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POPULAR ELECTRONICS

MARCH 1961

35 CENTS

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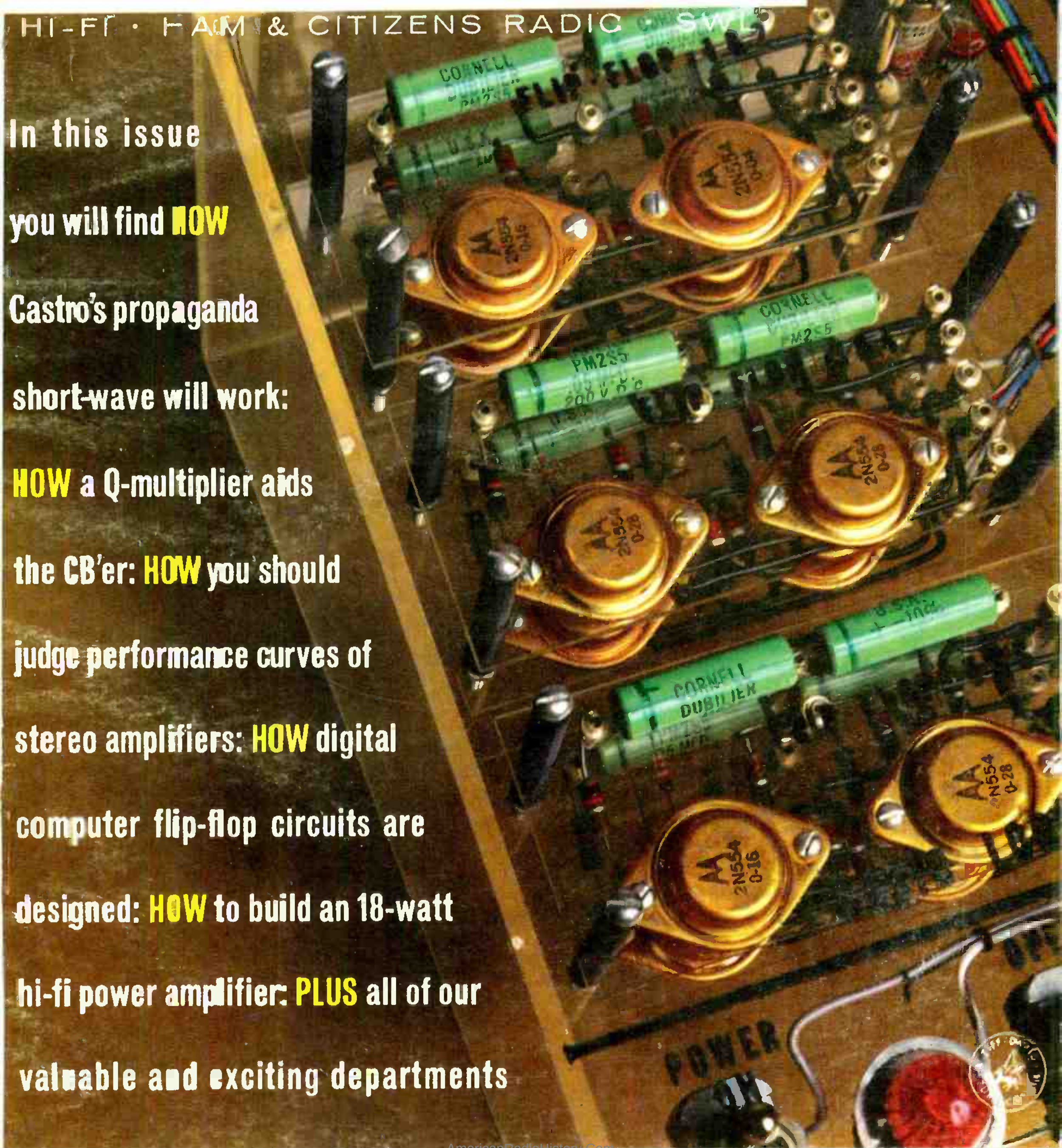

In this issue you will find **HOW** Castro's propaganda short-wave will work: **HOW** a Q-multiplier aids the CB'er: **HOW** you should judge performance curves of stereo amplifiers: **HOW** digital computer flip-flop circuits are designed: **HOW** to build an 18-watt hi-fi power amplifier: **PLUS** all of our valuable and exciting departments

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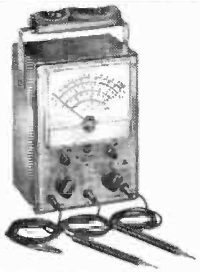

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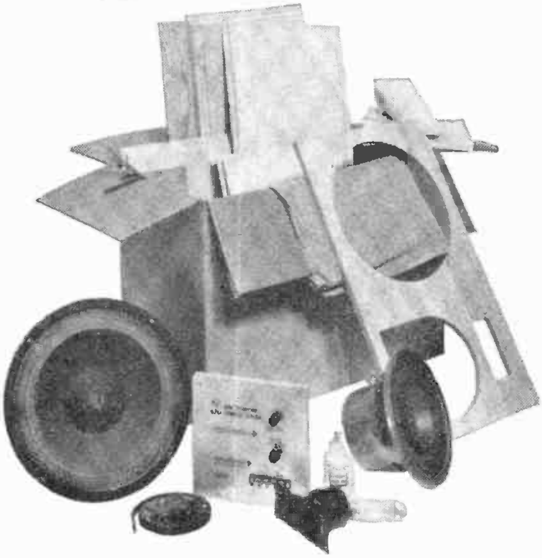

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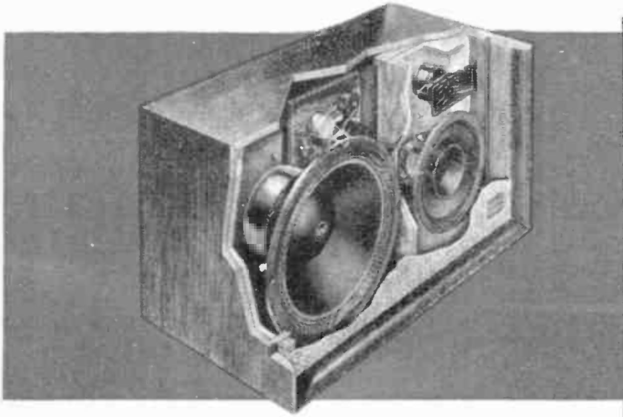

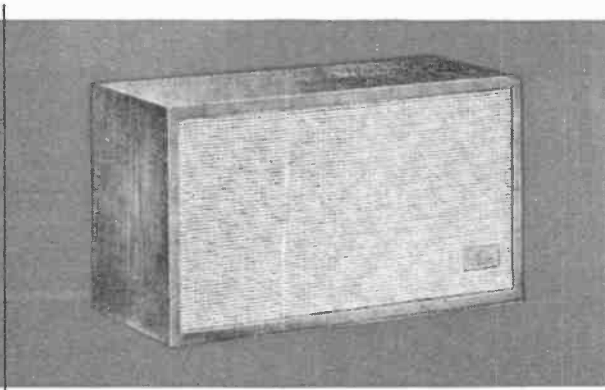

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MARCH 1961

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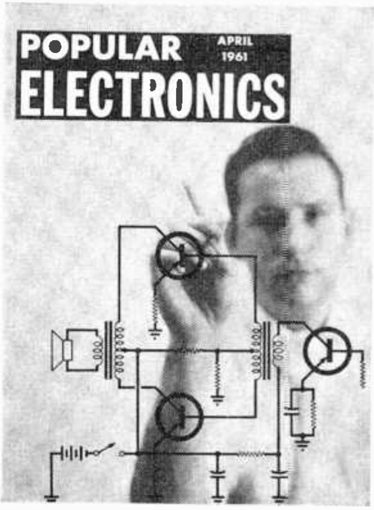

(ON SALE MARCH 28)

- **DIGITAL COUNTING**

  After reading this month's informative discussion on flip-flops (page 59), you'll want to see the concluding installment in the April issue. Learn how flip-flops can be teamed up to perform counting operations—the article will cover both theory and construction plans.

- **CUSTOM-MADE DIALS**

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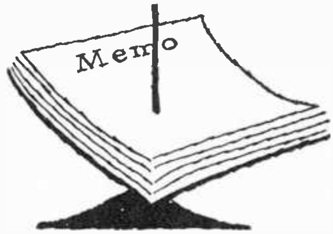


Notes from the Editor

THE SHORT-WAVE CRISIS. I have been reading a rather disconcerting report on the future of long-distance (DX) communications. In talking about the influence of sunspots on short-wave reception, the writer of this report correctly points out that many hams and short-wave listeners are unaware that the superb short-wave receiving conditions experienced throughout the last four years may soon be a thing of the past. In fact, he predicts that most of the short-wave broadcasting bands will be almost totally useless by early 1963!

The effect of sunspots on short-wave reception has been well established. As the number of sunspots increase, so does the maximum usable short-wave broadcasting frequency. During the peak sunspot activity in late 1958, there were instances of transcontinental reception at frequencies above 50 mc. Throughout this same period, reception was astonishingly good on all of the major short-wave broadcasting bands from 9 mc. to 26 mc. As the number of sunspots decline, however, we can expect to hear fewer and fewer broadcasts on the 15-, 17-, 21-, and 26-mc. bands from overseas stations--regardless of power. In addition, the number of hours the 9- and 11-mc. bands will be usable may be reduced by up to 50%.

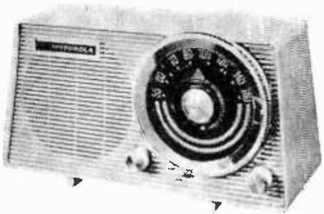
The rapidly approaching scramble for short-wave broadcasting frequencies below 12 mc. is not going unnoticed. Greater emphasis is being placed on v.h.f. scatter communications networks unaffected by sunspots. Extensive use of new underseas telephone cables is also visualized. POPULAR ELECTRONICS is in the midst of preparing a story on the "crisis in short-wave communications." But before that appears in print--a word to hams and SWL's. There is little doubt that the fall and winter of 1961-62 will be the last good seasons for DX above 15 mc.

REMEMBER YOUR FAVORITE AUTHOR. We would like to remind our readers of the "Double Rate Bonus" that is in effect for feature articles published in POPULAR ELECTRONICS from January through June of this year. Complete details were given in the December 1960 "Notes from the Editor." To review briefly, one bonus will be given for the best article on a hi-fi subject, a second one for a topnotch construction project, and a third will go to the writer of a major news feature in the field of electronics. The editors' decision as to the articles meriting consideration for the double rate will be based primarily upon reader reaction; so if you see a story that you particularly like, please let us know immediately. Since our feature articles normally pay between $150 and $300, the double rate will be good news for three deserving authors.

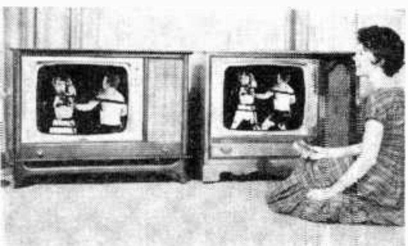
Oliver P. Ferrell

POP'tronics NEWS SCOPE

HOLLYWOOD LOST OUT when the Atomic Energy Commission signed up the Hughes mobile "Mobot Mark II." A "monster" on wheels, the Mark II is an improved version of its older brother. With three joints in each arm, it is strong enough to lift a lead brick, yet delicate enough to replace a light bulb. Two TV eyes mounted on snail-like tentacles focus on the work the hands are performing, keeping the operator—more than 100 "safe" feet away—informed of what is going on. Hughes engineers say this trainable "monster" can perform complicated jobs after only one lesson. Tapes, filed away for future use, act as its memory.



MOTOROLA BREAKS WITH TRADITION—the inexpensive conventional a.c.-d.c. table radio, tagged the "All-American 5" by servicemen, is giving ground to a jazzed-up job which sports a push-pull audio output stage and a tone-compensated loudness control. Motorola admits that its new sets aren't hi-fi in the "purest" sense of the word, but they claim that the improved circuitry reproduces virtually everything being broadcast by AM stations. Maybe this is the greatest thing to happen to radio since Kate Smith.

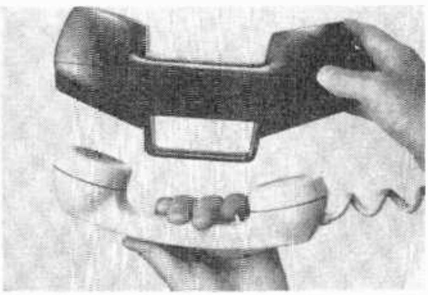


TV CLOSE-UPS or enlargements of the broadcast picture can be had by remote control in the 1961 Hoffman Electronics' home television receivers. Depressing the "Close-Up" button on the remote unit beams a high-frequency, transistor-powered signal to the TV receiver, instantly increasing the center of the image on the viewing screen by 25%. This close-up feature is ideal for watching sporting events such as boxing matches, horse races, bowling, and baseball games—spitball pitchers better be careful this coming season! In addition, the remote control lets the user select any TV channel, adjust volume to desired level, kill commercials with a mute button, and turn the set on or off.

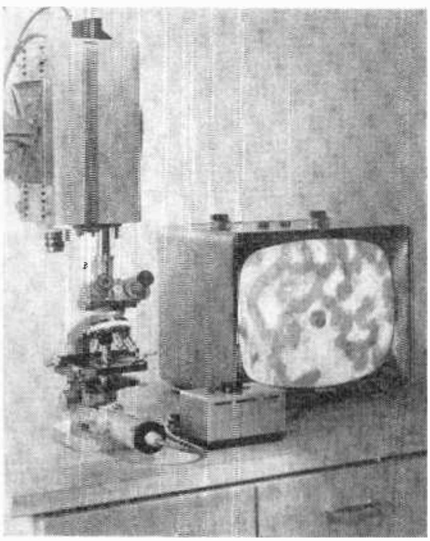
NEW SLANT ON SPACE—Resembling a tilted outdoor movie screen, the skyward side of this white-faced structure contains nearly 9000 tiny radar antennas. The result: this electronic Cyclops—known as ESAR—can "look" at a wide expanse of space without turning its "head" and thus track hundreds of space targets at one time. Built by Bendix for the U.S.A.F. Rome Air Development Center and the Advanced Research Projects Agency, ESAR (Electronically Steerable Array Radar) is already in operation at Towson, Md. Bendix engineers report that systems of this type may some day be used to communicate with space ships millions of miles from Earth.

TOMORROW'S U.S. Army riflemen will be able to spot the enemy better in the dark than World War II infantrymen—thanks to Raytheon's new lightweight "sniperscope" infrared gunsight. The target image on the new gunsight is twice as big, allowing more positive identification and making it easier to detect camouflage attempts. Also, the enemy can no longer detect the sniper—a remote infrared searchlight covers a large target area, and the sniper, using only the infrared detector on his "scope," simply hunts for suitable targets. When necessary, the rifleman can generate his own infrared beam at the flip of a switch.

THE FIRST SATELLITE REPEATER will soon be rocketed into orbit 22,000 miles "straight up." Travelling in the same direction as the Earth's spin, the satellite will appear fixed in the sky; and if all goes well with the shoot, it will be positioned over the mouth of the Amazon River. As a repeater, the satellite will burp back messages sent from Earth, receiving its power from 2700 solar cells and chargeable batteries. Its purpose: uninterrupted telephone and television communications between points in North and South America, and the western parts of Europe and Africa. The Hughes Aircraft people, who developed the cake-shaped satellite, foresee the day when satellite repeaters will permit all the world to view Jack Paar.



TELEPHONE "SCRAMBLERS"—electronic devices to prevent "high-level eavesdropping"—were first popularized early in World War II by the late President Roosevelt and by Prime Minister Churchill. Now, a portable security "scrambler" device developed by Delcon Corp., Palo Alto, Calif., permits secret telephone communication in business, industry, and law enforcement. The transistorized device is produced in matched pairs—only two alike—weighing only 27 ounces. Fitted against any standard telephone handset—without any wire connections, the first scrambler converts ordinary speech into incoherent gibberish, then transmits it over the telephone line to the second scrambler which translates the gibberish back into normal speech. This may be new to the electronics field, but women have been doing it for years.



SNOOPING ON MICROBES during classroom lectures is now possible with a closed-circuit TV-microscope system. Developed through the combined efforts of the Elgeet Optical Company (of Rochester, N. Y.), Allen B. DuMont Labs., and Sylvania, the TV microscope closes the gap between the maximum 2000X magnification capabilities of optical microscopes and the minimum 5000X magnification of electron microscopes. Accomplished by means of a special arrangement of objective lenses, the microscope's magnification potential is further increased by the 17-inch screen of the TV monitor. The TV microscope's comparatively low cost—under $1500 for a 300-line resolution system and under $2200 for 600-line resolution—places the new device within range of both schools and researchers.

FCC Report

By **ROBERT E. TALL**
Washington Correspondent

THE Class D Citizens Radio Service is destined to reach at least 300,000 licensees before its momentum starts to taper off (almost double the number of CB'ers as of December, 1959), and it will overtake and pass the Amateur Radio Service in number of licensees this year. These are the views of Ivan H. Loucks, who heads the FCC division responsible for the CB service.

The greatest utility of the CB service, the FCC official said, has been in introducing vehicular radio to the general population at bargain prices, and in serving as a steppingstone for more people to use radio communications of all kinds.

A flat "no" has been given to the Connelly Sales Co. of La Mirada, Calif., on its petition for CB rule changes to (1) increase the input power from 5 to 25 watts, and (2) require the use of the same frequency by two stations talking to each other. (See *FCC Report,* October, 1960.)

After the petition was publicized last year, the FCC received many letters from the CB fraternity, mostly concerned with the power question, and all but a few opposing any increase. Many of the CB'ers writing to the agency felt that complaints of too little communications range stemmed from the use of inefficient units and poorly designed antennas, and the FCC said it feels the same way.

According to the Commission, good engineering practice would require that an increase in power be accompanied by higher technical standards, such as those in effect for all other land mobile radio units operating with more than five watts; and this would increase the cost of the CB equipment and curb its appeal for many users. Also, the agency pointed out, the high-powered stations would not

These men are getting practical training in . . .

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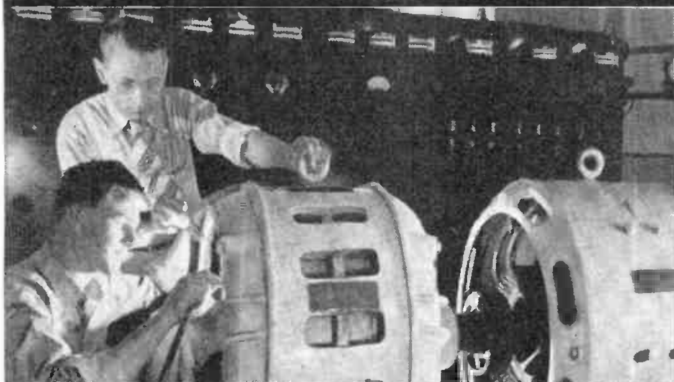

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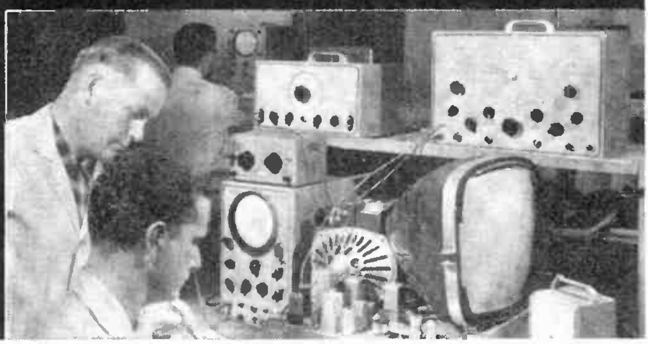
AM-FM and Auto Radios Transistors—Printed
Circuits—Test Equipment

(Right — Instructor helping students check the wiring and trace circuits of television receivers.)



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be compatible in the same area with existing five-watt equipment, and hundreds of thousands of existing CB units could be obsoleted.

On the question of requiring use of the same frequency by two stations talking to each other, the agency said that such a practice would be a good idea whenever possible; but if single-frequency communications were required, it would restrict the fullest use of the service. The Commission added, however, that if CB licensees abuse the privilege of cross-channel operation to further any type of hobby activities, it's going to reconsider its position.

Additional types of emission for the Citizens Radio Service were also requested by Connelly, and the West Coast outfit came off a little better on this one. The Commission said that either single or double sideband, with or without carrier, or with reduced carrier, "is included" in its current definition of permissible CB communications. Here again, however, a close watch over any such uses is going to be made, particularly in connection with power input; and if there are a large number of violations on this score, or if too much interference is being caused to conventional CB units, a cutback will be in order.

The application form changes for amateurs that we told you about last October have now been put into effect on an optional basis, and will become mandatory the beginning of July. After that time, you can't use the present Form 405-A (renewal without modification) or Form 602 (for a station at a military post).

Amateur Form 610—now employed for operator and/or station licenses and for clubs and additional station licenses—can be used after June 30 only for an operator license, a combined operator and station license, or a station license where the licensee already has an operator's license. And there's a new Form 610-A—which replaces the 602—to be used for an additional station, a club station, and a station "for recreation under military auspices," where more detailed information about the station is required.

Also, the time for filing renewal applications for amateur licenses has been changed from "within 120 days" of expiration of the old license to "within 60 days" of the expiration date. —30—

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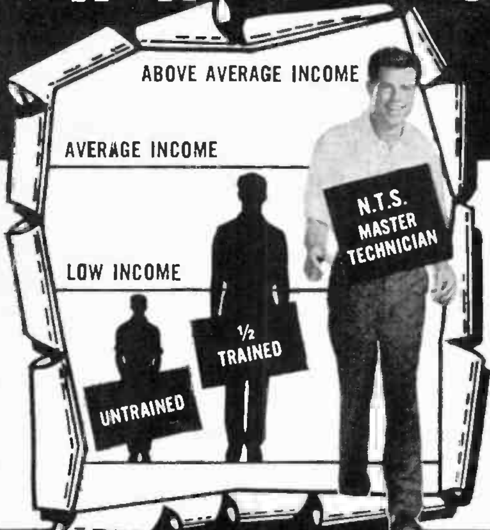

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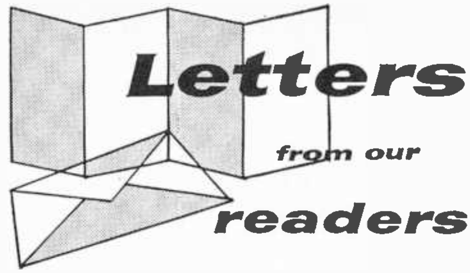


"Tiny Mite" P.A.

■ Glancing through some back copies of POPULAR ELECTRONICS, I came across the "Tiny Mite" amplifier in your June 1960 issue. I have been deliberating whether to construct this project, since I would like to connect the "Tiny Mite" to a public address system located some distance away. Could I get good results with this kind of a setup?

ALAN KOUDELKA
Long Island City, N.Y.

With the addition of suitable coupling components, the output from the "Tiny Mite" can be fed into any amplifier for greater gain or speaker listening. Since you state that the "Tiny Mite" would be located some distance from your amplifier, you would probably have to insert a cathode follower or other impedance-coupling device at the output of the "Tiny Mite."

One-Tube Tuner Recommended

■ I constructed several "one-tube wonders" similar to the FM tuner described in your August 1960 issue, and was completely dissatisfied every time. However, your model is an excellent performer and I should like to recommend it to others who want to listen to FM or who like to build experimental circuits. The parts values are not at all critical—I substituted almost every part and wound my own coils from junk-box odds and ends. The resultant tuner is adequate in every respect.

DUANE R. DUNGAN
Manhattan Beach, Calif.

"Sweet Sixteen"

■ I plan to build two of your "Sweet Sixteen" speaker systems (January 1961 issue), but I wonder if you can tell me how I can extend the range from 10,000 to 20,000 cycles?

R. G. KING
Costa Mesa, Calif.

A small (3" or 5") tweeter can be easily added to cover the range you mention—simply wire the

only for those who really need them...

CADRE

Only a short time ago, the FCC opened 22 channels for Citizens Band operation. Licensing was radically simplified. Where formerly two-way radio licenses were granted only to public safety agencies and certain other special groups, SUDDENLY, EVERYBODY COULD HAVE 2-WAY RADIO!

...providing, of course, he could afford the bulk and cost of the equipment that was then available.

Yet in spite of the bulk and the cost, nearly two million Citizens Band transceivers have been purchased to date! A tremendous demand has developed!

You can imagine what will happen now that compact, professional-quality instruments like the CADRE '500' and the CADRE '100' are available!

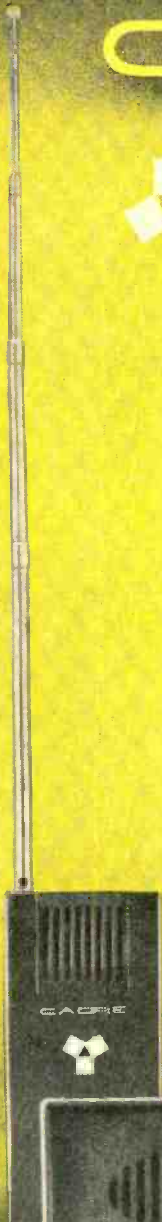
These CADRE units are built to the highest standards of the electronics industry, by a company that has been long established as a prime manufacturer of precision electronic research equipment and computer assemblies. CADRE transceivers are 100% transistorized—compact, lightweight ... engineered for unparalleled performance and reliability.

The CADRE 5-Watt Transceiver, at $199.95, for example, for offices, homes, cars, trucks, boats, aircraft, etc., measures a mere 11 x 5 x 3", weighs less than 6 pounds! Nevertheless, it offers 5 crystal-controlled transmit/receive channels (may be used on all 22), and a range of 10 miles on land, 20 over water!

The CADRE 100-MW Transceiver, $124.95, fits into a shirt pocket! Weighs 20 ounces, yet receives and transmits on any of the 22 channels ... efficiently, clearly ... without annoying noise. A perfect "pocket telephone"!

For the time being, it is unlikely that there will be enough CADRE transceivers to meet *all* the demand. Obviously, our dealers cannot restrict their sale to the fields of medicine, agriculture, transportation, municipal services, etc. However, since these CADRE units were engineered for professional and serious commercial applications—and cost more than ordinary CB transceivers—we believe that as "water finds its own level," CADRE transceivers will, for the most part, find their way into the hands of those who really need them.

Write for complete information and detailed specifications.



CADRE INDUSTRIES CORP., Endicott, N.Y.

Prices appearing in this advertisement are suggested retail prices.

Letters

(*Continued from page* 14)

tweeter in series with a 1- or 2-uf. paper or oil-filled capacitor and hook it across the two leads from the amplifier. If you don't have such a capacitor on hand, you can reach the required value by wiring a number of smaller units in parallel—the smaller the capacitance, the higher the frequency at which the speaker will become effective.

"Down With the FCC"

■ You have said that you believe the caliber of the Citizens Band operator will improve as the novelty wears off (*Letters from Our Readers*, Oct., 1960). I think you are mistaken.

The Citizens Band has been "squelched" by the FCC in its usually efficient manner. They called it a "Civilian Band," then made rules that buttoned it up to form a "Business Band."

It is my opinion that we need a little more democracy in this country—in other words, all

Commissioners should be re-elected every two years so that we can vote them out when we want to do so.

MYRON R. FOX
Brookville, Ohio

It is our opinion that what you want is a loosening of the rules to permit rag-chewing on the Citizens Band. This would turn a band that is useful for both business *and* personal *communications into a QRM-riddled mess. Why not consider amateur radio? There you can talk to your heart's content—if you can prove that you are technically competent to handle a transmitter.*

Carl and Jerry Fan

■ I enjoy your *Carl and Jerry* series very much and think it is a strong point of the magazine. But the author always tells us about the interesting things that Carl and Jerry build and never gives any construction details. There have been about a dozen projects that I wanted to build but didn't have enough information.

H. K. MONROE
Berea, Ohio

Carl and Jerry are fictional characters and, as such, are intended to entertain—not instruct. About the only "construction" we think you're likely to get out of a Carl and Jerry *episode is an idea for a project. From there on, it's up to you to dig into the available literature and come up with a project, much as they do. You'll have to work just that much harder, but you'll also experience the added satisfaction that comes from building "from the ground up."* —30—

FREE

Completion of the Master Course (both Sections) will prepare you for a First Class Commercial Radio Telephone License with a Radar Endorsement. Should you fail to pass the FCC examination for this license after successfully completing the Master Course, you will receive a full refund of all tuition payments. This guarantee is valid for the entire period of your enrollment agreement.

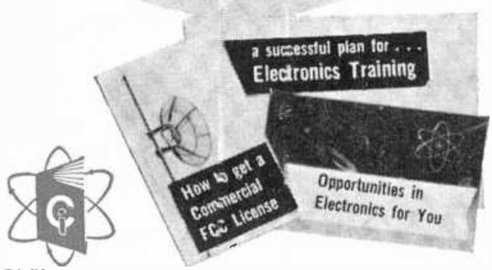
Your FCC Commercial License —or your money back

"License and $25 raise due to Cleveland Institute training"

"I sat for and passed the FCC exam for my second class license. This meant a promotion to Senior Radio Technician with the Wyoming Highway Department, a $25 a month raise and a District of my own for all maintenance on the State's two-way communication system. I wish to sincerely thank you and the school for the wonderful radio knowledge you have passed on to me. I highly recommend the school to all acquaintances who might possibly be interested in radio. I am truly convinced I could never have passed the FCC exam without your wonderful help and consideration for anyone wishing to help themselves."

CHARLES C. ROBERSON, Cheyenne, Wyoming

CIE HELPS TRAINEES GET BETTER JOBS



Cleveland Institute Announces

A New And Dynamic
Technician Training Program
in Computers, Servo Mechanisms,
Magnetic Amplifiers, and Others

Other advanced fields covered include Basic Math, A. C. Circuit Analysis, Pulse Circuitry, Color TV, Radar, Advanced Measuring Techniques, Industrial Electronics, Instrumentation, Automation, Radio Telemetry. Send for information today.

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Puts all the commonly used conversion factors, formulas, tables, and color codes at your fingertips. Yours absolutely free if you mail the coupon today. No further obligation!

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Please send Free Career Information Material prepared to help me get ahead in Electronics. I have had training or experience in Electronics as indicated below.

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- ☐ Radio-TV Servicing
- ☐ Manufacturing
- ☐ Telephone Company
- ☐ Amateur Radio
- ☐ Broadcasting
- ☐ Home Experimenting
- ☐ Other

In what kind of work are you now engaged?............
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In what branch of Electronics are you interested?.......
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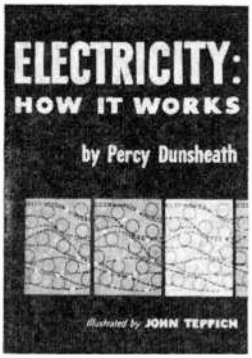
Address...
City...................... Zone.... State...........

PE-75

POP'tronics Bookshelf

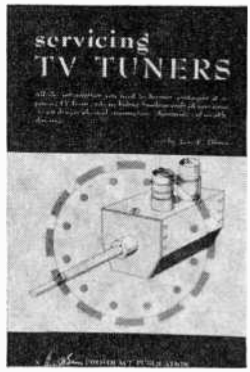
"ELECTRICITY: HOW IT WORKS," by Percy Dunsheath. Published by Thomas Y. Crowell Co., 432 Park Ave. S., New York 16, N. Y. 248 pages. Hard cover. $3.95.

This book takes you on a tour through the history of electricity, explaining new puzzles and mysteries as they appear. Sprinkled with descriptions of experiments illustrating many of the basic principles, the book also makes liberal use of figures and graphs. It concludes with a chapter on the free electron, thus bringing up the theory of electronics. Recommended for the beginner who wants to know more about this fascinating subject.



"SERVICING TV TUNERS," by Jess E. Dines. Published by Howard W. Sams & Co., Inc., 1720 East 38th St., Indianapolis 6, Ind. Soft cover. 272 pages. $4.95.

The compact structure and rather complex circuitry of TV tuners do not make for easy servicing. But the author believes that a serviceman should have little difficulty in handling any tuner trouble—if he has the full understanding of this important component that this book is intended to provide. One of a series on TV servicing by Mr. Dines, the book not only



Bookshelf

(*Continued from page* 18)

describes the mechanical and electrical characteristics of practically every type of TV tuner ever built, but also contains hundreds of schematic diagrams and photos which clarify the detailed circuit discussions. Recommended for anyone who needs a one-source reference volume on all phases of TV tuners.

New Literature

A colorful 64-page catalog, FR-61-G, on TV and radio chemicals, alignment tools, service aids, and hardware is available from GC Electronics Co., 400 S. Wyman St., Rockford, Ill.

The newest (36th) edition of the Harrison Electronic Material Buyer's Guide contains nearly 300 pages and lists a wide range of parts and equipment produced by some 165 different manufacturers. Write to Harrison Radio Corp., 225 Greenwich St., New York 7, N. Y., for your copy.

A complete line of crystals as well as a variety of printed-circuit subassemblies and other items are described in the 32-page 1961 catalog of the International Crystal Mfg. Co., 18 North Lee, Oklahoma City, Okla. New this year are all-transistor subassemblies which, when interwired, form a complete transistorized transceiver for CB or ham use.

Two educational handbooks for secondary-school science classes, "Laboratory Experiments with Radioisotopes for High School Science Demonstrations" and "Teaching with Radioisotopes," are highly recommended to the science teacher and to the "science-fair"-minded student. Copies can be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for 35 and 40 cents respectively.

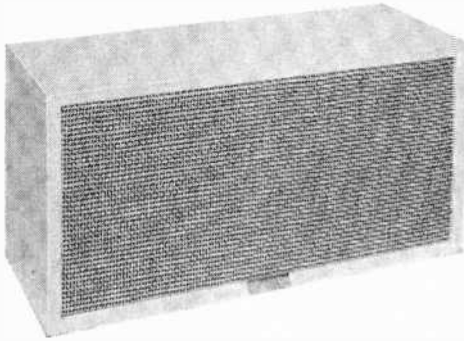
"Some Plain Talk About Fuel Cells" is a 12-page booklet that discusses recent work in fuel-cell experimentation and development. Write to General Electric Co., Schenectady 5, N. Y., for Booklet GED-4111. —30—

Hi-Fi Showcase

A WIDE RANGE of new hi-fi equipment—from complex and powerful stereo amplifiers to simple tape-head demagnetizers—continues to roll off production lines. Space prohibits us from covering every item, but some of the more noteworthy are discussed below. For additional information on any of the products mentioned, simply write to the appropriate manufacturers at the addresses given on page 24.

Quality is so high and price so low on *Heath*'s AA-10 monophonic hi-fi amplifier that the old "two for stereo" argument need hardly be presented. The AA-10 boasts a power response within ±1 db, 30 to 15,000 cycles, at 35 watts, yet sells for only $49.95 in ready-to-build kit form. Among the AA-10's many outstanding features: EL-34/6CA7 output tubes for low distortion and long life; Heath's special "bass-bal" circuit for perfect balance between output tubes; two a.c. accessory sockets for powering associated preamps, tuners, and the like. . . . For the more conventional stereo setup, *Allied Radio* offers two Knight stereo amplifiers, one in kit form and one factory-wired. Selling at $119.95, the kit incorporates a number of printed-circuit switches, boards, and resistor-capacitor assemblies, thus substantially reducing assembly time and minimizing any chance of error. This amplifier, 83YU934, delivers 35 watts per channel and incorporates several features that should appeal to tape fans. Among them: output recording jacks independent of volume and tone-control settings, a tape monitor switch permitting instant comparison between sound source and tape recording, separate and switchable equalization for 3¾" and 7½" tapes. The fully wired stereo amplifier carries a conservative rating of 37.5 watts per channel from tubes and components operating well below their maximum ratings. Priced at $169.50, the KN-775 includes provisions for headphones with a special front-panel jack that automatically silences speakers

A MIRACLE IN SOUND



THE A.E.S. *Gigolo*

After two years of research and development a speaker system we can unconditionally guarantee to be the finest bookshelf unit ever built for home use that you have heard, REGARDLESS OF PRICE, or your money back.

Thousands of these gigolos are now in use all over the country. The acceptance has been unbelievable. Never before a sound so realistic to so many people in so many different homes! These are the facts that enable A.E.S. to make this bold offer.

Product Research & Development Company

CONSUMER PRODUCT REPORT

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

REPORT SUBJECT: A. E. S. GIGOLO

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

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

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

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

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

PRD.

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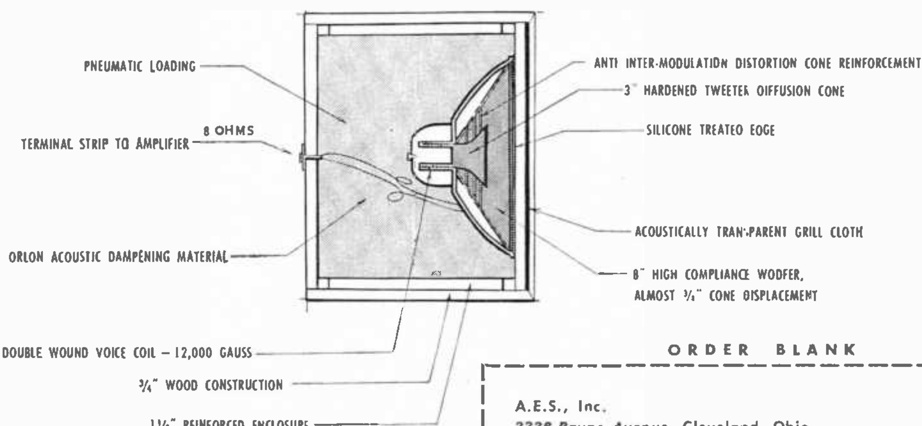

SIZE: 24" wide, 12" high, 9½" deep.
Response: 19-21,000 CPS

This unit will operate at maximum efficiency with amplifiers from 8 to 75 watts.

In limited quantity, and for a limited time only, $15.00 complete, plus shipping.

