such as: new stylus assembly for optimum compliance, new damping block assembly for better tracking, and new triple shielding to reduce hum pickup. These are the basic changes but we have been advised that there are others, although minor in nature. All in all, they do add up to *G-E*'s goal of producing a stereo cartridge that will attain recognition equal to that earned by the company in the monophonic magnetic cartridge field. Time alone will tell, but from what we have learned in checking two samples of the most recent design, the firm should be successful in reaching this goal.

There are two stereo cartridges in *G-E*'s new line—the VR-225 for professional-type tone arms and the VR-227, which we checked, for use in record players. Basically, the differences, according to the manufacturer, are as follows: The 225 has a .5-mil diamond stylus, 20 to 20,000 cps ± 3 db frequency response, 4×10^{-6} cm/dyne lateral compliance, 2.5×10^{-6} cm/dyne vertical compliance, and 2 to 4 gram tracking force. The 227 has a .7-mil diamond stylus, 20 to 17,000 cps ± 3 db frequency response, 3×10^{-6} cm/dyne lateral compliance, 2×10^{-6} cm/dyne vertical compliance, and 5 to 7 gram tracking force. Both cartridges are to be used with a 47,000-ohm load and have easily replaceable styli, like their well-known monophonic counterparts. The new designs are variable-reluctance magnetic type phono pickups.

Since the professional model was not available at the time of testing (it should be available by the time this gets into print), we had to be content to check the record-changer version. The results exceeded our expectations. As can be seen in the accompanying graph, the frequency response from 30 to 15,000 cps (limits of our test) was within 2.25 db of flat. The channel separation should be of particular interest to those who desire maximum possible separation between channels. This adds depth, or let us call it spaciousness, to stereo reproduction. There are differences of opinion on this point but we would prefer a channel separation of about 18 to 20 db right straight across the board from 1000 to 15,000 cps. This is impossible, at least at the present time, to obtain from any cartridge to date. The *G-E* cartridge provides about the best channel separation available of any that we have checked with the exception of the more expensive *ESL* cartridge in the frequency range from about 5000 to 9000 cps (reviewed last month).

The Model VR-227 with .7 mil stylus will retail at $24.95 while the Model VR-225 with its .5 mil stylus will cost $27.95.

Westrex 1A test disc was used for frequency response and channel separation data.



"Stop *playing* your pancakes and start *eating* them, or I'll take away that *Jensen Cartridge!*"

Listening tests did not show up any flaws such as distortion and tracking problems. In fact, we reduced needle pressure to 3 grams and found no difficulty in having the cartridge track loud passages. At this pressure the output voltage was 5.8 mv. at 5 cm/sec. recorded velocity. At greater pressures this output should be somewhat higher. The tonal quality is smooth without any noticeable coloration.

Let us not forget that we checked the non-professional unit. It is ideal for use with those record players that require greater stylus pressure for proper mechanical operation. We would not use it with the finest equipment in that the 6 gram pressure required is harder on stereo records than the lighter pressure would be. With this in mind, we will be looking forward to *G-E*'s professional model with its even better expected over-all performance.

NEW UNITED AUDIO Imported Record Player

WHEN it comes to record changers, we always felt that we had seen every possible combination of mechanical operation and that really not much new and exciting could be expected. We were foolish in this belief but then we never really gave too much thought to foreign producers who do, on occasion, come up with surprising ideas. On the other hand, it is rather difficult to beat the Germans and Swiss when it comes to precision workmanship and unique mechanical designs.

One of the best stereo record changers that we have seen to date will soon be imported from Germany and marketed in this country by *United Audio Products* as its Model DUAL-1006 Turntable/Changer. It is a dual unit in that it can be used as a record changer, intermixing any size record up to a total of ten (all the same speed), and then by replacing changer spindle with a shorter one, the machine operates as a single-play turntable.

