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POPULAR ELECTRONICS

JANUARY 1959

35 CENTS

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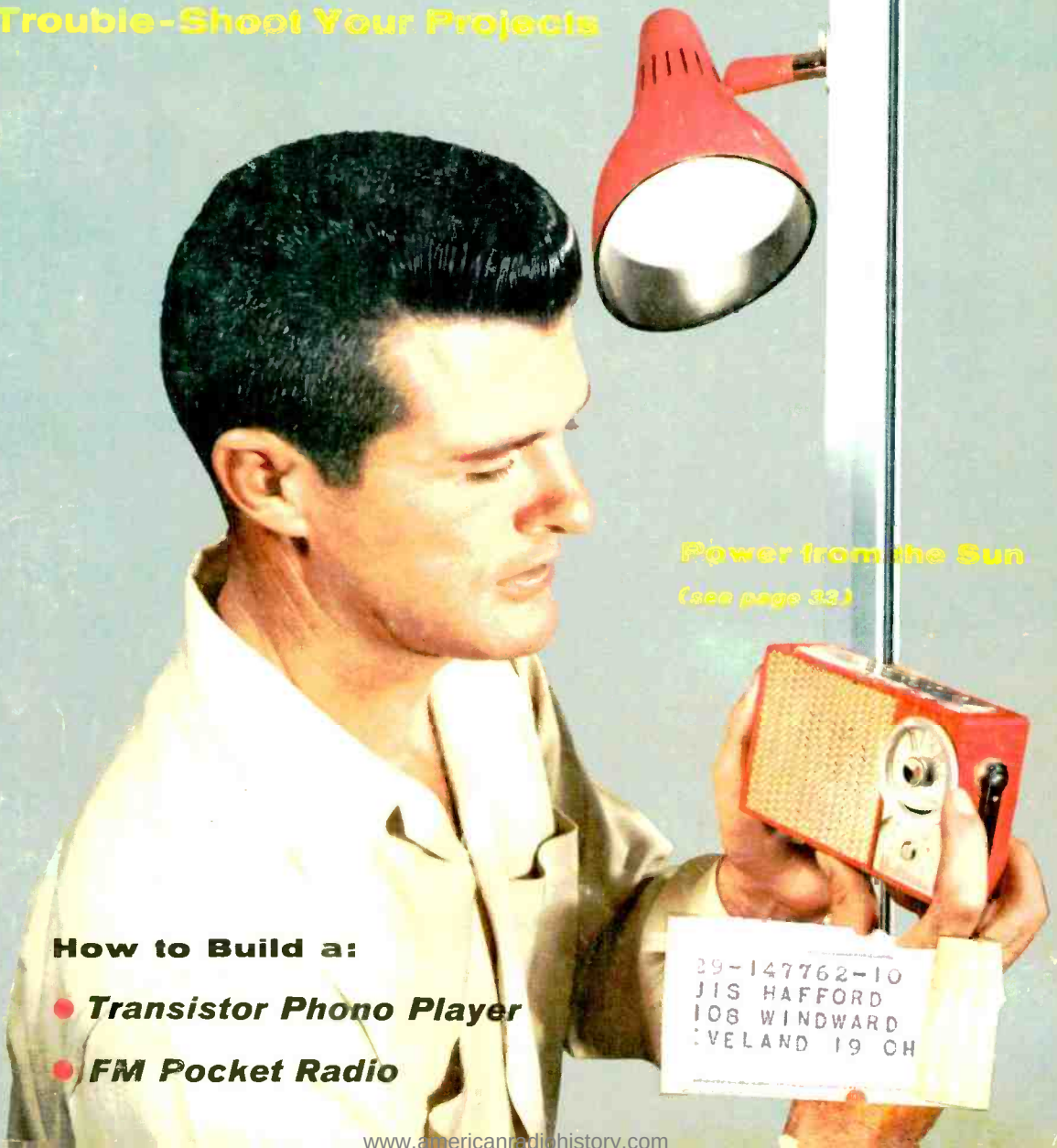

Power from the Sun

(see page 32)

How to Build a:

- Transistor Phono Player
- FM Pocket Radio

BIG NEWS!

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- Single-speed (33⅓) Crown-Spindle Belt Drive. Custom-made endless-woven fabric belt with thickness held to ± .001. Adjustment for belt tension.
- Assembly time: about 30 minutes with simple tools.
- Noise level: 47db.
- Motor: 4-pole induction, designed and built to Rek-O-Kut specifications.
- Built-in strobe disc: for checking speed.
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PERFECT TURNTABLE MATE . . . AUDAX TONEARM
the only stereo tonearm in kit form!

Assembles in just 15 minutes . . . no mechanical skill needed! A professional tonearm precision-engineered to highest broadcast standards. You save over 50% simply because you assemble it yourself. Ingeniously simple for foolproof operation, dependable performance. Takes all stereo cartridges. 12" arm—KT-12—$15.50. 16" arm—KT-16—$18.50.

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RK2

HOW TO MAKE YOUR OWN STEREO TAPES: Picture here shows Stereo Tape Transport in a *complete* stereo system with new Bell Stereo Amplifier. Engineer in photograph has just made copy of stereo record. With his left hand he is now adjusting level controls on Record Pre-amps for playback through Bell Stereo Amplifier. These two Bell components are all you need to playback and record stereo from records, tape and tuner.

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MAKE YOUR OWN STEREO TAPES!

Add this stereo component to your Hi-Fi system.

Make stereo recordings off the air; copy stereo tapes and records.

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The cost? Less than $300 for a complete stereo recording system.

Rated best for stereo recording, this Bell Tape Transport is definitely your best buy when you make your own stereo tapes.

Professional features of the Bell Tape Transport include three motors for positive tape control; there are no belts, pulleys or clutches. Nothing to cause trouble!

Easy to operate . . . you simply connect your stereo tuner, record player or other tape recorder. Recording level on each channel can be accurately set with Cathode Ray indicators. It's that easy!

Start now to build your own stereo tape library. It costs so little . . . and it's loads of fun. Ask your Bell dealer for a demonstration of this new Bell Stereo Tape Transport. Then try it yourself with a "live" stereo recording.

Your Bell Dealer has descriptive literature and complete specifications. Write for name of dealer nearest you.

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Departments

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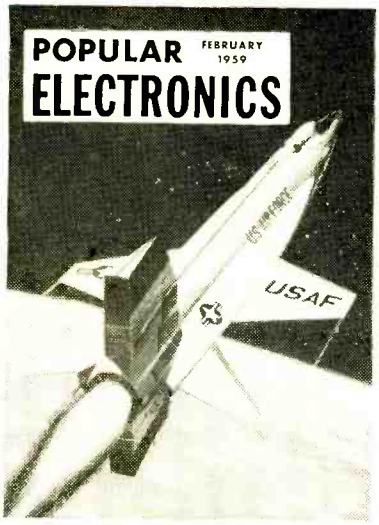
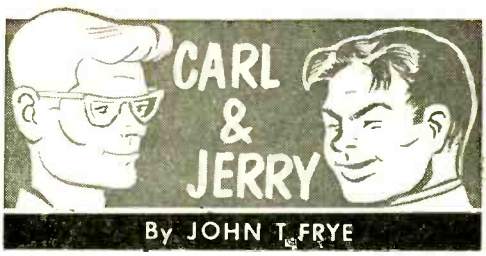
COMING NEXT MONTH



(ON SALE JANUARY 22)

February's cover shows an artist's view of the X-15 rocketing into outer space. In tune with the proposed flight of the X-15, POPULAR ELECTRONICS plans to unveil the role electronics will play in outer space explorations.

Heading the list of novel construction items will be an article on a "Bi-Fi" dual speaker system. Also, several transistor projects will delight the newcomer to electronics. And the kit builder will enjoy an informative article on soldering tips.



Little "Bug" with Big Ears

CHIEF OF POLICE MORTON sat on the worn leather couch in Carl and Jerry's basement laboratory, nervously sliding the rim of his hat through his fingers.

"We've had a kidnapping here," he said. "At first the parents asked us to help, but after they were contacted by the kidnappers, they clammed up. Now they beg us to stay clear away from them and to keep the story out of the newspapers. We know they've received threats that their little girl will be killed if the police are called in.

"We've got no choice but to follow their wishes, at least on the surface; but we're determined not to let the hoodlums get away with it. Actually, we know from experience the child is *more* likely to be harmed with us out of the case; furthermore, if those kidnappers get away with it this time, they'll do it again. We've got to nab them now."

"Where do *we* come in?" Carl asked.

"Well, we know that the father of the little girl is to contact the kidnappers from a public phone at one o'clock tomorrow morning. We got this from a maid who happened to overhear the first contact on an extension phone. We want to hear what is said in that contact tomorrow. Even more important, we want to know the number called in time to put a tail on the kidnapper before he can slip away from the public telephone he will undoubtedly use to take the call."

"Hm-m-m-m, I see the problem," Jerry said slowly. "You want to 'bug' the telephone the father will use, but you have no way of knowing in advance what telephone that will be."

"Exactly. I know it sounds impossible, but I was just hoping you boys—"

"It's not impossible," Jerry interrupted, "but I wish we had more time. I guess we'll have to use an inductive type bug. This is

Carl & Jerry (*Continued from page 8*)

really just a large inductance placed somewhere near the telephone induction coil. The field about that coil induces faint currents in our inductance that can be amplified until they are audible."

"What do you mean by 'near?'" the chief asked.

"Well, a large coil is supposed to be able to pick up conversations ten feet from the telephone; but I'll feel safer if we can place our bug five or six feet away."

"Do you have such an inductance?"

"Nope, but Carl and I can make one in shop class at school this afternoon. Really it's just a couple of pounds of very fine wire, say #40, wound on an iron core. This inductance could feed an amplifier-modulator that would modulate a small transmitter. That would allow the gadget to be placed near the telephone without any wires going to it. We could listen some distance away. The only trick is to place the bug close to the telephone the parent uses without arousing his suspicion or the suspicion of anyone watching him."

"Yeah," the police chief agreed. "We must tail the parent from the time he leaves home and be ready to plant the bug fast when he stops at a telephone. Who can be moving around the empty streets at one o'clock in the morning without arousing suspicion?"

"A milkman!" Carl blurted.

"Say, you've got something! We'll follow him with a milk truck."

"And we'll conceal the induction pickup and the little transmitter in a couple of empty cardboard milk cartons," Jerry said with mounting enthusiasm. "Somehow the policeman posing as a milkman will manage to place these cartons near the telephone being used. We'll be inside the truck with a receiver."

"And I'll have a portable two-way transmitter-receiver to contact headquarters the instant we decipher the number called from the dial clicks. The telephone company will be alerted to give us the location of that number at once. That will allow us to have a squad car there in a minute or so. A plainclothesman can follow the fellow making the call."

"Well, we better get going," Carl said impatiently. "We already have a complete miniature-tube transmitter we can use, but we still have to make the pickup coil and

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Carl & Jerry (*Continued from page* 10)

mount the whole business in the empty cardboard milk cartons. What will we use for a receiver?"

"We've got a sensitive battery-portable down at the station that will be fine for that," Chief Morton said. "I assume you'll have the little transmitter working at the end of the broadcast band."

"Right," Jerry answered. "And be sure the milk truck has the ignition noise suppressed. The motor will be running while we're listening. Better have the telephone company show us how to decipher the number called from the clicks. We can have our equipment ready right after supper."

"Fine. The milk truck will pick you up around eight and take you down to the station."

THE DAY really flew for the boys. Winding the coil was an easy matter with the aid of a lathe in the high school machine shop. For good measure they wound a full three pounds of wire on the coil. As Jerry explained, the extra turns not only increased the pickup efficiency but they also provided a better match to the high-impedance input of the amplifier. This coil took up one milk carton all by itself. The very

. . . They wound a full three pounds of wire on the coil. This took up one milk carton by itself . . .

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Carl & Jerry (*Continued from page* 12)

compact amplifier-modulator-transmitter, using miniature hearing aid tubes, was mounted in another carton together with its batteries.

The milk truck picked them up right at eight as promised. When they rolled into the police station garage, they found Chief Morton and a man from the telephone company. The battery-powered receiver was placed inside the milk truck and connected to an antenna strung underneath the chassis of the truck. The metal truck body made the receiver's loop useless, but the set had special provision for an external antenna.

The milk carton "bug" was placed near the garage telephone, and the boys and the chief listened while the telephone was dialed. Every click could be heard plainly. When the desk sergeant answered the call, both sides of the conversation could be heard clearly though faintly. Tests proved best results were had when the induction coil was in an upright position not more than eight feet from the wall telephone.

The telephone man showed them how to figure out the number called from the clicks heard. The only difficulty was in counting the rapidly occurring clicks, but a little practice solved that. All this took a surprising amount of time, and before they knew it the clock indicated twelve-fifteen.

"We better be starting," Chief Morton said. "We have a stakeout at the child's home, of course, but I want to be able to follow the father with the truck."

The chief and the two boys settled down in the back of the truck as the policeman, disguised as a milkman, rolled it out of the garage. Jerry idly tuned the receiver as they moved along the cold, deserted streets. Suddenly he muttered under his breath and bumped the receiver with the heel of his hand. "We're in trouble!" he announced; "this set has suddenly gone dead."

"Can we get another receiver?" the Chief asked.