ORDER BLANK

A.E.S., Inc.
3338 Payne Avenue, Cleveland, Ohio

Gentlemen please ship..GIGOLOS.

I understand these units are guaranteed and if I am not satisfied I may return for a full refund of sales price, $15.00 each.

Name..

Address..

City and State..

Enclosed find check.......................money order.........................

Showcase

(*Continued from page 22*)

whenever headphones are plugged in.

If you're in the market for a "broadcast quality" four-speed transcription turntable and manual tone arm at a rock-bottom price, take a long look at ***Lafayette Radio***'s PK-449. A free-floating, shock-mounted induction motor drives a 3-lb, rim-weighted 12" aluminum turntable with wow and flutter held to a low, low 0.2%. A speed control permits a ±7% adjustment of each speed, and ball-bearing suspensions on the 12" tone arm result in extremely high vertical and lateral compliance. Price? Only $49.50.

Completely assembled and wired, ***Radio Shack***'s Realistic 40/A stereo amplifier/preamplifier provides the heart of a stereo setup at a budget price. Priced at $79.50, the 40/A delivers 20 watts per channel from any one of four different stereo inputs: magnetic phono, tuner, tape head, or auxiliary high level. . . . If you own a tape recorder, a tape-head demagnetizer is a "must." ***Robins Industries***' HD-3, listing at $5.95, is an American-made unit with a special plastic sleeve at the tip of the probe to prevent accidental scratches on tape heads. Although the HD-3 is a low-cost "little brother" to the company's HD-6, its specially shaped probe fits into just about any tape head, either mono or stereo, for ready demagnetization. . . . With a power output of 100 watts (monophonic), harmonic distortion of 0.5% and first-order intermodulation distortion of 0.1% (both at full power), ***H. H. Scott***'s new 100-watt stereo power amplifier approaches the last word in amplifiers. Output circuits on the 290 are meter-monitored, which means that output tube bias can be readily adjusted at any time to maintain perfect balance between channels. Functionally attractive, the 290 is designed for use with the company's 122, 130, or other high-quality stereo preamplifiers. Price: $240.00.

Heath Co., Benton Harbor, Mich.
Allied Radio Corp. (Knight), 100 N. Western Ave., Chicago 80, Ill.
Lafayette Radio Corp., 165-08 Liberty Ave., Jamaica 33, N. Y.
Radio Shack Corp., 730 Commonwealth Ave., Boston 17, Mass.
Robins Industries Corp., Flushing 54, N. Y.
H. H. Scott, Inc., Dept. P, 111 Powdermill Road, Maynard, Mass.

TD-124
Turntable $99.75 net.
(Base only $9.00)

A pleasure to buy... a continuing pleasure to own!

Thorens has thought of many ways to make *buying* a Thorens TD-124 a distinct pleasure. A Thorens franchised dealer is a man of broad knowledge and ability, can command your immediate respect, That's why there aren't too many of them. The service *after* you buy is just as important as the initial sale. You get an almost unheard of full one year guarantee. All this in addition to "music as it's meant to be heard." See your Thorens dealer tomorrow . . . you're in for a real treat.

No other turntable combines all these features. The Thorens TD-124 gives you . . .

- *4 speeds — plays any record you have or can buy.*
- *Easy-to-use illuminated strobe lets you set exact record speed for best musical reproduction while record is playing.*
- *Extra heavy table (11½ lbs.) for extra smooth running . . . includes light-weight aluminum cueing table.*
- *Built-in level with easy-to-get-at fingertip control.*
- *Easy arm installation or change.*
- *Motor operates on 50/60 cps, any voltage from 100 to 250.*

THORENS

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SPRING-POWERED SHAVERS · LIGHTERS

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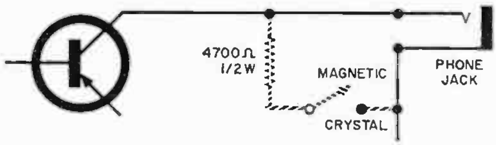
Guaranteed for one full year. Sold only through carefully selected franchised dealers.

Tips and Techniques

XTAL PHONES ON TRANSISTOR SETS

Simple transistor radios and amplifiers for earphone use can be hooked up to operate with crystal as well as magnetic phones. Simply add a 4700-ohm, ½-watt resistor and a s.p.s.t. switch across the phone jack as shown in the schematic,



and either type of phone can be selected by flipping the switch. Open the switch when using magnetic phones, and close the switch when using crystal phones. The purpose of the resistor is to pass d.c. to the collector of the transistor output stage when crystal phones are used. If crystal phones are accidentally plugged in with the switch in the magnetic phone position, no damage to the phones will result with most sets having low supply voltages.

—*Art Trauffer*

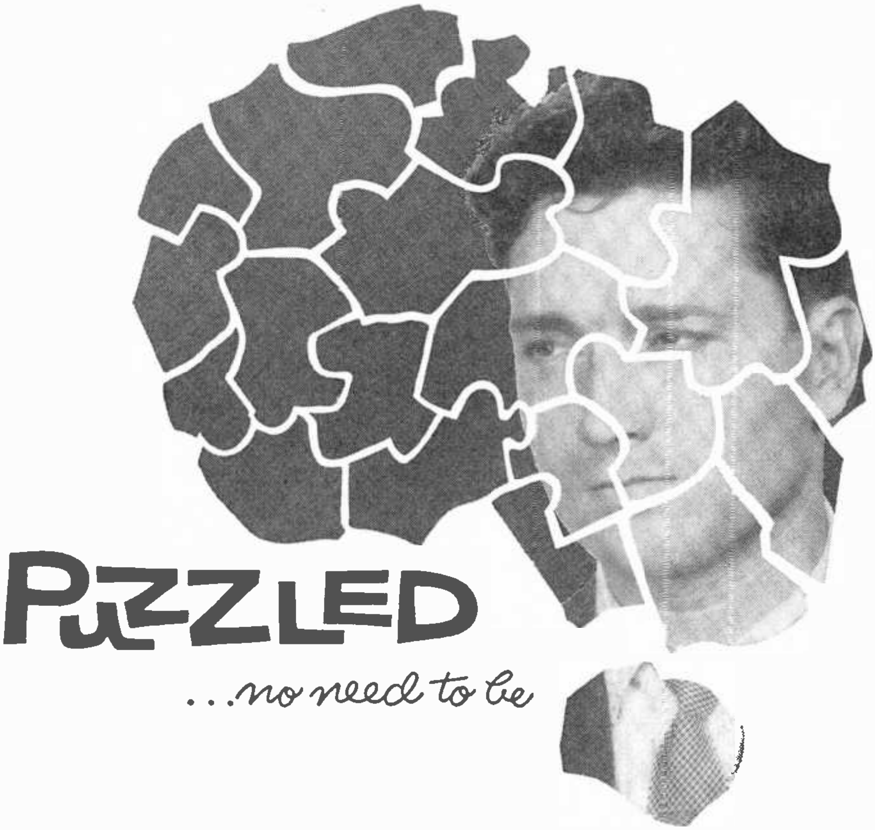
HANDY PARTS CONTAINERS

Empty fuse tins or pill boxes make fine containers for washers, nuts, lugs, and other small parts. Label each tin as to its contents—if you need a part in a hurry, you'll be able to find it quicker. Half a dozen of these tins will take up little space in your tool box and will keep the box ship-shape.

—*Clyde C. Cook*

REPLACING SOLDERING TIPS

Screw-type soldering iron tips that have become rusty can be easily removed for replacement. First, place a few drops of household ammonia around the threaded part of the tip after the iron is cool. Let the ammonia soak in a few moments and the tip will unscrew with little difficulty. Before installing the new tip, coat the



look to this sign of assurance!

The Distributor displaying this sign will solve your tuner problems at a profit to you.

He has available the New Standard Tuner Replacement Guide, including replacement parts listings. This is the only Guide of its kind in the world. Covers all Standard tuners produced through 1959. Includes replacements for many tuners not produced by Standard.

He handles our 48-hour Factory Guaranteed Repair Service and Trade-In Allowance on unrepairable Standard tuners.

See This Authorized Distributor Today

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INDUSTRIES INC. *Formerly Standard Coil Products Co., Inc.*
2085 N. HAWTHORNE AVENUE, MELROSE PARK, ILLINOIS

Tips

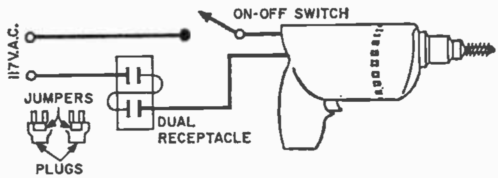
(*Continued from page 26*)

threaded parts with a small quantity of powdered graphite or lead pencil "dust." The carbon dust will prevent the tip from oxidizing, thus making for easy replacement the next time.

—*Edward Daniels*

POWER TOOL SAFETY INTERLOCK

You can prevent children from turning on your power tools with this simple safety interlock. Wire the interlock by connecting the power cord from the tool

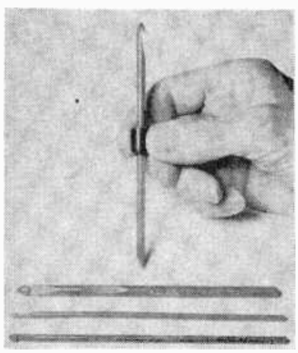


to a dual a.c. receptacle as shown in the schematic. To operate the interlock, make a couple of jumpers by connecting a wire across the terminals of two long-handled male plugs; when both plugs are inserted in the receptacle, the power tool is turned on. Hide the plugs when the tool is not in use for safety's sake. The on-off switch shown here can be left out of the circuit if your power tool already has a built-in switch.

—*Jamie Ellett*

CROCHETING NEEDLE "TOOL"

Plastic crocheting needles make convenient dial cord stringing aids and alignment tools.



Use the hooked end of a needle to manipulate dial cords in tight corners; file the other end to fit tuning slugs and screws on i.f. transformers. A small "knob" can be formed in the center of the "tool" by winding a few turns of plastic tape on it; the knob will provide more leverage when you're turn-

FREE!

LAFAYETTE'S 1961 CATALOG

324 GIANT SIZED PAGES

The Complete Catalog Featuring "The Best Buys In The Business"

- ☑ Stereophonic HI-FI Equipment
- ☑ Public Address Systems
- ☑ Tape Recorders
- ☑ Radio and TV Tubes and Parts
- ☑ Citizen Band Equipment
- ☑ Amateur Equipment
- ☑ Industrial Supplies

Send for Lafayette's FREE Catalog—the most complete, up-to-the-minute electronic supply catalog crammed full of everything in electronics at our customary down-to-earth money-saving prices.

CONTAINS HUNDREDS OF EXCLUSIVE LAFAYETTE ITEMS NOT AVAILABLE IN ANY OTHER CATALOG OR FROM ANY OTHER SOURCE — SEND FOR YOUR COPY NOW!

A "must" for the economy-minded hi-fi enthusiast, experimenter, hobbyist, engineer, technician, student, serviceman and dealer.

Our 40th Year

EASY PAY PLAN—the simplest, and quickest way to get what you want when you want it. As little as $2 down . . . up to 24 months to pay.

NEW!

29.95

2.00 Down

RK-125 Transistorized Portable Tape Recorder with Built-In Speaker

19.95

TE-15 Tube Checker

99.50

5.00 Down

HE-20 Deluxe Citizens Band Transceiver

13.50

RW-60 20,000 Ohms Per Volt Multitester

KT-200, Kit

HE-10, Wired

64.50

5.00 Down

79.95

5.00 Down

Communications Receiver

Two for

36.50

5.00 Down

49.95

2.00 Down

HE-29

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Tips

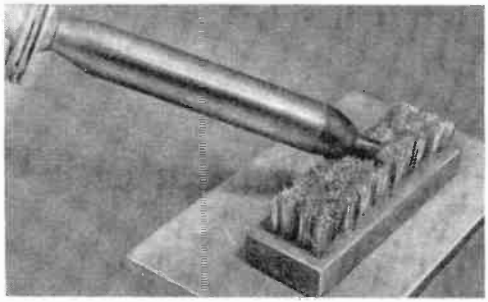
(*Continued from page* 28)

ing tight adjustment screws. Since crocheting needles come in several hook sizes and diameters, it's a good idea to buy a few different ones—they cost only a few cents each at variety stores.

—*Art Trauffer*

SOLDERING IRON CLEANER

A metal-bristled suede brush makes a handy soldering iron cleaner. Fasten the brush, bristles up, to your workbench or

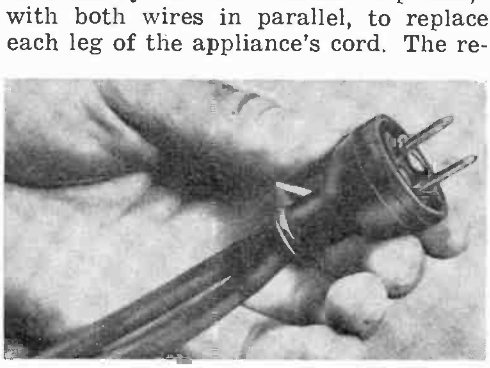


to a piece of plywood which can be screwed or nailed to an adjacent wall. To use the brush, simply wipe the iron's tip on the bristles; sludge and dirt will come off, and the tip will do a better soldering job.

—*Glen F. Stillwell*

HEAVY-DUTY POWER CORD

When the power cord on a high-drain appliance wears out, you can use a length of ordinary two-wire rubber "zip-cord," with both wires in parallel, to replace each leg of the appliance's cord. The re-



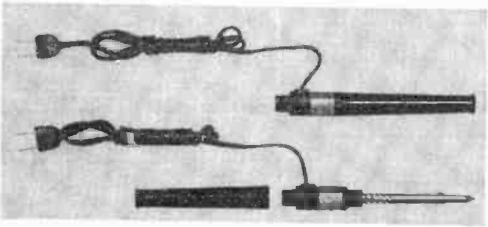
sulting doubled-up power cord will safely carry up to 1200 watts. However, be sure not to overload your power outlets.

—*Robert Micals*

NEW products

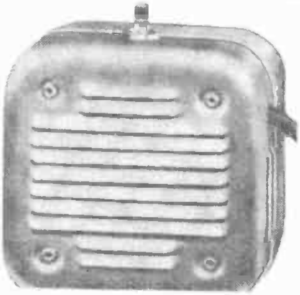
SOLDERING IRON

A new 30-watt soldering iron available from *L. I. Electro-Labs, Inc.*, subsidiary of Progressive "Edu-Kits" Inc. (1186



Broadway, Hewlett, N. Y.), has a removable handle that covers the tip when it's not in use. After a soldering job, you can switch the handle around and place the iron right in your tool box (or even your shirt pocket) without waiting for the tip to cool. The Model A1000 comes complete with carrying case for $2.75.

UNITIZED SPEAKER



The MISCO unitized speaker is designed for public address, test, or intercom use—indoors or out. A heavy steel case with a perforated and louvered front panel plus a plastic-impregnated speaker cone insures maximum reliability under adverse conditions. Installation is simple—the keyhole slot on the rear of the case will fit on a nail or hook on a wall. Available in 3.2-, 8-, and 44-ohm impedances, the speaker uses an Alnico V magnet and an aluminum voice coil. *(Minneapolis Speaker Co.,* 3806 Grand Ave., Minneapolis 9, Minn.) *(Continued on page* 36)

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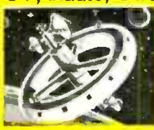

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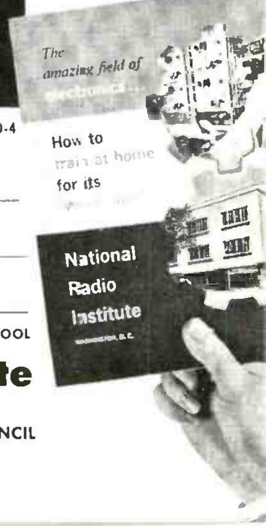

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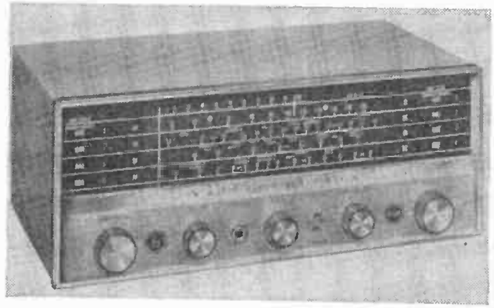
products

(*Continued from page* 32)

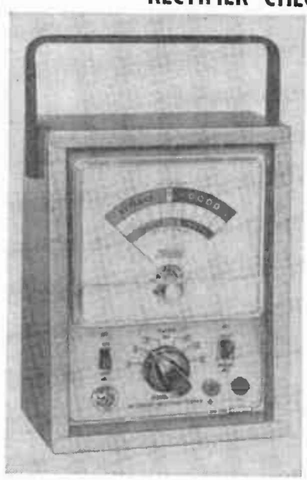
ALL-WAVE RECEIVER

A new Hallicrafters receiver covering the range from 550 kc. to 30 mc. offers compact, slim-line styling; an adjustable,



front-panel-controlled BFO; and provisions for up to three antennas. Essentially an improved version of the older S-38E, the S-120 comes with a built-in loopstick antenna for the standard broadcast band and a collapsible whip antenna for short-wave reception. Employing a sensitive, four-tube superhet circuit with a selenium rectifier, the S-120 also has its own built-in speaker. Price, $69.95. (*Hallicrafters,* 4401 W. Fifth Ave., Chicago 24, Ill.)

RECTIFIER CHECKER



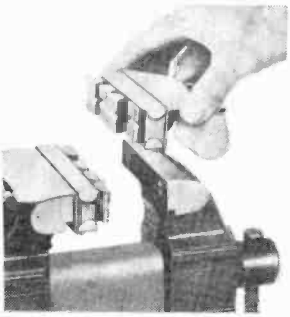
The Mercury Model 600 in-circuit tester will check any power rectifier, whether selenium, germanium, silicon, or copper oxide. You simply clip the instrument's leads across the rectifier (either in or out of the circuit), press the test switch, and get an instant indication of the rectifier's condition. Having a large (4½") meter equipped with easy-to-read, three-color scales, the 600 will check any rectifier for quality, shorts, fading, opens,

(*Continued from page* 36)

arcing, and life expectancy. Price: $27.50. (*Mercury Electronics Corp.*, 77 Searing Ave., Mineola, N. Y.)

AUXILIARY VISE JAWS

Machine vises can be converted instantly to universal vises by "hooking on" a set of adjustable jaws available from *Mid-American Import Co., Inc.*, 1919 Champa St., Denver 2, Colo. Steel fingers in each jaw adjust to hold any shaped object firmly. The "Uni-Grips," as they are called, will hold a steel ball, a triangular wedge, pipe, or just about anything else you can think of.

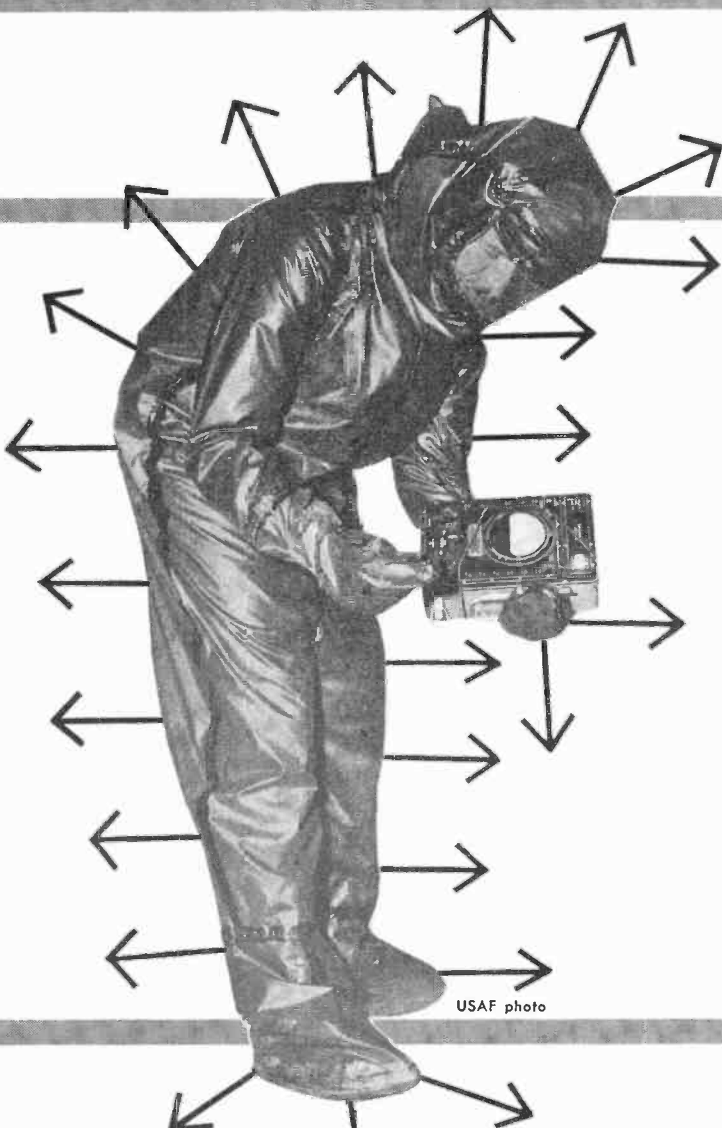


HAM TRANSMITTER KIT

A successor to the Heathkit DX-40, the new DX-60 amateur transmitter kit makes an excellent rig for the Novice as

well as the General Class amateur. Power input is 90 watts peak, carrier-controlled phone or c.w., on amateur bands from 80 through 10 meters, but the unit can be run at reduced power for Novice operation. Other features include a built-in low-pass filter for harmonic suppression, a neutralized final for high stability, and grid-block keying. Price: $82.95. (*Heath Co.*, Benton Harbor, Mich.) -30-

WHAT IS THIS MAN WEARING?



USAF photo

This four-layer suit consists of a neoprene-coated nylon coverall with attached mittens, boots, and headpiece to prevent arcing; two inner layers of silverized cloth to reflect radiation; and a cotton liner to protect the silverized cloth. It is designed to be worn by radar technicians at BMEWS radar stations.

He is wearing a newly designed

radar-resistant suit

To see why–turn the page

The Truth About
THE DANGER OF RADAR WAVES

EXCLUSIVE REPORT

By

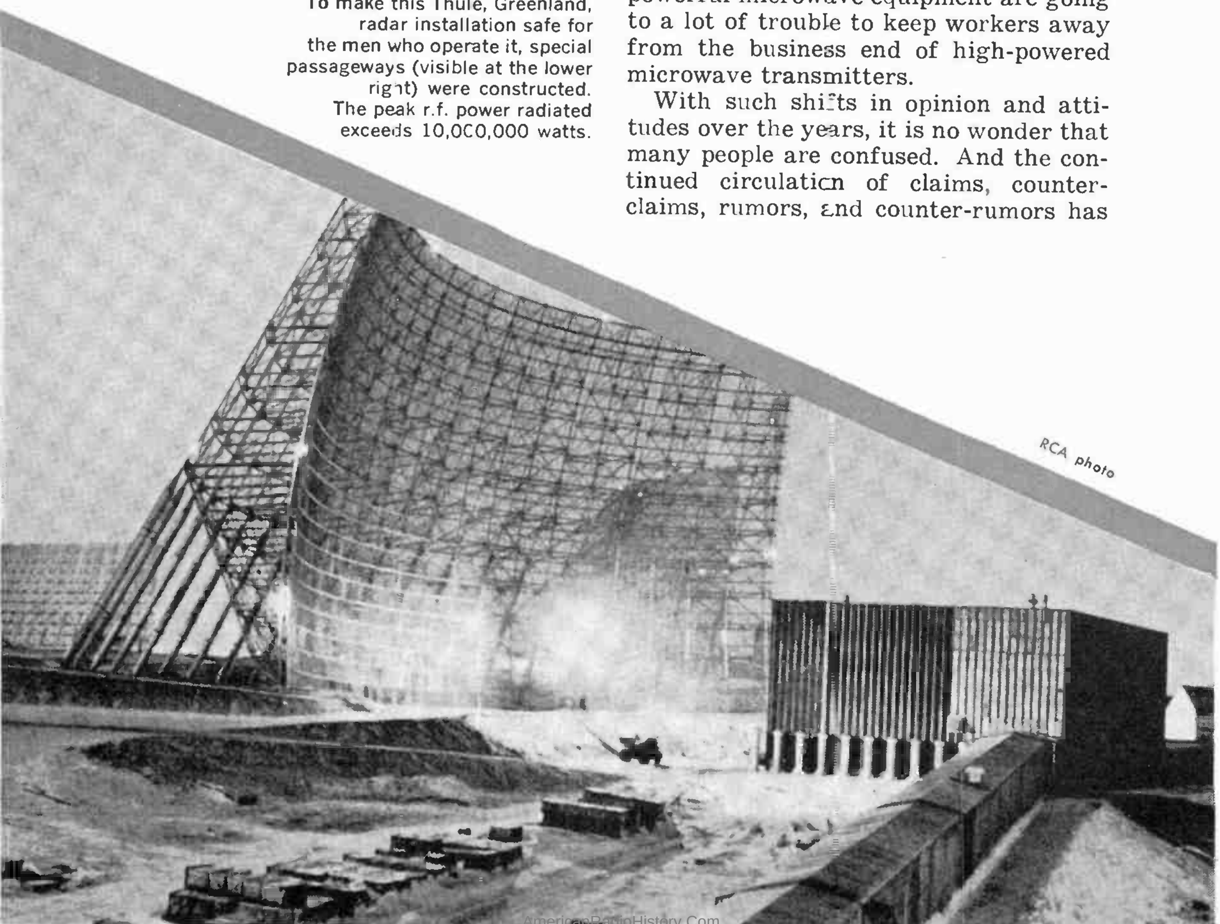
KEN GILMORE

SHORTLY AFTER radar was introduced during World War II, rumors about its dangerous side effects swept through the armed services. Men working around radar, the story went, would never have children.

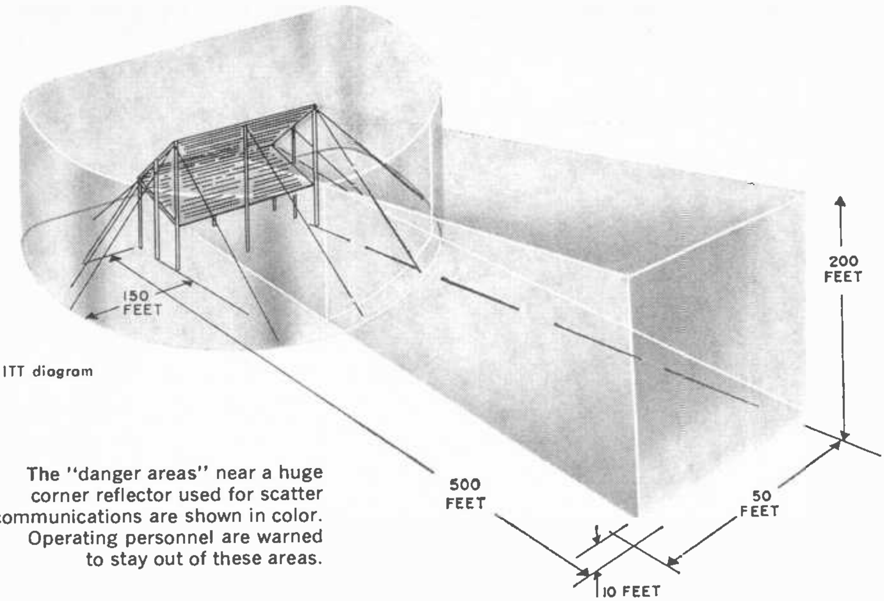
The rumors were officially denied and discredited, and eventually the furor died down. Everyone became so complacent, in fact, that until a few years ago it was common practice for men working around radar in cold climates to stand directly in the beam to warm themselves.

Recently we've been hearing again that radar waves are dangerous. The armed services and industries which manufacture, test, or operate radar and other powerful microwave equipment are going to a lot of trouble to keep workers away from the business end of high-powered microwave transmitters.

With such shifts in opinion and attitudes over the years, it is no wonder that many people are confused. And the continued circulation of claims, counter-claims, rumors, and counter-rumors has



To make this Thule, Greenland, radar installation safe for the men who operate it, special passageways (visible at the lower right) were constructed. The peak r.f. power radiated exceeds 10,000,000 watts.



ITT diagram

The "danger areas" near a huge corner reflector used for scatter communications are shown in color. Operating personnel are warned to stay out of these areas.

not helped. Less than two years ago, for example, a popular national news magazine reported that a radar technician had been killed by radar. True or false? To this day, not even the experts agree.

When it was anounced that a powerful radar station would be installed in northern England as part of our *Ballistic Missile Early Warning System,* a storm of protest broke loose. British newspapers, citizens groups, and individuals claimed that the mammoth transmitter would do everything from killing people in the area to frying bees and thus ruining agriculture by preventing pollination of crops.

Adding to the general misunderstanding, *microwave* radiation has become widely confused in the public mind with *ionizing* radiation. The fact is, the two are completely unrelated. Microwave radiation—the kind we are talking about—is energy generated by radar and other electronic equipment operating roughly between 200 and 30,000 megacycles. Ionizing radiation, on the other hand, is produced by radioactive materials and X-ray machines—it is the radiation we think of in connection with atom bombs, fallout, and the Van Allen radiation belt.

But what of microwave radiation? Is *it* dangerous, too? Should experimenters, hams, and others working with high-frequency electronic equipment be very careful?

Although much remains to be learned, intensive research over the past few years has pretty well answered these questions. Summarized briefly, here is what we now know about microwave radiation and the way it can affect us:

- Microwave radiation definitely can affect human tissue and cause damage.
- Only high-powered equipment, usually found either in military or industrial service, generates radiation sufficiently intense to be harmful to anyone.
- Even this high-powered equipment, if its hazards are understood and proper precautions taken, can be used in complete safety and confidence.
- And, most surprising, recent research indicates that microwaves, under certain conditions, can have beneficial effects that may some day be used in the treatment of disease.

Heat Causes the Trouble. Microwaves can cause damage by generating heat in human tissue. Diathermy machines used by doctors apply this heat-generation principle in a controlled way. It also accounts for the fact that technicians can stand in radar beams and get warm. But this is a mighty dangerous way to chase a chill. Recent experiments show why.

Not long ago, scientists at the National Institute of Neurological Diseases put monkeys directly in the output beam of a 200-watt u.h.f. transmitter operating at various frequencies between 225 and 400 mc. In each case the animals were dead within five minutes. The diagnosis: death by "hyperthermia"—excessive internal temperature. In further experiments, rats, mice, and other animals have proved that microwaves can kill.

Man, of course, can take more. His heat-regulating system is far more effective than those of the lower animals. So he can absorb far more microwave radiation and get rid of the heat. But there is a limit.

Have microwaves actually killed anyone? Scientists do not agree.

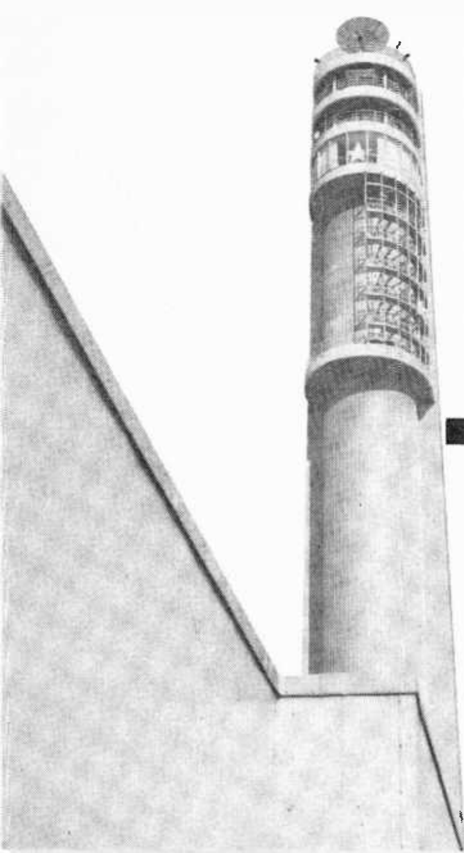
About four years ago, a 42-year-old radar technician in Glendale, California, was working about ten feet in front of a radar antenna. He felt a sensation of warmth in his abdomen, and moved quickly away. Nevertheless, he was taken ill a few minutes later. Doctors rushed him to a hospital and found he had a ruptured appendix. He was operated on, but shortly afterwards went into shock and died a few days later. The doctor in charge diagnosed the case as death from exposure to microwave radiation.

But many questions remained. One frankly skeptical Air Force doctor, also an expert in the field of microwave radiation, asked: "Why have thousands of men worked with the same or more powerful radars without even minor injury or discomfort, let alone fatal consequences?"

Many authorities feel that the man died from the results of his ruptured appendix, the operation, shock, or a combination of the three. The case remains unsettled.

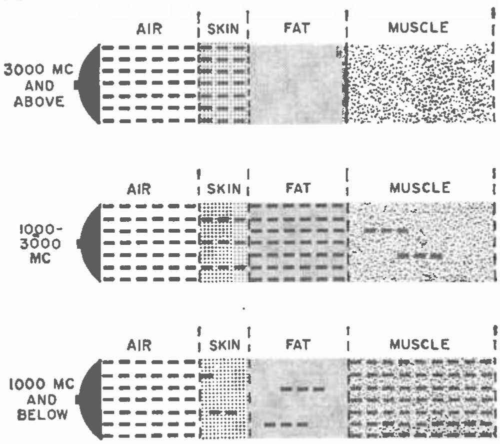
Microwaves and the Eyes. Although the danger is clearly present, cases of actual injury from radiation are hard to find. One doctor in Albuquerque, New Mexico, reported that a patient of his developed cataracts from exposure to microwave energy. The technician was in the habit of shoving his hand into a microwave horn to see if the transmitter was operating. If his hand got warm, the power was on.

In making this check, he had to look into the horn, and thus also put his eyes directly in the beam. One day, after spending a longer than normal time at work, he found that he could not see



This ITT tower in Nutley, N. J., is used for microwave experiments. To prevent the possibility of dangerous radiation, a trapdoor interlock shuts down the transmitters whenever a technician goes on the roof to service the antennas.

A dosimeter developed by Dr. A. W. Richardson of Saint Louis University is used to measure r.f. radiation. Worn by a maintenance technician, it sounds an audible tone when r.f. intensity becomes dangerous.



Frequency determines whether r.f. will be absorbed or reflected by outer layers of skin. As shown here, r.f. from about 200 to 1000 mc. is most dangerous—it penetrates the muscles and internal organs.

clearly. His doctor diagnosed the difficulty as several small cataracts resulting from r.f. radiation.

Can r.f. really cause cataracts? Tests with animals show conclusively that it can. Rabbits, whose eyes are very much like human eyes, have developed cataracts after exposure to intense radiation.

Tests have shown, as a matter of fact, that the eyes are the body's most radiation-sensitive organs, since they have the poorest heat dissipation system in the body. Elsewhere, blood circulation and perspiration can quickly get rid of excess heat. But our eyes tend to retain it and get hotter and hotter until damage is done.

Other Strange Effects. Next to the eyes, the most radiation-sensitive organs are the testes. Excessive exposure to microwave radiation, can, as the old rumors had it, make a man sterile. But the situation is not as bad as it seems: the effect is only temporary. Sperm cells are extremely sensitive to heat. Thus, those already manufactured by the body may be killed by a temperature rise of only a few degrees. But radiation *does not* interfere with the body's ability to make more sperm cells. One researcher in the field estimates that a dose of radiation strong enough to permanently sterilize a man would also probably kill him.