As a changer all records are piled over the center spindle. During the change cycle all records of the stack, with the exception of the bottom one, are lifted by the spindle action, to thus divorce the weight and pressure of the stack from the bottom record. The latter is then released for descent to the turntable. Finally, the stack is then eased down to the original position, placing the next record in proper position for next play. In short, the stack is not held in position on the spindle, but rather it moves up and then down again, simulating an elevator action. This method does not chip the edges of records nor enlarge the center holes as may be done with other types of changers.

Proper needle drop for various size records is accomplished by one of the most novel methods we have seen. After a record drops, the arm moves towards the center of the record and drops on roller feeler guides which ex-

United Audio Products DUAL-1006 imported record player which will retail in this country for $69.95.

tend down from the head beyond the stylus tip. The arm then moves outward with the roller guides riding over the top of the record. When the feeler guide reaches the edge of the record, proper stylus position is obtained.

For manual operation one has two choices—either to use the push-buttons for conventional single-play operation or to simply use the separate manual switch, in which case the arm can be lifted and moved back and forth at will. Automatic shut-off will operate with either method.

The DUAL-1006 is a 4-speed (16⅔, 33⅓, 45, and 78 rpm) record player, including such features as direct gear drive; stereo-mono switch; built-in pressure gauge reading 2 to 10 grams; heavy duty motor; and self-muting circuit. Three push-button switches (repeat, stop, and start) simplify operation while cycling, and automatic shut-off is possible with an unusually low 2-gram stylus pressure.

There is one other feature that requires special mention as it is a key factor in a design that permits changer operation with as little as 2 grams stylus pressure. This is with regard to the tone arm—it is literally free-floating. A novel friction type clutch design disengages the tone arm mechanically during all playing positions and engages only during start and stop operations.

We played the changer off and on during a weekend and put it through as severe a test as is reasonably possible. We suggest that anyone who is interested in a record changer for stereo hi-fi operation make sure that the dealer demonstrates this one for you. We used a *Pickering* "Fluxvalve" cartridge and had no trouble with hum. The wow and flutter is as low as in some professional-type turntables.

As is particularly important with any mechanical device, continuous trouble-free operation is a salient factor. It is impossible for us to pass on any specific guarantees. Just two days of operation doesn't provide an answer to this question.

There are two suggestions we plan to pass on to the manufacturer. During any change cycle the turntable operates at 45 rpm. With certain 33-rpm records a portion of the first groove is playing before turntable speed drops down to 33 rpm. The other point to be mentioned is that the automatic shut-off failed on one out of three attempts. Both of these faults should be able to be corrected with slight adjustments. Since these record players have not as yet reached the market (at the time of this writing), the manufacturer will no doubt check these points carefully before delivery.

Manufacturer's Comments: *As you anticipated, simple adjustments control the*

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change cycle slow-down action and the sensitivity of the velocity trip which activates the automatic shut-off. The factory has been advised, and will advance these settings. —30—

CALENDAR of EVENTS

SEPTEMBER 17-18

Engineering Writing & Speech Symposium. Sponsored by the PGEWS of the IRE. Sheraton-Plaza Hotel, Boston & Ambassador Hotel, Los Angeles. Program information from Jos. M. Cryden, Litton Industries, 336 N. Foothill Road, Beverly Hills, Calif., or Alexander M. Cross, Raytheon Co., Wayland, Mass.

SEPTEMBER 18-19

IRE Section Meeting. Sponsored by the Cedar Rapids Section of the IRE. Sheraton-Montrose Hotel, Cedar Rapids, Iowa. David G. Berry, Collins Radio Co., Cedar Rapids, Iowa, chairman of program committee.

SEPTEMBER 21-25

14th Annual ISA Instrument-Automation Conference and Exhibit. Sponsored by Instrument Society of America. International Amphitheater, Chicago. Program information available from H. S. Kindler, % ISA, 313 Sixth Ave., Pittsburgh 22, Pa.

SEPTEMBER 22-24

Industrial Nuclear Technology Conference. Sponsored by Armour Research Foundation of IIT, "Nucleonics," and Atomic Energy Commission. Morrison Hotel, Chicago. Inquiries regarding program should be addressed to the Conference, % Armour Research Foundation, 10 W. 35th St., Chicago 16.