"No time for that. Not one in a hundred would tune down to the crystal frequency of the transmitter. On top of that it must have external antenna facilities. Somehow, we've got to fix this one fast."

"Well, fix it!" Chief Morton exclaimed. "You're a radio man."

"It's not that easy. Without test instruments, I'm helpless. I can't really see, hear,

Carl & Jerry (*Continued from page* 14)

taste, smell, or feel electricity in the ordinary sense. I've got to have my test equipment to know if electricity is present and how much and what kind. Have the driver stop at my house."

THE TRUCK slid to a halt in the alley, and Jerry bolted into the basement laboratory. He grabbed up a handful of tubes, his VOM, resistor and capacitor substitution boxes, tools, and some clip leads. As soon as he leaped into the truck, it started on its way. While Carl held a flashlight, Jerry quickly removed the receiver from its case. One by one he substituted new tubes with no result. "Didn't think it was a tube," he muttered as he plugged test leads into the volt-ohmmeter. Rapidly he began a methodic check of the tube socket voltages.

"Oh, ho!" he suddenly exclaimed; "no screen voltage on this i.f. stage." He moved his red test lead to the other side of the screen dropping resistor, and the meter pointer swung over. A snip of his diagonal cutters freed one end of the shorted screen bypass capacitor. Instantly the receiver broke into a loud howl. Frantically Jerry plugged leads into the capacitor substitution box and connected the clip ends of the leads to where the bypass capacitor had been connected. As he turned the knob on the box, the receiver gave forth with broadcast music in normal fashion.

"Whew!" he exclaimed. "We'll just use it this way."

"And not a second too soon," the driver exclaimed. "There's our man just coming out of the house."

"Must not be going far," Chief Morton exclaimed. "It's only fifteen minutes until he is supposed to call. Stay well back. It looks as though he's going to walk."

Peeking over the shoulder of the driver, the boys could see the dark figure of the man walking briskly along the sidewalk. The truck driver stopped at the curb every now and then to deposit a bottle of milk on a door stoop.

"He's going to call from the booth on the next corner," Chief Morton said. "It's got to be the one; he only has a minute to go."

According to plan, the driver speeded up and passed the rapidly walking man and pulled to the curb just short of the phone booth on the corner. He stepped out of the truck with a wire carrier of milk cartons

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COMPARE FAST-CHECK WITH OTHER TESTERS RANGING FROM $40 TO $200

RANGE OF OPERATION

- ✓ Checks quality of over 650 tube types, which cover more than 99% of all tubes in use today, including the newest series-string TV tubes, auto 12 plate-volt tubes, OZ4s, magic eye tubes, gas regulators, special purpose hi-fi tubes and even foreign tubes.
- ✓ Checks for inter-element shorts and leakage.
- ✓ Checks for gas content.
- ✓ Checks for life-expectancy.

IMPORTANT FEATURES

● Checks each section of multi-section tubes and if only one section is defective the tube will read "Bad" on the meter scale ● Less than 10 seconds required to test any tube ● 41 long lasting phosphor-bronze tube sockets accommodate all present and future tube types . . . cannot become obsolete ● 7-pin and 9-pin straighteners mounted on panel ● Large D'Arsonval type meter is extremely sensitive yet rugged — fully protected against accidental burn-out ● Special scale on meter for low current tubes ● New tube listings furnished periodically at no cost ● Compensation for line voltage variation.

Other testers may have some of the above features . . . but only the FAST-CHECK has them all!

SHIPPED ON APPROVAL FOR 10 DAY FREE TRIAL

Try the FC-2 before you buy it! No obligation to buy.

PAY IN SMALL MONTHLY PAYMENTS

Easy to buy if you're satisfied. Pay at net cash price . . . no financing charges.

NO MONEY REQUIRED WITH ORDER . . .

CENTURY ELECTRONICS CO., Inc., 111 ROOSEVELT AVENUE Dept. 301, Mineola, N. Y.

Rush the FAST-CHECK for a 10 day trial period. If not completely satisfied I will return the Instrument within 10 days without further obligation. If fully satisfied I agree to pay the down payment within 10 days and the monthly installments as shown. No financing charges are to be added.

MODEL FC-2 . . . $69.50 — Pay $14.50 within 10 days.
Balance $11.00 monthly for 5 months.

Name.....

Address.....

City..... State.....

F.O.B., Mineola, N.Y.

Carl & Jerry (*Continued from page* 16)

in each hand. He set one carrier carelessly down on the walk beside the booth as he started up a nearby flight of stairs with the other. The approaching man paid no attention to him but stepped into the booth and closed the door.

Inside the truck three people held their breath as they listened to the clicks coming from the receiver. "Fleetwood 4-0351," Jerry whispered. The other two nodded confirmation, and the chief spoke rapidly but quietly into the mike of his portable transmitter. Then they listened to the conversation in which the parent was given instructions as to how to deliver the ransom. The conversation closed with a horrible threat as to what would be done to the little girl if the police were called in.

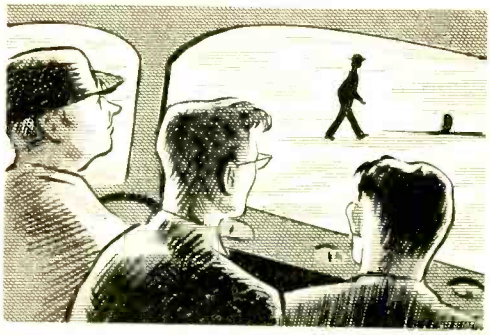
As soon as the man left the phone booth, the driver returned and picked up the milk cartons beside the booth and made a pretence of delivering them up another stairway. Then he returned to the truck and drove rapidly back to the police station.

THEY were greeted by a grinning desk sergeant: "Great work, Chief! Benny got there before the kidnapper quit talking. He tailed him to an apartment five minutes away. We closed in according to your plan and took them without a shot. The little girl is perfectly all right—not even scared. A squad car is taking her home right now."

"Well, boys," Chief Morton declared, "you've done it again. What can I say?"

"Skip it!" Carl said gruffly. "It was fun. But I'm starving. Could I have a bottle of that chocolate milk in the truck?"

"You sure can," Chief Morton said; "you sure can!" —30—

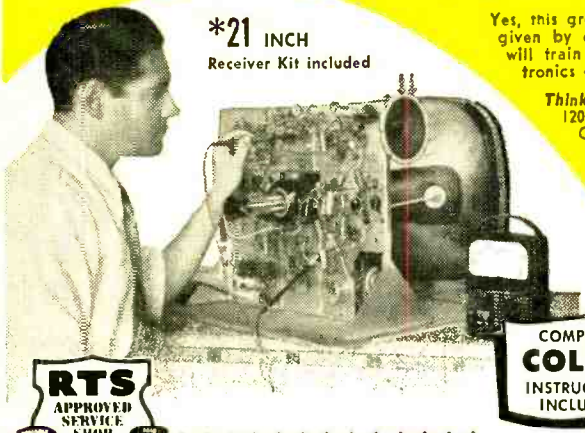


. . . The boys could see the dark figure of the man walking briskly along the sidewalk . . .

AT LAST!

RADIO-TV and ELECTRONICS TRAINING

.... AT A PRICE YOU CAN AFFORD!



Yes, this great course costs *far less* than *any* training of its kind given by other major schools! Radio-Television Training School will train you for a good job in Television or Industrial Electronics — **AT HOME IN YOUR SPARE TIME.**

Think of it—a complete training program including over 120 lessons, Fourteen Big Radio-Television Kits, Complete Color-TV Instruction, Unlimited Consultation Service . . . ***ALL at a really big saving to you.*** How can we do this? Write to us today . . . and find out!

And what's more — you can (if you wish)
OPEN YOUR OWN RTS-APPROVED AND FINANCED RADIO-TV SERVICE SHOP

We Want 100 More Shops This Year

This 35 year old training organization — called RTS, that's Radio-Television Training School — wants to establish a string of Radio-TV Repair Shops in principal cities throughout the U. S. So far, 36 such shops are NOW IN BUSINESS AND PROSPERING. We are signing contracts with ambitious men to become future owners and operators of these shops in all areas.

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FAMOUS RTS BUSINESS PLAN
find out how you can open
A REPAIR SHOP OF YOUR OWN

We supply and finance your equipment

When you are ready and qualified to operate one of our RTS-Approved TV Repair Shops ***WE WILL SUPPLY AND FINANCE EVERY BIT OF EQUIPMENT YOU NEED TO GET STARTED*** plus an inventory of parts and supplies. In other words ***we will stake you*** . . . **AN OFFER NEVER MADE BEFORE BY ANY TRAINING ORGANIZATION.** Under the RTS Business Plan you receive:

1. An electric sign for the shop front.
2. Radio and TV test Equipment.
3. Letterheads, calling cards, repair tickets, etc.
4. Basic inventory of tubes, parts, supplies.
5. Advertising and promotional material.
6. Plans for shop arrangement.
7. Instructions on how to go into business.
8. Continuous consultation and help.
9. The right to use RTS Seal of Anproval, and the RTS Credo.
10. The right to use the Famous Trade Mark.

you build all these units

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We must insist that the men we sign up be trained in Radio-TV Repair, Merchandising and Sales by our training methods—because WE KNOW the requirements of the industry. Therefore, we will TRAIN YOU . . . we will show you how to earn EXTRA CASH, during the first month or two of your training period. YOU KEEP YOUR PRESENT JOB. TRAINING TAKES PLACE IN YOUR OWN HOME, IN YOUR SPARE TIME!

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SEND ME FREE — all of these big opportunity books — "Good Jobs in TV-Electronics," "A Repair Shop of Your Own" and "Sample Lesson." I am interested in:

☐ Radio-Television ☐ Industrial Electronics (Automation)

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City & State _____

300

LETTERS FROM OUR READERS

Antenna Tuner Pepper-Upper

■ I receive POPULAR ELECTRONICS and really enjoy it above all others in the electronics field.

In your October 1958 issue, a change in the article "Put Pep in your Antenna Tuner" will improve performance. In the schematic on page 53, resistor *R3* should be changed to 12,000 ohms, ½ watt, and *R2* should be changed to 39,000 ohms, ½ watt. This will prevent a self-oscillating condition of the circuit.

JOE I. CARDOZA, JR.
Lemoore, Calif.

About Fuses

■ In the November issue of POPULAR ELECTRONICS there is a letter written by Mr. Henry Zykorie concerning series and parallel connections of fuses to obtain odd ratings. The latter interested me, and I think that certain conclusions are evident.

First, connecting fuses in series will not accomplish any purpose. As soon as the current through the circuit exceeds the rating of the smallest fuse, that fuse will blow and the circuit will be broken. Hence, if a 1-amp fuse, a 5-amp fuse, and a 10-amp fuse were connected in series, the 1-amp fuse would blow as soon as the current through the

circuit went higher than 1 ampere. Consequently, a series arrangement of fuses is not wise.

The parallel circuit remains to be considered. The current, upon entering a parallel circuit, is divided among the individual branches. Each path carries a part of the current inversely proportional to the resistance of that path. Actually the current rating of a fuse does not directly indicate its resistance with respect to another fuse of a different current rating. Considering two fuses in parallel, it is apparent that the current rating of the larger must be exceeded for the circuit to blow.

This is true because the larger fuse could carry this current by itself; the smaller fuse in parallel with it only serves to lessen to some extent the current passing through the larger one. Therefore, the current rating of the larger fuse must be exceeded to blow the parallel fuse circuit. (It should be noted that both fuses must blow in a parallel fuse circuit for the circuit itself to be considered blown; both current paths must be broken.)

We see that the circuit will blow before the current passing through it exceeds the sum of the current ratings of the two fuses. This is true

Letters

(*Continued from page 20*)

because, if the input current equals the sum of these two currents, at best each fuse will carry its own maximum rating. Unless the resistances of the fuses are just right, however, this ideal condition will not be met; one of the fuses will probably carry (for an instant only) a current in excess of its maximum rating, while the other will carry a little less than its rating. The first one will blow, leaving all the current to pass through the second. Since the current is equal to the sum of the two fuse ratings, it is greater than either, and the second fuse will then blow.

PAUL A. LEPANTO
New York, N. Y.

Club for TV DX'ers

■ I would like to start a club for TV DX'ers. The dues, if any, would be small. Is anyone interested?

ROBERT JOHN
Box 1027
George, Iowa

GMT

■ I receive your magazine every month and have enjoyed it always. But I have one suggestion to register with you, and that concerns the section known as the *Short-Wave Report* by Hank Bennett.

Being a newcomer to the short-wave broadcast bands I think that I—and many others like me—would be interested in an article that explains the 24-hour time system and breaks it down into local standard time.

BRUCE G. TRAYES
Mt. Kisco, N. Y.

In the near future we will present an article on GMT (Greenwich Mean Time).

Pick a Number

■ I wish to point out an error on page 44 of your November issue. The photograph shown is that of an IBM Type 407 output printer. The 704 which is mentioned in the caption is part of a computing system. The 407 receives information from a computer and prints it at a speed of 150 lines per minute with a maximum of 120 characters per line.

P. BASKIN
IBM Customer Eng.
N. Y.

Yes, It Can Be Done

■ When we finally admitted that something had to be done for the record player in our recreation room, we thought of hi-fi. Why not get an amplifier, tuner, crossovers, more speakers, etc., and enjoy some real audio reproduction? Ideas were plentiful till one pessimist started adding up the bill. A hundred bucks doesn't go very far when you want a full outfit of hi-fi!