All radiation damage to experimental animals so far noted is attributable to the effects of heating. But scientists have recently noted other strange effects that seem to have nothing to do with heat. Researchers at the University of Miami, for example, exposed chickens to a radar beam too weak to kill them. At certain frequencies the chickens began to stagger, lose control of their muscles, and sometimes collapse. When the beam was

(Continued on page 106)

DIRECT-COUPLED

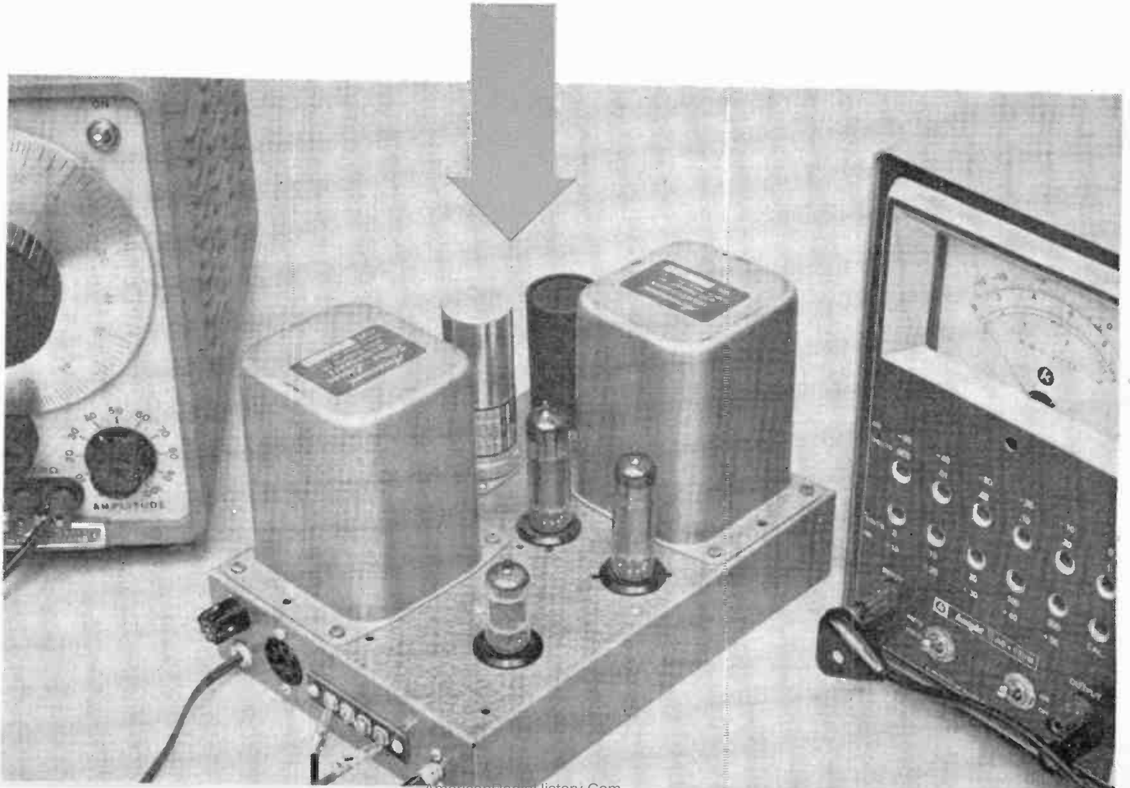
Complete construction details for a superior-quality 18-watt power amplifier with excellent frequency response and low transient distortion

By HERBERT I. KEROES

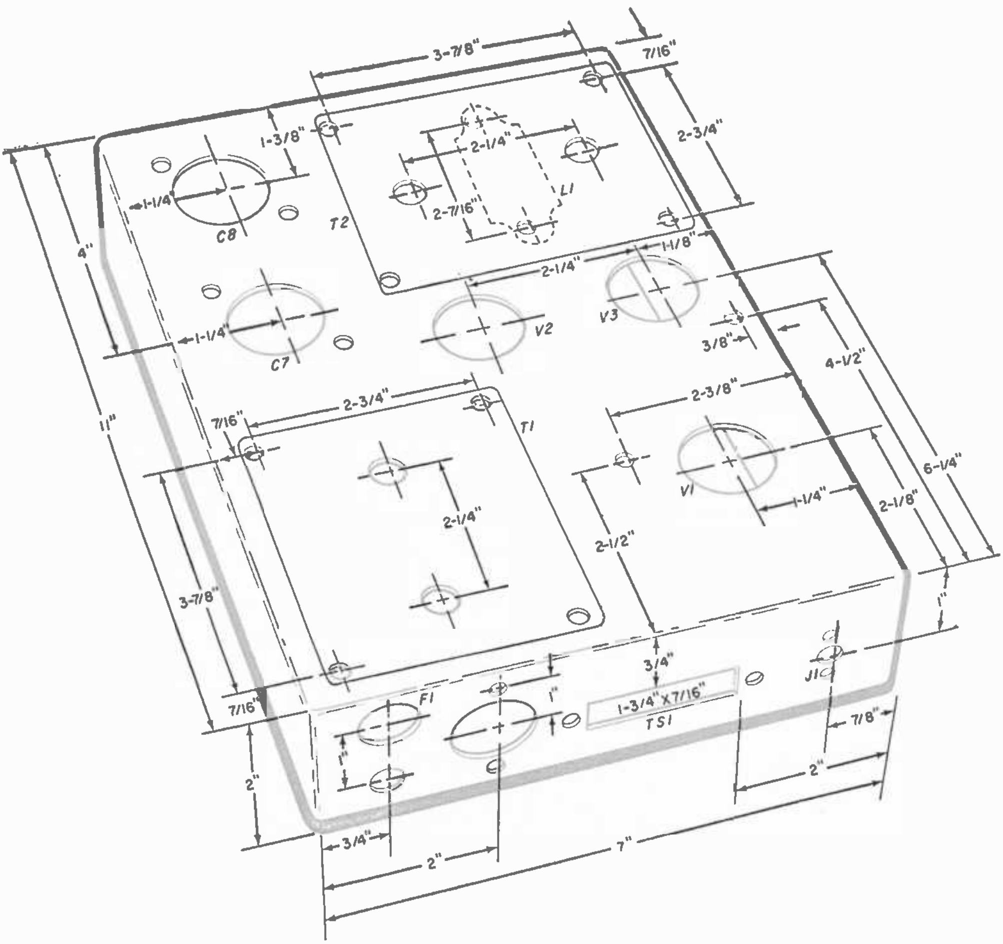
YEARS AGO, before the hi-fi era, an audio power amplifier was built that sounded better than any other then in existence. This unit was called the Loftin-White amplifier, after its designers, and had many ingenious features. It used direct coupling and a method of bias stabilization that was probably the first application of inverse feedback in an audio amplifier. Overall, it had distinctly better sound—noticeably reduced distortion and better bass response.

The modern theory of feedback amplifiers provides a ready explanation for the improvement brought about by the Loftin-White circuit. Direct coupling reduced the low-frequency attenuation and phase shift, and improved the stability of the amplifier so far as low-frequency transients were concerned. Today we know that an amplifier lacking low-frequency stability sounds weak and puny compared to one that is more stable but less powerful.

Here is a modern version of the Loftin-White amplifier that is free from distortion, is exceptionally stable, and has excellent frequency response. (See power



HI-FI AMPLIFIER

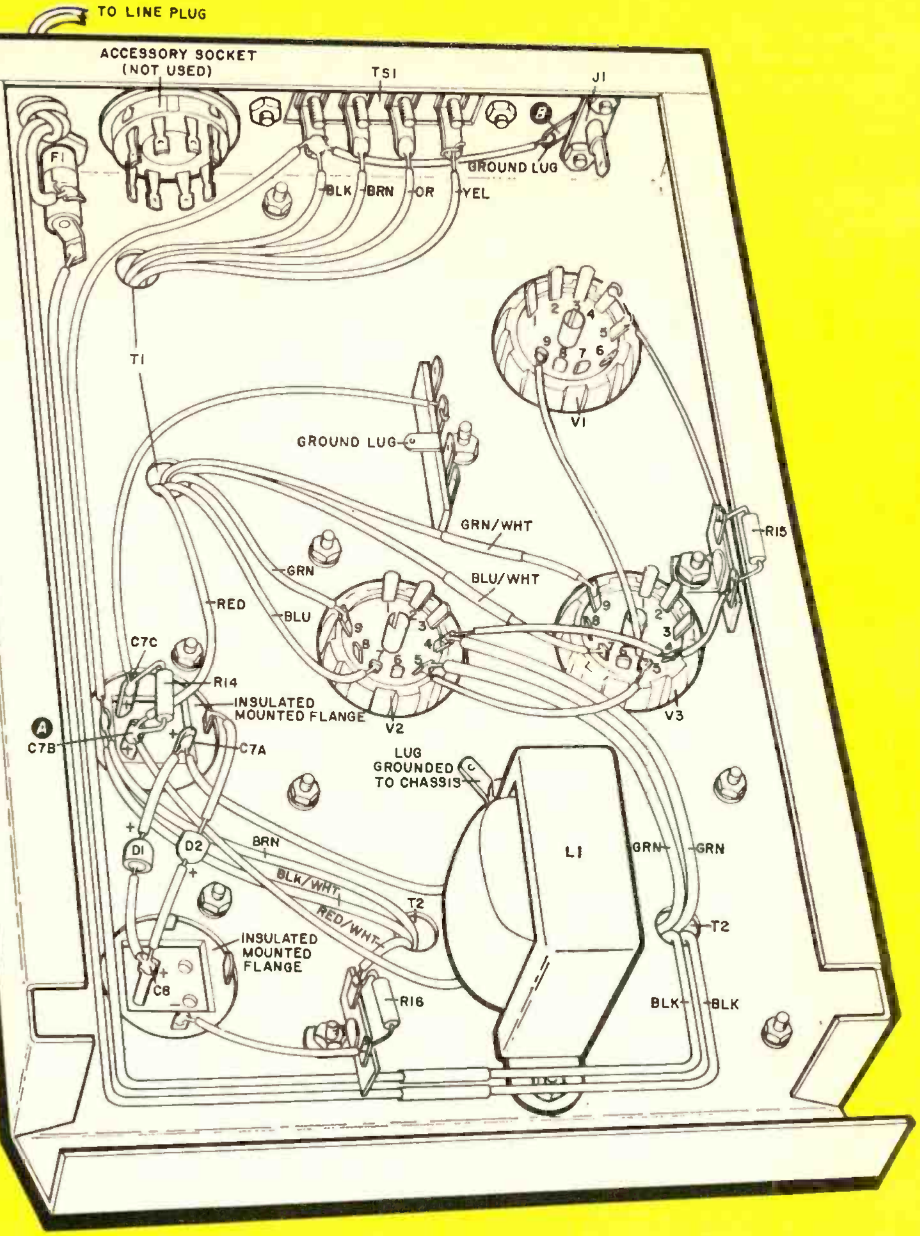


Drill and punch the amplifier's chassis before mounting any components. Filter choke L1 (dashed line) mounts under chassis below transformer T2.

output and frequency response curves on page 50.) With a push-pull ultralinear output stage and a voltage feedback of 20 db, the resulting amplifier is nominally rated at 18 watts but will actually outperform many amplifiers of considerably higher power.

Printed Circuit Optional. Building the amplifier is exceedingly simple if you follow the pictorial and schematic diagrams. If desired, you can purchase a pre-wired and pre-tested printed-circuit board which contains all of the circuit wiring and components with the exception of the power supply, tubes, and output transformer. The circuit board, the Acrosound Model 20, can be ordered through Allied Radio, 100 N. Western Ave., Chicago 80, Ill.; Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y.; or Radio Shack Corp., 730 Commonwealth Ave., Boston 17, Mass.

Both the audio output and power transformer used in the amplifier can also be obtained from the above-mentioned suppliers. When ordering ask for the Acro-

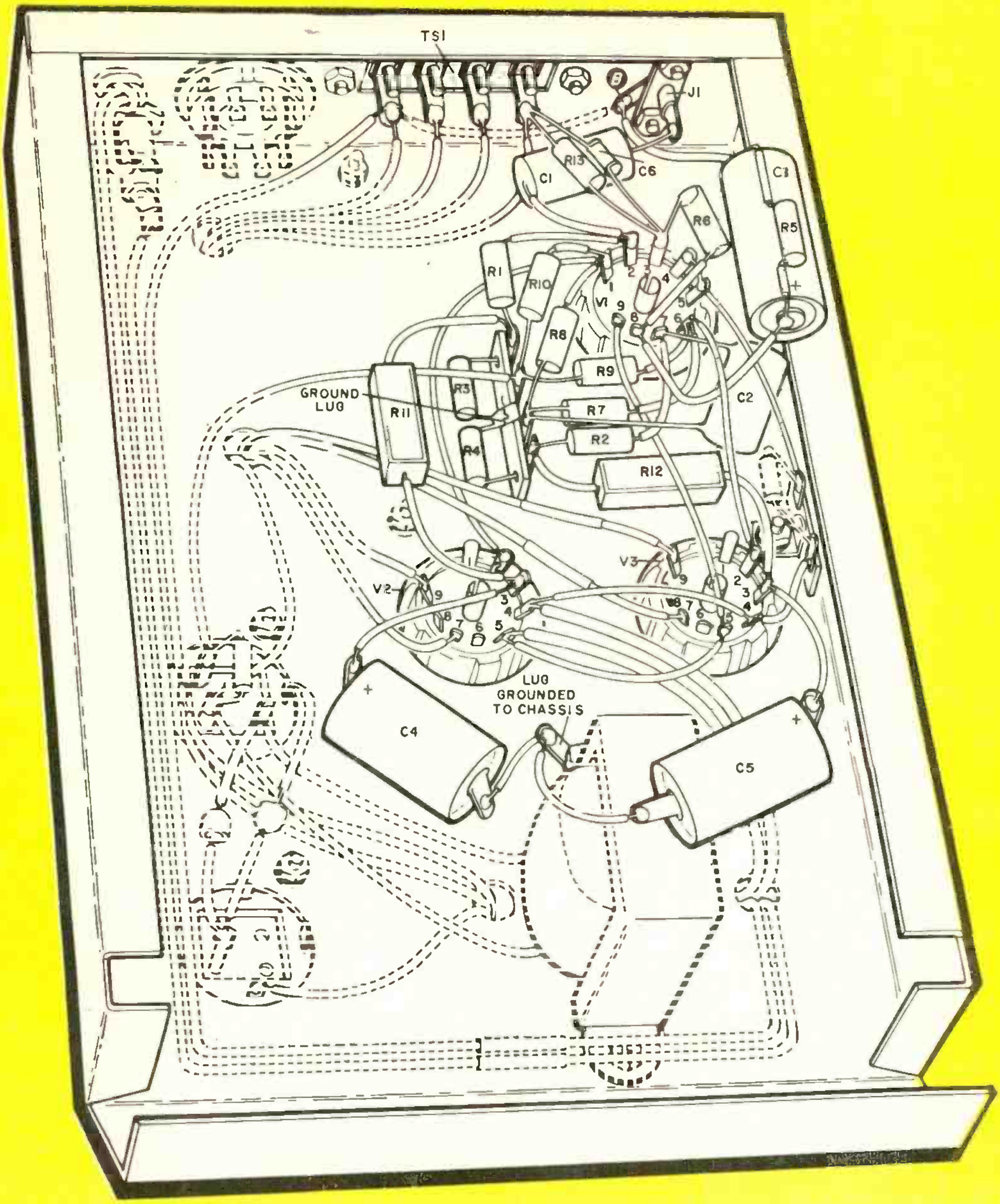


Power supply section of amplifier is completed before audio stages are hooked up. Rectified output appears between points A (positive) and B (negative).

sound TO-370 audio output transformer, (*T1* in the schematic) and the Acrosound TP535 power transformer (*T2*).

If you build the amplifier from scratch without the aid of the printed-circuit board, you will find it helpful to pre-drill the 2" x 11" x 7" chassis following the pictorial diagram shown on page 47. Once the chassis is drilled, the amplifier is built in two steps: first the power supply is wired and tested; then the audio stages are wired.

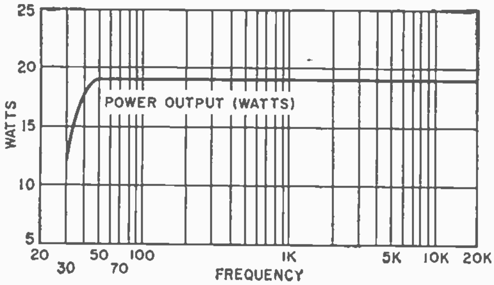
Wiring the Power Supply. Start by mounting all the components shown in the pictorial diagram above and hook up the power supply and output trans-



Audio stages of amplifier are wired last; power supply wiring is indicated by broken lines. Note that circuit is grounded to chassis at only three points.

former, being careful to follow the wiring shown. Note that the power supply is grounded at point *B* only and that filter capacitors *C7* and *C8* are both mounted on the chassis with insulated mounting flanges. It is also important to use an insulated fiber sleeve on capacitor *C8*'s can, since both terminals of *C8* are "hot" with respect to ground. And be sure to polarize silicon diodes *D1* and *D2* correctly.

Although an octal accessory socket is mounted on the chassis, it need not be wired unless you wish to power auxiliary equipment such as a preamplifier. If you do, connect point *A* to pin 3 of the octal



Power response of amplifier is shown above for a Harmonic distortion of 2%. Note that due to use of a special output transformer the output is flat from 48 to 20,000 cycles. Harmonic distortion at 18 watts output at 30 cycles is less than 3%.

socket and point *B* to pin 8; these are the 390-volt B+ and ground terminals, respectively. You should also connect pins 4 and 5 of *V2*'s tube socket to pins 2 and 7 of the octal socket to supply 6.3-volt heater current for your accessories. Do not ground either heater lead at the accessory socket since the power transformer has a grounded center-tap on the 6.3-volt winding.

When the power supply has been wired, test the resistance between points *A* and *B* with a VOM; you should find that it measures well over 1 megohm with the meter connected a few moments. If you get a low reading, reverse the leads to the meter. Should both readings be low, you probably have a defective filter capacitor (*C7*) or have made a wiring mistake; recheck the wiring against the pictorial and schematic diagrams.

Once the power supply checks out with the VOM, you can give it an operating check. Connect a 5000-ohm, 50-watt resistor between point *A* and point *B*. Power the circuit already wired, and test for 390 volts d.c. between points *A* and *B*. If the desired voltage is present, the power supply is operating under a load approximating actual operation.

Wiring the Audio Stages. With the power supply wired and tested, proceed with the wiring of the audio circuitry follow-

PARTS LIST

C1, C2—0.047-µf., 600-volt paper or ceramic capacitor
C3—250-µf., 6-volt electrolytic capacitor
C4, C5—40-µf., 150-volt electrolytic capacitor
C6—100-µµf., 500-volt ceramic capacitor
C7a/C7b/C7c—60/40/20-µf., 450-volt electrolytic capacitor with insulated mounting flange (Cornell-Dubilier CO365 or equivalent)
C8—100-µf., 300-volt electrolytic capacitor with insulated mounting flange (Cornell Dubilier AO340 or equivalent)
D1, D2—Silicon diode, 750 ma., 600 P.I.V. (Motorola 1N1096 or equivalent)
F1—3-amp. slow-blow fuse
J1—RCA phono jack
L1—2-henry, 200-ma. filter choke (Stancor C2325 or equivalent)
R1, R2, R7, R8, R9, R10—1-megohm, ½-watt, 1% resistor
R3, R4—10-ohm, ½-watt, 1% resistor
R5—2200-ohm, ½-watt, 10% resistor
R6—330-ohm, ½-watt, 10% resistor
R11, R12—1500-ohm, 10-watt, 5% resistor
R13—5600-ohm, ½-watt, 10% resistor
R14—220,000-ohm, ½-watt, 10% resistor
R15—6.8-ohm, 1-watt, 10% resistor
R16—22-ohm, 2-watt, 10% resistor
T1—Output transformer (Acrosound TO-370)
T2—Power transformer; 117-volt, 60-cycle primary; 185-volt, 200-ma., and 6.3-volt CT, 4.5-amp. secondaries (Acrosound TP-535)
TS1—4-lug, screw-type terminal strip
V1—12AX7 tube
V2, V3—EL84/6BQ5 tube
1—Fuse holder
1—2" x 11" x 7" aluminum chassis (Bud AC-407 or equivalent)
1—1⅜" x 3" fiber insulating sleeve for C8 (Mallory CE-6 or equivalent)
Misc.—Nine-pin sockets, octal socket, terminal strips, hardware, etc.

HOW IT WORKS

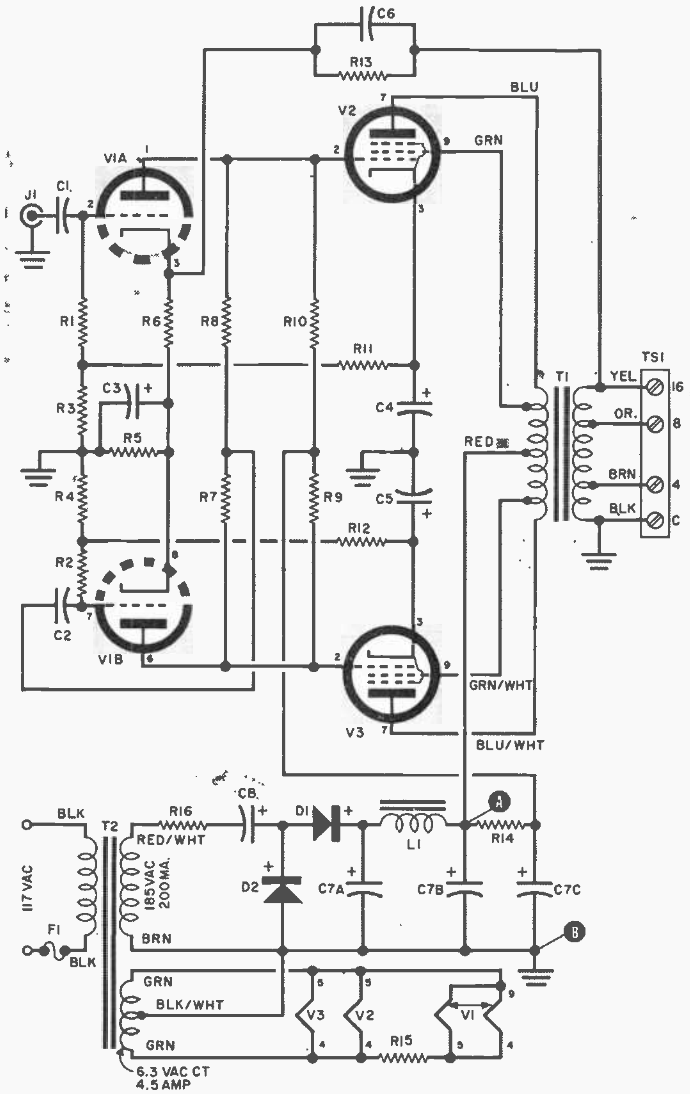
Input stage *V1* is used as a combination voltage amplifier and phase inverter. This tube operates with "starved" plate current to achieve maximum amplification, a condition created by the 1-megohm plate resistors (*R9* and *R10*). To obtain best linearity and maximum driving voltage, the heater of the tube is also "starved" by means of dropping resistor *R15*.

Direct coupling is used between *V1* and the push-pull output tubes *V2* and *V3*. The cathode current of each output tube flows through a separate resistor, *R3* and *R4* respectively, which is coupled to the corresponding grid of *V1*.

The current feedback through *R3* and *R4* accomplishes several purposes. First, it stabilizes the cathode current of each output tube under quiescent operating conditions. Secondly, the cathode current is also stabilized under dynamic operating conditions to the point where the stage operates almost completely as class A, resulting in minimum distortion. Finally, the stabilized direct coupling produces an amplifier which has only one principal source of low-frequency phase shift, output transformer *T1*; this provides perfect low-frequency stability.

In addition to the current feedback, 20 db of voltage feedback is provided by the capacitor-resistor combination *C6-R13*. The voltage feedback circuit is connected between the secondary of *T1* and the cathode of *V1a*.

Response of transformer *T1* drops only 1 db at 5 cps and 60 kc. The primary halves of *T1* are tightly coupled for distortionless high-frequency performance. Ultralinear screen taps are provided at the optimum ratio for the output tubes used.



In normal operation, voltage from point A to point B is 390 volts d.c. Heater current to tube V1 is "starved" by use of dropping resistor R15.

ing the pictorial diagram on page 49. The broken lines on this diagram indicate the power supply circuitry.

Note that many of the resistors used in the audio stages have 1% tolerance, as mentioned in the parts list. And be sure that the five-lug terminal strip to which most of the resistors are connected has a grounded center terminal. The only other ground connections to the chassis are at the lug under one of choke *L1's* mounting screws and at the audio input jack *J1* (point *B*).

With all the wiring completed, plug in the tubes and, without powering the amplifier, make a resistance check with a VOM between points *A* and *B*. Any reading of less than 1 megohm after the capacitors charge calls for a wiring check and a test of individual components.

After all tests are completed, connect a signal source with an output of about 1 volt to jack *J1* and hook up an appropriate speaker to the output terminals of *TS1*. The excellent performance of the amplifier should be readily evident. -30-

CASTRO'S RADIO VOICE

AFTER BEING in power for two years, Fidel Castro has started to build a radio propaganda network second to none in Caribbean coverage. Although principally concerned with keeping down unrest in his own country, Castro is obviously propagandizing all of his Latin American neighbors from Guatemala to Venezuela as well. Where will he stop is now the question. Annoyed by *Radio Swan* (see article below), Castro may well switch to English-language broadcasts on both the short-wave and broadcast bands. He has the personnel and he has the equipment.

Fidel, via one Antonio Nunez Jimenez, set up his propaganda network the easy way. Whenever and wherever a radio broadcasting station was needed, the Cuban government simply "borrowed" it. The only "new" link in this network is Jimenez's own station CMBN, *La Voz del INRA*. Remember the initials INRA and the name Jimenez—we may hear much more of them before 1961 has run its course.

Jimenez is the executive director of *Instituto Nacional de Reforma Agraria* (National Institute for Agrarian Reform), which was established as a result

RADIO SWAN

The thorn in Castro's side

PROBABLY no other one thing has frustrated Fidel Castro, Cuba's bewhiskered dictator, as much as a radio station with the picturesque name of *Radio Swan*. Located on a barren piece of Caribbean rock, the station has become a political hot potato. So wacky is the story behind *Radio Swan* that it could easily form the basis for an English political film comedy—another "Mouse That Roared."

Castro's feelings about *Radio Swan* are summed up in this remark which he made before the United Nations on September 26, 1960. As unofficially translated in *The New York Times*, Castro's comments were:

> *In the Caribbean Islands [is] a territory which belongs to Honduras and which is known as The Swan Islands, [and] the Government of the United States has taken over this island.*
>
> *It has set up a very powerful broadcasting station which it has placed at the disposal of war criminals and the subversive groups that are still being sheltered by this country.*

The "war criminals" who operate *Radio Swan* are a sedate group of American businessmen whose primary interest is making the station a commercial success. That they tweak Fidel's nose in the process is not of the slightest importance to them. They own the station in the name of the steamship-less Gibraltar Steamship Corporation.

Whose Islands? The Swan Islands are two coral and limestone islands lying at 17°24′N and 83°56′W, or about 97 miles north of Patuca Point, Honduras. The easternmost island, "Little Swan," is uninhabited. The western island, "Great Swan," is 2 miles long by ½-mile wide, and is inhabited by 20 Caymen Islanders—who grow coconuts, six employees of the U. S. Federal Aviation Agency, and about 20 *Radio Swan* operators and engineers.

The Swan Islands were declared a possession of the United States in 1863, although they now seem to be privately owned by a Mr. Sumner Smith of Boston,

By hook or crook, Cuba's Fidel Castro is extending his radio coverage throughout the Caribbean

By C. M. STANBURY II


UPI

of Castro's land reform bill of June 3, 1959. In Cuba the word "reform" can cover a tremendous amount of territory. Jimenez is responsible for confiscation of property, breaking up large land holdings, and redistributing them to tenant farmers.

La Voz del INRA. In late October, 1960, CMBN, *La Voz del INRA,* became the hub of Castro's new propaganda network. Residing on 1160 kc., formerly occupied by CMJK (a weak 500 watts), CMBN is destined to be a high-power outlet that will effectively jam *Radio*

(*Continued on page* 54)

By TOM KNEITEL, WPE2AB

Mass. Since the island is supposed to be his private property, the various tenants on "Great Swan" pay rent to Mr. Smith for the use of it. But Honduras has been grumbling that *it* really owns the territory, and recently Nicaragua began laying claim to it as well. *Radio Swan* solved this dilemma for themselves by paying Mr. Smith and not applying to any country for a radio transmitting license.

When *Radio Swan* went on the air in the summer of 1960, its owners began selling commercial time to all comers. They were fairly successful in lining up many sponsors (cigarette companies, a tissue company, etc.) plus a few private political groups—among them some anti-Castro exiles from Cuba and some anti-Trujillo exiles from the Dominican Republic.

Almost immediately, Fidel began raising the roof with his "war criminal" routine. But who could he complain to? He might have questioned the U. S. Government and received the same reply we got from the Federal Communications Commission dated September 16, 1960:

> *In response to your letter of September 12, 1960, you are advised that the Commission has no information regarding the radio operations to which you refer.*

Or he might have asked Honduras and gotten this answer:

> *In response to your letter of the 12th of this month, we wish to inform you that Radio Swan, located on Honduras' Swan Islands, has neither solicited nor obtained government permission to operate on Honduran territory.*

Meanwhile, *Radio Swan* has been going strong with a 50,000-watt broadcast-band transmitter and a 7500-watt short-wave rig.

The whole situation has understandably been pretty embarrassing to the U. S. State Department. Until we broke diplomatic relations with Cuba this past January, Fidel was putting the pressure on the State Department to get *Radio Swan* off the air—which, of course, it was unable to do since the Department felt it

(*Continued on page* 55)

CASTRO'S VOICE

(*Continued from page* 53)

Swan, and also be on the air more hours per day than *Radio Swan.*

The choice of call letters for CMBN was unusual since this station is located in Calbarien, in the central Cuban Province of Las Villas, which would not normally have the prefix CMB. Heretofore, the call "CMBN" had been allocated to a station on Isla de Pinos—ironically, an American tourist resort. Station CMBN is using the confiscated channel of CMJK, *La Voz del Camegueyano,* a station best remembered for its companion short-wave outlet on 9625 kc.

Under the enthusiastic guidance of Sr. Adrian Garcia Hermandez, *La Voz del INRA* could give the Soviets lessons in propaganda. Unless you happen to tune in during one of Castro's long emotionally-charged speeches, you could easily mistake CMBN for a commercial Latin American station. There is an abundance of popular Cuban music, news, plays, and even commercials; of course, these are for companies and products seized by the revolutionary government. Station CMBN fills in with very short propaganda blurbs and an occasional long political commentary—plus Castro's harangues.

Other INRA Stations. Of the independent stations now in the INRA propaganda network, CMBL, *Radio Aeropuerto,* (860 kc.), at the Jose Marti airport near Havana, is the most important. It furnishes a valuable short-wave outlet (COBL) on 9833 kc., which cannot be heard too well in the United States because of teletype interference and the 100-kw. signal of *Radio Budapest* on the same channel. It is a safe bet that Castro will soon order COBL to confiscate a new frequency and to up its power.

Meanwhile, CMBL is locked in a new struggle on the 860-kc. channel. This time it is with Trujillo's propaganda voice, *Radio Caribe,* which has unexpectedly taken up residence on this channel and is doing a good coverage job around Santiago, Cuba.

UPI

Another Havana station playing an interesting part in this propaganda war is CMBQ, *Radio Continental.* It has been in and out of Castro's favor since the revolution. Shunted from its strategic 1010-kc. channel to make room for CMZ, it is now spotted on 1150 kc. Station CMZ was inherited by Castro from Batista's Ministry of Education and for some reason still operates independently of INRA and Jimenez.

Station CMBQ is the news source for CMBN, CMBL, and the seven smaller transmitters operated by INRA. Of this latter group only CMGS, *Radio Varadero,* (1580 kc.), can be heard in the eastern United States. Most of North America is blanketed by Canadian Station CBJ, also on 1580 kc.

The INRA network has come up with propaganda especially designed for the Spanish-speaking nations in the Caribbean. It differs little from what they are used to and seem to prefer, but it is in sharp contrast with the dull programing of *Radio Moscow, Radio Budapest,* etc. Although *Radio Swan* is a powerful irritant to Castro, the major job of combating Latin American propaganda is being left undone. —30—

RADIO SWAN

(*Continued from page* 53)

had no control over the station in the first place.

"Invasion" Party. When the *Radio Swan* situation began to get hectic, a group of Hondurans decided it was time to take a firm stand on the Honduras claim to the Swan Islands. About a dozen brave souls set out from Honduras in a rented boat for an "invasion" of the islands.

After a rough trip, they "took the beach" and asked the boys at *Radio Swan* to give them some seasick remedies and to point out a location where they could run up a Honduran flag. The *Radio Swan* gang gave them a cordial welcome and directed them to an appropriate spot where they proceeded to "fly their colors."

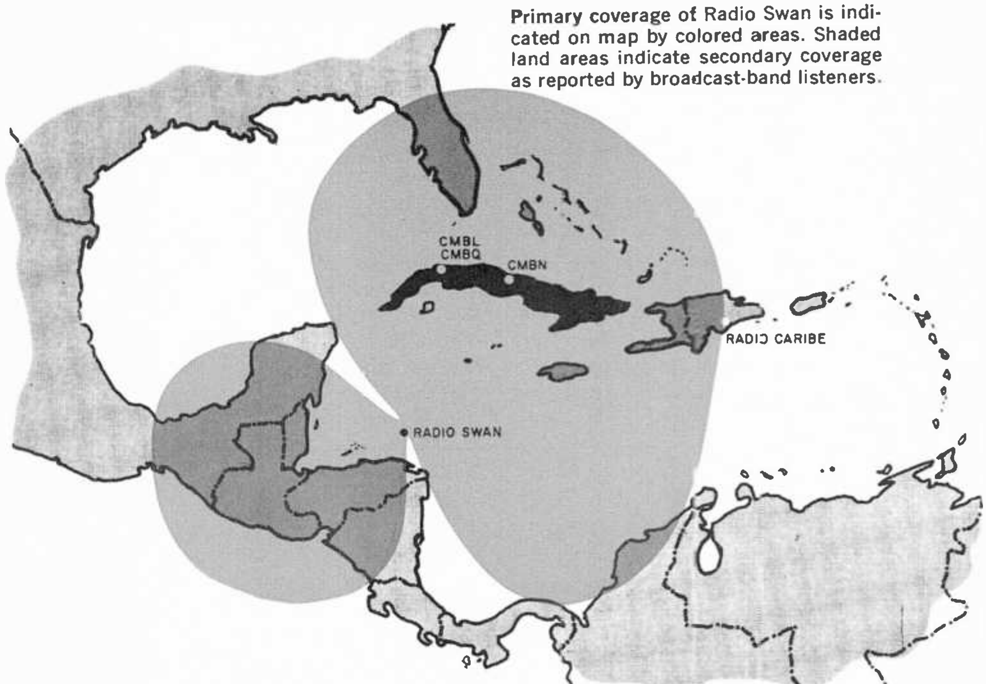
Lunch was served by the *Radio Swan* people, and a parting gift of a bottle of Honduran-made "Scotch" was given to the Swan Islanders by the invasion party before its return to Honduras. A good time was had by all.

Castro, on the other hand, established his own radio station, CMBN, on *Radio Swan's* channel in an effort to jam the frequency. But this jamming is said to be only mildly effective on an island-wide basis.

As we go to press, *Radio Swan* is still operating without a license and diplomats are still taking tranquilizers over the problem of who really owns the Swan Islands. Castro is still burning about the whole situation, and the land-bound Gibraltar Steamship Corporation is enjoying a profitable business venture.

Reports Welcomed. *Radio Swan* is anxious to receive reception reports from DX'ers, which the station will verify. On the air they announce their address as *Radio Swan,* Box 1247, General Post Office, New York, N. Y., but faster verification can be had if you write to *Radio Swan,* c/o Gibraltar Steamship Corp., 18 East 50th St., New York 22, N. Y. Previously reported addresses are no longer correct.

The station is scheduled to operate on 1160 kc. at 0500-0715 and 1800-2300 Monday to Saturday, at 1830-2215 on Sundays; and on 6000 kc. at 0800-1015 Monday to Saturday, 1830-2215 on Sundays. All times are EST. —30—



Primary coverage of Radio Swan is indicated on map by colored areas. Shaded land areas indicate secondary coverage as reported by broadcast-band listeners.

Ping-Pong Stereo

IT HAS BEEN SAID that Americans are a nation of "faddists," and this philosophy might have a certain germ of truth. There are few of us who can't recall some of the many fads which have swept the country . . . from the "Charleston" and raccoon coats—through chain letters, bubble gum, and the yo-yo—to the Mayo clinic diet, multi-colored shoe laces, the hula-hoop, and rock n' roll. Now a restless public has embraced a particular type of stereo recording as one of its latest fads.

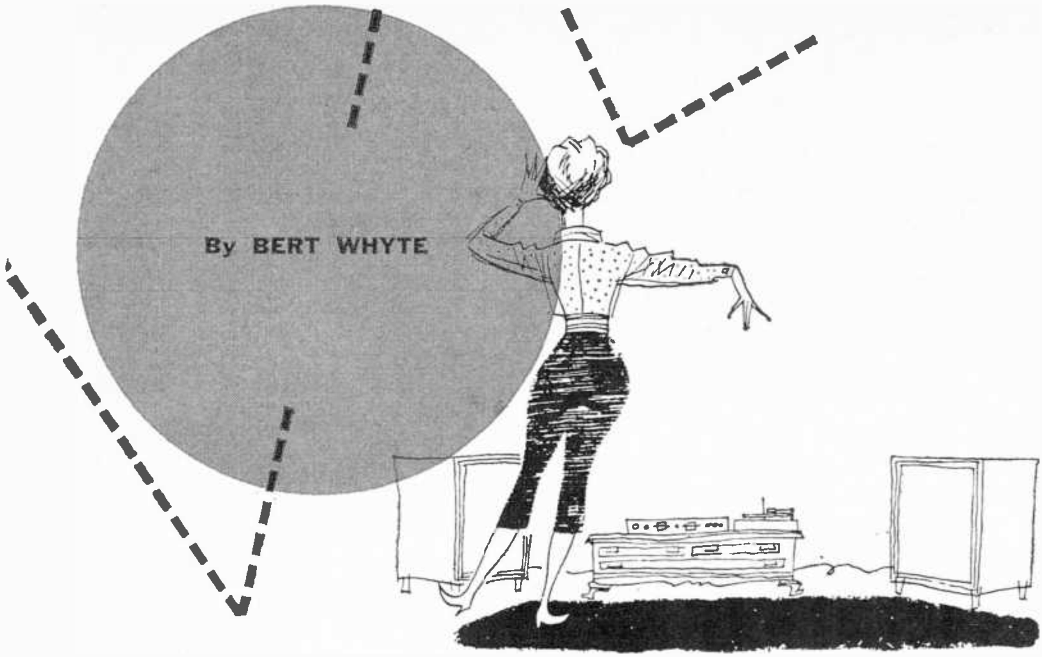
The so-called "super" or "spectacular" stereo records are instantly recognizable by their titles, which have spawned a whole new lexicon of musical usage. Since "percussion" seems to be the dominant theme in all these titles, some sociologists have drawn the inference that man is showing an unconscious predilection for this most primitive and basic of all forms of music!

As anyone who is even remotely interested in recorded music knows, we have had stereo records for almost three years. While there were the inevitable early "clinkers," hundreds of fine stereo discs have been produced. Why then this sudden fad for the new stereo recordings? If we accept their "super" or "spectacular" designations, are we to assume that other stereo recordings outside this special group are of lesser quality? Let us examine this phenomenon and find a reason for the attraction of the "special stereos" and just how they came into being.

The Stereo Console. It has become almost an axiom that in this country it is the women who "wear the pants." It is our charming sisters, wives, and mothers who keep a firm grasp on the American purse-strings. Because of their formidable buying power, they exert a tremendous influence on the manufacturers of every product from alphabet soup to zirconium.