SEPTEMBER 23-25

Special Technical Conference on Non-Linear Magnetic and Magnetic Amplifiers. Sponsored by PGIE of the IRE, AIEE, and ISA. Shoreham Hotel, Washington, D. C. Program information from F. G. Timmel, Westinghouse Air Arm Div., Box 746, Baltimore, Md.

SEPTEMBER 25-26

Ninth Annual Broadcast Symposium. Sponsored by PGB of the IRE and AIEE. Willard Hotel, Washington, D. C. Program data from George E. Hagerty, % Westinghouse, 122 E. 42nd St., N.Y.C.

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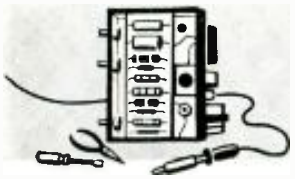

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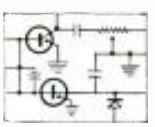

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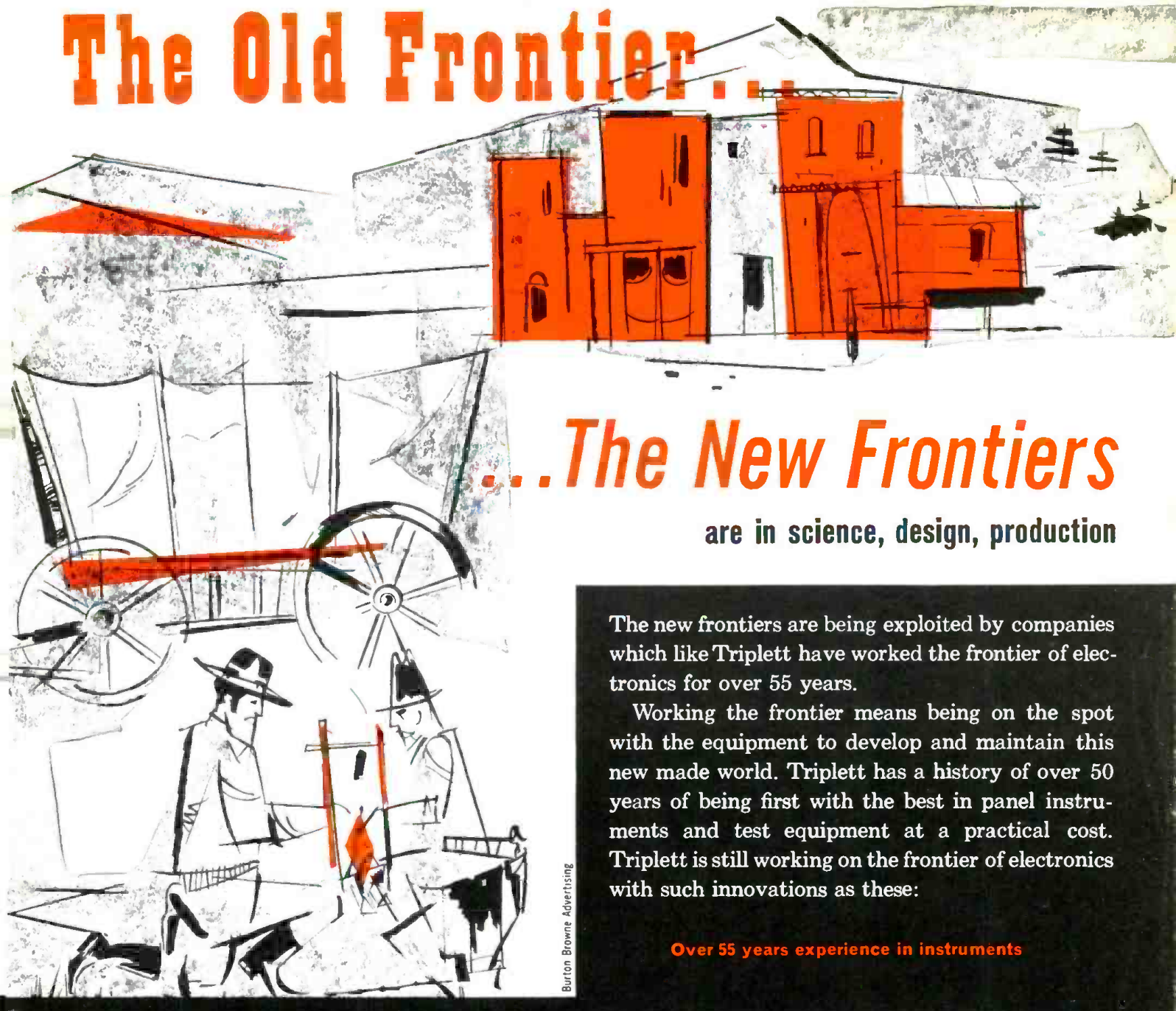