An adventurous fellow had an answer: "Let's build our own. POP'tronics says it can be done; they've always got suggestions for home-brewed hi-fi." So we turned the pages of back issues and

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YOU DON'T HAVE TO SPEND HUNDREDS OF DOLLARS FOR A RADIO COURSE

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL.

You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 16 Receiver, Transmitter, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for Television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the complete price of $22.95. The Signal Tracer alone is worth more than the price of the entire Kit.

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment.

Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, Practice trouble-shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. In a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are sixteen Receiver, Transmitter, Code Oscillator, Signal Tracer, and Signal Injector circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 16 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

FREE EXTRAS

- **SET OF TOOLS**
- **SOLDERING IRON**
- **ELECTRONICS TESTER**
- PLIERS-CUTTERS
- ALIGNMENT TOOL
- WRENCH SET
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

J. Stataitis, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself, I was ready to spend $240 for a Course, but I found your ad and sent for Your Kit."

FROM OUR MAIL BAG

Ben Valerio, P. O. Box 21, Magna, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the different kits; the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Troubleshooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

A Printed Circuit is a special insulated chassis on which has been deposited a conducting material which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.

Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.

UNCONDITIONAL MONEY-BACK GUARANTEE

ORDER DIRECT FROM AD—RECEIVE FREE BONUS RESISTOR AND CONDENSER KITS WORTH $7

- ☐ Send "Edu-Kit" postpaid. I enclose full payment of $22.95.
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Name .....

Address .....

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PROGRESSIVE "EDU-KITS" INC.

1186 Broadway, Dept. 552D, Hewlett, N. Y.

Letters

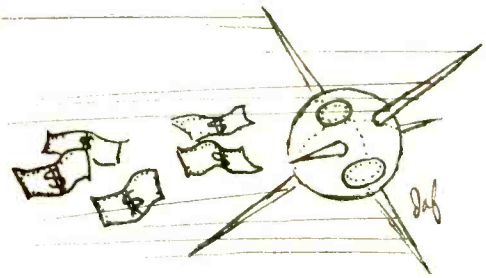
(*Continued from page 22*)

more back issues until we had some idea of what we wanted. We gathered up all usable components from our junk box, invested in a few items (only after great deliberation), and then went to work. We're very proud of the low-cost hi-fi system that we built.

FR. EARL MEYER, W3LXJ
Capuchin College
Washington, D. C.

Money is Everyone's Problem

■ The "homemade satellite" as shown in your October issue was very interesting, but I think it provided unfair competition for the other en-



trants in the National Science Fair. After all, how many school kids can afford to spend $200 for a project?

STEVEN HENDEL
Bronx, N. Y.

Ronald Benrey spent over a year in planning and building his satellite. His $200 expenditure was spread over this period. We are sure Ronald went many lunchless days in the true Edison tradition to pay for many of his parts. Since the prizes in the Fair were awarded for originality of thought rather than money spent, we feel that Ron more than earned his prize.

Help, Please!

■ A while ago I purchased a used Supreme Model 650 oscilloscope and have been unable to obtain any information on it. I would like a tube layout and schematic diagram, but Supreme is out of business. Can you or your readers help me obtain this information?

FRANK ST. PIERRE
4831 Chalmers
Detroit 15, Mich.

Ham In Trouble

■ I have a 6-meter Gonset III which I never had any trouble with until I went to college at New Mexico. Now I cannot receive a thing but static and I have gone over the entire transmitter. If any hams on 6 meters are around the New Mexico area, and can help, please write to me.

MIKE JACKVONY K1HDF/5
Box 153 Mesa Vista Dorm
University of New Mexico
Albuquerque, N. M.

We would like to hear from amateurs who are having trouble in the New Mexico area. We've heard of this problem before. —30—

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Now, for the first time, you don't need two full-range speakers to enjoy the added third dimension of stereophonic sound . . . thanks to a new application by Electro-Voice engineers of a basic principle of acoustics. As early as 1934 it was verified that bass tones below 300 cps do not indicate the location of the sound source . . . therefore, these tones contribute no stereo effect. This is because the ear lacks the ability to qualify direction when sound wave-lengths reach 2½ feet or more between their pressure crests. The *entire* stereo effect relies upon the directional placement of sounds *above* this point. The second sound source in stereo, therefore, need only be a system designed specifically to reproduce that directional part of the audio spectrum above 300 cps. Based upon this fact, Electro-Voice engineers developed the STEREON, an uncompromised second channel loudspeaker to match even the largest bass producer . . . a compact, functional furniture piece allowing greatest placement flexibility for optimum stereo. The STEREON is designed to complement any full-range speaker by reproducing only those frequencies required for stereo, thus eliminating your need for a *second* expensive bulky enclosure.

HERE'S WHAT HAPPENS:

Low bass frequencies from *both* stereo channels are properly phased through the XX3 STEREON Control Filter and channeled into your present full-range speaker to utilize its full-bass reproduction capabilities; the mid-bass, treble and very high tones are fed, one channel to your full-range speaker, the other channel to the STEREON . . . to give you full dimensional stereo . . . inexpensively, compactly.

Stereo—the Electro-Voice STEREON way—gives the impact and true-to-life spaciousness of the original performance . . . puts you in the best seat in the house.

(In larger rooms, by the way, when you'll want stereo with the scope and magnitude of the latest movie processes . . . you add-on two additional STEREONS, placing them inconspicuously around the room. The two central STEREONS simply parallel each of the channels and are adjusted to a slightly lower level to make a smooth sound picture . . . providing directionality and full depth . . . the ultimate in stereo.)

Hear the remarkably versatile Electro-Voice STEREONS demonstrated at your Electro-Voice show room. After one listening you'll agree that STEREONS are THE answer to stereo in *your* home.

GO-ON TO STEREON . . . FOR SUPERLATIVE STEREO NOW . . .

For more complete information on the Stereon and other Electro-Voice ways to go Stereo, write for free booklet on choosing stereo equipment.

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Foremost in Electro-Acoustics — *High Fidelity Loudspeakers and Enclosures for STEREO. Microphones. Phono-Cartridges and Public Address Speakers, Marine Instruments, EVI Professional Electronic Instruments and Military Material.*

STEREON III—3-way system for use with high efficiency systems. Employs MT30 mid-bass coaxial assembly and T35 VHF driver, built into integral 200 cps taper rate horn. Integral crossover network limits overall input to signals above 300 cps crosses over electrically at 3500 cps to Model T35 VHF driver. Flat response ± 2 db 300 cps to 19,000 cps. Two AT37 level controls at rear provide overall level match to full range speaker system. Quality match assured by individual control of "Presence" and "Brilliance" control. Available in mahogany, walnut, and limed oak. Size: 25" high, 17½" deep, 7½" wide. Shipping weight: 37 lbs. Net $129.50

STEREON 1A—Identical to Stereon III, for use with normal efficiency systems. Uses MT30B and T35B driver components. Shipping weight: 33 lbs. Net $99.50

XX3 STEREON CONTROL FILTER—For use with Electro-Voice Stereons. Uses matching transformer and crossover network components. All signal of 1st channel above 300 cps feeds Stereon; all signal below 300 cps from this channel is combined with full range output from second channel to utilize full bass reproduction capabilities of a single full range system. Input impedance from both amplifiers 8 ohms, output impedance 16 ohms nominal. Size: 5½" high, 4¾" wide, 5¼" deep. Ship. wt.: 8 lbs. Net $30.00

STEREO begins with the E-V totally compatible STEREO Cartridge—already the accepted standard.

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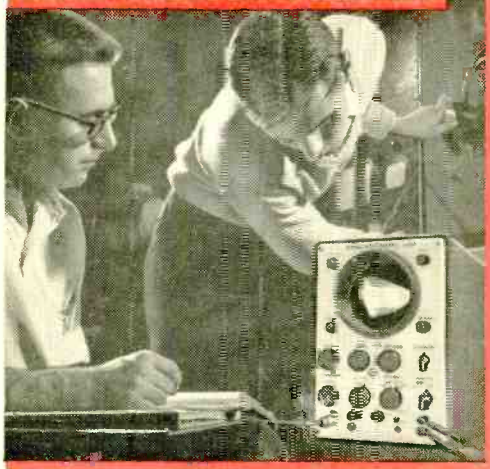

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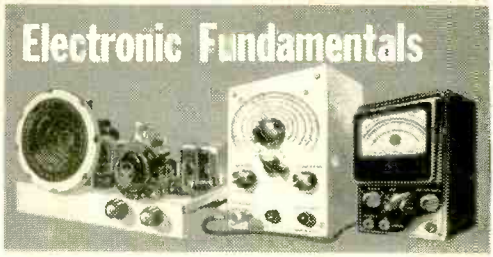
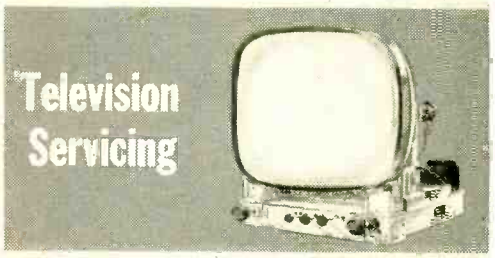


course II



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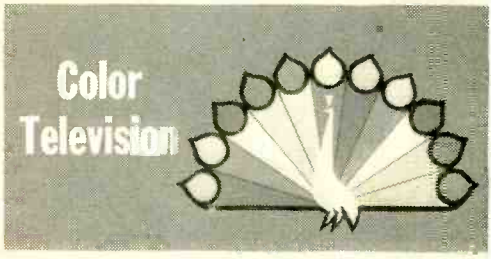

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Send for Our Complete Catalog FREE

BOOKSHELF

"TELEVISION SERVICING, THIRD EDITION" by Walter H. Buchsbaum. Published by Prentice-Hall, Inc., New York 11, N. Y. 380 pages. $6.75.

This new edition of "Television Servicing" follows the pattern of its predecessors in that it is divided, like Gaul, into three parts: theory; alignment and installation; and trouble-shooting. Incorporated into the book are the latest circuits and trouble-shooting techniques, remote control tuning, module-type construction characteristics, printed-circuit wiring, packaged circuits, color television, and test equipment. A minimum of mathematics is used and the explanations are clearly given.

Recommended: to people who are in the TV-repair business or would like to know what it's all about.

"GAS TUBES" edited by Dr. Alexander Schure. Published by John F. Rider Publisher, Inc., 116 West 14th St., New York 11, N. Y. Soft cover. 72 pages. $1.50.

Beginning with an explanation of ionization of gases, this book provides details of the physics of ionization and the basics of gas conduction and arc discharge. Gaseous rectifiers are described and compared with high-vacuum rectifiers. Gaseous voltage regulators and the circuitry involved are analyzed. The text also discusses thyratron control tubes and other gaseous devices intended for similar functions.

Recommended: to students, technicians, and junior engineers.

"PIN-POINT RECORD CHANGER TROUBLES IN FIVE MINUTES" by P. Sheneman, edited by R. T. Plemich. Published by Coyne Electrical School, 500 S. Paulina St.,

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Other .....

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.....

Bookshelf (*Continued from page 28*)

Chicago, Ill. 292 pages. Soft cover. $3.95.

This book will prove to be of value to the full- or part-time serviceman who occasionally runs up against record changers. Specific troubles and specific corrective procedures are given for the models covered and a diagram of each changer usually faces the page with the symptoms and cures for that particular mechanism.

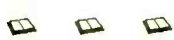
Recommended: to the electronic technician who needs help in solving the mechanical problems encountered in record-changer servicing.

"TRANSISTOR THEORY AND CIRCUITS MADE SIMPLE" by Harvey Pollack. Published by American Electronics Co., 1203-05 Bryant Ave., New York 59, N. Y. 124 pages. Soft cover. $1.75.

A frequent contributor to POPULAR ELECTRONICS, Harvey Pollack has made quite a reputation for himself as a writer who knows the field of electronics and, more important, can write about it with clarity and precision. In this book on transistors, Mr. Pollack follows his usual practice of taking a difficult subject and breaking it down to a form that is easily understandable.

The history, theory, and manufacture of transistors are clearly covered, as are various types of transistor circuits. The experimenter will find the twenty different transistor construction projects of particular interest.

Recommended: as an introduction and guide to transistors and transistor circuitry.



"BURGESS ENGINEERING MANUAL—COMPLETE DATA ON DRY BATTERIES FOR THE DESIGN ENGINEER." Published by the Burgess Battery Co., Freeport, Ill. 97 pages. Soft cover. $1.00.

Although written primarily for the design engineer, this manual will also be of interest to the electronic experimenter. Batteries covered range from 1½ volts to 510 volts and weigh from .013 to 16 pounds. Practical data provided includes: ASA reference letters and numbers, the size and number of cells used, weight, physical specifications, detailed service life graphs, voltage taps, and types of terminals used.

Recommended: for electronic design engineers and electronic experimenters.

"HOW TO BECOME A RADIO AMATEUR." Published by the American Radio Relay League, West Hartford 7, Conn. 148 pages. Soft cover. 50 cents.