Thus, quite early in the stereo era, the stereo console was born. Its design was obviously intended to appeal to the ladies. And it did—ah, they sighed, what lovely Queen Anne styling, what charming Provincial, such Colonial chic, etc., etc. The manufacturers had caught the brass ring again, and the ladies were happy.

Of course, solving this problem simply gave birth to another. The quality and finish of the consoles were equated with size and cost. Since even modest cabinetry is relatively expensive, and since the unit would be used in an average-sized living room, the size of the console



By BERT WHYTE

soon became fairly standardized. And so we have the stereo console of today—the regular garden variety of unit that can be seen in almost every department, appliance, and music store across the country.

Premium on "Directionality." Although the ladies and their spouses were happy with the cabinetry, they had been heavily hammered with the glorious virtues of stereo. Therefore, apart from keeping up with the Joneses or filling up a space in the living room, they actually expected to be enthralled by this fabulous new sound. What's more, when our lady-friend and her hubby were buying their unit, they probably were given a sales talk and demonstration by a clerk whose disorientation and lack of knowledge about stereo were only slightly less than theirs. Out of this hubbub of semi-fact and fiction, there lodged in the mind of the clerk and customer alike the term "directionality."

Like some great universal truth, directionality has come to be accepted as the prime function of stereo. Thus armed, our couple turns on their bleached walnut console and eagerly listens for this new miracle to unfold. But since the speakers in their unit are separated by as little as two feet, they strain their ears mightily. At the distance they are probably sitting from the unit, stereo direction is either barely perceptible or completely absent.

Keenly aware of the stereo console's strengths and deficiencies, Enoch Light, a veteran band leader and the head of several record companies, and a man fairly conversant with modern recording techniques, did some thinking. Along with Bob Fine, the well-known engineer who has been responsible for the superb Mercury classical recordings, he reasoned that to the average person stereo means directionality more than anything else. He knew that the average stereo console was incapable of any significant degree of directionality. Since this was the case, why not produce recordings which would deliberately enhance the directional effects and at the same time take advantage of the other shortcomings in these consoles?

Percussive Magic. Messrs. Light and Fine put in about a year of planning and experimentation, and formed a new company called "Command." Their first stereo disc burst on the public like a bombshell. Entitled *Persuasive Percussion*, it made the heretofore inadequate consoles sit up and do tricks, much to the delight of their owners who now saw the unit as a means of musical enjoyment as well as a piece of furniture. This successful disc was followed by others in rapid order. Inevitably, more companies jumped on the bandwagon and a flood of similar recordings reached the public.

Like anything else, this type of stereo recording has its good and its bad points. For while they do sound "good" on stereo consoles, these recordings are, by intent, completely contrived and artificial. Theirs is music rigidly confined to the purposes of recording—you could not take the orchestra involved, put it on a stage, and expect to hear in live form what you would hear in the recording.

Question any of the producers of these records and they will candidly admit that they are making the recordings specifically for the "inadequate" stereo units. Rule one, then, is that the various instrumentalists or instrumental "choirs" are recorded with far greater physical separation than in "normal" setups.

Tricks of the Trade. It is a characteristic of the average stereo console that the best and least distorted reproduction is in the middle ranges; generally there is only fair-to-poor high-frequency response, and not much response at all at the bass end. Rather, there is a more or less deliberate boost of what lows are achieved. Add cabinet resonances to this and the bass is best described as "boomy." Taking power considerations into account and the inherent gain versus hum of the average console, it is always an advantage to play back a recording which has a high sound level, thus keeping the hum down in proportion.

With this knowledge in mind, the "super" stereo engineer sets up microphones whose characteristics are complementary to a given musical instrument. Thus he may use a velocity-type mike on some instruments, a condenser mike on some others, and dynamic mikes on still others. The mikes may have variable patterns, but most likely they are set for the cardioid pickup, again allowing for maximum separation effects.

Depending on the dynamic power of the instrument involved, the mike is set as close as possible to the instrument—in some instances practically on top of it! This setup affords the engineer the best possible signal-to-noise ratio, and the close-up sound has great "presence." Depending on where the recording is made, some engineers will use natural reverb if it is controllable, while others prefer to record "dry" and then add the exact amount of artificial "reverb" or echo they desire. In almost all cases, reverb is considerable, for here again is an enhancement of stereo perspective and "presence." With a multiplicity of mikes being used, sometimes almost one for each instrument, and with the close pickup employed, the distortion contributed from the mikes and instruments is individually very little. As a result, the recorded sound is remarkably "clean" when suitably reproduced on stereo equipment.

Having done about as much as possible in the studio itself, the engineer can also employ other tricks at the mike control mixer or later in re-recording. For example, taking advantage again of the mid-range response of the average console, the mid-frequencies in the music being recorded are boosted a certain number of decibels. This makes everything in that range sound very "forward" and extremely "bright." Equalization is often boosted at the top of the middle range and into the high frequencies to emphasize high strings and such instruments as bells, triangles, vibraphones, and cymbals. The bass range is usually left alone for fear of exciting so much "boominess" that the result would be acoustic "mud."

Another trick is the rapid switching of one group of mikes and instruments to another position—from left to right and vice-versa, for example.

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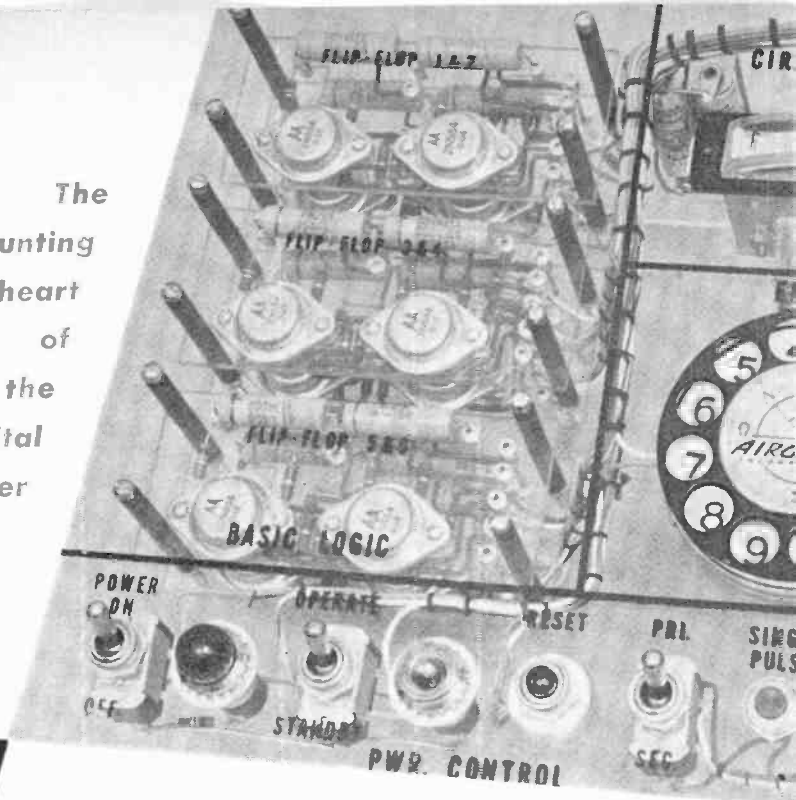


The counting heart of the digital computer

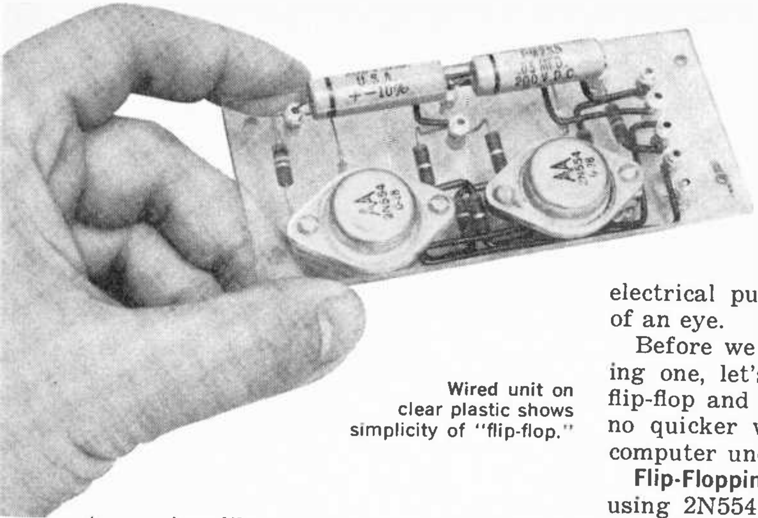
FLIP-FLOP CIRCUITS

This article discusses the transistor circuits used in the Digital Computer Demonstrator shown above and on this month's cover. Manufactured by Aironics, Inc., 1035 E. 26th St., Hialeah, Florida, the unit is an educational aid for demonstrating how simple transistor circuits can perform basic computations.

By JULIAN M. SIENKIEWICZ
Managing Editor

THE digital computer, the electronic brain so widely used in industry and science, is an awesome giant. It's true that some computers—those housed in office-sized desks, for instance—are relatively small physically. But to the untrained eye, their internal workings are a veritable electronic nightmare. Of even more gargantuan concept are the mammoth versions which actually occupy the whole of specially designed, air-conditioned buildings.

On closer inspection, however, the biggest digital computer proves to be only slightly more complex than a brick building. Made up of hundreds, sometimes thousands, of tiny printed-circuit boards —its "bricks," the digital computer also contains such rather unspectacular items as plug-in control panels, tape decks, and



Wired unit on clear plastic shows simplicity of "flip-flop."

typewriter-like read-out machines. Interconnecting its multitude of components are precisely what you might think—miles and miles of wire!

One of the building "bricks" which make up the counting heart of the digital computer is the "flip-flop" circuit, usually tucked away within the computer on a printed-circuit board about the size of a postcard. One such "flip-flop" is the Eccles-Jordan bistable multivibrator. An easy way to visualize its operation is to think of it as an on-off toggle switch. Like the switch, a flip-flop must settle in one of two stable states. But unlike the switch, the "flipping" or "flopping" of the Eccles-Jordan is accomplished by electrical pulses quicker than the blink of an eye.

Before we actually set to work building one, let's take a closer look at the flip-flop and see how it is used. There's no quicker way to get on the road to computer understanding.

Flip-Flopping. A typical flip-flop circuit using 2N554 *p-n-p* power transistors is shown in Fig. 1. Whenever power is applied to the circuit, one of the transistors will conduct and the other will be cut off. To understand how this happens, let's assume that transistor *Q1* is conducting ("on") and transistor *Q2* is cut off ("off"). The voltage at *Q1*'s collector is low—less than one volt—due to the large collector current through *R1*.

The current through *Q1* also passes through the common-emitter resistor, *R4*, developing a voltage drop which makes the top end of *R4* more negative than its grounded end. The value of *R4* is such that this would ordinarily make the base of *Q1* more positive than the emitter (reverse bias), preventing *Q1* from conducting. However, the base of *Q1* receives enough negative voltage from the collector of *Q2* to overcome this negative emitter voltage, keeping the base-emitter bias negative and transistor *Q1* conducting.

The voltage at the collector of *Q2* is approximately −7 volts (the same as the power supply voltage), since *Q2* is not conducting and the voltage drop across *R7* is almost zero. There is, however, a small current drain through *R7* due to *R6* and *R3* and collector-emitter leakage in *Q2*.

Transistor *Q2* is held at cutoff because the negative voltage at its emitter—due to the voltage drop across *R4*—is greater than the negative voltage reaching its base from the collector of *Q1*. In other words, the base of *Q2* is positive compared to its emitter (reverse bias) and *Q2* cannot conduct.

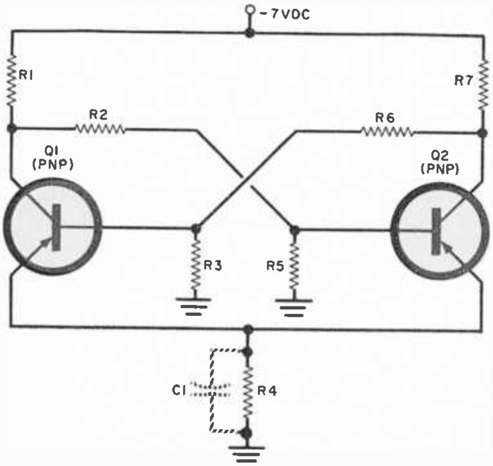


Fig. 1. Typical flip-flop circuit using power transistors. C1 is optional—see text.

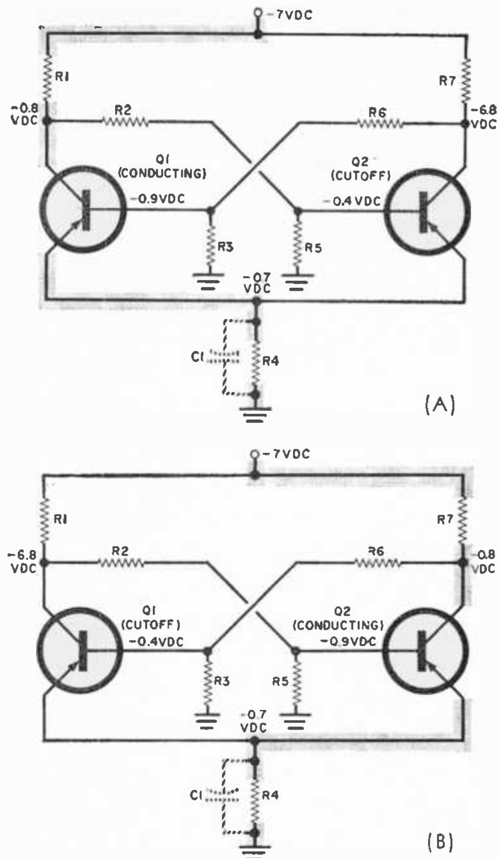


Fig. 2. Shaded lines indicate current path through flip-flop multivibrator when Q1 conducts (A) and when Q2 conducts (B).

Figure 2 (A) shows the current path through the flip-flop multivibrator and d.c. voltages measured to ground when *Q1* is conducting. The heavy lines show the current path from the —7 volt power supply, through *Q1*, to ground.

This state of affairs—*Q1* "on" and *Q2* "off"—will continue indefinitely because the flip-flop circuit is in a stable state. To reverse the transistor conditions—that is, to make the circuit "flip"—let's assume that we momentarily decrease the negative voltage on *Q1*'s base so that the transistor stops conducting. The flip-flop now goes through a transition period of very short duration.

As *Q1* cuts off, its collector voltage increases to —7 volts. The base of *Q2*, which was positive compared to its emitter, now becomes more negative, because the negative voltage at *Q1*'s collector is passed on to *Q2*'s base through a voltage divider, *R2-R5*. Transistor *Q2* now conducts heavily and *R7* drops the voltage at *Q2*'s collector to less than a volt. This low negative voltage is transmitted through *R6* and *R3* to the base of *Q1*, permitting *Q1* to remain in a cut-off state.

The circuit has now "flipped" and the transition period has ended. As before, the flip-flop is in a stable state, but *Q2* is "on" and *Q1* is "off." The multivibrator will remain in either stable state until a pulse from an external triggering circuit causes it to flip or flop. Figure 2 (B) shows the current path and circuit voltages when *Q2* is conducting.

During the transition period, incidentally, when one transistor cuts off and the other is turned on, the voltage drop across *R4* remains practically unchanged.

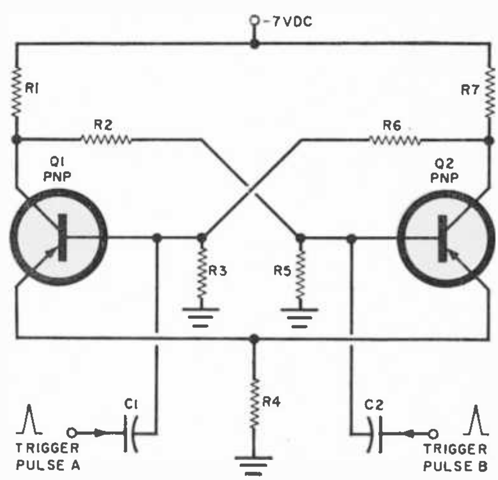


Fig. 3. The circuit of Fig. 1 with two trigger inputs added.

In many flip-flop circuit applications, *R4* is bypassed by a high-value electrolytic capacitor, *C1*, to insure constant voltage on the emitters of *Q1* and *Q2* during the flip or flop of the multivibrator.

Triggering. Before we can put the flip-flop to work for us in a digital computer, some additions to the basic flip-flop circuit are necessary so that we can make either transistor conduct at will. The circuit shown in Fig. 3 is identical to that in Fig. 1 except that two input triggering signals can now be applied to the base of either transistor through capacitors *C1* and *C2*. By applying a positive pulse to the base of the "on" transistor or a negative trigger pulse to the base of the "off" transistor, the circuit will switch from one state to the other. Let's consider the positive trigger pulse because we will see later that it can be obtained with a simple circuit using only a push-button switch and a resistor.

When *Q1* is conducting (Fig. 3), a positive trigger pulse (*A*) is applied to the base of *Q1*. If this positive pulse is of sufficient amplitude, the base will be driven positive with respect to its collector and *Q1* cut off. The collector voltage of *Q1* will rise rapidly to —7 volts and a part of this voltage will be applied to the base of *Q2* through voltage divider *R2-R5*. Transistor *Q2* will now conduct, its collector voltage will drop to less than a volt, and this voltage will be applied to the base of *Q1* via *R6* and *R3* to hold *Q1* at cutoff when the positive trigger ends.

Obviously, we have just "flipped" the circuit. This same action takes place when a positive trigger pulse (*B*) is applied to *Q2* as this transistor is conducting, although nothing will happen in the event that a positive pulse is applied to either transistor when it is *not* conducting. This results from the fact that when the transistor is cut off, a positive pulse only helps to keep it in its cut-off state. Therefore, no change will take place.

The flip-flop shown in Fig. 3 requires two trigger signals to "switch" it from one state to the other and back again. With the modified triggering circuit shown in Fig. 4, only one signal source is necessary.

Let's see what happens in the circuit of Fig. 4 when *Q2* is conducting. From Fig. 2 (B) we know that *Q2*'s collector is more positive than its base. Diode *D2*, connected across the base and collector of *Q2* through *R9*, is biased so that it will conduct heavily the instant a positive trigger pulse passes through *C2*. Diode *D1* is wired in the same manner except that its anode is about six volts negative with respect to its cathode. Therefore, a positive trigger pulse must overcome this large negative bias before it can pass through *D1*.

Switch *S1* controls the positive pulse that flips the circuit; note that the junctions of *C1*, *C2*, and *S1* are connected to —7 volts through *R10*. When *S1* is depressed, the —7 volts at this junction are

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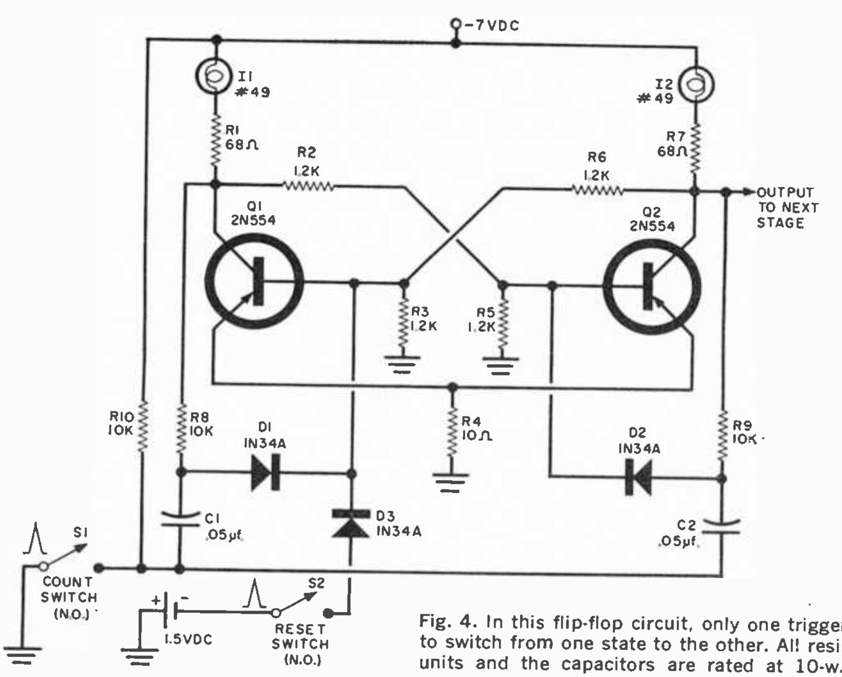


Fig. 4. In this flip-flop circuit, only one trigger input is needed to switch from one state to the other. All resistors are ½-watt units and the capacitors are rated at 10-w.v.d.c. minimum.

Buying an amplifier?

Then here's what you should know about

CURVES

By G. H. HARRISON

ONE DAY last fall, a fellow we'll call Joe Rodgers caught the hi-fi fever and ran panting—checkbook in hand—to his hi-fi dealer's showroom.

Joe's next-door neighbor, Sam, had a fine system to which Joe had turned an ear on many an occasion. Since everybody said it sounded great, Joe decided to get one just like it. He bought a turntable, arm, cartridge, and speaker just like Sam's. But when he got to the amplifier, his bank balance was running low.

The dealer pointed out another amplifier—with the same power rating—whose price tag was a good bit lower than the amplifier Joe really wanted. But the specifications of the two units were almost identical. "Frequency response flat from 20 to 20,000 cycles, power output 10 watts, harmonic distortion below 1% at full rated power output," ran the spec sheet. Just like the specs of Sam's amplifier, Joe remembered. So he bought the cheaper amplifier.

Later, at home, Joe settled back to enjoy some real music. There was only one trouble—his system didn't sound as good as Sam's! In particular, it didn't produce the rich, satisfying bass Sam's did; and the highs, especially the violins, didn't sound as crisp and clear as Joe thought they should.

The Whole Story. The mistake our friend made was a common one: he didn't realize that most amplifier "specs" tell only part of the amplifier's story. To find out what's really happening when an amplifier starts hammering watts into a speaker, you need more than the specifications most manufacturers include on the sales brochures: you need *curves*.

Why curves? Because a collection of six or eight accurate curves, covering frequency and power response, distortion at various frequencies and output levels, tone-control characteristics, equalization errors, loudness contours, and so on, can tell you more in a minute than you can learn from studying pages of performance data all day.

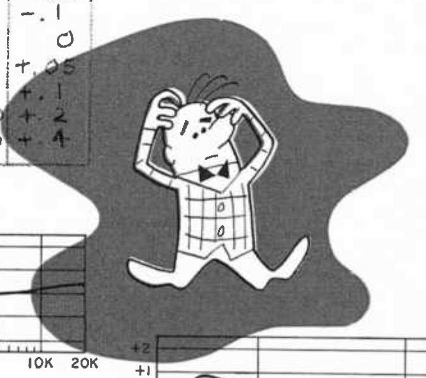
As hi-fi fans in general have begun to understand the importance of curves in judging an amplifier's quality, manufacturers have begun to publish them in ever greater quantities. And although you may have to do some digging—not all manufacturers include complete curves with instruction manuals—you can now find curves for just about any piece of equipment you're interested in.

Curves may at first seem mysterious and complicated, but understanding them is really no trick at all. A curve is simply a visual way of presenting a mass of statistics clearly and graphically.

Frequency Response. Although the frequency response of an amplifier can be shown in tabular form as in Table 1, Fig. 1 shows the same information in curve form. And a single glance at the curve tells us everything a careful reading of all the figures in the table does. (These figures indicate how many decibels—"db"—the amplifier's gain varies at different frequencies; 1 db is the amount a signal must change for our ears to detect that there has been a change in level.)

freq	db.	freq	db.
20	-.5	800	+.15
50	-.3	1000	0
70	-.2	2000	-.05
90	-.1	3000	-.1
100	0	5000	0
200	+.1	6000	+.05
300	+.2	8000	+.1
500	+.3	10000	+.2
600	+.25	20000	+.4

Table 1.



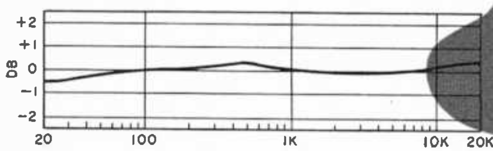


Fig. 1.

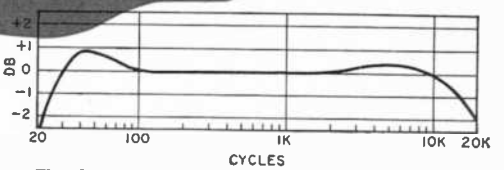


Fig. 2.

The amplifier whose curve is shown in Fig. 1 has a very fine frequency response. Its output is almost "flat" over the entire audible range from 20 to 20,000 cycles, inasmuch as it stays within 0.5 db of the center or "reference" line. And since our ears can't hear a change of less than 1 db, we would be able to hear no change in level over the entire range.

Figure 2 shows the frequency response curve of another amplifier. This one has a pretty good frequency response, but not as good as the one in Fig. 1. It breaks at 10,000 cycles and is down 2 db at 20,000 cycles.

Frequency response is the amplifier characteristic most frequently shown in curve form. Unfortunately, frequency response curves are probably the least important ones we could see on modern amplifiers. This isn't because good frequency response isn't important, since it is. But output transformers—which once seriously limited frequency response—and amplifier circuitry in general have improved so much that all but the most inexpensive amplifiers now boast excellent frequency response. Consequently, other curves—ones you don't see nearly so often—can be far more revealing about an amplifier's true quality.

Power Response. Curves showing power response, for instance, tell you a lot about an amplifier's performance that you can't learn easily in any other way. A power response curve simply shows how many actual watts of power an amplifier can deliver over its entire frequency range without producing distortion.

Figure 3 is the *power* response curve for the amplifier whose *frequency* response is shown in Fig. 1. Again, this is an excellent amplifier. Its maximum power at 20 cycles is down only about 5 watts from full power. It is up to a full

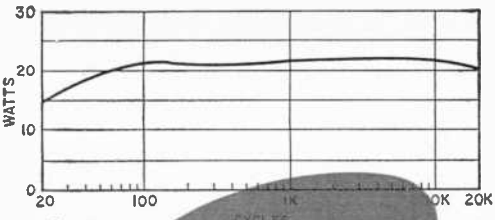
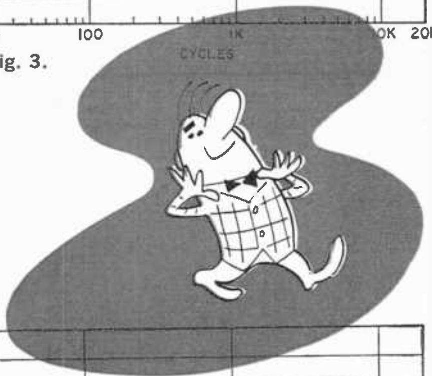


Fig. 3.



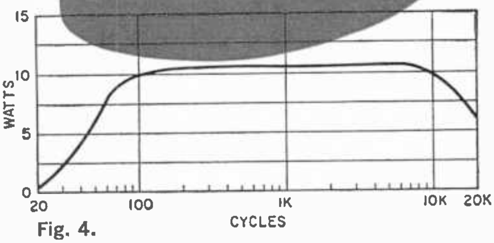


Fig. 4.

20 watts at 50 cycles, and, at 20,000 cycles, the curve has just barely begun to dip.

Figure 4 is the response curve of a considerably less flat but by no means unusual amplifier. As you can see, it doesn't really put out full power below 100 cycles and response begins to fall off pretty sharply above about 8000 cycles. Going back to our friends Sam and Joe, the Fig. 4 amplifier could be the one that Joe bought. Its power output may have been rated the same as Sam's, and both may have had flat frequency response over the audio range. But it's easy to see why Joe's amplifier didn't grind out enough bass to suit him. It just couldn't produce full power below 100 cycles.

Distortion Ratings. Every amplifier specification sheet mentions distortion, usually of two types—harmonic and intermodulation. Although the two types are due to different conditions, they have similar results: more than a tiny amount of either and you get unpleasant sound.

The amazing thing about manufacturers' quoted distortion specifications for many amplifiers—even inexpensive ones—is that they all seem so low. "Less than 1% harmonic and intermodulation distortion at normal listening levels" is a common claim. But a full picture—such as told by the curves in Fig. 5—is frequently quite different. The "normal listening level" referred to is usually about 1 watt or less. And what happens during climaxes? Just what you think. Distortion rises rapidly, and the music sounds "fuzzy" or otherwise distorted in loud passages.

Figure 5 shows a family of distortion curves for a fairly good 10-watt amplifier. At the 1-watt level, both IM and harmonic distortion—measured at 1000 cycles—are below 1%. But the IM has already climbed to 2% at 3 watts, and to

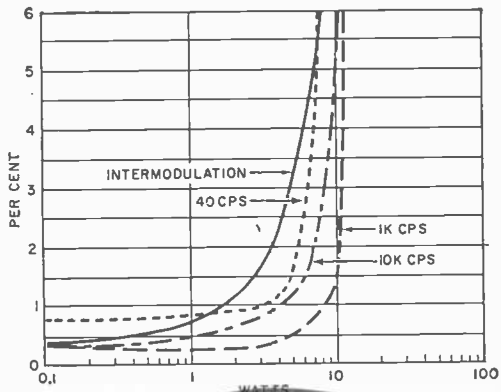
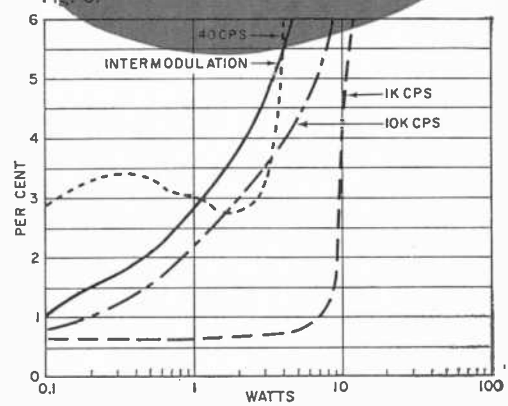


Fig. 5.

Fig. 6.



6% at 8 watts. Harmonic distortion at 1000 cycles remains low—below 1%—almost to 10 watts. But the figures at 40 and 10,000 cycles again tell a different story.

Figure 6 shows distortion curves for an actual amplifier which is not so good. This is Joe's amplifier, whose power response curve appeared in Fig. 4. The manufacturer probably emphasized the fact that the amplifier's harmonic distortion was below 1% almost all the way to 10 watts. But he probably didn't mention that this was at 1000 cycles only, and that readings at other frequencies were somewhat different, and considerably worse. No wonder Joe felt the fiddles were "fuzzy"—anything over a whisper at high frequencies and distortion begins to soar.

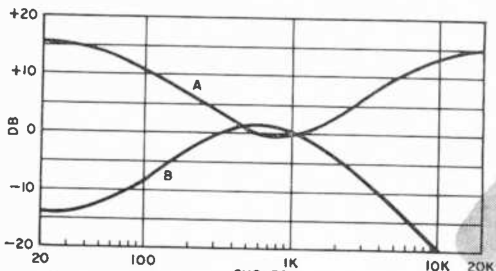


Fig. 7.

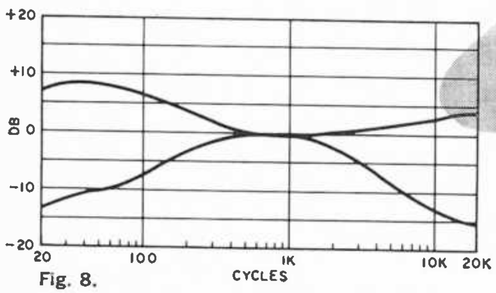


Fig. 8.

Tone Controls. Curves can tell you quite a lot about the way your tone controls work, too. Figure 7 shows what happens to an amplifier's frequency response with the two tone controls—bass and treble—turned to their extreme positions. When the bass control is turned all the way up, bass response is boosted 16 db at 20 cycles (curve A). With the bass all the way down, response is down 14 db (curve B). About 15 db of high boost and 29 db of high attenuation can be accomplished with the treble control.

Figure 8 shows the response characteristics of another amplifier with far less effective controls.

You may at times see a so-called "family" of tone control curves, and these can be even more revealing. In Fig. 9 is a family of curves of the conventional "losser" type of tone control, similar to those we have just seen. Three boost and three attenuate curves are shown for each control, that is, three different amounts of bass boost, three of bass attenuation, etc.

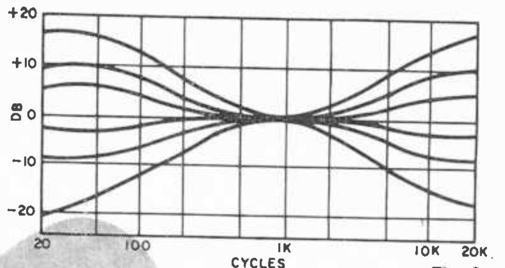
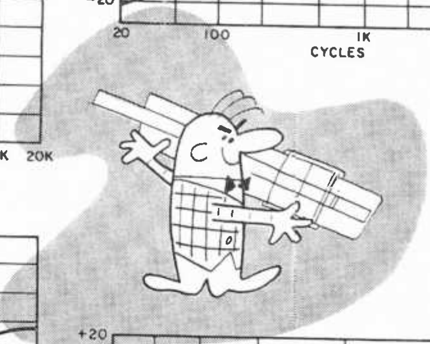


Fig. 9.



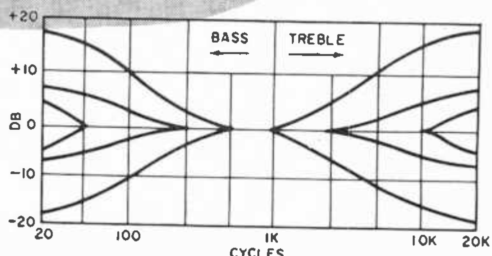


Fig. 10.

Figure 10 is another family with three curves for each function, but note the striking difference from Fig. 9. This is the response characteristic of the famous Baxandall tone control you have probably heard about.

(*Continued on page* 118)

Across the Ham Bands

By
HERB S. BRIER
W9EGQ

TROUBLE-SHOOTING HAM EQUIPMENT

WHAT would you do if your ham transmitter or receiver suddenly stopped working? Among other possibilities, you could send it back to the manufacturer or the dealer from whom you purchased it—after receiving shipping instructions; you could enlist the aid of a local ham expert; or you could repair it yourself.

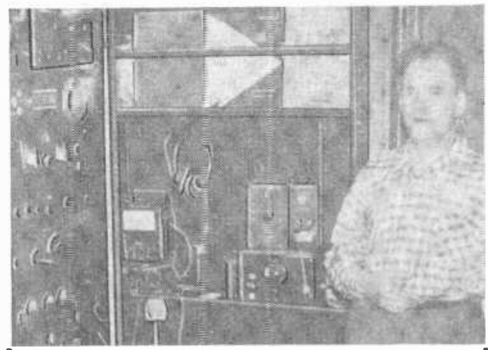
If the gear is still under guarantee and the trouble seems to be of a major nature, the first course might be the wisest one. However, most ham equipment failures are the result of the breakdown of a single component, such as a tube, capacitor, or a resistor.

Do It Yourself. If you have the instruction manuals and a good volt-ohmmeter, you should be able to run down most causes of trouble in your ham equipment yourself. A tube tester or a set of replacement tubes known to be good is also helpful.

Suppose, for example, that your transmitter has stopped working. You know that the rig is getting power, because its tubes light or it blows fuses. You have tested the tubes or have substituted others that you know to be good. What do you do next?

First, read the entire instruction manual to refresh your memory as to how the equipment is supposed to work and the function of each control. Then locate the circuit diagram, the parts list, and the illustrations showing the position of the various parts. Also, locate the tables showing the resistances and voltages to be expected at specified test points.

Power-Off Tests. With these preliminaries out of the way, pull out the power plug and remove the transmitter from



Ham of the Month

R. B. Smith, VE3CKG, Kingston, Ontario, Canada, became a ham three years ago shortly after a friend lent him a short-wave receiver. "Smitty" operates on all ham bands from 80 to 10 meters from his home and works 75-meter phone from his automobile. He has worked all Canadian provinces and most of the United States, plus many foreign countries. However, he prefers an interesting chat with a local ham station to a hello-and-goodby contact with a rare DX ham.

Smitty likes to build his own ham equipment or to modify war-surplus gear to his needs. His home station is housed in the metal cabinet from a soft-drink dispenser to which he has added shelves to support his equipment. When he is not operating his station, Smitty closes and locks the cabinet door. In this way, he prevents unauthorized persons from tampering with the equipment and either damaging it or injuring themselves.

Interestingly enough, VE3CKG's home-transmitter power is 50 to 75 watts, while his mobile transmitter power is 100 watts. He powers the mobile transmitter from a 117-volt a.c. generator which he constructed from a Ford Model-A "powerhouse"; the generator is driven from the automobile fan belt.

By profession, Smitty is an Area Electrical Inspector for the Ontario Hydro-Electric Power Commission. He is also Activities Chairman for the Kingston Amateur Radio Club.

cabinet. Set it on end, and blow out ssive dirt and dust. Then inspect the ssis for obvious troubles, such as broken or burned-out components, dangling wires, and bits of wire or solder lodged between any socket terminals or lugs.

Now, open the instruction manual to the resistance table, and systematically measure the resistances at the specified test points. Compare your measured values with those listed in the proper table. When you find a resistance materially different from the specified one, carefully test all components connected to that point.

Then measure the resistance of all of the capacitors. If a resistance is low, replace the capacitor. A good paper, ceramic, or mica capacitor will show a resistance measured in megohms, and a good electrolytic capacitor will measure over ½-megohm after a minute or two.

When you unsolder leads to make measurements, replace them at once so you don't find yourself with a maze of disconnected wires and no idea where they belong. And after replacing a shorted component, check the associated components—the short may have damaged them, as well.

Higher-than-normal resistance readings also call for measuring the resistance of components connected to the test point in question. Compare your measurements with the values indicated in the circuit diagram and parts list. Chokes, coils, and transformer windings usually have quite low resistances.