...The New Frontiers

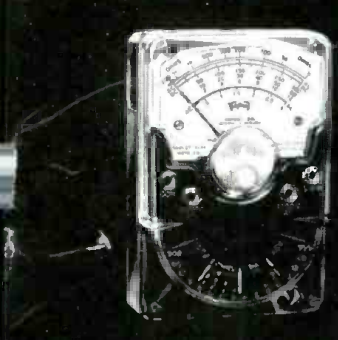
are in science, design, production

The new frontiers are being exploited by companies which like Triplett have worked the frontier of electronics for over 55 years.

Working the frontier means being on the spot with the equipment to develop and maintain this new made world. Triplett has a history of over 50 years of being first with the best in panel instruments and test equipment at a practical cost. Triplett is still working on the frontier of electronics with such innovations as these:

Over 55 years experience in instruments

Burton Browne Advertising



Model 310 a complete miniature V-O-M with single switch selection and the ranges and accuracy of units several times its size. Used with Model 10 clamp-on ammeter plugged in it becomes one of the world's most versatile pieces of test equipment—even measuring current flow without stripping wires.

Model 630-PL V-O-M with such advanced features as an unbreakable clear plastic front for wide range, shadowless, instant vision, polarity reversing switch, single king size knob for selecting both range and circuit, continuous resistance readings from 0.1 ohm to 100 megohms.

Model 690-A, a new Transistor Tester with more Triplett "plus" in accuracy and simplicity, for testing leakage and gain of all low and medium power PNP and NPN transistors. Small, rugged, battery-operated, it measures DC Beta from 5 to infinity. Affords exact tests for shorts, checks forward & reverse leakage of diodes. Features single switch selection of transistor types, positive "off" to prevent accidental battery drain, separate "calibrate" and "gain" buttons eliminate errors, transistor socket and external leads for any basing arrangement.

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THE ONLY ULTRA-COMPACT

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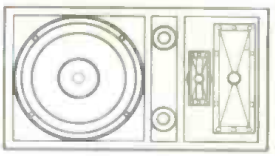
Electro-Voice

HIGH FIDELITY

REGAL



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Ideal as an economical "first" system, an "add-on" or in a pair for stereo

You need **not** be an acoustical engineer to understand why there is so much stereo value in this ultra-compact speaker system. The same *exclusive features* that have always made ELECTRO-VOICE systems best for monaural are an absolute necessity for true stereo . . . and you *get* these vital features in the REGAL III.

Acoustically-correct enclosure is matched to specially-designed 12-inch LF driver for *exceptional extension of bass response and unusual dynamic range* . . . without sacrificing efficiency and without the need for unusually-large amplifier power.

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E-V Diffraction, in both the Horn-Loaded Mid-Range Driver and the Super-Sonax Tweeter, gives you all-important

FUSION

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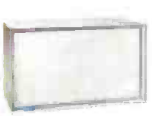

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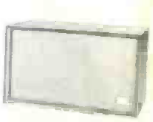

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