There must be a great many people who would enjoy working the ham bands but have never gotten started simply because they didn't know *where* to start. This book tells you exactly where to start and how to get on the air. It contains a beautifully written explanation of basic electronics which every beginner should be able to understand. This is followed by explicit instructions for building various simple pieces of ham equipment such as a two-tube receiver and a one-tube transmitter. V.h.f., code practice, and licensing are also covered.

Recommended: to youngsters and oldsters who would like to ham it up.

Free Literature Roundup

An informative booklet on converting monaural tape recorders to stereo is being offered by The Nortronics Co., 1015 South Sixth St., Minneapolis 4, Minn. The Nortronics people have taken 17 questions that are most frequently asked about stereo tape recording and given to-the-point answers in this booklet, which is called "Questions and Answers about Stereo Tape Recording."

The electronic experimenter will find a new catalog available from Switchcraft, Inc., 5555 N. Elston Ave., Chicago 30, Ill., to be invaluable in selecting various jacks, plugs, switches, etc. Ask for Catalog S-58.

Service Instruments Corp., Addison, Ill., has announced a new catalog containing circuits, descriptions, and photographs of its test instrument line. Write for Catalog No. 119 if you would like to have a copy.

A 20-page guide to stereophonic and monophonic high fidelity is available from H. H. Scott Inc., Dept. P, 111 Powdermill Rd., Maynard, Mass. This guide includes sections explaining stereo and monophonic operation and shows various ways of building a hi-fi system. —30—

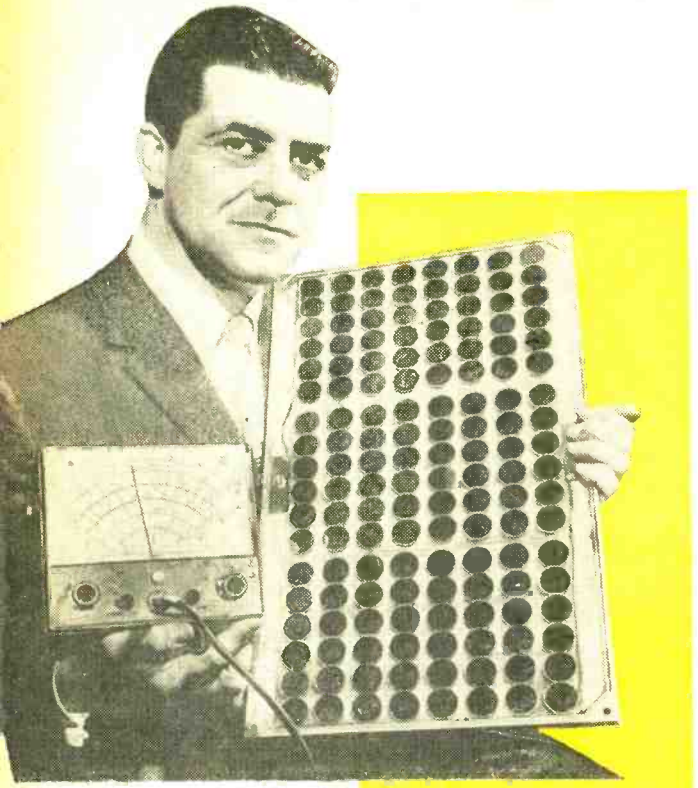
POWER from the SUN

By FURMAN HEBB
Associate Editor

AS TECHNOLOGY ADVANCES and the population of the earth increases, power requirements for modern living are skyrocketing. At the same time, the "fossil" fuels are being used up at an alarming rate. What will we do for power sources when our present reserves of coal and oil are depleted?

We immediately think of atomic power. However, at present, atomic power is unwieldy to use and there is the ever-present danger of radioactivity. In addition, currently used

Two contrasting examples of solar applications. At top of page is part of 75-kilowatt solar furnace at Mont Louis, France. Above, solar cells power a Hoffman portable radio.



A series-parallel combination of 144 Hoffman silicon solar cells will supply five watts of power to a 6-volt battery system in bright sunlight.

atomic fuels are also limited in quantity, and may eventually run out.

An inexhaustible source of power, however, is offered by the sun, one of man's most ancient divinities and the basis of all life. The sunshine of a pleasant summer day represents an incredible amount of energy. Three days of sunlight on the earth equals the total energy of all our stored fuels. Power unlimited is all around us. The problem is: how do we convert solar power into useful forms?

Methods of Conversion. Man has long tried to find a practical way to employ solar energy. One of the first methods was the use of a glass lens to concentrate the rays of the sun and start fires for Various shapes of lenses ous shapes of lense trators have been e focus the sun's rays to create hot water or the steam is then used engines and other steam verters. The largest solar po plant ever built, one with 10 horsepower capacity, was operated successfully near Cairo, Egypt, just prior to World War I.

Another method of harnessing the power of the sun, through photo-thermal conversion, is best illustrated by a device called the "Umbroiler," which allows campers to cook meals without bothering with liquid fuels or charcoal. The largest solar furnace ever built, located at Mont Louis in the French Pyrenees mountains, has a reflector 35 feet in diameter which is made up of 3500 small flat mirrors. The Mont Louis solar furnace is capable of generating heat equal to 75 kilowatts of power and can melt more than 200 pounds of metal at one time. Since solar furnaces produce heat uncontaminated by burning fuels, they are particularly useful in making metallurgical studies.

About 100 years ago, scientists began experimenting with devices that would convert solar energy directly into electrical energy. Experiments at that time concerned themselves with the use of thermopiles and, at a later date, photogalvanic cells and photovoltaic cells. The best these devices could do was to convert about 1% of the available solar power into electrical power.

In 1953, Chapin, Fuller, and Pearson of Bell Telephone Laboratories, while working on the development of the transistor, discovered that they could attain conversion efficiencies of 6% by the use of silicon junction devices. By late 1954, these cells had been put into commercial production by Hoffman Electronics Corporation. Effi-

(*Continued on page* 113)

"Umbroiler" portable cooker (left) reflects sunlight from metalized plastic surfaces to a conventional cooking utensil. (Umbroiler Co., Denver)

A solar furnace in Bouzaréah, Algeria (below), can produce 50 kilowatts of energy when weather is clear.

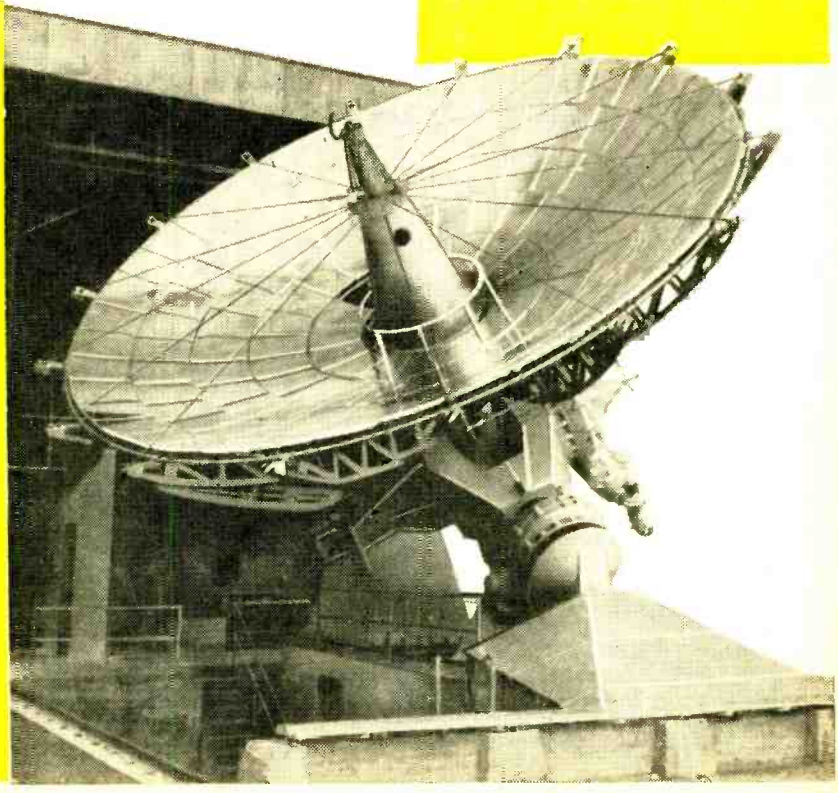
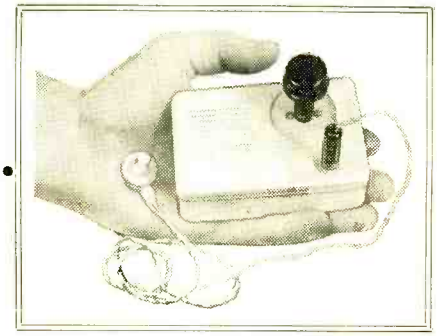


Photo at right and top of page 33 courtesy of French Embassy.

Pocket FM Receiver



By HERB COHEN*

HERE'S a miniature FM receiver that requires no external antenna, uses only one miniature tube and has good fidelity. The entire FM broadcast band is covered with enough selectivity to separate weak from strong signals even in metropolitan areas.

And it's possible to complete this "under $10.00" project in just one evening. Component placement is not critical even though the radio is constructed within a plastic case that is no larger than a cigarette pack.

Construction. The subminiature 1AG4 tube socket should be pre-wired before installation. Follow detail view, soldering plate and screen lugs together and then connecting 2½" lengths of hookup wire as shown. Connect *C2, C3* and *R1* directly to the grid lug. The tube socket can be glued directly to the case with a drop of Duco cement.

Antenna coil *L1* is made by winding four turns of #14 gauge solid wire around a form ⅜" in diameter. The turns should be spaced as close together as possible without actually touching each other. Remove *L1* from the form and solder its two ends directly across tuning capacitor *C1*. All leads should be as short as possible.

Quench coil *L2* is a four-section 2.5-mh. choke. Tap into *L2* between the first and second section as shown. Then carefully scrape the connecting wire clean and solder a thin flexible 3" lead to the tap.

All components can now be screwed or glued into place. In order to eliminate hand capacitance effect, an insulated shaft extension is used with *C1*. A dynamic earphone of 2000-3000 ohms impedance should be plugged into *J1*.

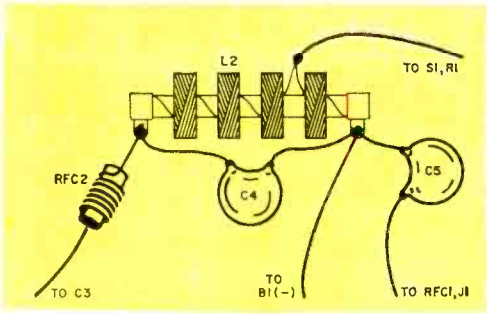
Trouble-Shooting. Before turning the unit on, check for shorts in the wiring. Turn *C1* to full mesh and *S1* to the "on" position. If the unit is functioning, a loud hiss will be heard. Tune *C1* across the band until the hiss subsides and a station appears. A large dead area may appear at the high end of the FM band. If this happens, shorten the leads in the tuning circuit.

If a hiss is not heard, touch *C1* with an insulated screwdriver. A click should be heard indicating that the ultra-audion section is oscillating but the quench circuitry is not functioning. Check all components, particularly the tap on *L2*, for a short, break or wiring error. Check battery voltage—if *B2* drops below 1.3 volts, oscillation will be difficult to obtain.

One method of calibrating your set to cover the entire FM band is to place the pocket receiver near a commercial FM set. Tune the commercial FM receiver to 88 mc. Then tune *C1* until a rushing noise is heard. Mark this spot on the pocket receiver's case. Repeat this procedure for the upper end of the FM band at 108 mc. If the high

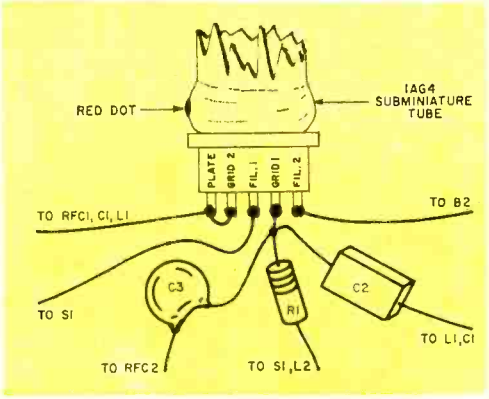
(*Continued on page* 112)

* General Transistor Corp., Applications Engineering Dept.

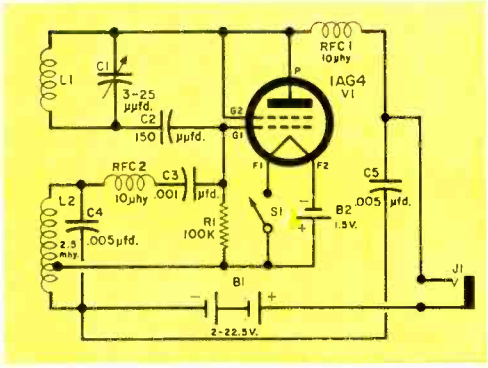


Wiring details of quench oscillator coil L2. Note added coil tap.

Detail view of wiring of sub-miniature tube socket. Red dot on tube is guide for proper installation.