Power-On Tests. Some defects do not reveal themselves until power is applied. Therefore, if resistance measurements do not turn up anything suspicious, apply power to the transmitter and go through the measuring process again. But this time, measure voltages, and compare them with the values shown in the instruction manual voltage chart.

Be extremely careful while making voltage measurements to avoid a painful or even fatal shock. Also, keep a wary eye open for smoke or other indications that components are being overheated.

The above procedures will not enable you to find every cause of transmitter and receiver troubles, but they will do the trick most of the time. Try them and see.

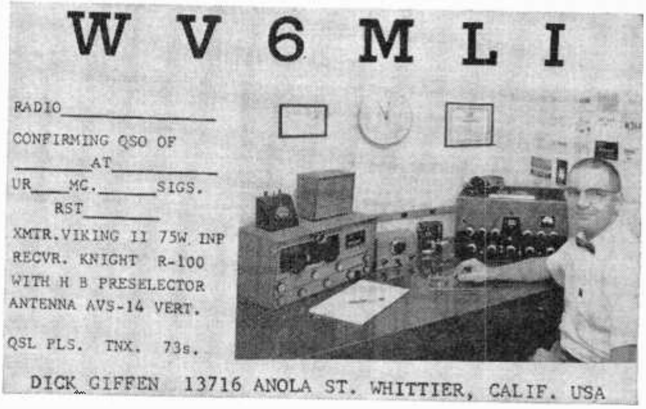
TWO-TUBE SCREEN MODULATOR

Ken Kendall, K9EXD, designed and built the two-tube screen modulator at right for his WRL Globe Chief 90A transmitter, but it can be used with any transmitter draining up to 90 watts input to the final. This power input results in a solid 30 watts of well-modulated r.f. power to the antenna.

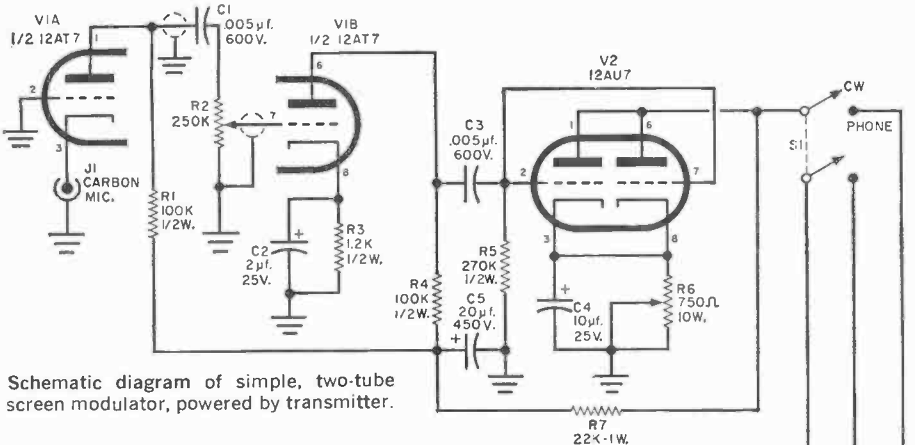
Construction. Ken built the modulator on the chassis of his Globe Chief. The modulator is small enough to fit somewhere on the chassis of most transmitters, but it can also be constructed in a 4" x 5" x 3" utility cabinet with attached chassis (Bud C-1795 or equivalent). If you use the cabinet, terminate the external connections in an octal plug and mount a matching socket on the transmitter.

To build the modulator in the "Chief," mount the 12AT7 (*V1*) and the 12AU7 (*V2*) tube sockets and the panel controls in the approximate positions shown in the photograph. Locate microphone connector *J1*, gain control *R2*, and phone/c.w. switch *S1*, one above the other, on the right side of the 90A's front panel. Then mount a 5-lug terminal strip (*TS1*) under the chassis about 1½" in front of

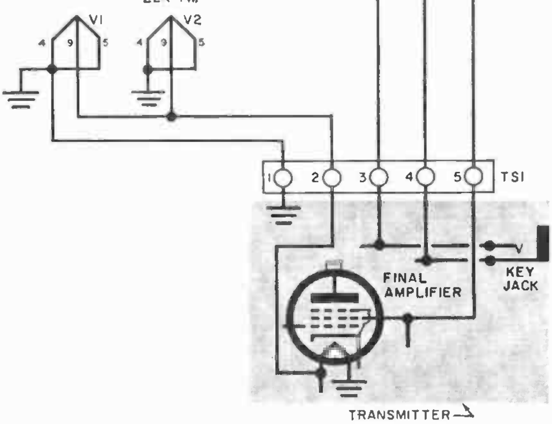
(*Continued on page* 120)



Personalized QSL card used by WV6MLI, who has worked 43 states.

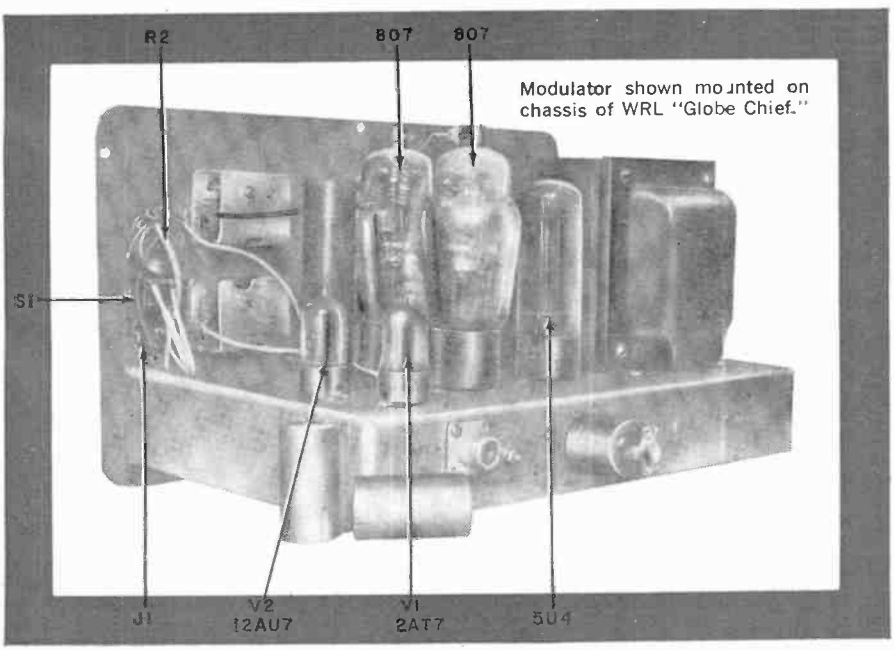


Schematic diagram of simple, two-tube screen modulator, powered by transmitter.



PARTS LIST

C1, C3—0.005-µf., 600-volt disc capacitor
C2—2-µf., 25-volt electrolytic capacitor
C4—10-µf., 25-volt electrolytic capacitor
C5—20-µf., 450-volt electrolytic capacitor
J1—Microphone connector
R1, R4—100,000-ohm, ½-watt resistor
R2—250,000-ohm, audio taper potentiometer
R3—1200-ohm, ½-watt resistor
R5—270,000-ohm, ½-watt resistor
R6—750-ohm, 10-watt adjustable resistor (set for approximately 500 ohms—see text)
R7—22,000-ohm, 1-watt resistor
S1—D.p.s.t. toggle switch
TS1—Five-lug terminal strip
V1—12AT7 tube
V2—12AU7 tube
1—4" x 5" x 3" chassis box (optional—see text)
Misc.—Hardware, tube sockets, etc.



Modulator shown mounted on chassis of WRL "Globe Chief."

Protect Your Car with this... BURGLAR ALARM SYSTEM

By WILLIAM C. LEWIS

AT ONE TIME OR another, most automobile owners have wondered whether or not the contents of their cars—or even the cars themselves—were safe from theft. Fortunately, it's not too difficult to install a burglar alarm in an automobile if you are handy with tools.

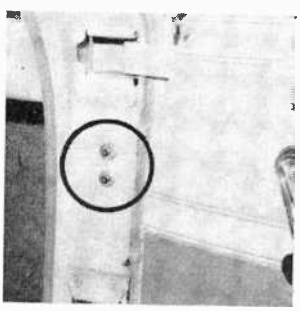
The cost of such a system depends on the type of vehicle involved and the degree of protection desired, but the minimum is generally around $12 to $15.

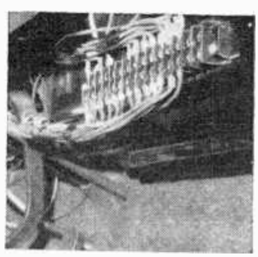
The heart of the system is s.p.s.t. relay *K1* (see diagram) which has one purpose: it prevents the burglar from disabling the alarm. Once energized, it locks itself on so that it cannot be shut off except with a key. Select either a 6- or a 12-volt relay—to match your car's electrical system.

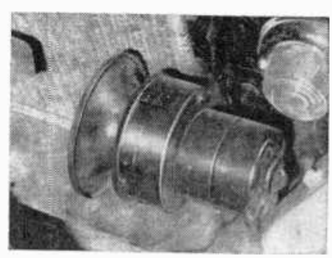
Six s.p.s.t. switches were installed by the author—on the hood, the trunk, and on all four doors. (The windows are not protected—a potential thief generally breaks a window, then unlocks and opens a door.) If desired, you can even install mercury switches to trigger the alarm if the car moves (in case the car is rolled away), or if a window is broken to admit the thief without opening the door. Simply wire any additional switches in parallel with *S1* through *S6*.

Key-operated switch *S7* will turn the alarm on and off. It should be a good-quality s.p.s.t. switch and have a key that is removable in both the "on" and "off" positions. The cheaper switches generally have simple locks and are easier to "pick."

Mount on-off switch *S7* in a convenient location, but not where it will fill up







Mounting details of the alarm system are shown in these photographs. Door switch is mounted on frame just below dome-light switch (at left, above). Terminal strip for alarm and accessory wiring is mounted below the dash (center). Alarm siren (at right, above) is located behind the radiator under the hood. The key-operated switch that controls the system (below, left) fits neatly on the doorpost.

HOW IT WORKS

An alarm—siren or auto horn—is connected across the coil of relay *K1*. When a car door is opened, one of the sensing switches (*S1* to *S6*) closes and lights pilot lamp *PL1*. With key-operated switch *S7* closed, *K1* energizes and locks up on its own contacts. With *K1* locked up, the alarm sounds until key-operated switch *S7* is opened. Opening *S7* de-energizes *K1*, and the alarm is silenced.

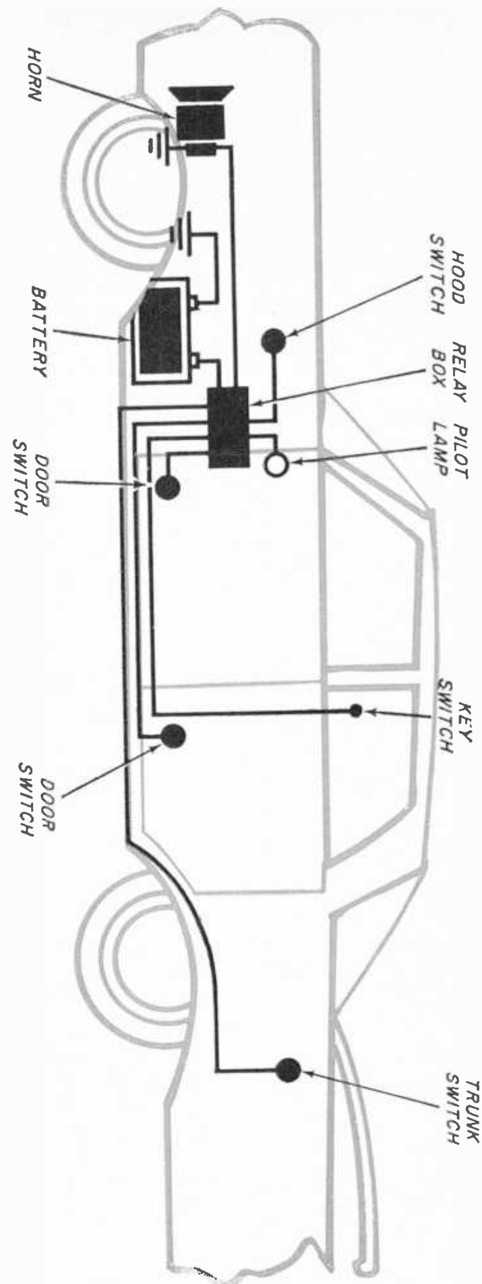
Pilot lamp *PL1* lights when any sensing switch is closed; the setting of *S7* does not affect its operation. When *PL1* is not lit, all sensing switches are open and the alarm is ready for operation.

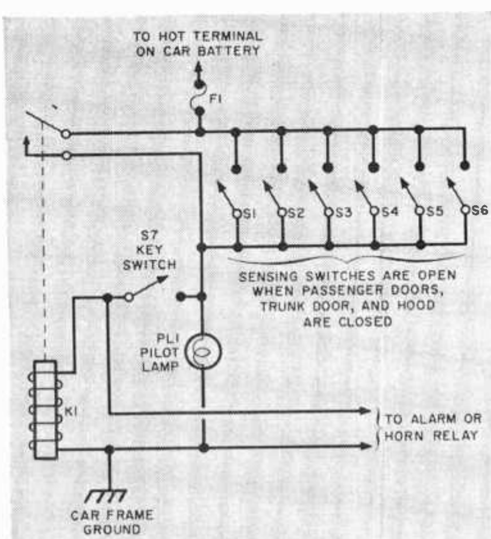
with water and freeze during the winter months.

The actual alarm should be loud and have a distinctive sound that you can easily recognize; the cheapest alarm is the existing auto horn. A separate horn or siren can be used, but this boosts the cost somewhat.

As the door switches are operated rather frequently, there is a chance of their failing. There is also a chance that a short will occur in the system wiring and blow a fuse. To avoid the possibility of this happening without the driver knowing about it, a pilot lamp *(PL1)* is used. It should light whenever any of the doors (or trunk or hood) are opened. If it doesn't light for one door but does for another, check the switch and wiring on the first door. If it doesn't light at all, check fuse *F1*.

The relay box in the author's system is mounted under the dash along with a terminal strip for the alarm system and accessory wiring. Dress the wiring into existing channels and tunnels to prevent excessive wear and the possibility of a short circuit. The fuse should have a rating high enough to handle the relay, pilot lamp, and alarm. -30-

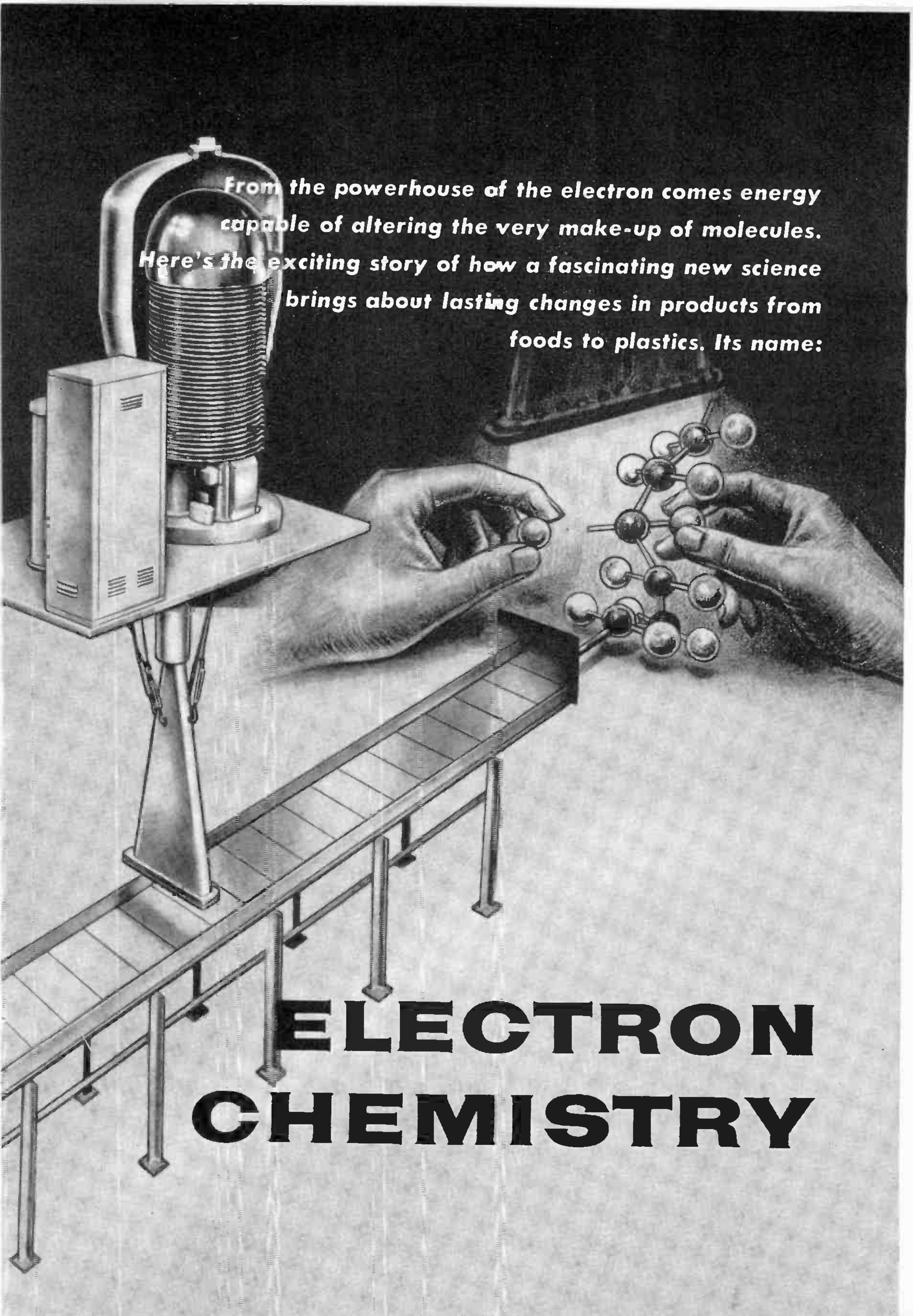




The alarm operates and relay K1 locks up when both key-operated switch S7 and any sensing switch (S1 to S6) are closed. Sketch at right, above, shows suggested spots for placing sensing switches.

PARTS LIST

F1—Fuse and inline fuse holder—see text
K1—S.p.s.t. 6- or 12-volt coil relay (Potter & Brumfield Type MR or equivalent)
PL1—6- or 12-volt pilot lamp (No. 47 for 6 volts, No. 1488 for 12 volts) and socket assembly (Dialco No. 111 or equivalent)
S1-S6—S.p.s.t., normally closed, push-button switch
S7—S.p.s.t. key-operated switch (J. C. Whitney No. 74437 or equivalent)
Misc.—Terminal strip, relay box, etc.



From the powerhouse of the electron comes energy capable of altering the very make-up of molecules. Here's the exciting story of how a fascinating new science brings about lasting changes in products from foods to plastics. Its name:

ELECTRON CHEMISTRY

By FRED E. EBEL, W9PXA

High Voltage Engrg. Corp.

READY to irradiate polyethylene with two million volts of electron energy," annouced the radiation chemist.

We nodded, and felt strangely excited as we stood in the control room adjoining the thick, concrete-walled irradiation facility. Inside those walls was a two-million-volt electron beam generator.

"Mood music" for the setting was furnished by the whine of a motor-generator set and the sibilant *sh-h-h* of a tube-window cooling blower. These sounds were augmented with a host of visual effects—meters, knobs, and dials galore, bearing such labels as *Megavolts, Milliamperes, Beam Position,* and *Focus.*

"Look through the window," instructed the radiation chemist. "You'll see something interesting."

Directly behind the radiation-resistant window was a mirror, one of several strategically positioned to provide an image of the irradiation process.

"Beautiful!" we exclaimed at the sight of three polyethylene plastic bottles, all bathed in an eerie blue fluorescence. Directly above the plastic bottles was the funnel-shaped anode of the huge electron-beam generator, looking something like a king-sized water spray attachment.

After the chemist had injected a short "spray" of high-energy electrons, we entered the test cell—but only after harmful ozone had been cleared away by a powerful exhaust system. We picked up a bottle and then—on second thought—dropped it as though it were a lit firecracker.

The chemist smiled. "Don't worry—there's no chance of radioactivity. All radiation ceases when the machine is shut off."

"Doesn't seem to be any change," we remarked, turning the bottle over and over cautiously. Again the amused smile—the radiation chemist was obviously enjoying his dramatic role.

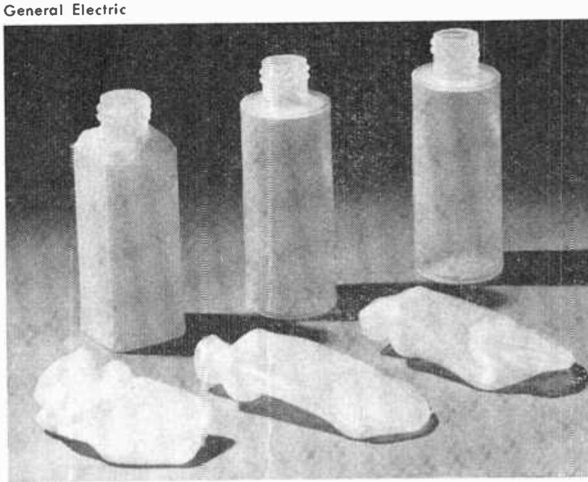
"You'll see," he said prophetically, placing the three irradiated bottles along with three non-irradiated bottles in an autoclave steam sterilizer.

We soon stood in awe at the amazing result. After twenty minutes' subjection to a temperature of 250°F, the non-irradiated polyethylene bottles had melted to shapeless blobs. But the irradiated bottles stood proudly erect, unaffected by the heat.

We had just seen one practical application of a revolutionary new science—electron chemistry.

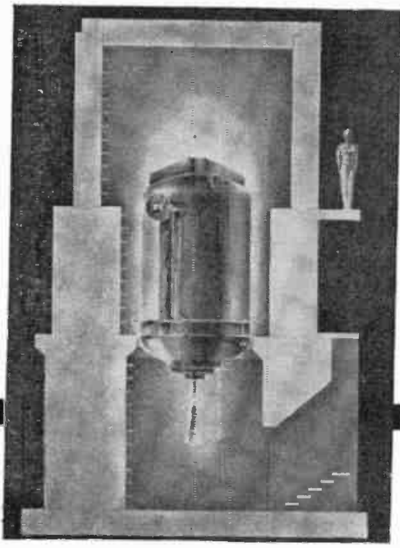
High-Energy Electrons. Scientists define electron chemistry as the use of accelerated high-energy electrons to alter or change the fundamental structure of matter to create new or improve existing products.

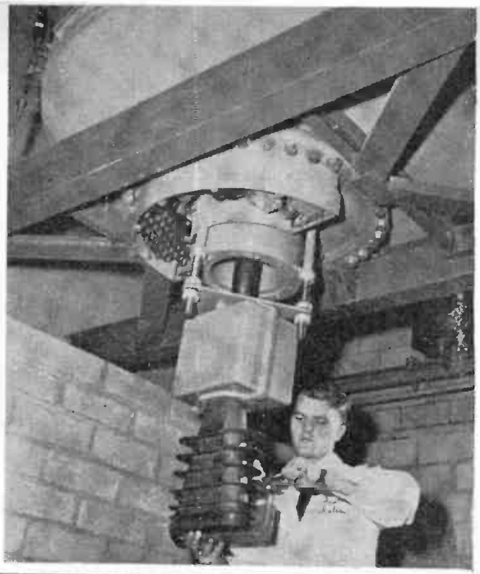
General Electric



Irradiated polyethylene bottles (top), comprised of "cross-linked" molecules, can withstand prolonged exposure to temperatures as high as 250° F. Non-irradiated bottles (bottom) wilt to shapeless blobs.

This new science uses none of the conventional paraphernalia of chemistry. Absent are acids, bases, salts, and catalysts. Nor are beakers, retorts, or pressure vessels employed. The electron is the "reagent." It was, for example, the high-energy electrons that made a stronger "unmeltable" plastic by altering





Mammoth electron beam generator (left), produced by General Electric, delivers some 3.5 million electron volts. Electrons emerge from thin titanium window at bottom of anode (funnel-shaped structure with cooling fins, above).

the molecular structure of the three polyethylene bottles.

These electrons are, in kind, the same tiny, negatively charged particles which make possible all types of electronic equipment. But here they are "beefed up"—they have "muscle." Traveling at nearly the speed of light, they boast energies in the millions of electron volts.

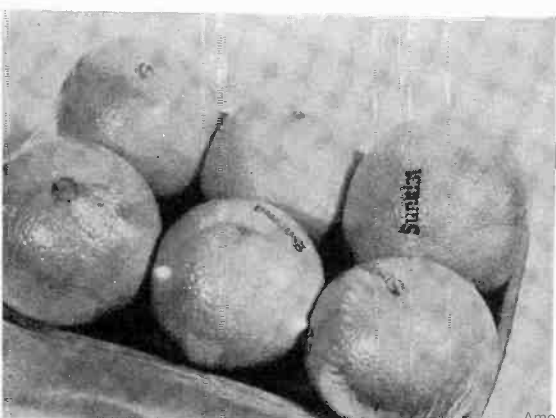
To understand why high-energy electrons can exert profound chemical changes within a substance, consider, for example, how "weak" the electrons are that bind or hold together atoms and molecules—a feeble ten electron volts, puny energy indeed compared to the one to ten *million* electron-volt "muscle-men" of an electron accelerator!

No wonder these penetrating high-energy electrons can shake up the relatively anemic binding power of electrons in molecules. Naturally, something has to happen when a powerful electrical force meets a small one. In this case, the big guy wins, and ionization or dissociation of the molecule is a result.

Polymerization. What happens is that the molecule takes on some of the energy of the powerful bombarding electron and becomes so disturbed that it throws off a planetary electron. The electron-deficient molecule is now an ion carrying a positive charge of electricity.

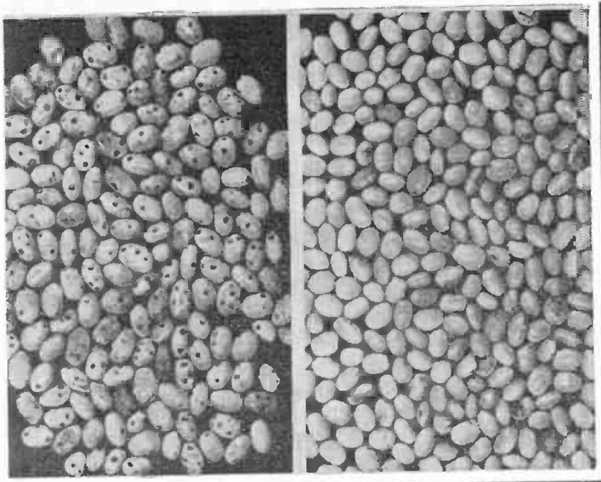
These wandering ions and other fragments of the irradiated substance enter into reactions with molecules that were not affected by the electron radiation. The "snipped-off" pieces speedily recombine to form new molecules with new properties.

This "snipping off" of atomic and mole-

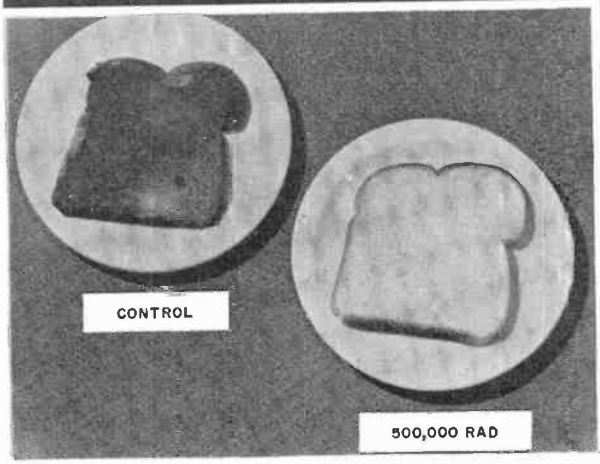


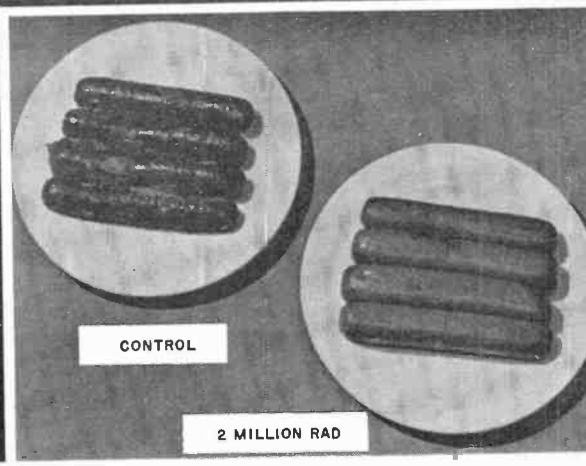
General Electric photos

Packaging film made by electron-irradiating low-density polyethylene is clear, strong, and glossy. A blast of hot air shrinks the film to make an attractive, skin-tight wrap that prevents fruit from shifting or being bruised.



Death rays for food-destroying organisms, high-speed electrons can help preserve a variety of foods. Both bean samples at left, for example, were inoculated with bean weevils, but only the irradiated sample (directly at left) resisted the insects. Applied to potatoes and onions, electrons can inhibit sprouting and greatly increase storage life. Below, left, irradiated bread remains fresh three months after treatment; frankfurters (below, right) look "good enough to eat" 92 days after irradiation.





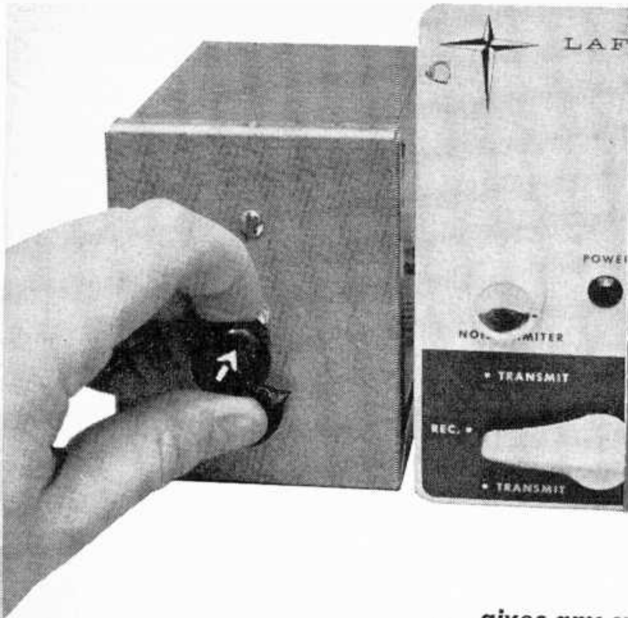
cular parts is often termed "tailoring" by polymer chemists. Polymers, if your high-school chemistry is a bit rusty, are giant molecules composed of thousands of so-called monomer units, the starting substance. In his molecular "tailoring," the radiation chemist uses high-energy electrons to "scissor-off" "parts" of molecules. These "parts" then speedily reassemble to form a new "suit."

Making giant molecules out of little ones is called polymerization. High-energy electrons can polymerize small monomers, such as ethylene gas, into giant polymers—polyethylene in this instance—without chemical assistance. And there are many polymers—rubbers, plastics, glue, and cellulose are but a few examples.

Cross-Linking. If we examine the structure of polyethylene, we can see how "cross-linking" strengthens the substance. Polyethylene is composed of long "chains" of molecules in a random configuration looking much like wet spaghetti. But by "cross-linking" the "chains," the molecules are joined together into a three-dimensional network, effectively bringing order out of chaos and greatly strengthening the polyethylene.

To put it more technically, hydrogen atoms are knocked out of polymer chains or branches, permitting cross-linking or tieing of the adjacent chains into one super molecule. In this way, irradiation furnishes the "electronic glue" that

(*Continued on page* 112)



Citizens Band Q-Multiplier

. . . gives any superhet razor-sharp selectivity

. . . cuts down on noise and static pickup

By DONALD L. STONER, 11W1507

CITIZENS BANDERS, hams, or SWL's plagued by interference on the crowded bands can pep up their receivers with an easy-to-build Q-Multiplier.* The unit improves a set's selectivity by narrowing its i.f. bandpass, thus eliminating interfering stations and reducing static and noise pickup.

Since the Q-Multiplier operates on the receiver's i.f. frequency, it can be used with any superhet receiver, including CB, ham, or SWL sets, regardless of its tuning range. However, the receiver must have an i.f. near 455 kc. or between 1300 and 1800 kc.

Completely self-contained, the Q-Multiplier has its own a.c. power supply and requires only a two-wire connection to the receiver. Operation is simple, too; using only two controls, you select the desired station and reject the ones you don't want.

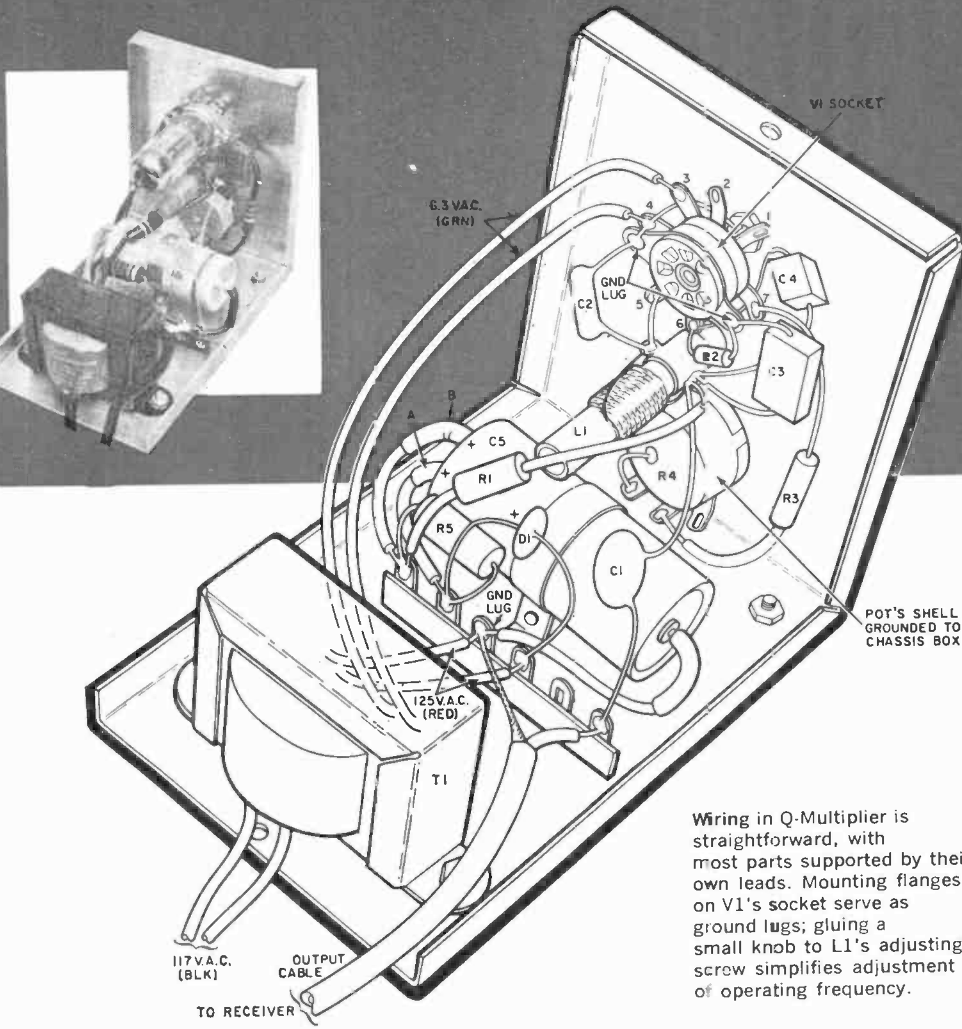
As for construction, there are no expensive parts; with all parts purchased new, you can build the unit in an evening or so for around $10.00. The wiring is not critical.

Construction. Build the unit following the layout shown in the pictorial diagram. The tube socket, tuning coil *L1*, and potentiometer *R4* are fastened to the front panel of the box; however, each requires soldering or modification before mounting.

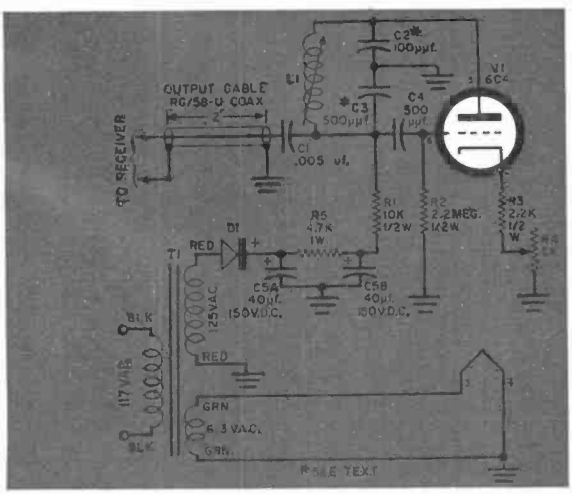
Bend out the solder lugs on the tube socket before fastening it to the front panel. Then solder a bare wire jumper through the socket's ground sleeve, pin 4, and the socket's mounting flange. Mount the socket so that pins 1 and 7 are pointing to the left when viewed from the front of the box. The socket is fastened to the box by soldering its ground sleeve to a machine screw mounted on the front panel with a nut and lock washer.

If the Q-Multiplier is to be used with a receiver having a 1300- to 1800-kc. i.f., remove 100 turns of wire from the winding of tuning coil *L1*, which is a Miller 2007 ferrite loopstick. For sets with 455-

**Developed by O. G. Villard, Jr., the original Q-Multiplier was first described in the engineering monthly "Electronics" in April, 1952.*

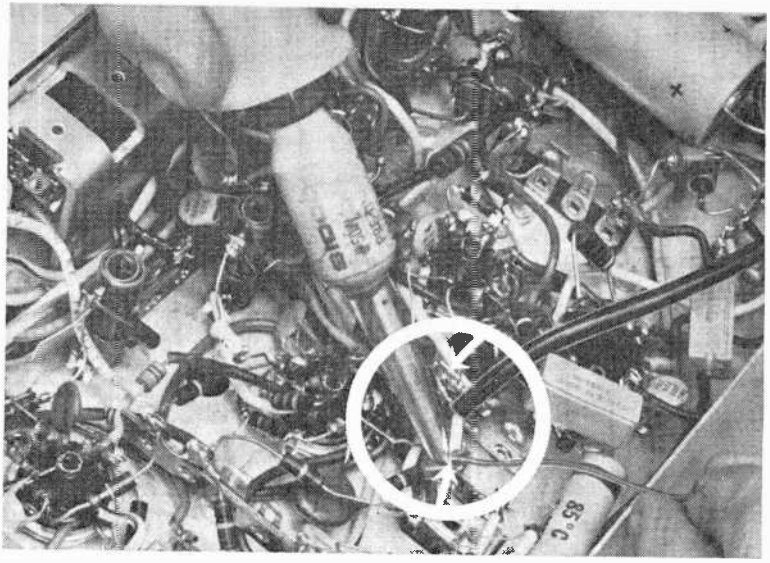


Wiring in Q-Multiplier is straightforward, with most parts supported by their own leads. Mounting flanges on V1's socket serve as ground lugs; gluing a small knob to L1's adjusting screw simplifies adjustment of operating frequency.



PARTS LIST

C1—0.005-μf., 500-volt ceramic disc capacitor
C2—100-μμf., 500-volt mica capacitor—see text
C3—500-μμf., 500-volt mica capacitor—see text
C4—500-μμf., 500-volt mica capacitor
C5a/C5b—40/40 μf., 150-volt electrolytic capacitor
D1—Silicon diode, 200 P.I.V., 200 ma.
L1—Ferrite loopstick (Miller 2007—see text)
R1—10,000-ohm, ½-watt resistor
R2—2.2-megohm, ½-watt resistor
R3—2200-ohm, ½-watt resistor
R4—5000-ohm potentiometer, linear taper (Mallory U-14 or equivalent)
R5—4700-ohm, 1-watt resistor
T1—Power transformer; 117-volt primary; 125-volt, 15-ma., and 6.3-volt, 0.6-amp secondaries
V1—6C4 tube
1—5" x 4" x 3" aluminum box (LMB 435 or equivalent)
Misc.—Hardware, RG-58/U coaxial cable, 7-pin tube socket, etc.



Hot lead of Q-Multiplier's output cable can be connected to plate of first i.f. tube at i.f. transformer (lower arrow in photo). Cable's shield should be soldered to ground lug nearby (upper arrow).

kc. i.f.'s, do not modify *L1,* but change capacitors *C2* and *C3* to 680 $\mu\mu$f. and .0025 μf., respectively.

Ground one lug of potentiometer *R4* to the shell of the control with a short bare-wire jumper, as shown in the pictorial diagram. Then mount the control.

The remaining wiring is straightforward. However, take care to watch polarities on diode *D1* and filter capacitor *C5.* Note that the output cable shown on the schematic is a 2′ length of RG-58/U coaxial cable.

Connection and Adjustment. If you build the Q-Multiplier to operate on 455 kc., it should be adjusted when you connect it to the receiver. The 1300- to 1800-kc. model requires a preliminary adjustment before being connected. To make the preliminary adjustment, tune the receiver or any broadcast-band set to approximately 1600 kc., and place the hot lead of the Q-Multiplier's output cable near the receiver's antenna. Set selectivity control *R4* to its minimum resistance position and adjust tuning coil *L1* until you hear a whistle in the receiver's speaker.

Before hooking up either model to your set, turn off both the receiver and the Q-Multiplier. Then connect the hot lead of the output cable to the plate of the first i.f. tube in the receiver, and solder the output cable's shield to the nearest ground point. If you use the Q-Multiplier with a dual conversion superhet, you must connect the hot lead to the plate of the i.f. tube which operates in the frequency range of the Q-Multiplier.

Now power the receiver and Q-Multiplier, and set selectivity control *R4* to its maximum resistance position; this is the point where the Q-Multiplier does not oscillate. When you tune in a station on the receiver in the normal manner, you should notice a considerable reduction in the volume of the received station.

To adjust the 455-kc. Q-Multiplier and to touch up the tuning on the 1300- to 1800-kc. model, set *R4* to its minimum resistance position. Adjust *L1* until a strong whistle is heard from the speaker. Now reset *R4* to maximum resistance. For maximum output, you can repeak the plate tuning adjustment on the first i.f. transformer; a quarter turn in either direction is all that is needed.

Operation. Starting with *R4* at maximum resistance, slowly decrease the resistance; you will find that the volume of the received station starts to increase as you do so. Soon the volume will increase noticeably, and voice signals will begin to sound rather bassy. Any further decrease in *R4*'s resistance will cause the Q-Multiplier to oscillate and the received station will be blotted out.

Back off *R4* until the oscillation just stops; this is the most selective point in *R4*'s range. Now adjust both *L1* and *R4* slightly, for best results. Whenever you tune in a new station, both of these controls should be readjusted. -30-

On the Citizens Band

By TOM KNEITEL, 2W1965

I'M beginning to feel that a hefty percentage of CB'ers can be sorted into the following categories:

A. Those who have never read Part 19 of the FCC Rules
B. Those who have read it, but can't read well
C. Those who have read it, but couldn't understand it
D. Those who understood it, but don't give a hoot

Now, your personal opinion of Part 19 is your business—no one will say that you haven't a right to that opinion. And don't think that an IBM machine writes this column every month—I also have my own opinion of Part 19. It may or may not agree with yours. But that's not the point.

You might not like traffic lights but when one turns red you either bring the Model T to a halt or take your chances with getting your lumps from the law. And so it is, dear friends, with CB.

There is no possible excuse, at this stage of the game, for so much flagrant disregard of FCC regulations. And I especially aim a bony accusing finger at you guys with the low call signs who have been around for a while and *do* know better.

No matter how boobish you may think the FCC is (and you evidently do if you are openly ignoring their rules), you can't really think they don't know that your "test" call is a thinly veiled "CQ." You can't really think the FCC monitor is smiling and saying, "Boy, that Elmer is a wonderful CB'er—keeps testing his rig to see if it's operating properly. Guess he's got a licensed technician with him in case the transmitter does need some adjustment."

This goes for playing music over the air, working "skip" DX, jamming with a dead carrier because someone had the nerve to use "your" channel, interjecting "clever" remarks into other stations' traffic, and other assorted megacycle mayhem common to CB.

Unless you wiseacres cut out the monkeyshines, you're going to have only yourselves to blame when the Day of Reckoning comes and you're sitting with an unlicensed "wasted investment" CB rig. I'd also suggest that good-natured parents who bought "Junior" a CB rig and then obtained "his" license in their own name, take a good look at what "Jr." might be doing to their good name in the community.

Saw some nice "Scotchlite" reflective call letters on a mobile unit the other day. They looked so neat that we asked the CB'er for the scoop on them.

The letters are two inches high and white with a black border to reflect light at night. Each set costs $1.50, and for 50 cents more you can also get "USA" in reflective letters. If you order two call-letter sets, the "USA" is thrown in at no extra cost. The distributor is Allied-International, CBC Index Div., P. O. Box 112, Prince Station, New York 12, N. Y. Allow two weeks for delivery.

CB for the birds? It has gone to the Portland (Oregon) Zoo, that's for sure. The zoo operates a network of Raytheon

CB rigs between their Tom Thumb kiddie railroad station and the rolling stock of the line (a miniature streamliner and a miniature antique steam train). Just like the for-real railroads, the Tom Thumb Line uses two-way radio to dispatch trains and maintain proper schedules. The trains take the kiddies on a tour through the zoo over a four-mile stretch of track.

We goofed in the January column when we reported that the "Jersey 5 Watters" were soon to become an independent affiliate of another CB club. Jack Orlovsky of the Jersey 5 Watters called us to set the record straight. His club has made no plans to date to team up with any other organization. By the way, if you live out Jersey way and would like to join an active CB club, write to the Jersey 5 Watters, 113 Dailey Ave., Hillside, N. J.

Speaking of clubs, newspapers were received here recently from Cleveland's Hillcrest Citi-Band Club and The Southern California 11 Meter League. Many of the advantages of belonging to a club which takes the trouble to publish a club paper are borne out by these two papers. Technical hints, news of club activities and services, sell and swap items, personal items, etc., are to be found in both. And the Cleveland club has a strong anti-nonsense on-the-air policy which we certainly commend.

A real swingin' club in Syracuse, N. Y., has the interesting name "MCEU," meaning Mobile Civil Emergency Unit. Their fine 14-page newspaper contains information on each of their various chapters around New York State. A look through its pages shows that they aren't sitting around rag-chewing on the band, but instead are giving the members quite a bit of service for their dues. For instance, they have design contests, supervised "drag" races, advice on the use of CB equipment, barbeques, picnics, etc. MCEU members can be identified by the snazzy window sticker shown here, —most are in the 20W call area. Contact 20W1267 for details.

Up in Holyoke, Mass., CB'ers belong to the Pioneer Valley Five Watters, whose 7-page paper gives details of their PVFW Emergency Net. Write 1W6903 if you're interested.

The Chicago CB gang receives club information from the nifty bulletin of the Citizens Radio League, Inc. The CRL makes good use of humor in its bulletin (and we got a big kick out of it, incidentally) as well as providing interesting information on members and doings. For more data on the CRL, get in touch with 18W5847.

Quite a few readers have written to this column about the taxi cab dispatcher on Channel 11 that goes on hour after hour and never signs a call. Unbeknownst to most CB'ers in the east, this station is audible through the entire midwest and Gulf Coast. It has a woman dispatcher announcing such places as Government Gate, Happy Valley, North Street, Mount Hill, etc. Our Editor, 2W1665, has just returned from Washington and tells me that the station is in Bermuda! It is legit, since the 11-meter band is assigned to such services outside of the U.S.A.

Here's some happy news about the work CB'ers are doing in conjunction with Boy Scouting.

Thirty-two CB mobile units directed a convoy of 550 cars and buses bringing 10,000 Scouts to a Boy Scout powwow in Ottawa, Ill. The whole operation took only 30 minutes, after which the mobile units stayed in operation for the entire three days of the shindig.

Using two control centers on Channel 16, the messages became so numerous that it took two secretaries to log them. By the end of the operation, over 2500 messages had been handled, including eight emergency calls. This traffic-handling involved 1100 man-hours.

The participating CB'ers were members of the Ottawa Five Watters and the Utica Mighty Modulators. –30–

ADVANCED EXPERIMENTERS CORNER

Radio-Control 11-Meter Receiver

By PERRY WINTER
Associate Editor

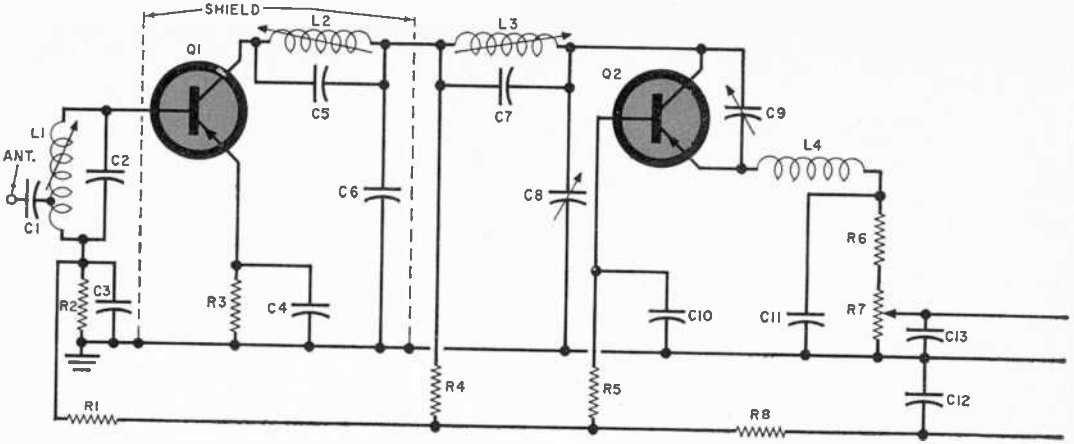
USING only five transistors, this sensitive R/C receiver is intended to be a companion unit for the 11-meter R/C transmitter described in the February 1960 issue of POPULAR ELECTRONICS. But you don't need the companion transmitter if you already have a Citizens Band transmitter—your present CB rig or Part 15 pocket transmitter will operate the receiver on the 27.255-mc. radio-control frequency with only a slight modification. More about that later.

The receiver was designed* to operate on a r.f. signal modulated with a 750- to 1400-cycle tone. This means that nearby transmitters, even diathermy machines operating on the same r.f. frequency as the receiver, won't key the receiver unless they too are modulated with the required tone. The receiver is so sensitive that only 1.2 microvolts at the antenna with a 50% modulation at 1000 cycles will energize the receiver's control relay.

Starting from scratch, all the parts needed to build the receiver cost approximately $35.00. Wiring in the two r.f. stages of the unit is more or less critical. However, over half the receiver's circuitry operates at audio frequencies and doesn't require any special shielding or wiring precautions.

The construction job should give you

*Designed by Texas Instruments Inc., Box 312, 13500 N. Central Expressway, Dallas, Texas.



Transistorized 11-meter receiver has only two
and Q5 operate relay K1 when tone-modulated

PARTS LIST

B1—22.5-volt battery (RCA VS084, Burgess U15 or equivalent)
C1, C3, C4—0.01-µf. ceramic disc capacitor
C2, C7—18-µµf. mica capacitor
C5—22-µµf. mica capacitor
C6—68-µµf. ceramic disc capacitor
C8, C9—1.5 to 7 µµf. ceramic trimmer capacitor
C10—0.001-µf. ceramic disc capacitor
C11, C15—0.1-µf. ceramic or paper capacitor
C12—0.05-µf. ceramic disc capacitor
C13, C14—0.02-µf. ceramic disc capacitor
C16—0.002-µf. ceramic disc capacitor—see Alignment/Adjustment Procedure
C17—5-µf., 25-volt electrolytic capacitor
C18—50-µf., 6-volt electrolytic capacitor
C19—100-µf., 25-volt electrolytic capacitor

All capacitors 50 w.v.d.c. unless otherwise specified

K1—10,000-ohm relay, s.p.d.t. contacts (Potter and Brumfield RS5D or equivalent)
L1, L2, L3—14 turns of No. 25 enameled wire close-wound on Cambridge Thermionic PLS6-2C4L/O or equivalent 30-mc. slug-tuned coil form 27/32" long x 1/4" diameter—coil L1 is center-tapped
L4—22-microhenry, 2.5-ohm r.f. choke (Delevan 1537-44, Ohmite Z-28 or equivalent)
L5—25-millihenry choke (Millen 24225 or equivalent)
L6—8.5-henry choke (Stancor C1279 or equivalent)
Q1, Q2—2N1107 transistor (Texas Instruments)
Q3, Q4, Q5—2N185 or 2N1370 transistor (Texas Instruments)
R1—22,000-ohm resistor
R2—3900-ohm resistor
R3, R4, R6—1000-ohm resistor
R5—220,000-ohm resistor
R7—100-ohm linear potentiometer (IRC WPK or equivalent)
R8—3300-ohm resistor
R9—47-ohm resistor
R10—6800-ohm resistor
R11—62,000-ohm resistor
R12—4700-ohm resistor
R13—27,000-ohm resistor

All resistors 1/2-watt unless otherwise specified.

S1—S.p.s.t. switch
T1—Transistor transformer, 10,000-ohm primary to 2000-ohm center-tapped secondary, CT not used (Thordarson TR-7 or equivalent)
1—Aluminum box—see text
Misc.—Hardware, transistor sockets, feedthrough studs, etc.

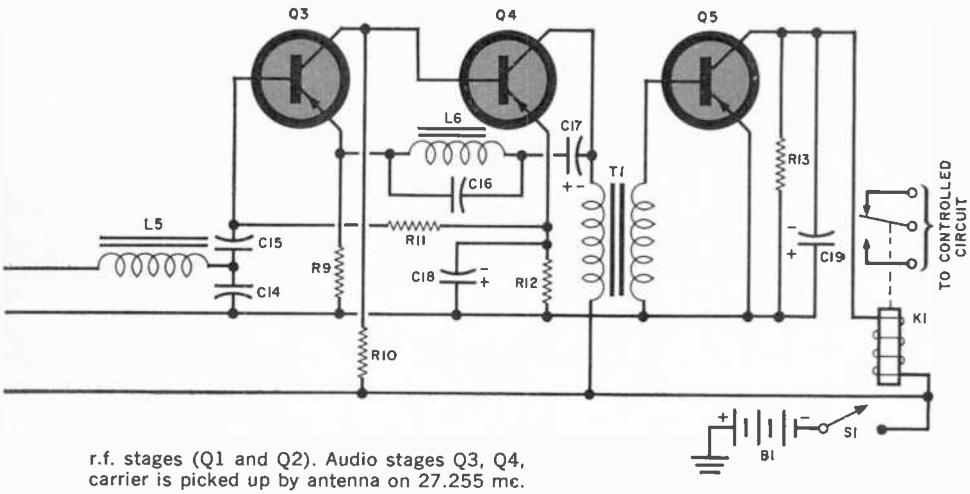
no trouble if you are familiar with the short, direct wiring and shielding techniques that are the stock in trade of high-frequency circuits.

Circuit Design. Let's examine some of the design details to see how the receiver does its job. The incoming signal, a tone-modulated carrier on 27.255 mc., is applied to a common-emitter r.f. amplifier (*Q1*.) While it provides only a little gain, *Q1* mainly serves to isolate the superregenerative detector (*Q2*) from the antenna; the presence of *Q1* also makes the detector easier to adjust.

Transistor *Q2* operates as a self-quenched superregenerative stage; the r.f. signal is fed into the collector and the audio output is taken from the emitter. A detector of this type is desirable for remote-control equipment because of its high gain and simplicity. The detector's lack of selectivity can be tolerated since it is followed by a high-gain narrow-band audio amplifier (transistors *Q3* and *Q4*).

Detector *Q2*'s output is an ultrasonic quench signal of about 50 kc. mixed with the audio of the detected signal. The quench filter (*L5-C13-C14*) passes the audio and rejects the quench frequency. Without the filter, the quench signal would overload the audio stages, preventing their proper operation.

The audio signal from the quench filter is then amplified in the two-stage tuned amplifier (*Q3* and *Q4*). Undesired sig-



r.f. stages (Q1 and Q2). Audio stages Q3, Q4, carrier is picked up by antenna on 27.255 mc.

nals outside of the receiver's designed 750- to 1400-cycle bandpass are eliminated in the amplifier; thus, unmodulated stray carriers on the receiver's frequency will not key the receiver.

After amplification, the audio is rectified and re-amplified by *Q5* to operate relay *K1*. The relay contacts can be used to control such equipment as garage door openers, driveway lights, or model boats and trains.

Construction. For valuable construction hints on how to build the receiver, refer to the article on the companion transmitter previously mentioned. In any case, the larger the box you use for the receiver, the fewer the construction problems. With a 7" x 5" x 3" aluminum box (Bud CU-2108A or equivalent), you should have little trouble mounting the parts.

No matter what size box you choose, be sure there is enough room to mount the two interstage shields. One shield is located between transistor *Q1* and antenna coil *L1*, the other between coils *L2* and *L3*. The shields are made from sheets of scrap aluminum and should span the width of the box.

For best results, use a single No. 14 tinned busbar for the ground bus. This busbar should run unbroken from the side of the shield next to *Q2*, down the length of the receiver to *Q5*. Only the ends of the busbar should be grounded. A separate ground is made on the other side of this shield as well as on each side of the shield between *Q1* and *L1*.

Use a second busbar for the B-minus line. Note that this line is interrupted by resistor *R8*, which isolates the audio and r.f. sections of the receiver. The B-minus bus should be passed through the shields, with insulated feedthrough studs.

Coils *L1*, *L2*, and *L3* are the familiar slug-tuned coils which are mounted by their threaded screws. All other parts are supported by their leads or are fastened to the box with standard hardware. The transistors are soldered to terminal strips using a heat sink, or sockets can be used, as desired.

Alignment and Adjustment. To speed up alignment and adjustment of the receiver, it's best to have an a.c. VTVM and a 0-5 ma. milliammeter on hand before you start. You'll also need either the modulated version of the companion, Part-15 11-meter transmitter or a CB transmitter equipped with a 27.255-mc. crystal. If you use a Part 15 transmitter, no license is required; but if you use a CB rig, you'll need a Class C (radio-control) license.

With the CB transmitter and the Class C ticket, a pitch-pipe or 1000-cycle generator is also required. To key the receiver, you will have to whistle the tone into the CB transmitter's microphone when called for in the adjustment procedure. (See instructions on next

ALIGNMENT/ADJUSTMENT PROCEDURE

Starting with alignment of the r.f. section, connect a low-impedance (50- to 75-ohm) Citizens Band antenna to the receiver's antenna terminals. Switch on the receiver and proceed as follows:

1. Set coils *L1, L2, L3* and trimmer capacitors *C8 and C9* to their mid-range positions.
2. Rotate the arm of potentiometer *R7* to its ungrounded end.
3. Connect an a.c. VTVM, set to a low-voltage scale, between the collector of *Q4* and ground.
4. Temporarily disconnect either side of capacitor *C17* from the receiver's circuit.
5. Adjust trimmer capacitor *C9* until the detector stage *(Q2)* regenerates—oscillation will be indicated by a large increase in the reading of the VTVM.
6. Turn on the transmitter. If you use the companion 11-meter transmitter, remove its antenna and bottom cover—only a weak r.f. signal source is needed for the receiver. If a CB rig is used, no modulation is required in this step.
7. Adjust coil *L3* for a maximum reading on the VTVM.
8. Couple the transmitter closer to the receiver's antenna.
9. Adjust coil *L1* for a maximum reading on the VTVM.
10. Adjust coil *L2* for a maximum reading on the VTVM.
11. Adjust trimmer capacitor *C8* for a maximum reading on the VTVM.
12. Adjust trimmer capacitor *C9* for a maximum reading on the VTVM. If regeneration stops when *C9* is adjusted—this will be indicated by a sudden drop in the VTVM reading—back off on *C9* a bit until oscillation is restored.
13. Repeat steps, 9, 10, 12, and 11, in that order.
14. Reconnect capacitor *C17*. This completes the r.f. alignment.

After r.f. alignment, the audio filter *(L6-C16)* is adjusted to provide best gain and selectivity at 1000 cycles. This is done as follows:

1. Set potentiometer *R7* to its mid-range position.
2. Connect an a.c. VTVM, set to a low voltage scale, between the collector of *Q4* and ground.
3. Turn on the transmitter—the rig should now be modulated with a 1000-cycle tone as described in text.
4. Change the value of fixed capacitor *C16* by substituting different values until the highest reading is obtained on the VTVM. This completes the adjustment of the audio filter.

When both the r.f. alignment and the 1000-cycle filter *(L6-C16)* adjustments have been completed, the sensitivity control, potentiometer *R7*, is then adjusted. To get maximum sensitivity from the receiver, adjust *R7* as follows:

1. Disconnect the receiver's antenna.
2. Insert a 0-5 ma. milliammeter in series with relay *K1* and the B-minus busbar.
3. Adjust *R7* for a 1.5-ma. reading on the milliammeter—this level is approximately 2 ma. less than the required energizing current for relay *K1*.
4. Test the operation of *K1* by connecting the receiver's antenna and by keying the companion transmitter or tone-modulated CB rig. Relay *K1* should energize when the transmitter is keyed and it should de-energize when the transmitter is turned off. With the CB rig, the relay should de-energize when the tone modulation is cut off—the unmodulated carrier, by itself, should not cause *K1* to operate. If relay *K1* does not de-energize in the transmitter-off or modulation-off condition of the respective transmitters, then *R7* should be readjusted slightly until *K1* de-energizes. This step completes the maximum sensitivity adjustment of the receiver.

page.) If you don't have a pitch pipe, connect a calibrated audio generator to the microphone jack.

No external modulation is required if you use the modulated version of the companion transmitter, since a 1000-cycle tone generator is incorporated in it. When this transmitter is keyed on, it will generate a carrier on 27.255 mc. modulated with 1000 cycles.

Operation. Under actual operating conditions, maximum sensitivity of the receiver may not be needed. In fact, high sensitivity may cause control relay *K1* to lock on after the tone-modulated carrier is removed. It is also possible that nearby transmitters on 27.255 mc. could accidentally key the receiver if these transmitters were modulated with an audio tone near 1000 cycles. For example, a 3.7-microvolt r.f. carrier modulated with 750 cycles or a 10-microvolt carrier modulated with 1400 cycles could key the receiver if it is adjusted for maximum sensitivity.

To avoid accidental keying of the receiver and for operation over short ranges, proceed as follows. Align the receiver's r.f. section and the 1000-cycle filter (*L6-C16*), as described above. Then, mount the receiver and its antenna in their permanent locations. Connect the antenna to the receiver using RG-58/U or RG-59/U coaxial cable, and switch on the receiver.

Place the transmitter at the maximum range from which operation is desired. If you are going to operate your garage door or driveway lights with the contacts of relay *K1*, for example, locate the transmitter in your driveway. Now, turn on the transmitter's modulated carrier and adjust *R7* in the receiver until relay *K1* just "pulls in." Turn off the transmitter. Relay *K1* should now be de-energized; if it does not de-energize, readjust *R7*. —30—

Transistor Topics

By LOU GARNER

ALTHOUGH chill breezes continue to howl over many parts of the nation and snow is still piled high in some areas, it's not too early to start shaping up your plans for spring and summer. Boating enthusiasts, particularly, may want to review their sea-going electronic gear with a view toward adding a few new items—and if these items are to be assembled from kits, *now* is a good time to start wiring them to insure shipshape equipment when launching time arrives.

Pehaps the most valuable item a boat owner can add to his vessel is a good radio direction finder. This instrument can be used for entertainment purposes, as a source of weather news, and—when you're out of sight of familiar landfalls—as a real aid to navigation.

Heath's DF-3 "Mariner" combines most of the features desired in a radio direction finder. Available in both kit and factory-assembled form through locally franchised dealers as well as direct from the Heath Company, Benton Harbor, Mich., the DF-3 is a fully transistorized, battery-powered, three-band superhet receiver. With an i.f. of 455 kc., the instrument tunes

Heath DF-3 "Mariner"

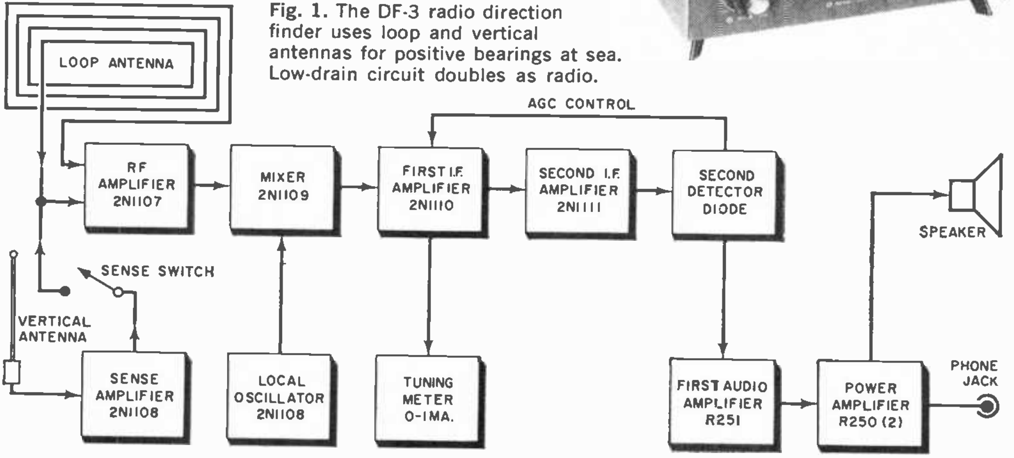
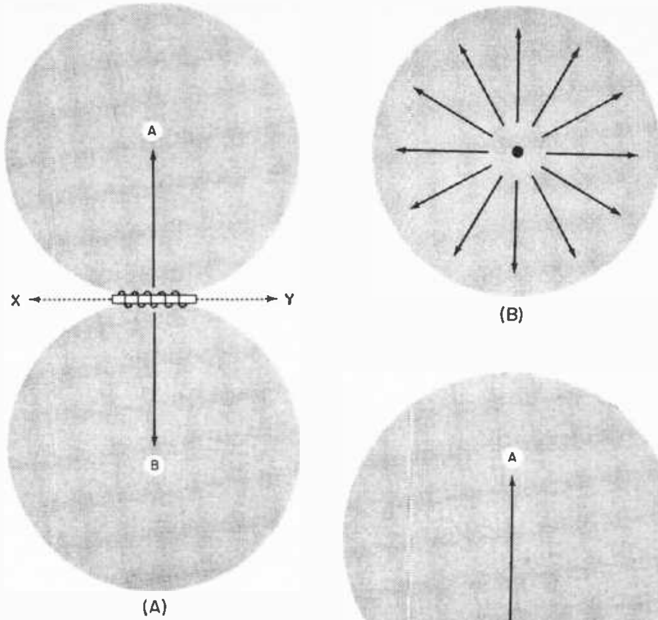


Fig. 1. The DF-3 radio direction finder uses loop and vertical antennas for positive bearings at sea. Low-drain circuit doubles as radio.



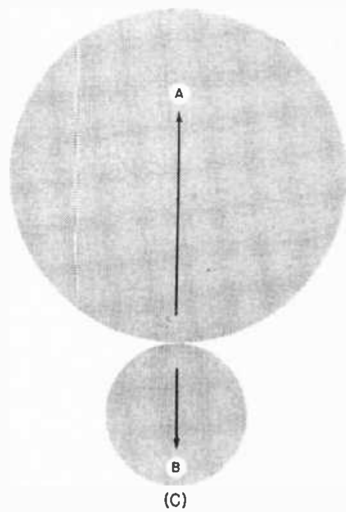


Fig. 2. Operation of a radio direction finder can be explained by analyzing the pickup patterns of two different types of antennas. A loop antenna (A) has maximum pickup in directions A and B, minimum pickup in directions X and Y; a vertical antenna (B) has a uniform sensitivity pattern. Combining the two antennas (C) provides maximum sensitivity in direction A only.

the low-frequency beacon band (198-410 kc.), the standard AM broadcast band (535-1620 kc.), and the short-wave marine band (1650-3450 kc.). Maximum audio output power is 380 milliwatts, delivered to a 4" x 6" oval weather-resistant PM loudspeaker.

Operating power is supplied by a built-in power pack made up of six standard size-"D" flashlight cells supplying a total of 9 volts. Current drain is approximately 20 ma. at a 50-milliwatt output level, giving an average battery life of from 500 to 1000 hours. Physically, the DF-3 measures 8" high by 9" deep by 10" wide and weighs 9¼ pounds (with batteries installed).

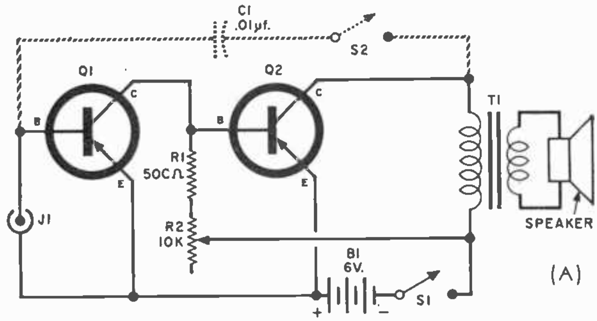
A block diagram of the receiver is given in Fig. 1; *p-n-p* transistors in the common-emitter arrangement are used in all stages.

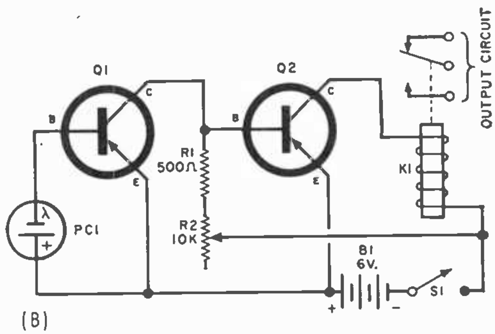
In addition to the familiar loop antenna, a vertical whip antenna and broadband untuned r.f. amplifier are provided. The vertical antenna and r.f. amplifier combination can be connected in addition to the receiver's loop antenna, and serves to add a directional "sense" to the instrument's indicated heading. To see why the additional circuit is needed, and how it works, refer to Fig. 2.

In its basic form, a loop-type antenna has a sensitivity pattern resembling a figure "8," as shown in Fig. 2(A). Maximum sensitivity is at *right angles* to the plane of the loop (or bar), with minimum sensitivity along a line *through* the bar. Thus, maximum signal pickup is in directions "A" and "B" and minimum pickup in directions "X" and "Y." This directional characteristic is well known, and can be demonstrated quite easily with *any* portable receiver using a loop-type antenna. Simply tune in a weak station and rotate the set slowly, noting increases and decreases in receiver volume.

Although the simple loop can be used for directional indication by rotating it for maximum (or minimum) pickup from a station, it suffers from a serious disadvantage—the station may be located on either side of the loop. (It was this disadvantage, according to many authorities, which caused the crew of that ill-fated World War II bomber, the "Lady Be Good," to overshoot its base and crash in the Libyan desert.) A vertical or

Fig. 3. Two circuits submitted by reader A. Ravindranathan, of India, are essentially the same but are used for different purposes. In his first circuit (A), capacitor C1 and switch S2 convert a standard audio amplifier into an oscillator. In the second circuit (B), light falling on the sun battery PC1 energizes relay K1. See text.





"whip" antenna, in contrast to the loop, has an omnidirectional pattern; as shown in Fig. 2(B), it picks up signals equally well from *all* directions.

When the signals picked up by both loop and vertical antennas are combined, the resulting pattern is that of a somewhat distorted figure "8," shown in simplified form in Fig. 2(C). This pattern results because the signals picked up in one direction from the loop are out-of-phase (and tend to cancel) with the signals picked up by the vertical antenna, while signals picked up on the opposite side of the loop are in-phase with (and reinforce) the signals picked up by the vertical antenna. Thus, when both antennas are used together, maximum signal pickup is in direction "A"—see Fig. 2(C)—and adjustment of the loop for a given directional heading will provide an accurate indication.

In the DF-3, the vertical "sense" antenna is used only when needed for position and heading checks. It is not needed when the receiver is used as a simple broadcast set for entertainment, or for weather or news reception.

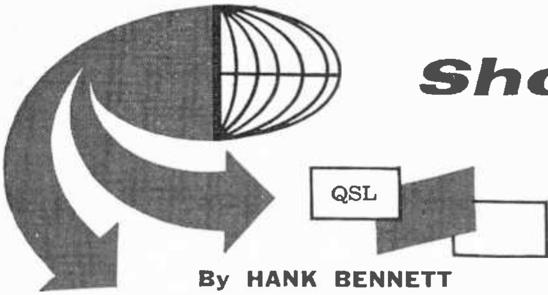
Many potential assemblers of the DF-3 will be pleased to hear that Heath has preassembled, wired, and *prealigned* the entire "front-end," including the r.f., mixer, and local oscillator circuits. The rest of the receiver is comparatively easy to assemble and adjust using the large-size pictorial diagrams and step-by-step instructions furnished.

Readers' Circuits. Many overseas readers complain that they have difficulty securing transistors, diodes, and other U. S.-made components for their projects—a number of them rely on friends in this country to help them obtain parts. In view of this situation, yours truly was pleasantly surprised by a recent letter from a Mr. A. Ravindranathan in India. Mr. Ravindranathan enclosed several interesting circuits he had developed using standard (U. S.) components, two of which are shown schematically in Fig. 3. These circuits are essentially alike, featuring a pair of *p-n-p* transistors as direct-coupled common-emitter amplifiers. A combination audio amplifier and oscillator is shown in Fig. 3(A), and a light-controlled relay in Fig. 3(B).

In operation, signals applied to transistor *Q1*'s base-emitter circuit are amplified by this stage and applied directly to transistor *Q2*'s input circuit. The amplified output signal from *Q2*, in turn, is applied to the output load device—the primary of audio transformer *T1* in Fig. 3(A) or electromagnetic relay *K1* in Fig. 3(B). Transistor *Q1*'s adjustable collector load resistor, *R1-R2,* serves both to determine *Q2*'s fixed base bias and to control *Q1*'s effective stage gain. In both circuits, *Q1* is an RCA Type 2N215, *Q2* a Type 2N217. Resistor *R1* is a 500-ohm, ½-watt unit, and *R2* is a standard 10,000-ohm potentiometer.

In the amplifier-oscillator circuit, *J1* is a standard phono jack, capacitor *C1* a 0.01-µf. ceramic or paper unit, switch *S2*

(*Continued on page* 114)



Short-Wave Report

By **HANK BENNETT**
W2PNA/WPE2FT

GEORGE and Nancy Ann Wlodarski—a brother-sister DX'ing team—live at 4337 289th St., Toledo 11, Ohio. Nancy is 17 years old, a sophomore in high school, and holder of the call WPE8BOO. George, 22 years old, and the operator of amateur station K8ABR, was just recently discharged from the U. S. Air Force where he specialized—for four years—in radio and radio repair.

The line-up of equipment at the Wlodarski's is formidable, and in all likelihood is in operation more than it is off. The bank of receivers consists of three Hallicrafters units: an SX-99, an S-38D, and an SX-140. All three of the receivers operate from one antenna, a Mosley vertical mounted 20 feet above the top of the house.

Nancy is the real SWL of the family, for it is she who has compiled a log of 20 countries heard, 8 verified. She has been SWL'ing for nearly two years. In all, she has a total of 20 verifications, and the list is growing steadily. Her best veri to date is from OZF, *The Voice of Denmark,* Copenhagen.

Nancy's favorite short-wave bands center around 19 and 49 meters (15,000 and 6000 kc., respectively) and, in addition, she is very much interested in the long-wave band from 10 to 100 kc. (Brother George has just completed construction of a converter to cover this band.) Her favorite programing—musical—comes from Stockholm, Warsaw, Berne, and Copenhagen. Moscow also rates as a favorite, for Nancy is able to obtain news from the Iron Curtain standpoint and use some of it in her classes at school.