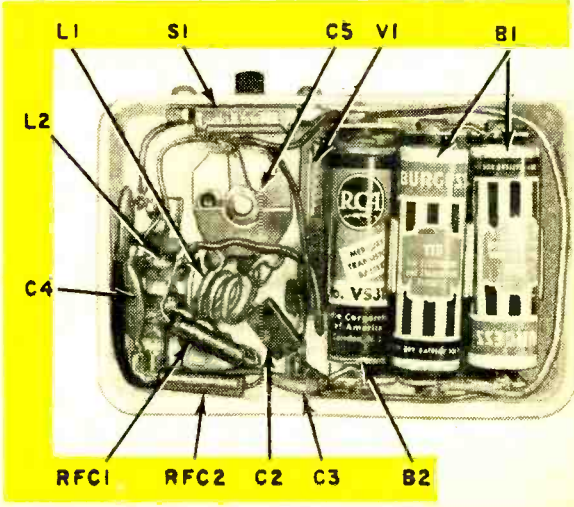
Sensitive superregen circuit pulls in FM band— without an antenna



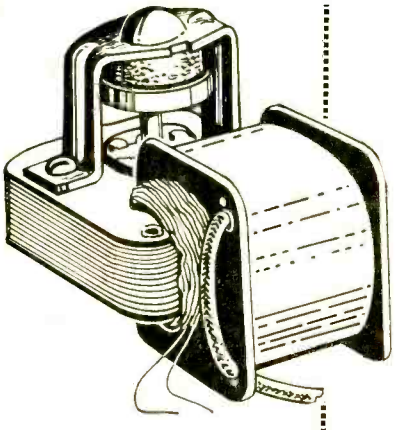
PARTS LIST

B1—2-22.5 volt battery (Burgess Y15)
B2—1.5-volt penlight cell
C1—3-25-μμfd. variable capacitor (Hammarlund APC-25)
C2—150-μμfd. mica capacitor
C3—0.001-μfd. disc ceramic capacitor
C4, C5—0.005-μfd. disc ceramic capacitor
J1—Miniature open-circuit phone jack
L1—Four turns of #14 solid wire (see text)
L2—2.5-mh. choke (Miller 4537)
R1—100,000-ohm, ½-watt resistor
RFC1, RFC2—10-μh. choke (Miller 4612)
S1—S.p.s.t. slide switch
V1—1AG4 electron tube
1—Plastic shaft extension
1—Plastic cabinet (Lafayette MS-302)
2—Battery holders (Acme 5 and Acme 45)
1—Subminiature tube socket

Antenna coil L1 is the only one requiring special winding. All others are commercially available. For longer battery life, a mercury cell can be used as B2 instead of standard penlight cell.



Parts placement shown should be followed carefully for best results. Consult the two detail views above for exact positions. All leads should be as short as possible.



Phono Motor Powers Amplifier

By
LOYD A. BARNES

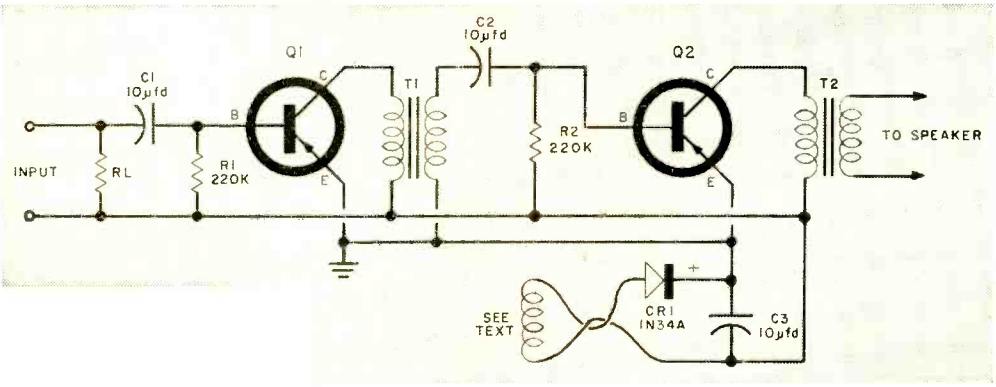
THIS record player and amplifier were constructed as part of a plan to divert a two-year-old away from the living room hi-fi rig. The player is so designed that the child simply places his favorite record in the slot provided and lifts a lever. The internal mechanism of the RCA Victor "Slide-O-Matic" 45-rpm player takes over from there with automatic positioning of both the record and the tone arm. The author's addition to the commercial machine is a transistor amplifier that is switched on and off automatically by the record player. There are no batteries to replace and no shock danger.

The transistorized amplifier is powered in a unique manner. Note that the coil on the RCA phono motor leaves room for the addition of a number of turns of small-diameter insulated wire on the motor core immediately adjacent to the motor coil. Approximately 50 turns of Litz wire are wound in this space and, coupled with the rectifying circuit shown in the schematic, will provide about 3 volts d.c. to the amplifier. The diode rectifier and the filter capacitor can be mounted on the motor winding by drill-

(*Continued on page* 120)

PARTS LIST

C1, C2, C3—10-μfd., 25-volt electrolytic capacitor
CR1—1N34A diode
L1—50 turns (approx.) of small-diameter wire wound on phono motor core—see text
Q1, Q2—CK722 transistor (or equivalent)
R1, R2—220,000-ohm, ½-watt resistor
RL—Original phono cartridge load resistor
T1—Transistor interstage transformer, 20,000-ohm primary, 500-ohm secondary
T2—Transistor output transformer, 20,000-ohm primary, 8-ohm secondary
SPKR.—2½", 8-ohm speaker and baffle



An extra winding (L1) added on a phono motor core will "steal" enough current to power a two-transistor amplifier. The same technique can be used with almost any small phono motor. The + lead of C2 should be shown connected to T1.

VHF-AERO

The Phone DX'ers Future

By
TOM KNEITEL

"*UNITED six two zero climb to and maintain twelve thousand*" crackled from my loudspeaker. Was I listening to a science fiction broadcast? No, I was spending a pleasant evening getting a preview of the "phone DX'ers band of the future," otherwise known as the "v.h.f. aircraft band." Just what is this band, and how does it affect the DX'er?

The v.h.f. aircraft band lies between the high end of the FM broadcasting band (108 mc.) and the region just below the low end of the 144 mc. (2-meter) ham band. It is the stamping ground for virtually every U. S. aircraft, most foreign aircraft, and hundreds upon hundreds of airports and landing fields located throughout the world.

Stations Heard. This band is used by various aeronautical communication and navigation stations. A brief run-down on

There are QSL's galore in the v.h.f. aero band (108-144 mc.) if you know the tips and techniques needed to get them

GLOSSARY OF TERMS

TERM	DEFINITION
ATC	Air Traffic Control
Cone of Silence	"Z" Marker Beacon
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
Fan Marker	Radio signal which indicates to a pilot the location of his plane while flying along a radio range
GCA Station	Ground Controlled Approach Station—radio facility equipped for "talking" an aircraft in by means of radar and other instruments
Glide Slope	Radio signal used by pilots to determine proper altitudes to use when landing
IFR Conditions	Instrument Flight Rules (poor visibility)
ILS	Instrument Landing System—a navigational aid to pilots consisting of Glide Slope, Localizer, Outer Marker, and Middle Marker
Localizer	Low-powered radio beacon located at an airport
Middle Marker	Fan marker located at an airport
Outer Marker	Fan marker located 2 to 5 miles from an airport
Pattern	Landing route assigned to an aircraft by a control tower
Range Station	Radio navigational aid to pilots which transmits directional beacons that can be used like highways in the sky
Tower	Control Tower
VFR Conditions	Visual Flight Rules (visibility is sufficient to navigate plane without depending solely upon instruments)

Most airlines use v.h.f. to advise their pilots of weather conditions at the landing field.

the types of stations which can be heard includes:

• *Control Towers.* These facilities instruct pilots regarding which runways to use when landing and taking off, also provide information about other aircraft which may be flying in the vicinity of the aircraft approaching the field.

• *ATCS (Air Traffic Communications Stations).* These stations provide a means of communications for en-route aircraft. Planes contact the ATCS's during their flight to report positions. The CAA (Civil Aeronautics Administration) operates these stations. However, most U. S. airlines maintain similar facilities for private communications with their own aircraft.

• *UNICOM (Aeronautical Advisory Stations).* These stations are normally located at private airports and small landing fields. They give pilots information regarding runway condition, available service facilities, hangar space and gasoline octanes, and other communications of more or less non-official nature.

• *Radionavigation Stations.* Beacons, called "Omni Ranges" (or VOR, short for V.H.F. Omni Range) are the "highways in the sky" for all types of aircraft. Specialized types of radionavigation stations also operate in the v.h.f. aero band; these are "localizer" stations which indicate to the

Pilot calling the control tower for take-off instructions via v.h.f. radio.

Photos courtesy United Air Lines

pilot whether he is headed towards the center of the runway that he is about to land on.

● *Flying School Stations and Flight Test Stations.* These are used for communications between students and instructors, and test pilots and flight engineers.

Frequencies Used. The above stations are assigned specific operating frequencies, which are determined by the nature of the service the station is engaged in. See the table of frequencies at right.

Reception of the v.h.f. aero stations, like all radio reception, is determined by the receiver and antenna used. The higher the antenna the better. However, an antenna only 35 feet above ground will give surprisingly good results. All voice communications are amplitude - modulated.

MAJOR V.H.F. AERO FREQUENCIES

FREQUENCY	USE
108.2 (+200 kc.) 111.9	Localizers G/A
108.2 (+200 kc.) 112.0	Low Power Beacons G/A
112.1 (+100 kc.) 117.9	High Power Beacons G/A
118.1	Towers (Int'l. Flights) A/G
118.3 (+200 kc.) 121.3	Towers A/G
121.5	Emergency A/G
121.7, 121.9	Ground Control (Taxiing Aircraft & Trucks)
122.1	Private Aircraft to ATCS A/G
122.2	ATCS Broadcasts and Communications G/A
122.3	Private Aircraft to ATCS A/G
122.5, 122.7	Private Aircraft to Towers A/G
122.8	Unicom and Air to Air
122.9	Private Aircraft to Towers A/G
123.0	Unicom A/G
123.1, 123.3, 123.5	Flying School and Flight Test A/G
123.7 (+200 kc.) 125.5	Towers A/G
125.7, 125.9, 126.1	Towers (Airliners) A/G
126.18	Towers (Military) A/G
126.3, 126.5	Towers (Airliners) A/G
126.7	Aircraft to ATCS A/G
126.9	International Aircraft to ATCS A/G
127.1 (+200 kc.) 131.9	Airline Stations A/G
132.2, 132.3, 134.64	Towers A/G
135.0	ATCS to Aircraft on 135.9
135.9	Aircraft to ATCS on 135.0
136.8, 137.88, 140.22	Towers A/G
142.74	Towers (USN) A/G

G/A means that aircraft stations do not transmit on the frequency, only receive; A/G means both aircraft and ground stations transmit on frequency; +200 kc. means assignable frequency located each 200 kc. between first and last frequency. This list of frequencies is intended solely as a guide. The latest aviation radio frequency allocations may be obtained from "The Airman's Guide" (see text).

Most control towers and communications stations operate on more than one frequency; specific frequencies assigned to individual airports and communications stations can be obtained as follows:

Information regarding the frequencies used by U. S. aeronautical facilities is best obtained in a copy of "The Airman's Guide," which is issued bi-weekly by the CAA. This publication can be purchased from The Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Prices of individual issues vary, but average about 35 cents. The radio data is not printed in every issue, so when

(*Continued on page* 105)

. . . introducing the first of a series of interviews with prominent hi-fi manufacturers. POPULAR ELECTRONICS goes behind the scenes to get the latest, most authoritative hi-fi information. This month . . .

Popular Electronics Visits A Hi-Fi Turntable Manufacturer

. . . an exclusive interview with Mr. Avery Yudin of Rek-O-Kut, exploring the techniques of turntable design and manufacture.

Q. Mr. Yudin, what would you say is the most exacting production problem involved in the manufacture of a Rek-O-Kut turntable?

A. There is no *one* most critical operation. The motor must meet exacting performance specifications and at the same time, the motor pulley, which is machined to very close tolerance, must also pass such inspection. The turntable itself is machined from a solid piece of cast aluminum, and must meet instrument measurements. The turntable shaft is micro-honed and case-hardened. In essence the manufacture of a turntable can be likened to the strength of a chain, in that a chain is only as strong as its weakest link. Therefore, it is imperative that in the manufacture of a turntable all the links in the chain be on the same qualitative level.

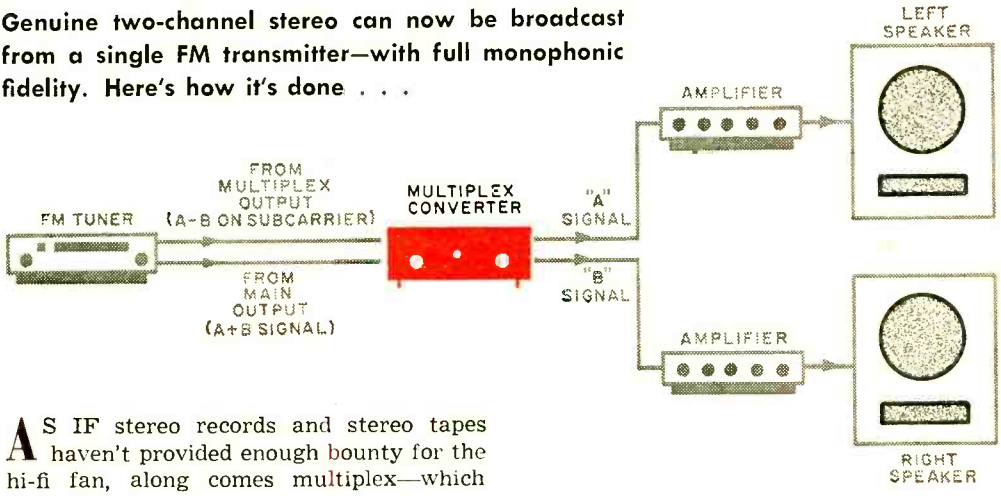
Q. In Rek-O-Kut advertisements we frequently see a figure indicating the noise level of a turntable. What assurance does a buyer have that the turntable he buys will meet these specifications?