When George takes over on two-way communications, Nancy's activities are hampered somewhat—her future plans call for an amateur license of her own. If George looks familiar to you, it may be because you saw his picture in last month's *Across the Ham Bands,* together with the Wlodarski equipment.

Nancy Wlodarski and her brother George, who holds amateur call K8ABR, share the same listening post. The Wlodarski's have quite an array of equipment, only part of which is shown here.

In Libya, three years ago, George operated with the call 5A3TF and worked

(*Continued on page* 124)

By
JOHN T. FRYE
W9EGV

Carl and Jerry

A Low Blow

IT WAS two whole weeks since Carl and Jerry had talked face to face. Jerry had been home from school sick with influenza, and the boys' parents had kept them apart to prevent Carl's catching the virus infection. The two had managed to keep in touch by chatting on the phone, by talking over their ham stations, and—since their bedroom windows faced each other—even by blinking Morse code on flashlights from one window to the other. But Jerry had finally recovered sufficiently to be down in his basement laboratory this warm, windy Saturday morning, and to have Carl visit him.

"Hi, Jer," Carl said gruffly as he came in through the outside basement door. "How's my puny pal? You look kinda pale around the gills."

Jerry turned away from the large, wide-mouthed glass jar sitting on the workbench in front of him to bestow a fierce scowl on his friend.

"Don't 'puny pal' me, you big ox! Disgustingly healthy people make me sick!"

"Now, now, there!" Carl murmured with mocking solicitude. "We mustn't get upset. Remember: we are not well. And what are we doing with that goldfish bowl?"

"*I* am getting ready to test my infrasonic microphone," Jerry said curtly, turning back to the fishbowl that had a thin membrane of rubber stretched over the top. Inside was a small, brass-topped glass jar containing some transistors and other components mounted on a little circuit board. Two tiny twisted wires of the sort used in record-player tone arms came out of a wax-sealed hole in the bottom of the jar, ran up over the edge of the bowl beneath the rubber membrane, and were connected to the input of a tape recorder sitting on the workbench.

"I need more information than that," Carl cheerfully confessed. "What is this 'infrasonic' jazz? I've never heard you mention a project like that before!"

"In physics you *should* have learned that sound recognized as such by the human ear goes down in frequency to about 12-15 cycles," Jerry explained; "but there are other compression and rarefaction waves in the atmosphere at much lower frequencies. These are called 'infrasonic waves,' and we are surrounded by them even when our ears hear nothing.

They obey the same laws as sound waves: their speed varies as the product of the square root of the absolute temperature and a constant related to the conducting medium.

"At 32°F," he continued, warming to the subject, "sound travels about 1087 feet per second in air, and the speed increases as the temperature rises. The rate at which sound power is absorbed and dissipated into heat depends on the frequency. The fraction of sound power absorbed per unit distance of propagation is roughly proportional to the square of the frequency. That explains why you hear the bass drum of an approaching band first, and it also means that only low inaudible frequencies can be propagated great distances."

Carl started to say something, but Jerry didn't give him a chance.

"When the volcano Krakatoa exploded in 1883 in the East Indies, inaudible waves from this disturbance traveled around the world several times with a pressure so great that it produced readable deflections on barographs. The impact of the great meteor that fell in Siberia in 1908 had the same result. During World War I, it was noticed that cannon fire could be heard within a radius of 100 kilometers, and often beyond 200 km., but not *between* 100 and 200 km."

"The sound waves must have been skipping the way our radio waves do," Carl noted.

"Exactly! Observers figured that something far above the earth must be deflecting the sound waves back down. The only thing that could do so would be a layer of air warmer than the air at the earth's surface which would speed up the top edge of the sound wave entering it at an angle and bend the wave back toward the earth. By listening for the lowest audible frequencies and by checking the transit time of the wave from the source to the distant observer, those smart cookies figured out *where* and *how warm* that layer of air had to be! Very recent information gathered by our space probes confirmed their calculations.

"As you go up in a quiet atmosphere," Jerry went on, "the temperature falls sharply at first and then zigzags back and forth until you reach an altitude of about 105 km. From that point on up, for at least a considerable distance, the temperature increases steadily, reaching much higher values than here—"

"Just a cotton-picking minute," Carl interrupted. "You didn't know all this when you got sick. How did you get so smart?"

"Some time back," Jerry explained, "I noticed a newspaper article about how the National Bureau of Standards was carrying on experiments on the detection and recording of infrasonic waves. I wrote the Bureau asking for more information, and Mr. Paul Walsh and Mr. Donald M. Caldwell kindly sent me a lot of interesting information about their installation near Washington, D. C."

"How do they work it?"

"They have four infrasonic microphones set up at different locations several miles apart. Signals from each mike are fed to a central location where they are amplified, bandpass-filtered, and recorded as ink-on-paper traces. By noticing the difference in time of the signal's arrival at various mike locations, its speed and source-direction can be determined."

"I can't imagine what sort of mike you'd use to pick up signals of one or two cycles per minute," Carl muttered with a thoughtful frown.

"Neither could I," Jerry agreed, "but the dope I got says the mike is a condenser type with a diaphragm of thin, specially-formed brass mounted on a reference volume. One side of the diaphragm connects to a noise-reducing pickup pipe. Movements of the diaphragm modulate the frequency of an oscillator."

"I see—I think," Carl said doubtfully, "but what's this about a noise-reducing pipe?"

"When the mike diaphragm is exposed directly to the open air, pressures produced by the wind develop a lot of signal-masking noise. These specially designed metal pipes lie on top of the ground and are each about 1000 feet long. Each pipe has 100 small holes distributed along its length. A signal traveling toward the microphone along the length of the pipe is attenuated very little, but random variations in pressure caused by wind turbulance are greatly reduced."

"What sort of sounds, or whatever you call 'em, are picked up?"

"Well, on May 5, 1960, when the weather bureau reported 19 tornadoes and funnel clouds in Oklahoma, Texas, and Kansas in a four-and-a-quarter-hour period, the microphones recorded waves of periods between 12 and 50 seconds

(*Continued on page* 96)

50-WATT STEREO AMPLIFIER AND CONTROL CENTER

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

Kit Model AA-100 .... **$84.95**
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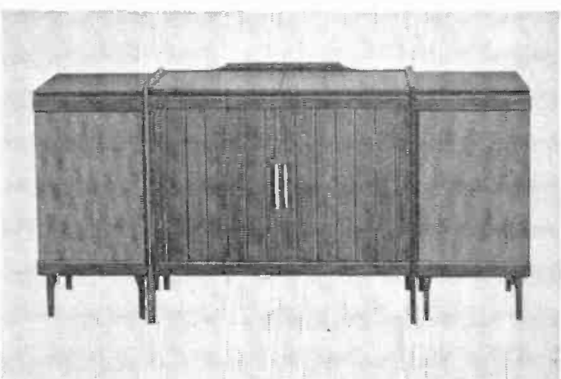
Modest only in size and price, this new Heathkit Stereo-Phono Console amazes every listener with its room-filling, true-to-life stereo sounds. Proportioned to fit any room, it's less than three feet long and only end-table height, yet it houses a complete stereo-phono system with features usually found only in much larger consoles. There's *six* speakers . . . two 12" woofers for smooth "lows," two 8" speakers and two 5" cone-type tweeters for "mid-range" and "highs". The 4-speed automatic stereo/mono record changer is equipped with an "anti-skate" device and a turn-over diamond and sapphire styli cartridge. On the front panel are separate, dual bass and treble controls plus a concentric volume control. The handsome cabinet with solid genuine walnut frame, walnut veneer front panel, and matching "wood-grained" sliding top measures just 31¾" L x 17⅝" D x 26¾" H. Whether you buy the ready-to-play or kit form, the cabinet is factory assembled and finished. 70 lbs.

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

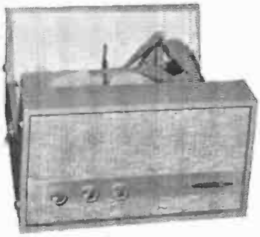


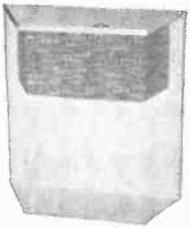
COMPLETE 28-WATT AND 50-WATT STEREO CONSOLES

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

Assembled Model HFS-26 . . . 215 lbs. **$475.00**
Kit Model HFS-27 . . . 215 lbs. **370.00**
Assembled Model HFS-28 . . . 264 lbs. **675.00**
Kit Model HFS-29 . . . 264 lbs. **550.00**
(Cabinets available separately, write for information)

HEATHKIT® by DAYSTROM





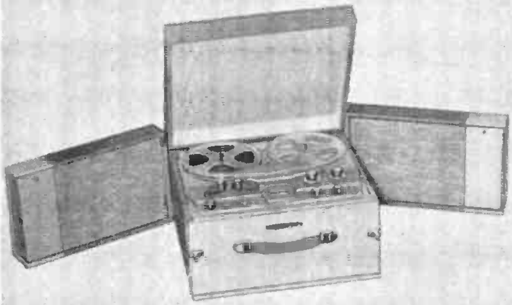
STEREO/MONO PORTABLE PHONOGRAPH

Now you can thrill to magnificent stereo wherever you are, wherever you go! The smartly-styled cabinet with two-tone aqua and white durable vinyl covering comes completely preassembled. In closed carrying position the speaker wing and main cabinet blend into a single handsome unit in dazzling aqua and white vinyl. In use, the detachable speaker-wing top may be spaced at any distance for maximum stereo effect. The completely preassembled automatic changer plays your favorite stereo and mono records at speeds of 16, 33⅓, 45 and 78 rpm, while controls on the amplifier section give you complete command of volume, stereo-balance and tonal quality. 28 lbs.

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

. look forward to the happy months ahead

of outdoor living with Heath equipment



PORTABLE 4-TRACK STEREO TAPE RECORDER

Plays and records 4-track stereo tape for endless hours of delight! Can even be used as a hi-fi center to amplify and control tuners, record players, etc. Has "record," "play," "fast-forward" and "rewind"; 2 speeds (3¾ and 7½ IPS); tone balance and level controls; monitoring switch for each channel to let you hear programs as they are recorded; pause button for editing; and two "eye-tube" recording level indicators. Speaker wings are detachable. Cabinet and tape mechanism are preassembled; all amplifiers and speakers included. 49 lbs.

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

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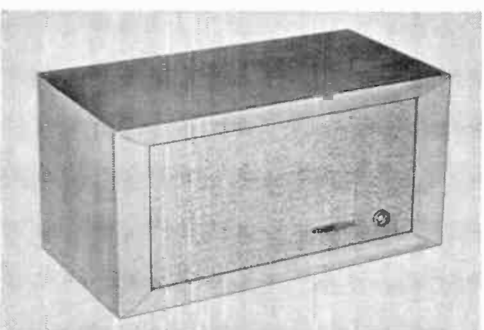
Model AD-80A, GE VR-227 cartridge **41.95**

Model AD-80B, Shure M8D cartridge **42.95**



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Kit Model GD-61M (mahogany) or **GD-61W** (walnut) each **$69.95**

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2. HEATHKIT factory-built, ready to use.
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HEATH COMPANY / Benton Harbor, Michigan

TWO AND SIX METER TRANSCEIVERS

The "ham on the go" will find the new Heathkit "Shawnee" 6-meter and "Pawnee" 2-meter transceiver kits irresistible! Both of the handsome units offer complete AM and CW facilities with: single knob tuning . . . tracked VFO and exciter stages; 10 watt output; built-in low pass filter; three-way power supply built-in for 117 VAC, 6 VDC or 12 VDC with separate DC and AC plugs and cables included; dual-purpose modulator . . . 10 watts for high level plate modulation or 15 watts for PA operation; double conversion receiver . . . crystal controlled first oscillator; tuning meter . . . auto-switched for received signal strength or relative power output; VFO or crystals . . . front panel switch of VFO or four crystals for novice, CAP, MARS or net operation; "spotting" switch; complete shielding of power supply, final and receiver front end; ceramic microphone . . . push-to-talk with coiled-cord. And many more outstanding features . . . write for information. 34 lbs.

Kit Models HW-10 (6 meter) **and HW-20** (2 meter) **each $199.95**

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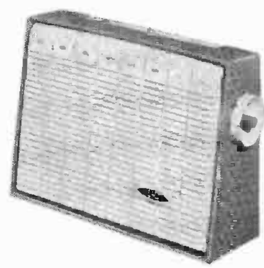
6-TRANSISTOR PORTABLE RADIOS



These award-winning, smartly-styled portables are ready to go anywhere! Both feature vernier tuning; 6-transistor circuit; 4" x 6" speaker for big set tone; prealigned transformers. 6 flashlight cells furnish power. (less batteries).

Kit Model XR-2P (plastic) . . . 6 lbs................ **$29.95**
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Ideal companion for the outdoorsman . . . talk to friends up to a mile away. No license required . . . anyone can use it . . . Features 4-transistor circuit, superregenerative receiver, crystal controlled transmitter. Powered by single long-life battery. Case included. 3 lbs. (less battery)

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Attention Amateurs! Compare it feature for feature, the Warrior paces KW rigs at double this low price! Completely self-contained, the amplifier, HV, filament and bias supplies are built-in. Drives with 50 to 75 watts. no matching or swamping network required. Stable g-g circuit with up to 70% efficiency. Oil-filled capacitor and 5-50 henry swinging choke. Bands: 80 through 10. Max. power input; SSB—1,000 watts PEP; CW—1,000 watts; AM—400 watts (500 using controlled carrier mod.); RTTY—650 watts. Write for information.

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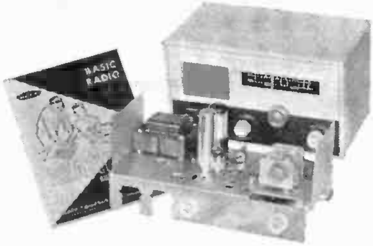

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Carl and Jerry

(*Continued from page* 90)

with speeds about equal to that of sound in air and with pressures slightly less than one dyne per square centimenter. Hearing a tornado 1000 miles away is sharp listening! A system of detectors like this could track tornadoes. In fact, another installation is planned near Boulder, Colorado.

"On August 18, 1959," Jerry continued, "sound pressure produced by the big earthquake in Montana was observed at the NBS Washington laboratories. An earthquake wave traveling along the earth's crust moves the surface up and down like the cone of a giant speaker and sends sound waves almost vertically into the atmosphere. Information gleaned from these waves valuably supplements data gathered by seismographs regarding the nature of a quake and its original source.

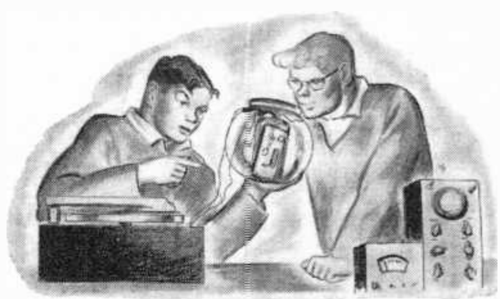
"Magnetic storms also produce strange 'sound' waves of periods greater than 20 seconds with a trace velocity up to three times the speed of sound. These waves usually arrive from the north during magnetic storms, and they have a large angle to the surface of the earth. The Bureau hopes to study them to learn more about the interaction of the sun and the earth's magnetic field."

HOW did you make your mike, and what are you going to do with it?" Carl asked as the ground shook with a low growl of distant thunder.

"I stretched a diaphragm of very thin brass shim stock tight over a little steel hoop. Another disc of brass mesh wire is separated from the shim stock one by a thin insulating washer. This assembly, mesh disc down, is mounted on top of the little glass jar with an airtight seal. The homemade printed-circuit board inside the jar contains two transistorized crystal oscillators and a diode mixer to combine their outputs. The capacitor formed by the diaphragm and the screen is across one of the crystals. The two oscillators are tuned—you can tune a crystal oscillator a little, you know—so that their frequencies are only one kilocycle apart; and this means that the difference frequency of 1000 cycles comes out of the mixer. Any movement of the brass diaphragm produced by pressure waves against it is translated into a frequency shift of the crystal oscillator associated with the condenser mike, and an accompanying change in the beat-frequency tone coming out of the mixer."

"Hey, old buddy, that's pretty sharp!" Carl applauded.

"Nothing any bored American boy shot full of antibiotics couldn't do!" Jerry replied modestly. "The roughest job was drilling two holes through the bottom of the glass jar without breaking it. Leads from the mixer come out one, and the other is covered with a brass disc with a very tiny hole punched in it with a needle. That keeps our mike from respond-



ing to very slow pressure changes caused by barometric variations, yet allows it to respond to waves with periods up to several minutes in length."

He switched on the tape recorder, and soon a 1000-cycle note was heard from the speaker. At the same time, a meter connected across the recorder speaker rose to half-scale.

"That's a simple audio frequency meter I've calibrated to indicate frequencies between 100 and 5000 cycles," Jerry answered Carl's questioning look. "We don't have any ink-on-paper recorders, but that meter pointer will swing back and forth in step with any low-frequency waves received. Tape-recording the changes in tone will give us a chance to double-check on any waves we think we observe. Now, let's see what happens when we test it out.

"I drop this little steel ball on the rubber membrane, like so, and this causes a very small increase in the pressure inside the bowl. See that meter kick down? If I've calculated right, it will start creeping back in a couple of minutes as air leaks through the tiny hole to equalize the pressures on both sides of the diaphragm."

The microphone passed the test with flying colors. It responded to very small changes in pressure; yet, if the pressure was left applied, the tone returned to 1000 cycles in the space of a few minutes.

"Now all you need is that pipe pickup," Carl remarked.

"We've got it!" Jerry said promptly. "Didn't you notice that the men laying that new 8" gas line in the street stopped directly in front of the house last night? Welders will weld the joints together Monday and put the pipe down in the trench, but right now it stretches cut to the west on top of the ground for a couple of thousand feet with the joints all neatly butted tight together. I'm hoping small air leaks at these joints will serve as the holes in the pipe used by the National Bureau of Standards.

"The beauty of it all is that the weather bureau has a tornado alert out for the area to the west of us. We may be lucky enough to hear a tornado! Suppose you go out, Carl, and fasten our mike in the end of the pipe with this wooden collar, and run this twisted pair from it into the cellar window."

CARL carried out the assignment quickly because huge drops of rain had begun spattering down. When the wires were connected to the input of the tape recorder, the meter pointer immediately began to hunt restlessly up and down the scale.

"What we're looking for is a slow, rhythmic swing of the meter pointer," Jerry shouted above the roar of the wind outside, which had begun whipping up the trees and was now pounding furiously at Jerry's house.

But there was nothing slow or rhythmic about the pointer as it swung wildly up and down. Suddenly it began to go up and up, hesitated for a moment, and then fell back to zero and stayed there. The tone disappeared.

"Something's happened to our mike," Jerry shouted as he grabbed up his

(*Continued on page* 102)

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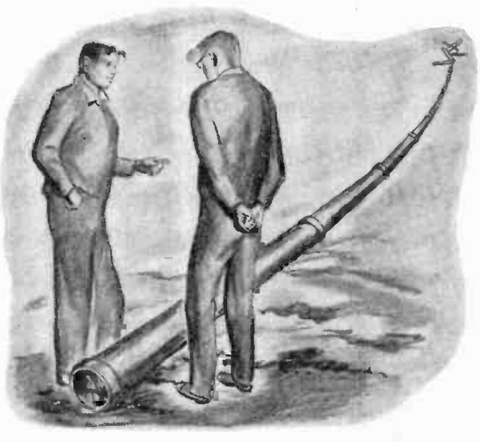
jacket and headed for the door. At the top of the steps he stopped dead in his tracks and stared up into the northwestern sky. Carl, looking over his shoulder, saw the writhing, twisting, unmistakable shape of a small tornado funnel high above the ground and moving off to the north. Even as the boys watched, the little tornado disintegrated.

They raced over to the pipe and pulled out their mike. The thin brass diaphragm was ruptured, with the jagged corners curled outward somewhat like the petals of a flower.

"Jer, look way down there at the other end of the pipe," Carl said in awe. Jerry followed his pal's pointing finger and saw that the straight line of the pipe was broken four or five blocks away, and the sections of pipe were scattered over the street like jackstraws. A small temporary tool house nearby had been smashed to kindling and the tools strewn about like scraps of paper.

"That little twister must have dabbed down squarely on top of the pipe and then hopped back up," Carl said thoughtfully.

"Yeah, and it sucked on that end of the pipe hard enough to bust our mike



diaphragm at this end," Jerry finished. "The tornado dealt us a low blow. We aren't really sure our infrasonic mike works."

"I'm not complaining," Carl said philosophically as he started back for the house. "We're mighty lucky the twister was sucking on *that* end of the pipe and not on *our* end!" —30—

Flip-Flop Circuits

(*Continued from page* 62)

quickly dropped to ground potential because one side of the switch is grounded. The sudden rise in voltage from −7 volts to zero is actually a positive pulse which is coupled through *C2*, and through conducting diode *D2*, to the base of *Q2*.

Although the same positive pulse passes through *C1* to the anode of *D1*, it is not large enough to overcome the negative bias on the diode. When the positive pulse is applied to *Q2*'s base, the circuit switches its conducting state and is ready for the next pulse. Now, a positive pulse will pass through diode *D1* to the base of *Q1* because the voltages seen by the diodes are reversed—refer back to Fig. 2 (A). The circuit will continue to flip and flop depending upon the number of positive pulses supplied to it.

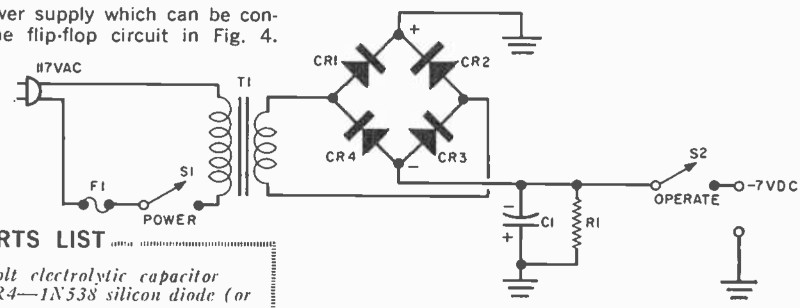
Counting. The only things left unexplained about Fig. 4 are the two lamps and the reset circuit. The lamps indicate which transistor is conducting. When *Q1* conducts, the large current passed by it must pass through *I1*. At the same time, *I2* is not illuminated because *Q2* is cut off. These lamps are useful in determining how many positive pulses are supplied by the count switch, *S1*.

Let's assume the count switch is depressed only once. Although one bulb will go out and the other will come on, we as yet have no way of determining which bulb will light—this will depend solely on which transistor was conducting before the button was depressed.

The reset switch, *S2*, is the answer to our problem. By depressing it before any count is made, we enable *B1* to apply a positive voltage through *D3* to the base of *Q1*, cutting off the transistor. Now, *I1* is out and *I2* is on, indicating a count of "zero." Although *I2* should be in the circuit for balance, you can paint its glass so that it will show no light, since it is not used for counting.

With our flip-flop in operation, pressing *S1* will turn *I1* "on," indicating a count of "one." Pressing *S1* a second time will return the lamp to the "off" state, indicating zero again. Although a single flip-flop such as this one can only indicate counts of zero and one by itself, other flip-flops can be added to the circuit and higher counts obtained. How this is done will be explained in the next issue of POPULAR ELECTRONICS. Binary counting will also be covered.

Fig. 5. Seven-volt power supply which can be constructed to power the flip-flop circuit in Fig. 4.



PARTS LIST

C1—1000-µf., 10-volt electrolytic capacitor
CR1, CR2, CR3, CR4—1N538 silicon diode (or equivalent)
F1—1-amp. fuse
R1—10,000-ohm, ½-watt resistor
S1, S2—S.p.s.t. toggle switch
T1—Filament transformer; 117-volt primary; 6.3-volt, 3-amp. secondary, (CT not used (Knight 62G031 or equivalent)

Build a Flip-Flop. In the meantime, so that you will fully understand how flip-flop circuits work, we suggest that you build the circuit shown in Fig. 4.

Measure the voltages at the terminals of the transistors and see how they agree with the theory discussed in this article. There may be slight voltage variations between the circuit you build and the values given in Figs. 2 (A) and 2 (B), but this is to be expected due to variations in tolerances of the components. Breadboard your circuit, keeping in mind that you will want to reuse the parts in circuits which will appear next month.

Figure 5 is the schematic diagram of a seven-volt power supply for the flip-flop. If you build it, wire it neatly—you will be using it again. —30—

The Danger of Radar Waves

(*Continued from page* 45)

turned off, they recovered immediately. Rats reacted the same way.

No one is certain why this strange behavior takes place, but here's the best theory devised to explain it so far. At certain frequencies, signals apparently resonate with certain nerve paths, or the spinal cord, "short-circuiting" the normal electrical signals the brain sends the muscles to control them. The case clearly points up the fact that there are still many unanswered questions about how microwaves affect us.

Safety Pays Off. The fact that only two known cases of death or injury have been reported in this country—and even these are not confirmed—is testimony to the fact that adequate precautions are being taken where hazards exist. Air Force scientists at Rome Air Force Development Center have concluded that no microwave damage of any kind has ever been observed unless the experimental animal was absorbing at least 0.2 watt of microwave energy for every square centimeter of surface area. To put it another way, to be in danger, they had to absorb more than a watt per square inch of exposed skin.

Since 0.2 watt/sq. cm. is the danger level for animals, and man can probably stand more, the Air Force plays it extra safe by specifying that personnel shall be exposed to radiation fields no greater than one-twentieth that amount, or 0.1 watt/sq. cm.

Most companies observe the same standards but a few are even more conservative. Operators of the *Distant Early Warning* radar network which stretches across northern Canada, for example, have set 0.001 watt/sq. cm.—one-tenth as much as the Air Force—as the exposure limit.

Industry and the armed services go to great lengths to protect personnel from radiation exceeding these limits. International Telephone and Telegraph Company, for example, interlocks all dangerous areas. The radar antenna on top of the ITT tower in urban Nutley, N. J., is not dangerous from the ground—but it would be from the radar platform. So the trap door on the roof leading to the antenna is interlocked: open the trap door and you automatically kill the antenna power.

BMEWS Protection System. Undoubtedly the most elaborate preventive measures ever taken are now in effect at the Air Force's BMEWS station in Thule, Greenland. Its huge radars put out pulses of microwave energy at the incredible power level of ten million watts.

The transmitter building is especially shielded to protect technicians from the tremendous radiation. The covered passageways are also solidly shielded—ceiling, walls, even floors—so that crews can go from one building to the other with the radars in operation.

Shielding of the buildings and passageways presented quite a few problems during construction. Even though the walls were made of galvanized steel sheeting, too much radiation energy got through. So first all joints were welded to eliminate cracks. Then, two layers of copper screen were added inside where necessary. And this was topped off in particularly troublesome spots with concrete.

Even small holes in the screen let in too much radiation. Every one of them had to be patched and soldered. Special ventilators that would let in air but not radiation had to be designed and tested.

With all buildings carefully shielded. only one more serious problem remained. Sub-zero temperatures and howling arctic blizzards are prevalent during winter in Greenland. No equipment can stand up forever under such punishment, and outside repairs must be made from time to time. The problem was to figure out a way to make repairs without turning off the radar or cooking the personnel.

The answer: radiation suits designed and built by the Wright Air Development Command especially for BMEWS workers. With this modern-day armor, technicians are able to work safely in r.f. fields that would kill an unprotected man in minutes.

Beneficial Uses. While most of the problems of protecting electronic workers from radiation have now been pretty well solved, scientists are vitally aware that there is a great deal they don't know about radiation and its biological effects. But this knowledge gap is fast being bridged. Both military and civilian scientists are pressing forward at top speed ying to unravel a few of the mysteries ill surrounding the subject.

At the Fourth Annual Tri-Service Microwave Conference held in New York last summer, researchers made some startling disclosures. Lt. Col. Sven A. Bach of the Army Medical Research Laboratory in Fort Knox, Kentucky, for example, told how he had discovered a "profound molecular change" in human gamma globulin which had been subjected to microwave radiation at certain frequencies. Said Bach, the gamma globulin molecules showed "at least a fourfold increase in biological activity."

What does this mean to you? Gamma globulin plays an important part in the body's defenses against disease. Speed up its activity fourfold and it may be four times as effective a disease fighter. Some day your doctor may give you "a shot of microwave" to keep you well.

Dr. Joe Howland of the University of Rochester found that dogs which had been exposed to microwaves were able to withstand heavy doses of X rays far better than dogs not so treated. No specific application for this technique is now known, but such discoveries frequently lead to undreamed-of advances.

And, finally, some evidence has been gathered to indicate that certain kinds of cells, under the right conditions, will simply disintegrate—fly to pieces—in the presence of the right radiation. But surrounding cells are unaffected. Could such a selective beam ever be used to destroy cancer cells while leaving healthy tissue unaffected? Scientists don't yet know.

Said Col. George M. Knauf, one of the foremost experts on the biological effects of microwaves, speaking of these recent advances, "Our work has progressed sufficiently for us to be fairly certain that the beneficial uses to which this energy may be put will greatly outweigh any harmful results it may produce in men."

All this, of course, does not mean we should forget that uncontrolled microwave energy can be dangerous. But like fire or X rays, microwaves can, when used intelligently and with understanding and respect for the hazards involved, be among man's most valuable tools. —30—

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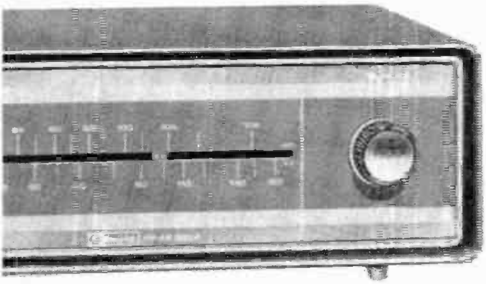

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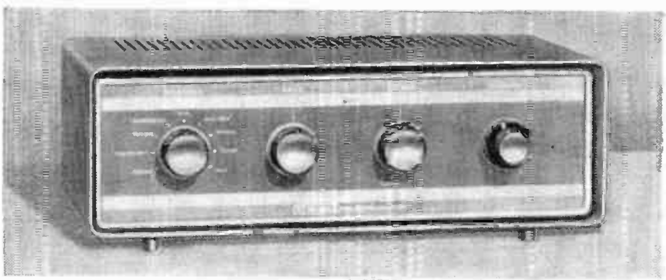

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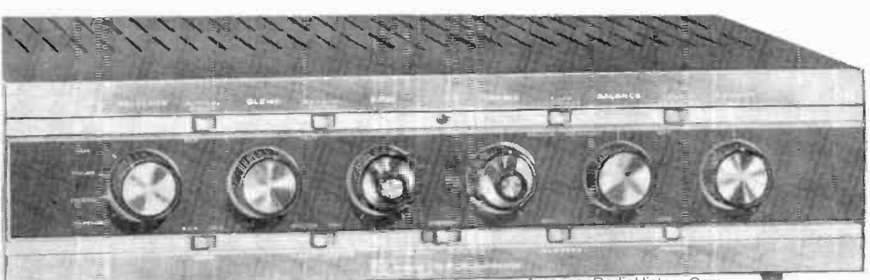

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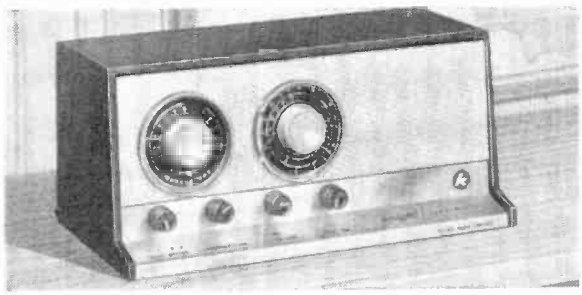

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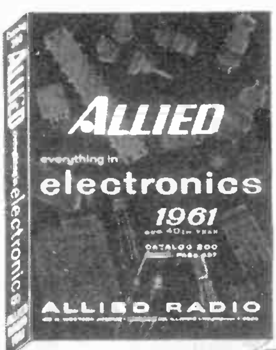

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Electron Chemistry

(*Continued from page* 75)

makes a much stronger polyethylene than the non-irradiated, many-branched ordinary molecular structure. Actually, it was this cross-linking process that strengthened the three polyethylene squeeze bottles of our illustration.

Food Preservation. Electron irradiation of food has been called the most significant advance since Nicholas Appert discovered canning and heat sterilization in 1809. Its great appeal lies in the negligible amount of heat required. As a result, undesired effects of prolonged heating are greatly minimized, if not entirely eliminated.

Irradiation destroys bacteria, sterilizes the food, and greatly extends shelf life. Foods can be kept fresh for months, sometimes years, at room temperature or economical above-freezing refrigeration temperatures.

Drug Sterilization. Heat sterilization produces undesired effects in drugs, especially in sensitive hormones, antibiotics, vaccines, vitamins, anticoagulants, proteins, and alkaloids. Some of these untoward effects are discoloration, chemical changes, precipitation, and loss of potency.

Electronic irradiation is "cold sterilization." Some two or three million rads from an electron-beam generator will safely destroy the microorganisms in almost any drug. (The rad is the basic unit of radiation dosage, a measurement of the absorption of 100 ergs of energy per gram).

Another exciting use of irradiation is the all-important cold sterilization of delicate human tissue for surgical transplant. And while more expensive than heat sterilization, the cold sterilization of heat-sensitive catgut sutures by irradiation is a routine practice today. Advantages cited are minimum damage to the sutures, sterilization in the final sealed container, better packaging, and continuous rather than batch processing.

Electron-Beam Generators. Although nuclear reactors, isotopes, and waste fission products can be used as gamma-ray sources for irradiation, special electron machines are still the most dependable source and will likely continue to be widely used for production processes. Typical high-energy electron machines include the Van de Graaff, linear, and Dynamitron accelerators, as well as the standard electron-beam generator.

An important feature of the electron-beam generator is its resonant transformer. Designed without an iron core, the resonant transformer uses an air-core secondary coil tuned to the primary frequency of 180 cycles. Inductive and capacitive reactances cancel out, leaving energy free to oscillate at this resonant frequency without the need for a continuous iron core. Output voltages range from 1 million to 3.5 million electron volts.

The resonant transformer furnishes this super-high voltage to a permanently evacuated electron beam tube. A hot-wire filament serves as the source for electrons; high voltage is applied to the accelerating electrodes of the tube, causing the electrons to gain speed and energy. Traveling at nearly the speed of light, electrons emerge from a 0.0075-inch thick titanium "window" to the product treatment area. The electron beam is deflected over a wide area to distribute the electrons evenly.

Danger—Radiation! The familiar emblem signifying radiation hazard is always in evidence during electron irradiation. An analytical reader might well inquire: why the need for heavy concrete walls for radiation protection when it is well known that electrons can only penetrate matter a few tenths of an inch for each million volts of accelerating potential?

The answer lies in the fact that X rays are produced wherever electrons are stopped. And since X rays have great penetrating power, poured concrete or solid block concrete walls as much as seven feet thick may be required.

We have barely scratched the surface of electron chemistry. Staggering the imagination, as we have seen, are the many possibilities in food preservation, drug sterilization, polymerization and cross-linking of plastics. And with hundreds of materials being subjected to the magic of the electron beam, more and better products will ultimately result from this most exciting new science. —30—

Transistor Topics

(*Continued from page* 87)

a s.p.s.t. toggle switch or conventional hand-key. Almost any standard transistor output transformer may be used for *T1*—suitable types are the Stancor TA-42, the Thordarson TR-114, or the Argonne AR-164. (Since each of these three transformers is a center-tapped unit, use the primary connections that give optimum results.) Any 6-8 ohm PM loudspeaker can be used, although you'll find that larger (6" or 8") units are more efficient than the miniature speakers generally used in transistor circuits. The power switch, *S1*, can be a toggle, slide, or rotary switch, as you prefer.

The feedback circuit (broken lines in diagram) converts the amplifier into a code practice oscillator and is an optional feature. Therefore, capacitor *C1* and

Portable radio-phonograph introduced by Lafayette Radio—the FS-225—is fully transistorized. See page 115 for details.

switch *S2* can be omitted if you want to use the circuit as a straightforward audio amplifier.

The light-controlled relay circuit is almost identical to that of the amplifier, but with the feedback feature omitted; photocell *PC1* is used instead of input jack *J1*, and a sensitive relay, *K1*, instead of output transformer *T1*. Mr. Ravindranathan did not specify the type of relay used in his model, but any relay requiring less than 10 ma. (at 6 volts) for operation should give satisfactory results; an Advance Type SO/1C/1000D relay should work nicely, although you may have to adjust armature-spring tension for best performance.

With commercial parts in limited supply, Mr. Ravindranathan used a rather unique photocell in his model. Experimenting with a defective 2N217 transistor, he found that this unit made an acceptable photocell when its outer case was removed so that the germanium junction could be exposed to light. Connections were made to the base and collector electrodes. As an alternative unit, an International Rectifier Type B2M photocell should give excellent results.

Either of the two circuits can be assembled on a conventional metal chassis, on a plastic or fiber board, or built breadboard fashion on perforated Masonite. Neither layout nor lead dress should be critical. Power can be supplied by a single 6-volt battery, such as a Burgess Type Z4, or by a power pack made up of four penlight or flashlight cells connected in series. After assembly, *R2* is adjusted for best performance. In the audio amplifier, *R2* acts as a limited range volume control; in the light-operated relay circuit it serves as a sensitivity control.

Overseas News. From Japan comes news of all-electronic refrigerators and water-coolers using semiconductor thermoelectric elements. Thus far, only handmade prototypes have been assembled, but both units compare favorably in performance with conventional equipment using compressor-type cooling devices. The manufacturer? Tokyo Shibaura Electric Company, Tokyo, Japan.

Transistorized television is making news all over the world—at least two major firms are producing these sets in the U. S., another in Japan, and still another in Germany. With summer approaching, and the resulting increased interest in battery-powered equipment, watch for the announcement of new models by several manufacturers.