A. In answer to this question, I would like to point out to you some of the careful and calculated tests to which we subject our turntables in order to make certain that the published specifications are met on the assembly line: the grinding operations on the motor pulleys, the dynamic balancing operations, the wow and flutter tests, the electronic strobe mea-

(*Continued on page* 106)

MX Means MULTIPLEX

Genuine two-channel stereo can now be broadcast from a single FM transmitter—with full monophonic fidelity. Here's how it's done . . .



By LEONARD FELDMAN

AS IF stereo records and stereo tapes haven't provided enough bounty for the hi-fi fan, along comes multiplex—which may some day prove to be of greater importance to the music lover than stereo discs or tapes.

For some years now, many broadcasting stations have used a technique of stereo broadcasting which leaves much to be desired. This method—possible only in cases where the same broadcaster operates an AM *and* an FM station—involves sending the "left" channel via FM while the "right" side of the stereo material is transmitted via AM. A listener equipped with both an AM and an FM set, on an evening when there is little or no static, can enjoy the pleasures of stereo—but will still be conscious of the fact that the AM channel is noticeably inferior to the FM channel.

The fate of the listener who possesses *only* an AM set or *only* an FM set during these stereo broadcasts is even worse. Since each channel presents only half of the total sound, such a listener is forced all the way to the side—either the left or the right "side," depending on whether he listens to FM or AM. In the case of symphonic music, for example, he will hear an overemphasis of first violins (left) or brass (right)—in short, a totally unbalanced experience.

Appreciating this difficulty, some broadcasters have been choosing their recorded material very carefully—selecting program material somewhat lacking in stereo effect, i.e., material wherein the left side sounds almost like the right side. When such "half-stereo" sources were not available, a few engineers have even stooped to a bit of inter-channel mixing at the studio—which yields neither a good stereophonic program nor a satisfactory monophonic one.

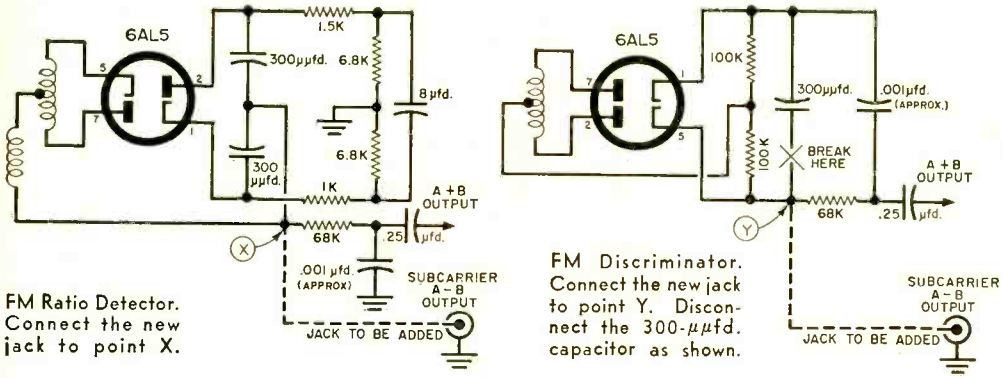
Single-Station Stereo. Into this dilemma stepped Mr. Murray G. Crosby, President of Crosby Labs in Long Island and a pioneer in FM development. Mr. Crosby, it seems, had been sitting on a pair of patents that had been applied for five years ago—just waiting for the public and stereo sound to catch up with him.

Mr. Crosby disclosed that it is possible to send two-channel stereo over a *single* FM station. Both the left and right channels can be truly hi-fi with a frequency response out to 15,000 cycles, just like present monophonic FM broadcasting. The most amazing part of his technique (and the part covered by his patents) is the

The sleek-looking Madison Fielding MX-100 is typical of the many multiplex adapters that will soon be available. The left-hand knob controls volume, the right—dimension.

well be the "hidden" second channel of a regular FM station.

A supersonic signal with a frequency of about 50 kc. modulates the FM carrier along with the regular program. This supersonic "carrier" is then itself modulated by background music in much the same way that the *main* program modulates the *main* r.f. carrier. While both signals are received by a conventional FM tuner, only the main program is heard—the high frequency of the subcarrier causing it to get lost in the tuner's de-emphasis network. To be heard, the subcarrier signal must be picked off *before* the de-emphasis network



FM Ratio Detector. Connect the new jack to point X.

FM Discriminator. Connect the new jack to point Y. Disconnect the 300-μμfd. capacitor as shown.

FM tuner circuit modifications which may be required for a multiplex output.

"compatibility" of his system. If you listen to a stereo program being transmitted using Crosby's technique and you don't have a Crosby-type multiplex stereo adapter, you will, nevertheless, hear a complete high-fidelity monophonic program on your present FM tuner.

Fortunately, the pioneering audiophile can purchase an adapter and can listen to this type of broadcasting stereophonically on an experimental basis (until the FCC gives a final okay) in several metropolitan areas. At this time, WBAI-FM in New York and WJBR in Wilmington, Delaware, already have daily schedules utilizing the Crosby multiplex system.

How MX Works. Broadcasters have long known about multiplexing. It is a method of transmitting two signals on one basic carrier frequency. The background music you hear in your favorite restaurant may and fed into the special "decoding" equipment.

So it is nothing new to send out two signals over one FM station. However, if the left stereo channel were sent out over the main FM, and the right channel were sent out over the multiplex subcarrier, the monophonic listener would still receive a "one-sided" program if he listened to his FM receiver only, just as in the AM-FM method. This is where the Crosby system steps in.

The Crosby System. Suppose we add the left and right channels together and send that information out over the main FM channel. This is the A + B signal; A is the left channel and B is the right channel. Then the monophonic listener will hear a complete and balanced program. Now suppose we electrically subtract the right channel from the left (A/B) and send out

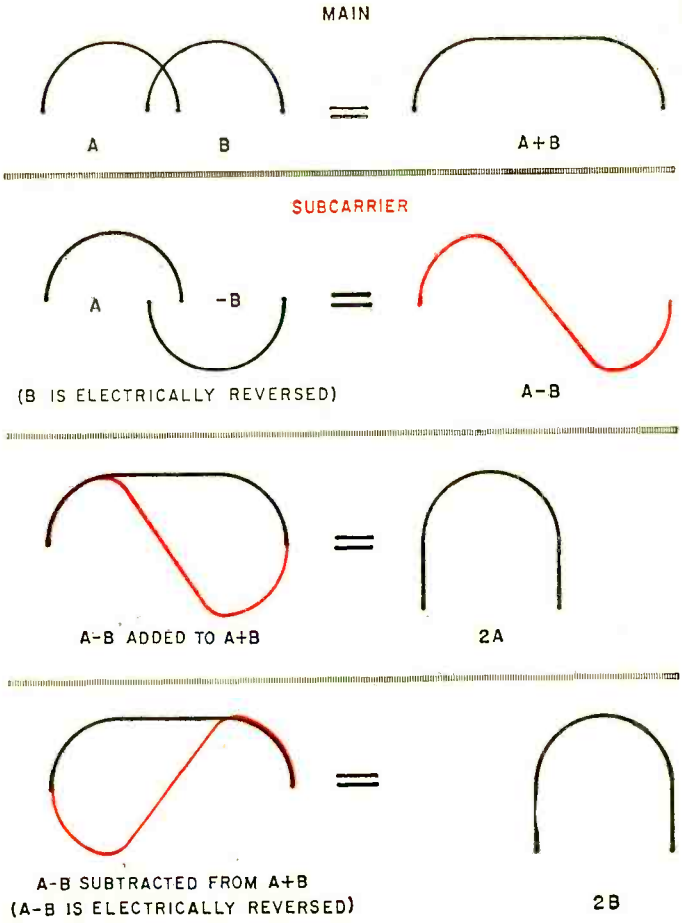
this "difference" signal over the supersonic subcarrier.

The multiplex adapter, in addition to detecting or "decoding" the A − B audio signal, must perform some electronic addition and subtraction. Let's take the main channel signal (A + B) and add to it the difference signal (A − B). And let's take A + B and subtract A − B. Both of these steps are performed electronically by the use of mixing circuits.

To appreciate what happens, take a pencil and a piece of paper, and using simple algebra, solve the two problems. From the first equation you will get 2A and from the second you will get 2B! Try it again if you don't believe it. The multiplex adapter actually recovers the true left and right channels (the factor of "2" is not significant). The separate outputs of the adapter are then fed to a pair of amplifiers (or a stereo amplifier) just as you would any other stereo source.

Note that in the Crosby system there are two separate feeds from the FM tuner to the MX adapter. One lead comes from the "standard" FM output jack of your tuner, the second connection is made between the "multiplex" output jack found on most recent FM tuners and the appropriate input on the MX unit.

If your present tuner lacks a multiplex output jack, it is easily added, as shown in the diagram, which covers both "ratio detector" and "discriminator" types of FM tuners. No additional parts are required—just an extra output at the circuit point shown. The cable length from this new output should be kept short, however—no more than three feet.



THE ALGEBRA OF MULTIPLEX

A = Left channel
B = Right channel
A + B = Balanced monophonic sound on main FM subcarrier
A − B = Difference sound on supersonic subcarrier

A + B and A − B signals are transmitted on the same FM channel. When they are received by the multiplex adapter, the following action takes place:

(A + B) + (A − B) = A + B + A − B = 2A (left channel),
and
(A + B) − (A − B) = A + B − A + B = 2B (right channel).

Plugging the "Hole." You will recall that the A + B signal constitutes a full monophonic program. Also, adding—sub-

(*Continued on page 98*)

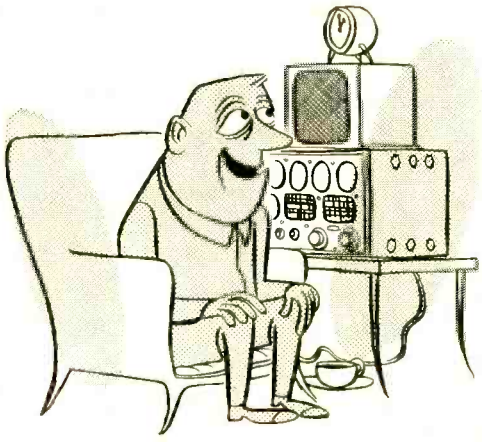
SOUND INVESTOR

With some fellows it's wine, women, cards and close harmony: with *this* chap it's hi-fi and constant harmony. He follows the amazing progress of the hi-fi field, keeping his collection of components and improved pieces of equipment abreast with new issuance of modern hi-fi instruments.

By CARL KOHLER

The Live-Wire Set

Anyone who enjoys a true passion for electronics knows the field is comprised of various schools of thought and peopled with various types of individuals whose respective eccentricities only add color and character to every phase of electronics. Here are a handful of such enthusiasts . . .



GOOD LISTENER

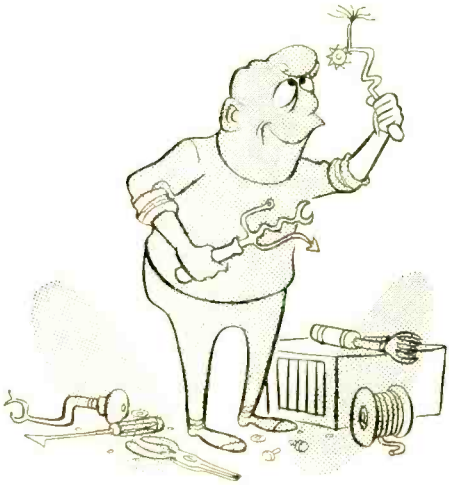
This individual knows other phases of electronics fairly well, but has just discovered that he has a real talent for listening to short-wave broadcasts, and spends every spare moment doing just that. He gave up regular radio, television and poker with no sense of loss.

PLODDER

Once he begins a project, he is ready for another one. This enthusiast has more unfinished electronic projects lying around his workbench than any ten of his fellow enthusiasts. He prefers to think of his projects as being "in development stages." In early 1959 he definitely plans to complete a radio repair job for a relative (which was originally taken on during 1937).

PLAYBOY

This one stumbled into radio-controlled fun some time ago—and will never be the same again. He builds his own models, designs his own R/C units and goes into a rage if any of the neighborhood children come within twenty yards of his fine R/C play-toys.

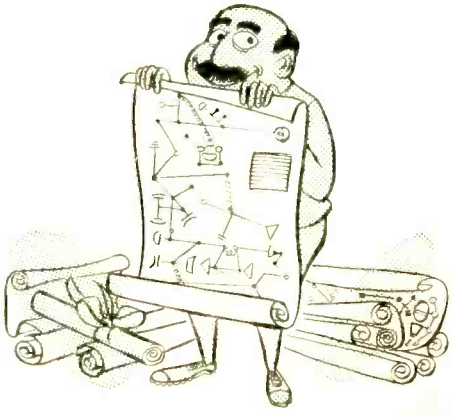


MALCONTENT

He long ago discovered a chronic dissatisfaction with the standard tools used in electronics work. Now he devises his own. Some day he plans on making a real fortune by developing a special combination-tool that will easily get into *all* those inaccessible spots in tuners, amplifiers and transmitters.

AVID READER

He makes no effort to disguise his love of cleanly drawn, well-planned schematics. His idea of a splendid evening is to pore over a stack of exciting diagrams, and he wonders what anybody else can see in regular books and newspapers. He also admits (with small chagrin) that he has been too busy reading all the latest electronic schematics available to attempt starting a definite project of any kind.



"Why do you need so much power? You only use about one watt under normal listening conditions . . . And why a supersonic frequency response? Your ears can't hear much above 15,000 cycles anyway."

DISCUSSIONS on the above rage furiously in the hi-fi salons. Let's see what the story is, and why I, for one, want a good-quality amplifier with between 50 and 100 watts of usable power and a low-

High Power for Hi-Fi

One man's opinion on "what's watt with power amplifiers"

level frequency response from 10 to 100,000 cycles ± 1 db.

High and Wide. First let's consider frequency response. Everyone knows that pure sine waves above 16,000 cycles are inaudible to most people. But who ever heard of a perfect sine wave associated with music? The special sound character of a musical instrument is due to both its overtones and harmonics (which make for jagged waveforms) and the rate of attack (speed with which the sound rises to maximum intensity).

Plucked instruments, for instance, have a very fast attack time, as do cymbals and triangles. This fast rise time can be compared to the wavefront of a square wave—and like a square wave, can be shown to consist of very high frequencies. (See March 1958 POPULAR ELECTRONICS.)

Your amplifier, to reproduce the instruments with their characteristic tonal quality, *must* be able to reproduce cleanly to the highest frequencies "buried" in the waveform. If you want your amplifier to reproduce a guitar so that it sounds like a guitar, the amplifier *must* have a wide frequency response.

A Powerful Argument. The case for high power is based on two widely-talked-about but little-understood culprits: intermodulation and harmonic distortion! The accompanying graph shows typical curves.

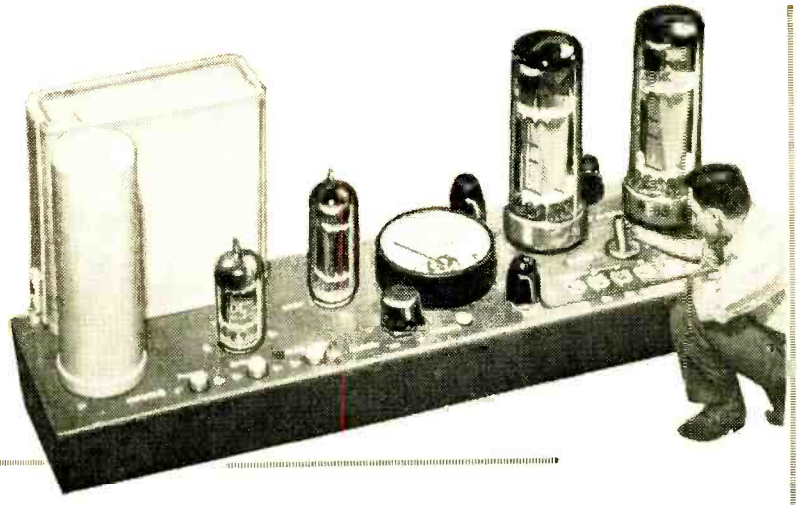
Both types of distortion contribute to what's called listener fatigue. You may ask, "Why work so hard to cut down the distortion in the amplifier when most of the distortion originates from other components, especially the speaker?" The answer is that distortions are additive and in some cases are higher than the sum of the distortion of the individual components.

For instance, if there is 10% IM distortion in the speaker and 3% in the amplifier, the total may come to more than 13%. The best way to keep the amplifier distortion down is to start out with good quality and then have plenty of reserve power.

Distortion Level. The authorities agree that IM distortion should be no higher than about 2% for music which has an upper frequency limit of 15,000 cycles. Like all distortion tolerance figures, this is a rough estimate because of the difficulty of measuring individual response.

How much drive power does the speaker require? Audio engineers have estimated about 0.4 watt as the average acoustic power required to give normal room level sound with orchestral material. The key words here are *"acoustic power."* Remember, however, that we are feeding the speaker *electric* watts—which the speaker has to *transduce* into acoustic watts. If the speaker is only 5% efficient (and that's an average figure), we will need 8 watts from the amplifier to drive the speaker cleanly to room listening level.

Looking at the graph, we are still under 2% using a good 10-watt amplifier. But



A Lafayette LA-70

B Dynakit Mark III

C Acrosound Ultra-Linear II

D Tech-Master 19

E Leak Stereo 50

F EICO HF-60

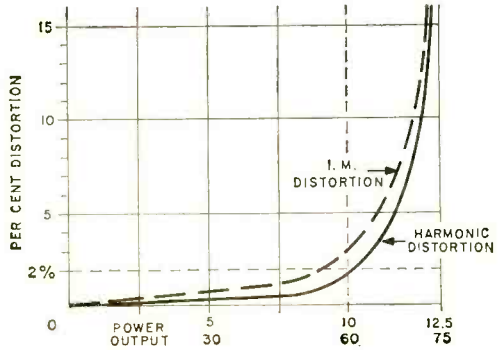
G Heathkit W-6

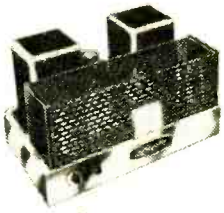
H "Peri-50"

By
BRICE L. WARD, JR.

suppose a loud passage suddenly puts a 12-watt demand on the amplifier? It becomes apparent that we have far exceeded the tolerable distortion. And loud passages containing full orchestra are where we need low intermodulation distortion the most. Now with a 60-watt amplifier putting out 6 watts, our distortion remains below ½ of 1%, and does so even when the full orchestra demand may be put on it. What more could any man's "golden" ears ask? —30—

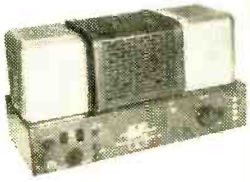
The graph below shows how the higher powered audio amplifiers maintain a low distortion level on orchestral peaks.





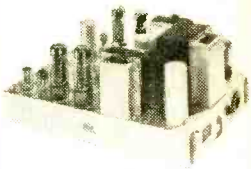
A

B



C

D



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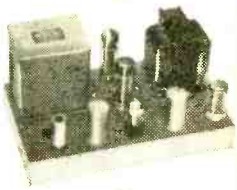

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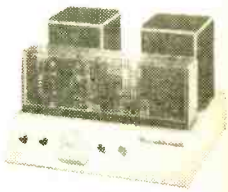

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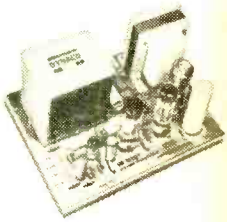


H

A selection of 50-70 watt amplifiers which are available in both kit and wired form.

Test Instruments

Part I

THE VOLT-OHM-MILLIAMMETER —D.C. VOLTAGE RANGES

By LARRY KLEIN
Technical Editor

Typical VOM range switch. The precision multiplier resistors are arranged on a wiring board adjacent to the switch terminals.

THE BASIC electronic test instrument is the volt-ohm-milliammeter. Commonly known as the VOM, it presents a fascinating study of just how many useful functions can be crammed into a small black plastic cabinet. Before we get our VOM into action, let's go through the circuit and find out what it will do—what it won't do—and why.

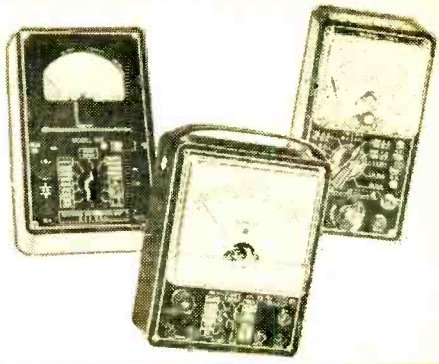
The heart of the VOM is its meter movement. In most 1000-ohms/volt multimeters, the movement has a sensitivity of 1 milliampere d.c. This indicates that with 1 ma. of current flowing through the meter the needle will be fully deflected to the last scale division mark on the meter face. The descriptive term "1000 ohms/volt" is a little more complicated. Practically, it indicates the amount of resistance needed in the meter circuit (for a given voltage range) to limit the current through the meter movement to 1 ma. (See Fig. 1.)

Once this basic principle is understood, setting up various voltage ranges is easy. For a 1-volt range, the resistance of the circuit must allow exactly 1-ma. current flow in the meter (full scale deflection) with 1 volt across the test leads. Ohm's law ($R = E/I$) tells us that the circuit resistance should total 1000 ohms. Since the meter movement has an internal resistance (R_{int}) of 100 ohms, adding a 900-ohm series resistor ($R1$) will do the trick. Applying 0.5 volt across the VOM's 1000-ohm internal resistance will result in 0.5-ma. current and a half-scale reading.

Multi-Range Meters. Additional d.c. voltage ranges can be incorporated simply by adding other precision multiplier resistors. Remember that for every volt we

want to add to the range, another 1000 ohms of resistance must also be added in order to limit the meter current to a maximum of 1 ma. For a 10-volt scale *R1* is 9900 (*R1* plus R_{int} = 10,000). For a 50-volt scale, *R1* is 50,000 ohms (actually 49,900 ohms, but the 100-ohm difference represents only 0.2% and can be ignored).

Figure 2 illustrates the circuit of a multirange d.c. voltmeter which switches in various series resistors to provide the different ranges. Note that the resistors are *added*



Test instruments—meters, signal generators and scopes—are as vital to the electronics field as the microscope, stethoscope and electrocardiograph are to the medical profession. They are the tools of the trade. In electronics, where things happen as invisible waves of submicroscopic particles traveling at the speed of light, our senses are helpless. Test instruments, then, are eyes, ears and fingers, enabling us to "see," "hear" and duplicate phenomena far outside our normal range of perception.

You'll find computermen tracing through the "nerve" paths of giant electronic brains with volt-ohm-milliammeters like those employed by your local TV service technician. The oscilloscope displaying the splitting of the target atom in a cyclotron is not too much different from the one used by the modern automotive mechanic tuning up an ignition system. Audio and r.f. generators are found in applications as diverse as checking out your hi-fi set, aligning your TV, or tracking a satellite orbiting through space.

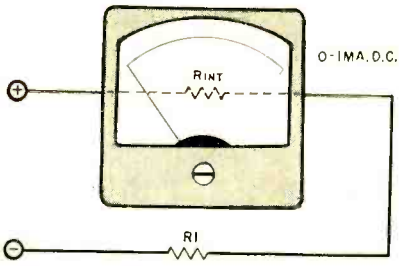
It's evident that a first-hand knowledge of test equipment is vital to activity in all areas of electronics—from the construction of a one-transistor amplifier to the design of a 1000-watt ham rig. But how do you get started; what instruments do you need, what do their specifications mean, and most important, how do you go about getting the most mileage from your test equipment dollar?

Those are some of the questions that POPULAR ELECTRONICS *is going to answer for you. Each month we will put a standard test instrument on our workbench and run it through its paces. We'll see what makes it tick and how it can be put to work solving practical trouble-shooting problems—testing your hi-fi system, ham rig, construction projects and all types of electronic gear.*

to provide each next higher range. For example, the 5-volt range which comprises R_{int}, *R1* and *R2* totals 5000 ohms. A jump to the 10-volt range adds *R3*—another 5000 ohms. And as can be expected, the 50-volt range has a total of 50,000 ohms resistance (R_{int}, *R1*, *R2*, *R3*, *R4*).

Higher Sensitivity. Aside from an occasional 100,000-ohms/volt or 25,000-ohms/volt model, the other most-often-used VOM's are rated at 20,000 ohms/volt. The principle of operation of the 20,000-ohms/volt d.c. meter is identical to the 1000-ohms/volt job, except that a 50-microamp (.05-ma.) meter movement is used. The chart of Fig. 2 il-

Fig. 1. Conversion of d.c. milliammeter to read voltages.



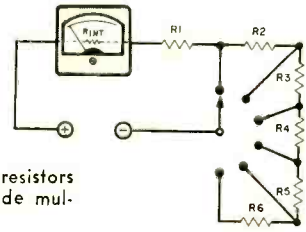


Fig. 2. Series resistors wired to provide multiple ranges.

RINT	RI	R2	R3	R4	R5	R6	SENSITIVITY
APPROX 100	900	4K	5K	40K	50K	150K	1000 OHMS/VOLT
APPROX 2K	18K	80K	100K	800K	1MEG	3MEG	20,000 OHMS/VOLT

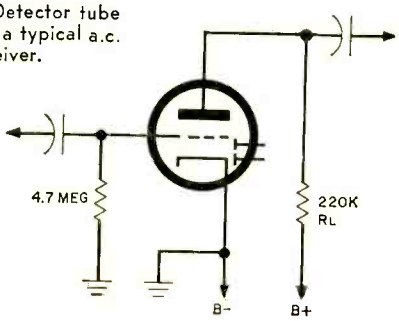
lustrates the difference in multiplier values required for the two sensitivities.