Our forward-looking South American neighbor, Brazil, has started transistor production in a big way. One local firm is making transistors under U. S. patents, while several foreign-based producers are planning to open local facilities. A high percentage of currently produced units is for internal consumption, but with rising production, Brazil will probably export to other Latin American nations.

Product News. Lafayette Radio (165-08 Liberty Ave., Jamaica 33, N. Y.) has introduced a fully transistorized portable radio-phonograph. The radio section features seven transistors, one diode and a thermistor. The phonograph tone arm is equipped with a flip-over cartridge, while the turntable can be switched for 33 1/3-, 45-, and 78-rpm records; a speed compensation control permits a fine adjustment of turntable speed to allow for battery wear. The unit, stock No. FS-225, sells for $52.50, less batteries, F.O.B. New York City.

A Philadelphia firm, the Navigation Computer Corporation (1621 Snyder Ave., Philadelphia 45, Pa.), is now manufacturing a line of miniature felt discs for use as soldering heat sinks. The felt discs are fitted over transistor leads and saturated with a volatile fluid. During soldering operations, the evaporating fluid absorbs heat from the transistor leads, preventing internal damage. These discs sell for $5.00 per 100 in quantities of less than 1000, or for $3.00 per 100 in large quantities. Minimum order is 100 discs.

From the West Coast comes news of a power transistor capable of delivering respectable amounts of power at frequencies up to 30 mc. Pacific Semiconductors, Inc. (1255 Chadron Ave., Hawthorne, Calif.) is in pilot-line production of a triple-diffused silicon mesa transistor which can deliver *5 watts* at 30 mc. with a power gain of 10 db. This expensive unit, Type PT-530, presently sells for $125.00 *each* in small quantities.

Several new items have been announced by RCA's Semiconductor Division (Somerville, N.J.): a low-cost *p-n-p* power transistor suitable for high-fidelity sound equipment, and two new computer transistors—Types 2N414 and 2N1450. In addition, RCA's Electron Tube Division (Lancaster, Pa.) is now marketing a solid-state high-frequency oscillator; featuring a tunnel diode, the unit delivers almost a milliwatt over the range of 1100 to 1400 *megacycles*.

That's "all she wrote" for the present, fellows—I'll be back next month with more news.

—*Lou*

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This standard text book in the T.V. servicing field provides clear descriptions of the fundamentals of T.V., and practical instruction on the diagnosis and correction of typical trouble. $7.50

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2011. STEREO & HI-FI DIRECTORY, 1961, Ziff-Davis

New! Over 1200 component listings, 800 photos; latest models, prices! Entire sections on every phase of stereo and monaural high fidelity. $1.00

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Brand new edition. Advanced discussions and instructions on every phase of audio. Special features make this an excellent guide for the advanced audiophile. $1.00

2755. THE PRACTICAL HI-FI HANDBOOK, King

A guide to high fidelity sound reproduction for the service engineer and amateur. Chapters on amplifiers, loudspeakers, pick-ups, microphones, record players, disc, tape and stereo. $5.95

2765. YOUR TAPE RECORDER, Marshall

This book helps to eliminate trial and error under all conditions. Includes illustrations of 55 magnetic recorders with specifications. $4.95

2750. ELEMENTS OF MAGNETIC TAPE RECORDING, Haynes

How to get professional results with tape the way the experts do. Basic techniques, how to splice and edit, how to repair and maintain your recording equipment. $7.95

2752. HIGH QUALITY SOUND REPRODUCTION, Moir

A perfect manual for both the professional engineer and the serious amateur in high fidelity. Complete coverage of sound reproduction in 591 pages. $15.00

2002. ELECTRONIC KITS DIRECTORY, Ziff-Davis Publishing Company

New 1960 edition lists over 750 kits, latest models, prices and features for hi-fi, ham radio, SWL, shop improvement, Citizen's Band, fun and education. $1.00

2006. ELECTRONIC EXPERIMENTER'S MANUAL, Findlay

With a few dollars worth of basic tools and this book to guide you, you can explore electronics experimentation more completely than ever before. 10 big sections. $4.95

2351. RADIO PROJECTS, Marcus

10 easy-to-construct radios described in this book cover the field thoroughly and completely, progressing in difficulty from the simple crystal detector to the superheterodyne receiver. $3.85

2001. 1960 ELECTRONIC EXPERIMENTER'S HANDBOOK, Ziff-Davis Publishing Company

40 projects for home and shop, 20 of which are transistorized. Special section on understanding transistor circuits. $1.00; 2009. cloth, $1.95

2004. HI-FI ANNUAL & AUDIO HANDBOOK, Ziff-Davis Publishing Company

1960 edition. Prepared by the editors of Electronics World. An excellent advanced guide to theory, construction and circuitry. $1.00.

2008. CLASS D CITIZENS RADIO, Sands

First complete book on Citizens Radio operation. Covers Class D history, rules, applications, how it works. Many illustrations. $4.95

2901. HAM RADIO, Hertzberg

Tells exactly how to become a "ham"—how to obtain a ham "ticket," how to learn code, how to select receivers and transmitters—everything you need to know is between the covers of this handy guidebook. $2.50

2907. RADIO OPERATING QUESTIONS AND ANSWERS, Hornung & McKenzie

Presents specific information on radio law, operating practices and theory for those studying to pass the FCC commercial radio operator exams of the various license grades. $6.25

2600. TRANSISTORS, Gillie

Describes and analyzes semi-conductors and transistors and how they behave. 300 pages, illustrated. $7.95

2000. STEREO-HI-FI GUIDE, Ziff-Davis Publishing Company

Just published! 1960 edition features 60-page exclusive by Joseph Marshall on components and how they work. $1.00

2501. ELEMENTS OF ELECTRONICS, Hickey and Villines

This basic electronics text offers an excellent course for training radio and electronics technicians and for students in television, radar and sonar. $6.95

2007. COMPUTERS AND HOW THEY WORK, Fahnestock

A fact-filled guidebook to electronic computers. Explains the working of every major computer system. Must reading for all who want a more complete knowledge of this important field. $4.95

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Curves

(*Continued from page* 66)

The difference is simply this. In the losser type, there is a tone control "midpoint," and every tone control frequency response curve slants up or down starting from this point (in Fig. 9, the midpoint falls at about 1000 cycles). But in the Baxandall circuit, if you turn up the bass boost just a little, only the frequencies below 50 cycles are boosted, as in Fig. 10, and the response is still flat between 1000 and 50 cycles. Turn it up a little more and it boosts everything below 200 cycles, and so on.

In other words, the Baxandall circuit varies not only the *amount* of boost or cut, but the *frequency* at which boost or cut begins as well. In action, the two different kinds of tone control circuits—losser and Baxandall—can sound quite different, and a family of curves will quickly tell you which an amplifier has.

Equalization. A curve that will indicate quite a lot about how records played on your system will sound is called the "equalization error" curve. To understand it, let's talk a little first about equalization in general.

When a record is made, engineers find it necessary to attenuate the low frequencies and boost the highs. They cut down on the lows because the wide swings of the cutting stylus at full power at these frequencies would slash deeply into the groove walls; if not attenuated, such low frequencies would interfere with the adjacent grooves, and perhaps even cut all the way through the walls. And the highs have to be boosted, since surface noise at high frequencies is enough to drown out the music unless the highs are amplified more, or, as the engineers say, given "pre-emphasis."

Curve A in Fig. 11 is the standard RIAA (Recording Industry Association of America) recording curve. At 20 cycles, the bass is *down* 20 db; and at 20,000 cycles, the treble is *up* 20 db.

A recording with the RIAA equalization would sound pretty funny if we played it back on a perfectly flat amplifier. The highs would seem shrill and piercing; the bass, very weak. So all preamplifiers designed for record playing have built-in equalization networks to

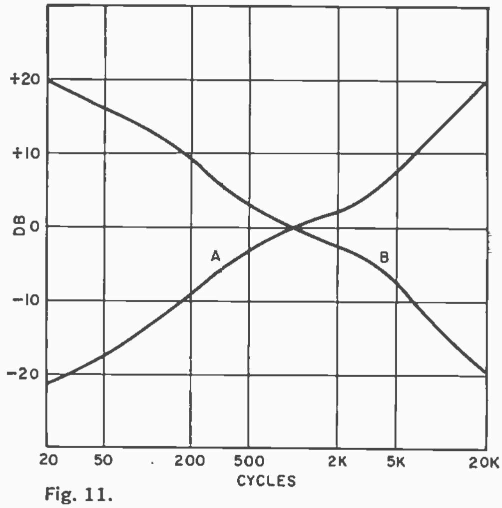


Fig. 11.

correct this situation by attenuating the treble and boosting the bass. If this circuit were perfect, its characteristic curve would be the exact opposite of curve A in Fig. 11 and would look like curve B.

As is usually the case in electronics, the actual circuit is never perfect. An equalization error curve (Fig. 12) shows just how much the equalization is off at each frequency over the audio range. If this curve is reasonably flat—within a db or so at all frequencies, then your equalization network is doing the job it is meant to do, and doing it well.

Figure 13 shows a poor equalization error curve—it varies 8 db from one extreme to the other—displayed by one amplifier on the market.

Loudness. An amplifier you are considering buying may have a "loudness"

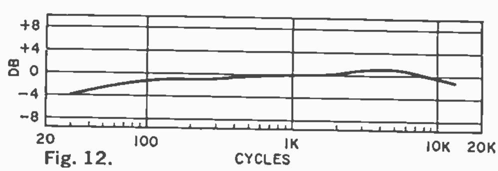
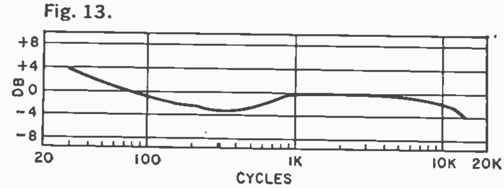


Fig. 12.

Fig. 13.



control. This circuit attempts to compensate for the fact that our ears have different frequency response characteristics at different sound levels.

A loudness control is often necessary for the simple reason that music is seldom reproduced at its original volume. As many authorities have pointed out, it's impossible to place an orchestra in the average living room.

But while we almost invariably listen to records at less than their original volume, by making use of some rather ingenious loudness circuits we can counteract our ears' deficiencies and make all music sound balanced over the entire range at whatever level we play it. Figure 14 shows a set of loudness curves for one popular amplifier.

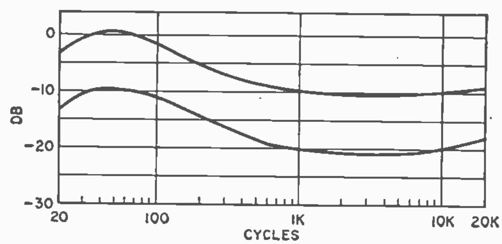


Fig. 14.

Other Curves. There are many other curves: sensitivity, which tells us how much input signal at each frequency it takes to drive an amplifier to full power output; tape equalization, similar to record equalization, but with a shape of its own; channel separation, which charts the channel-to-channel crosstalk over a wide range of frequencies for stereo amplifiers; rumble, scratch, and "presence" curves; to name a few. But if you understand those we've discussed so far, you're well on your way to being able to separate the sheep from the goats—in amplifiers, that is—with only a quick glance at the curves.

Now it's clear why Joe went wrong back at the beginning of our story. He didn't know that two amplifiers with the same or similar specifications could have very different curves and sound quite different as well. If you examine carefully the curves of any amplifier you may be thinking of buying, you won't make the same mistake. -30-

Across the Ham Bands

(*Continued from page* 69)

the tube sockets; *TS1* serves as an input and output tie point for the modulator. You should also place a couple of solder lugs under nearby mounting screws for ground terminals. If necessary, move the antenna coil under the chassis a bit to give yourself a little more working area.

Wiring of the modulator in the "Chief" is point-to-point, with the resistors and capacitors supported by their leads; slip spaghetti tubing over their leads to prevent shorts. Be careful to observe polarity when installing the electrolytic capacitors. Use shielded wire between the microphone connector (*J1*) and the gain control (*R2*) and between *J1* and the 12AT7 (*V1*); use tube shields on both *V1* and *V2* to minimize feedback.

Connect the heater lead (lug No. 2 on *TS1*) to the ungrounded heater terminal of the nearest 807 in the Globe Chief, and connect lug No. 5 on *TS1* to the screen-grid terminal (pin 4 of the 807). Also, connect lugs 3 and 4 on *TS1* across the transmitter's key jack; switching *S1* to "phone" automatically closes the key circuit for phone work.

Operation. Place *S1* in the c.w. position and tune up the transmitter in the normal manner; first tune for maximum r.f. output and then increase the antenna loading to reduce the output a trifle. Now, note the r.f. amplifier plate current and set *S1* to the phone position.

Adjust the slider on resistor *R6* until the amplifier plate current drops to half of the value noted. (Be sure to turn off the transmitter and discharge the Chief's filter capacitor before adjusting *R6*.) Then adjust the gain control (*R2*) so that talking into the microphone at your normal speaking level will cause the amplifier plate current indicator to kick slightly on occasional voice peaks.

News and Views

Bob Effrain, WV2NOH, 62-14 80th St., Middle Village 79, N. Y., is studying madly for his General ticket—his father has promised him $200.00 for a beam and a rotator when he gets it! Bob uses a Sonar SRT-120 transmitter held down to 75 watts, and he receives on a Hallicrafters SX-110. This combination and a 15-meter doublet gave him 25 contacts his first two weeks on the air. When you work

WV2NOH, ask Bob about his 2-meter "walkie-talkie." . . . . **Gerald Finn, KN7KRB,** 721 N. Delaware, Chandler, Ariz., excites the ether on 40 and 15 meters with an EICO 720 transmitter and receives on a Hallicrafters SX-99 aided by an RME DB-23 preselector. His brag list shows more than 200 contacts all over the mainland, Canada, Alaska, and Hawaii. . . . Looking for Delaware? Well, look for **John Rhoads, KN3MXJ,** Ten Granite Road, Wilmington, on 7160 kc. He uses a Heathkit DX-40 feeding a 40-meter dipole, and will hear you on a National NC-66.

Jeff Kadet, K1MOD, 501 Greendale Ave., Needham 92, Mass., parlayed his Novice license, a Johnson Adventurer transmitter feeding a 40-meter dipole, and a Hallicrafters SX-100 receiver into 25 countries worked and 47 states confirmed. Not bad for a lad just turned 13. The three states he still needs are Utah, Arkansas and Delaware. . . . **Carlton Carlson, WV2LYP,** 28 Country Club Dr., Mount Marion, N. Y., combines a yen for building his own ham equipment with good operating. His home-brew, 45-watt transmitter, a long-wire antenna, and a six-tube, home-brew receiver worked 420 contacts in 18 states, all on 80 meters. California was his best DX. . . . Bob Anderson, WPE1BDB, reported for his friend **Joel Wilks, K1PCE,** 82 Wilcox St., New Britain, Conn. Joel just received his Conditional license and works mostly 15 and 20 meters with a Heathkit DX-20 transmitter feeding a 20-meter dipole. He receives on a Heathkit AR-3, plus a Q-Multiplier. Twenty-two states confirmed, Canada, Puerto Rico, and Venezuela comprise his Novice record.

Jimmy Owen III, K4CGY, Box 215, Eagle Rock, Va., works all bands from 10 through 75 meters with his Heathkit DX-100B—his favorites are 10 and 75. Jim receives on an SX-99 and transmits on a 75-meter inverted-V antenna. Out of 38 states worked, 36 are confirmed, and he has three countries confirmed. K4CGY QSL's 100% to all hams and SWL's. . . . New hams in the northwest who are interested in learning how to handle messages via amateur radio are invited to join the Northwest Slow Speed Net. It meets daily except Sunday at 2100 PST on 3700 kc., and code speed is kept down to 5 to 8 wpm. For further information, contact **Samuel M. Van Wyck, K7BWV,** P. O. Box 187, Lapwai, Idaho.

Alan A. Memley, WV6MLH, 2609 W. 102 St., Inglewood 4, Calif., works 15 meters with a DX-20 transmitter and a SX-110 receiver. Ready for the day when he gets his General ticket, he has a 3-element tri-band beam. Al also works 2 meters with a Gonset Communicator feeding a ground-plane antenna. . . . **Fred N. Affleck, VE7BED,** 4624 Winnifred St., Burnaly 1, B. C., Canada. runs 85 watts to a home-brew transmitter on 40 and 20 meters. His antenna is a combination 40/20 meter dipole. With them, he has worked 20 states and two provinces. Fred has just finished building a 15-tube receiver.

Why not send us *your* News and Views picture, and construction project? 73,

Herb, W9EGQ

Ping-Pong Stereo

(Continued from page 58)

Now enter the musical arrangers. They know that their job is stereo enhancement and the scoring is entirely directed to this end—thus the almost universal use of heavy brass, woodwind aggregations, and the ubiquitous percussion.

The End Results. What kind of results does all this achieve? The degree of "sensationalism" varies widely, depending on the skill of the engineers and the cleverness of the arrangers. As a general rule, nearly all of these recordings give new life and stereo effect to the machines for which they were intended —the "department-store" stereo console. And even a fair percentage of the cheaper component systems are made more "stereoistic" and sonically exciting to their owners.

"SUPER" STEREO SAMPLER

Bongos Bongos Bongos
—Command RS809SD

Percussion on Stage Camelot
—Time S2022

Percusive Jazz
—Audio Fidelity DFS7002

Pertinent Percussion Cha Cha's
—Command RS814SD

Pinpoint Percussion
—Time S2016

Provocative Percussion
—Command RS806SD

Provocative Piano
—Command RS811SD

The Sound of Dynamic Woodwinds
—Medallion MS7505

The Sound of a Marching Band
—Medallion MS7507

From a strictly musical viewpoint, the recordings have been howled at and condemned by the critics as "flashy trash," "stereo Pablum for the musical moron," and worse. But one still must tip the hat to the people involved. Make no mistake: it takes a top engineer, a stereo-oriented arranger, the finest equipment, and the best musicians to produce a really prime example of this new type of stereo recording.

Now some observations about these

recordings, as heard on a "money-is-no-object" highest-quality component stereo system. For one thing, many of the companies boast on their record jackets about the "great dynamic range" of their discs . . . not so . . . the music itself is dynamic, but they are mistaking high-level recording for dynamic range.

When channel switching is employed, it is easy for a keen ear to detect one channel switched off completely, even to reverb! Needless to say, the stereo directionality becomes almost outrageous in a high-quality component system, especially if strict two-channel "left and right" positioning was cut on the disc. The "hole-in-the-middle" is then about the size of the Grand Canyon!

Depending on whether natural or artificial reverb was used, a curious phenomenon occurs. If natural reverb was used and some very high-level trumpets were being played on the left side, you would hear the fundamental sound from the left; on the right you would hear the same sound as reverb, being picked up by the mikes on the far right. On some setups, such a double image can be very confusing! If artificial reverb was used, sometimes the amount varies on the channels and the "presence" on one overrides that of the other.

As for the claims of total frequency response . . . the generally whooped-up mid-range is projected far out of balance on a good system, and on massed strings the results are excruciatingly painful to the ear and the musical sensibilities. The high frequencies are equally out of balance and some of the high percussive transients can almost cut off your ear! The low frequencies usually appear to be somewhat lacking, this partially through intent as explained previously, but most often as a result of the tremendous velocities and high levels recorded on the discs.

How long this type of recording can survive is anybody's guess, although it is currently selling very well. But even if the sound is very artificial, the discs are affording pleasure to a great many people. And while the perspective may be somewhat distorted, they are at least allowing the general public to hear some of the potential of stereo sound. -30-

Short-Wave Report

(*Continued from page* 88)

many stations in the U. S. as well as numerous stations which classify as real DX. He was also able to tune in excellent musical programs from England and Germany. (Your Short-Wave Editor wonders if he ever tuned across the long-wave band from 100 to 500 kc.? While in Germany, we were able to enjoy many fine programs from *R. Luxembourg* and other long-wave stations.)

George originally started out in the radio field back in 1952 by rebuilding and repairing old radio receivers. Before going into the Air Force, he attended night school to study code and to deepen his knowledge of electronics. If you hear him on the air as K8ABR, be sure to send him a report—he will QSL 100%.

Do we have any other brother-sister DX'ing combinations among our readers?

Current Station Reports

Numerous frequency changes are featured in the resume of current reports this month. All times are Eastern Standard and the 24-hour system is used. At time of compilation all reports are as accurate as possible, but stations often change frequency and/or schedule with little or no advance notice. Please send your reports to: Hank Bennett, P. O. Box 254, Haddonfield, N. J. (Requests for Short-Wave Monitor Certificates and call letters *MUST* be sent to: Monitor Registration, POPULAR ELECTRONICS, One Park Ave., New York 16, N. Y. See registration form on page 109.)

Australia—*Radio Australia* plans to add within the next year two 100-kw. xmtrs with calls of VLE and VLF. *(WPE8MS)*

Austria—*Osterreichischer Rundfunk*, Vienna, has test xmsns as follows: 0600-0800 on 9770 kc.; 2300-0000 and 0800-1400 on 7245 kc.; 0400-0600 on 7200 kc.; and 0000-0400 and 1400-1600 on 6155 kc. The 0000-0400 xmsn on 6155 kc. is heard best, with waltzes and marches, and anmts in German, Eng. and French. Reports go to Box 700, Vienna 70, Austria. *(WPE1KO, WPE2BYI, WPE2HF, WPE3AGZ)*

Belgium—Brussels is heard well on two new channels: 9765 kc. to N.A. at 1615-1800 and 1815-2000; and 6085 kc. at 2030-2215, in Dutch. *(WPE4FI)*

A mailbag period is conducted on Saturdays at 1530 and 1930. Reports go to Station ORU, P. O. Box 26, Brussels 1, Belgium. *(WPE3BIK, WPE5AWL, WPE8BXG)*

Canary Islands—*Emissora de la Isla de la Palma*, Santa Cruz de la Palma, has moved from 7390 kc. to 7345 kc. and is heard well at 1600-1805. *(WPE4FI)*

Colombia—A new station is *R. Santa Fe,* Bogota, 4965 kc., noted at 2105-2230 with L.A. music. Reports go to Apartado Aereo 9339, Bogota, Colombia. *(WPE1AAC, WPE1BM)*

Congo—Leopoldville *(Radio Congo)* is heard well on 11,755 kc. at 1700-1900 with test broadcasts in English; this frequency has caught many DX'ers unaware as the station announces that it is operating on 11,795 kc. There is another Eng. period at 1330-1400 and a test in French to Europe at 1300-1330. Reports go to P. O. Box 3171, Leopoldville. *(WPE1AGM, WPE1ASX, WPE1BM, WPE1CAU, WPE1CR, WPE2CKI, WPE2DPD, WPE2DRH, WPE3AK, WPE4BYE. WPE4EC. WPE4FI. WPE4HJ, WPE5XX, WPE6AA, WPE8BYX, WPE8FV, WPE8WT, WPE9KM, WPE0AE, WPE0ATE, WPE0BHG, VE3PE1DO, FE)*

Cyprus—The BBC East Mediterranean Station, Limassol, broadcasts in Arabic at 1100-1600 to Iraq and the Persian Gulf on 7130 kc. This frequency replaces 6790 kc. *(WPE8MS)*

Dominican Republic—*R. Caribe* has opened a new outlet on 15,065 kc. that is operating parallel to 9485 *and 6210* kc. despite numerous reports that 6210 kc. has been replaced by the new outlet. The schedule reads 0500-0200. Reports from many DX'ers indicate that reception of the 15,065-kc. broadcasts is excellent during the day and generally poor at night in eastern areas, good to excellent at any time in midwest and western areas. Call-signs are HI3U on 9485 kc., HI2U on 6210 kc.; the call-sign on 15,065 kc. is not known yet. *(WPE1BZD, WPE2ANW, WPE2AXS, WPE3AK, WPE3NF, WPE4BC, WPE4FI, WPE6BPN, WPE7AT, WPE8AIJ, WPE9AGK, WPE9KM, WPE0AE, BL)*

Ethiopia—*R. Addis Ababa* is heard well at 1315-1345 in Eng. to Europe and at 1515-1545 in Eng. to West Africa on both 11,955 and 17,773 kc. Reports should be sent to P. O. Box 1364, Addis Ababa. *(WPE1AGM, WPE1CR, WPE2AXS, WPE4BC, WPE4FI, WPE6EZ, WPE9KM)*

Germany—*Deutsche Welle (Voice of Germany)*, Cologne, operates at 1215-1515 to Africa, replacing 11,870 kc. with 11,915 kc., dual to 15,275 kc. *(WPE3BSY, WPE4FI)*

Greece—*R. Athens* operates at 1215-1245 to France and England on 6075, 9605, 15,345, and 17,720 kc.; at 1400-1500 to Northwest Europe on 9605 and 11,720 kc.; to Greek Mariners at 1700-1730 on 11,720 kc. and at 1800-1830 on 6075 and 9605 kc. All Sunday broadcasts begin 75 minutes earlier. Reports go to Hellenic National Broadcasting Institute, 16 Mourousi St., Athens, Greece. *(WPE3BOC, BL)*

Guinea Republic—*R. Conakry*, Conakry, has been noted on 4910 kc. at 0145 with Eng. lessons. French news is given at 0200. *(WPE0VB)*

India—*All India Radio* stations noted lately, other than those in Delhi, include: Bombay on 7120 kc. at 2030-2230 in native language; Madras on 15,380 kc. at 0630-0730 with Indian music; and Gauhati, 4775 kc., weakly, from 0735 in native language. *(WPE3NF, WPE4FI)*

Israel—Tel Aviv was noted on 11,922 kc. at 1515 with Eng. news, dual to 9009 kc. Reception of signals from both outlets was excellent. *(WPE3NF)*

Italy—Add 6010 kc. and delete 11,905 kc. for

Eng. to N.A. at 1930-1950 and 2205-2225. *(WPE1BDB, WPE2DKP, WPE4FI, WPE6BME, WPE8MS, WPE9KM)*

Jordan—The 100-kw. xmtr of the Jordan B/C Service, Amman, is heard well on 7155 kc. at 2230-2240 with an all-Arabic xmsn. This frequency replaces 9530 kc. *(WPE4FI, WPEØVB)*

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World Radio Handbook (WRH)

Katanga—*R. Katanga*, Elisabethville, 11,865 kc., has native music with French ID and anmts at 2306-2320. A veri letter from the station reads in part: "We are very pleased to know that, although we are emitting with very small power, our station can be heard well in the United States." The letter does not give the actual power but it does state that 20- and 50-kw. xmtrs are expected shortly, at which time additional foreign language broadcasts, including Eng., will be started. Reports should be specifically addressed as follows: *Radio Katanga*, B.P. 1152, Elisabethville, Katanga State, *via Brussels and Usumbura. (WPE1BM, WPEØVB)*

Kuwait—*R. Kuwait* operates at 1400-1730 in Arabic with a news and weathercast at 1500-1515. This is a daily xmsn. Power is 5 kw. *(VE7PE2M)*

Malaya—The BBC Far Eastern Relay, Singapore, operates to N. & E. China, Korea, and Japan at 0415-0600 on 11,955 kc.; to Burma and Thailand at 0800-1150 (Saturdays to 1205) on 9690 kc. and at 0845-1150 (Saturdays to 1205) on 11,955 kc. The 11,820-kc. outlet is heard at 0520-0555 with Eng. variety shows. *(WPE3AGZ, WPE6AZG)*

SHORT-WAVE ABBREVIATIONS

anmt—Announcement	L.A.—Latin America
BBC—British Broadcasting Corp.	N.A.—North America
B/C—Broadcasting	R.—Radio
Eng.—English	s/on—Sign-on
ID—Identification	s/off—Sign-off
kc.—Kilocycles	veri—Verification
kw.—Kilowatts	xmsn—Transmission
	xmtr—Transmitter

Netherlands—Hilversum now broadcasts at 0900-0950 to S. Asia on 15,445 kc., replacing 15,425 kc., and at 1615-1705 to Europe and N.A. on 11,730 and 9590 kc., replacing 15,220 and 6020 kc. Another N.A. xmsn is scheduled at 2030-2120 on 9590 and 6025 kc. A xmsn in Dutch was noted from 2230 to 2256 s/off and also at 2030-2100 in Dutch on 6085 kc. *(WPE1BM, WPE2AXS, WPE2BRH, WPE2CYE, WPE2DFB, WPE2DRF, WPE6AA, WPE9KM, VE3PE5S, VE5PE2D)*

Nigeria—A veri letter is in from Peter Proudman, General Manager of the Eastern Nigeria B/C Service, P. O. Box 350, Enugu, Nigeria. Their schedule reads: 0000-0300 (Sundays from 0100) and 1030-1730 (Sundays from 1030, Saturdays to 1800) on 4855 kc.; and 0500-0900 (Saturdays to 0930, Sundays at 0330-1000) on 9635 kc. *(WPE1BM)*

Northern Rhodesia—Federal B/C Corp, Lusaka, has news and sports in Eng. at 0000 on 9580 kc. and African music at 0010. The signal is good at first but rapidly deteriorates after 0015. *(WPEØVU)*

Panama—The following short-wave stations are currently inactive: HOM50, 5995 kc.; HP5K, 6005 kc.; HORT, 6060 kc.; HOO, 6090 kc.; HP5H, 6122 kc.; HOQQ, 6140 kc.; HP5G, 6175 kc.; and HOJ53, 9645 kc. *(WRH)*

Paraguay—ZPA1, *R. Nacional del Paraguay*, Asuncion, is testing on 15,135 kc. at 1930 in Spanish. Reports go to Cnel. Martinez 224, Asuncion. *(WPE9AGK)*

Philippine Islands—The Far Eastern B/C Corp., Manila, gives a partial Eng. schedule as follows: 1600-1845 and 2030-0715 on DZH9, 15,300 kc.; 1600-1900 and 2030-1130 on DZI8, 21,515 kc.; 1830-2000 on DZF3, 15,385 kc.; 2130-0400 on DZH8, 11,855 kc., and DZI6, 17,805 kc.; 0230-0400, 0700-0815, and 1100-1130 on DZH7, 9730 kc.; 0400-0500 on DZH6, 6030 kc.; and 0715-1130 on DZF2, 11,920 kc. *(WPE3AK)*

Portugal—The latest schedule from *Emissora Nacional,* Lisbon, reads: to U.S.A., East Coast, at 1900-2300 on 11,875 kc. and at 1945-2300 on 9750 kc.; to U.S.A., West Coast, at 2100-2300 on 9740 kc.; to Brazil at 0930-1200 on 21,700 kc. (Sundays only on 17,895 kc.), at 1430-2045 on 17,895 kc., and at 1645-2100 on 15,125 kc. Another new channel is 6025 kc., noted at 1630-1700 and at 2100-2300 with the station's usual format. *(WPE2AXS, WPE2MI, WPE8AIJ, WPE8FV, WPE9KM)*

Portuguese India (Goa)—According to the only Eng. newspaper in Goa, *The Voice of Goa* is now on 21,580 kc. with xmsns to Africa at 1030-1130 in Portuguese and at 1130-1230 in Concani. *(WPE1AAC)*

South Africa—Paradys has opened 21,495 kc. at 0700-1130, replacing 21,525 kc. and 17,855 kc. at 1130-1500, dual to 15,265 kc. In addition, 11,935 kc. is now assigned to Eng. to Africa on Tuesdays, Thursdays, and Saturdays, Afrikaans on remaining days at 1300-1500. *(WPE4FI, WPE0AE)*

Sweden—*R. Sweden,* Box 955, Stockholm 1, operates in Eng. at 0730-0845 to Far East on 15,420 and 7230 kc.; at 1115-1145 to Middle East on 15,240 and 11,705 kc.; at 0945-1015 to S. Asia on 15,240 and 9605 kc.; at 1245-1315 and 1445-1515 to Africa on 11,705 kc.; at 1530-1600 to Europe on 7210 kc.; at 0900-0930 to Eastern N.A. on 17,840 kc. and at 2045-2115 on 9725 kc.; and at 2215-2245 to Western N.A. on 9725 kc. *(WPE2BRH, WPE3BIX, WPE3BSY, WPE4BNP, WPE4FI, WPE8MS, WPE0LN)*

Tanganyika—Dar-es-Salaam is operating daily at 2215-0000, 0830-1415 (Saturdays to 1430) and Saturdays and Sundays at 0400-0530 on 5050 kc.; 0400-0615 on 7277 kc.; 1130-1415 (Saturdays and Sundays to 1430) on either 4845 or 4785 kc. *(WPE8MS)*

Thailand—Bangkok operates to N.A. at 2315-0015 on 11,910 kc. with news at 2325-2340. The General Service is aired at 0625-0757 with an Eng. newscast at 0530-0545 on the same channel. *(WPE5AG, GG)*

Togo Republic—*Radiodiffusion du Togo,* Lome, operates on 5047 kc. from 0100 s/on with an anthem to past 0145. A newscast in French is given at 0130. *(WPE0VB)*

Tunisia—Tunis is heard at 0700-1100 in Arabic on 17,720 kc. This replaces the former 17,705-kc. outlet. *(WPE4FI)*

United Arab Republic—Cairo has moved to 11,745 kc. from 11,675 kc., but more checking is required to determine whether this is a permanent move. It was noted at 2200 s/on in the usual Arabic. *(WPE9KM)*

Windward Islands—St. Georges, Grenada, now operates at 1600-1745 on 15,395 kc. after previous use of 15,400 kc. (in November), 15,150 kc. (in October), 15,370 kc. (in September), and 15,085 kc. (in August). It moves to 11,715 kc. at 1800-2115. *(WPE1CR, WPE2CRX, WPE3AK, WPE3BSY, WPE4BC, WPE4FI, WPE4HJ, WPE8AIJ, WPE9CDY, WPE9KM, WPE0AMN)* —30—

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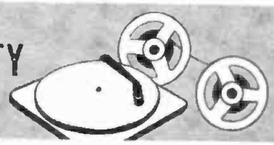

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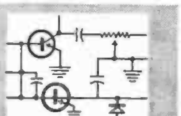

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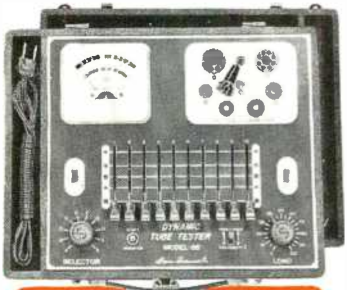
Superior's New Model 85—a *DYNAMIC type* TRANS-CONDUCTANCE

TUBE TESTER



Model 85—Trans-Conductance Tube Tester. Total Price—$52.50. Terms: $12.50 after 10 day trial, then $8.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

● Employs latest improved TRANS-CONDUCTANCE circuit. Tests tubes under "dynamic" (simulated) operating conditions. An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured as a function of tube quality. This provides the most suitable method of simulating the manner in which tubes actually operate in radio, TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

● **SYMBOL REFERENCES:** For the first time ever in a trans-conductance tube tester, Model 85 employs time-saving symbols (★, +, ●, ▲, ■,) in place of difficult-to-remember letters previously used. Repeated time studies proved to us that use of these scientifically selected symbols speeded up the element switching step. As the tube manufacturers increase the release of new tube types, this time-saving feature becomes more necessary and advantageous.

● **THE "FREE-POINT" LEVER TYPE ELEMENT SWITCH ASSEMBLY** marked according to RETMA basing, permits application of test voltages to any of the elements of a tube. The addition of an extra switch position permits the application of the necessary grid voltage needed for dynamic testing and insures against possible obsolescence due to changes in basing design.

● **NEW IMPROVED TYPE METER** with *sealed air-damping chamber* provides accurate, *vibrationless* readings.

● **FREE FIVE (5) YEAR CHART DATA SERVICE.** The chart provided with Model 85 includes easy-to-read listings for *over 1,000 modern tube types.* Revised up-to-date subsequent charts will be mailed to all Model 85 purchasers *at no charge* for a period of five years after date of purchase.

● **SPRING RETURN SAFETY SWITCH** guards Model 85 against burn-out if tube under test is "shorted."

● **7 AND 9 PIN TUBE STRAIGHTENERS** have been included on the front panel to eliminate possibility of damaging tubes with bent or out-of-line pins.

● **AN ULTRA-SENSITIVE CIRCUIT** is used to test for shorts and leakages up to 5 megohms between *all* tube elements.

Model 85 comes complete, housed in a handsome portable cabinet with slip-on cover. Only......... **$52.50**

Superior's New Model 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER

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

Model 77—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.

● Extra large meter scale enables us to print all calibrations in large easy-to-read type.

● Employs a 12AU7 as D. C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability. ● Meter is virtually burn-out proof. The sensitive 400 micro-ampere meter is isolated from the measuring circuit by a balanced push-pull amplifier. ● Uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

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

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

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

SPECIFICATIONS

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

Comes complete with operating instructions, probe leads, and streamlined carrying case. Operates on 110-120 volt 60 cycle Only....... **$42.50**

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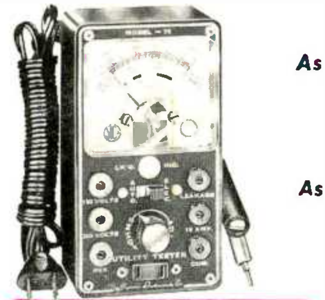
Superior's New Model 70 UTILITY TESTER®

FOR REPAIRING ALL ELECTRICAL APPLIANCES and AUTOMOBILE CIRCUITS



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- Incorporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, motors, etc.
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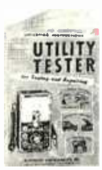

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Model 70 comes complete with 64 page book and test leads

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Superior's New Model TV-50A **GENOMETER**

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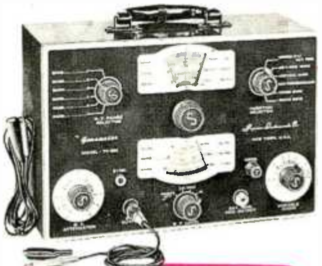

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This Versatile All-Inclusive GENERATOR Provides ALL the Outputs for Servicing:

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