In practical terms, what will the more expensive 20,000-ohms/volt VOM do on the test bench that a 1000-ohms/volt job will not do? The expensive meter movement's advantages appear in the d.c. voltage and ohmmeter functions. We'll look at the voltage ranges first.

Let's say we want to check the plate voltage of the 12AT6 or 12SQ7 tube in a typical a.c./d.c. radio (Fig. 3). The negative lead of the meter is clipped to the B– ground return. (The negative terminal of the filter capacitor is a good spot, as chassis ground may be isolated from electrical ground.)

Now set your VOM for the 250-volt d.c. range and check the voltage on the tube's plate. What will the reading be? Oddly enough, the meter reading will depend on the sensitivity of the meter used. A 20,000-ohms/volt meter will read about 55 volts and a 1000-ohms/volt VOM will read about 42 volts. And if the 1000-ohms/volt VOM is switched to the 50-volt range, the reading will drop to about 17 volts.

Fig. 3. Detector tube circuit of a typical a.c./d.c. receiver.



Meter Loading. Why does this happen? It may come as a surprise, but the difference in reading among the three types of meters isn't due to difference in accuracy, but rather to the fact that the voltage being measured actually *changes* as each meter is connected. The plate circuit of the tube doesn't care about the sensitivity of the meter as such; what it does respond to is the amount of resistance appearing across the VOM test leads that shunt the plate resistor.

Looking at the matter this way, it is easy to see how the 250,000-ohm shunting effect of the 1000-ohms/volt meter (when set on the 250-volt range) is a lot more significant than the 5 megohms internal resistance presented by the 20,000-ohms/volt job. When the VOM is switched from the 250-volt range to the 50-volt range, the effective resistance across the meter test leads falls to 50,000 ohms. The effect of this lowered resistance on the voltage read is demonstrated above. A vacuum-tube voltmeter (VTVM) would read the highest voltage of all—and we'll cover that later in this series.

On any d.c. voltage range, it can be seen that the 20,000-ohms/volt meter presents only 1/20 the shunting resistance of its less expensive 1000-ohms/volt brother. But how important is this? The answer is—*only* with certain types of measurement.

Any time a d.c. voltage reading is to be taken across a high resistance such as R_L of Fig. 3 (or any resistance high enough to be close to the internal resistance of the VOM), the shunting effect of the meter resistance *must* be considered. On the other hand, voltages taken across a low effective resistance such as a heavy-duty battery or power supply will read the same with any standard voltmeter.

Now that we've gotten the basic principles of the d.c. ranges under our belts, the remainder of the VOM's circuits will be no problem. Next month we will switch through the a.c. voltmeter, the ohmmeter and the current ranges—and see how they go about doing their particular jobs. —30—

WANTED 100,000 Technicians

By **SIMON DRESNER**
Associate Editor

EVERY YEAR thousands of fuses are blown in American homes by experimenters plugging in their first home-made radios. For many would-be Edisons, this is their first and last contact with the world of electronics—their interest vanishes along with the house lights. For others, the blown fuse will have sparked a life-long interest in a field which may make each of them one of American industry's most wanted men: *the electronic technician.*

Today's electronic technician is more sought after than engineers, he is paid as much or more than any other skilled laborer, he commands professional respect, but he *doesn't* need a university degree. Today's electronic technician works as part of an engineering team—the day of the lonely scientist in an isolated laboratory has disappeared forever. On the average, every creative engineer needs five technicians to help him design, build, and maintain new equipment.

This means that the technician shortage may be five times as high as the engineer shortage. That's why industry is not waiting for science-minded youngsters to grow up into the field—it's going right after capable men in every type of work, and is spending millions to train them in electronics, through company training courses and tuition refund for schools.

Since the technician's job didn't exist 15 years ago, he doesn't have to be young or old. At one time he may have been a draftsman, a machine operator, or an assembler. What he *knows* is more important than what he *was.*

What Kind of Technicians? To find out exactly what the current need for technicians is, POPULAR ELECTRONICS interviewed a number of personnel managers from some leading companies which employ large numbers of technicians. Here are some representative and candid answers to some basic questions about technicians today:

• *What type of technicians are you looking for?*

"We like hams and people who carry electronics into their home life. We always need sharp individuals—we're past the need for the mediocre. We need high level technicians and not just testers—we haven't recruited testers for 18 months and see no need for them in the coming year."

"We're looking for people we can promote quickly. We've upgraded so many men from within the company that we've exhausted our skill pool."

• *Where is the biggest demand for technicians?*

"Men with transistor circuitry experience are practically unavailable."

"Most needed is specific experience in

missile and guidance systems. Complete familiarity with military standards and test procedures is a necessity."

"Technicians need more courses in digital and analog computers. We've got 65 openings and have advertised for two weeks, yet all we've placed are five men."

"We need people with industry experience. There's a great shortage of men with transistor experience."

• *How high can a technician go?*

"The sky's the limit. Our senior lab technicians have weekly salaries between $120 and $145. If they're good, they'll be promoted to Test Methods Engineer, earning between $145 and $200 a week. Average salary is about $750 a month. Top pay for a technician with 5-10 years experience runs to $800 a month."

• *Do your technicians eventually become engineers?*

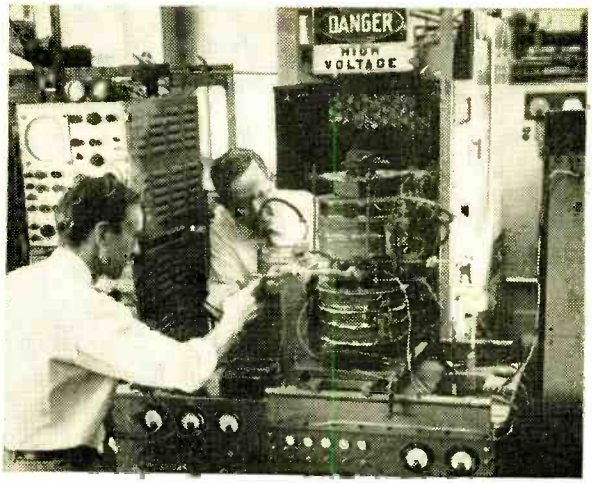
"A good many of them do become engineers. Our highest title for a technician is Field Engineer, or Methods Test Engineer. He's got the title of engineer although he doesn't have an engineering degree — he's probably had more experience than an engineer."

"They can definitely become engineers without an engineering degree."

How Much Training? Learning basic theory and some practice in servicing is a necessity, but it takes more than that to reap the rich rewards available in electronics.

Many employers want advanced training in electronic theory, and they're willing to pay to send you to school to get that training. But before they do that, they want you to have shown some interest in electronics. If you take the trouble to learn electronics on your own, chances are you'll be courted with dozens of job offers throughout the country.

The more theory that you know, the better will



Experiments in super-high current radar techniques carried on at RCA research laboratories require technicians to design and build special equipment.

NOT REQUIRED: A College Degree

Just how much education does it take to get a job as an electronic technician? Here are some questions and the answers given by personnel managers and engineers—the people who actually hire technicians:

Question: *As an employment requirement, do you demand a technician who is studying for an engineering degree?*

Answer:

Personnel Managers	Engineers
NO—91%	NO—95%
YES— 9%	YES— 5%

Both engineers and personnel managers agree that a technician need not be working toward a degree.

Question: *Do you require* laboratory research technicians *to have a mathematics background through calculus?*

Answer:

Personnel Managers	Engineers
NO—47%	NO—72%
YES—53%	YES—28%

Most engineers feel that a technician doesn't need calculus, but a good number do require it. Personnel managers are split 50-50 on this issue.

Question: *Do you require* general electronic technicians *to have a mathematics background through calculus?*

Answer:

Personnel Managers and Engineers
NO—90%
YES—10%

Calculus is not usually required for a general electronic technician. Both engineers and personnel people are emphatic on this point.

Question: Do instrument maintenance technicians *require calculus for employment?*

Answer:

Personnel Managers	Engineers
NO—100%	NO—97½%
YES— 0%	YES— 2½%

Almost no one requires calculus for maintenance technicians.

From a survey by United Electronics Laboratories, Louisville, Ky.

Trouble-shooting highly complex equipment requires a well-trained electronic technician. Here a Remington Rand man has localized a faulty computer circuit with an oscilloscope, and is substituting a new chassis unit.

Programing a big computer is a tricky job, and it takes a specially trained technician to do it. While the Univac II is being warmed up, the electronic technician below is setting up "turn-on" instructions on the control panel.

be the job offers. Once you've been hired and show promise, a company will sometimes pay to send you back to school for advanced specialized training in its particular type of equipment, such as radar, servomechanisms, computers, transistors, or the like.

To get yourself hired, you don't need much math, but to get ahead you do. The reason is simple—you can't learn advanced electronic theory without the proper tool, calculus. That doesn't mean that you have to be a math whiz—a basic understanding of the principles of calculus plus knowing how to *apply* calculus formulas is enough for any technician.

But math need not be a stumbling block in getting started. With algebra and trigonometry, you can learn enough basic electronics to get a job. If a company sends you back to school for more advanced theory, you'll learn *applied* calculus at the company's expense.

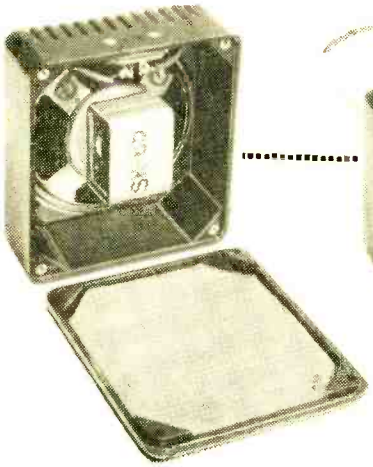
The training in electronics is not all brainwork. Besides knowing theory, a technician has to be able to handle a soldering iron without burning down the laboratory, and manipulate delicate electronic circuits without damaging the equipment.

Psychologists who have studied human aptitudes know that intellectual skills and manual dexterity are rarely found together in one person. Many top-flight scientists and engineers can't nail up a picture without hammering their thumbs. On the other hand, a lot of skilled mechanics haven't got the intellectual aptitude to study electronics. It takes both skills to make a good electronic technician, and there simply aren't enough people who can combine a good head with nimble fingers.

Technician or Professional? This label of "technician" is a better one than "semi-professional." No one likes to be known as half of anything. The title raises the technician several notches above the level of "mechanic," whose future is limited by a lack of electronics know-how.

As experience adds up, the "technician" title can give way to "engineering aide." And if you've got the energy and ambition to earn an engineering degree, you'll always be welcome as a professional.

Electronic training never walked in the front door. You have to go out and get it. You will find that the rewards are well worth the effort. —30—



Improve Miniature Speaker Baffles

The miniature plastic speaker baffles supplied with several of the transistor radios currently on the market are beautiful looking jobs, but their tone quality and efficiency can be improved considerably.

Simply drill a few holes in the back cover of the box, which will provide an outlet for the sound waves radiated by the back of the speaker cone. If the box is completely closed, the lack of air space within it raises the resonant frequency of the speaker and results in less bass, a "boxed-up" sound, and loss of efficiency.

Sixteen ¼"-diameter holes were drilled in the back cover of the box shown and a piece of fabric was cemented to the inside of the cover to act as a grille cloth. The cloth is loosely woven to allow the sound to come out, but it keeps dust from entering the box.

—Carl Dunant

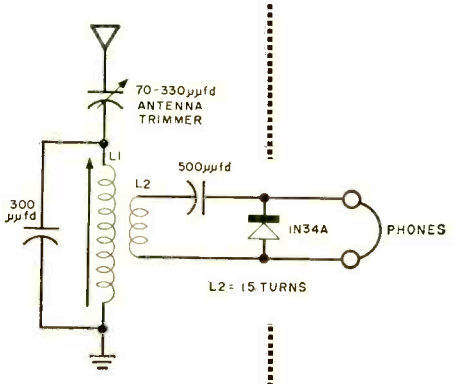
Simple Crystal Receiver

The crystal receiver circuit shown in the accompanying diagram is simple and efficient, and is an ideal project for the beginner. Whereas most crystal sets have a high-impedance output, this one has a low-impedance output. The impedance of the phones used can be from 200 ohms up.

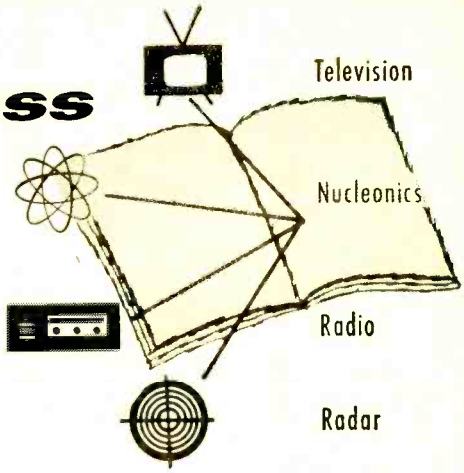
L2 is 15 turns of fine wire wound over the top of a ferrite loopstick antenna coil. Fewer turns would result in increased selectivity but less sensitivity.

The author has successfully operated a small speaker with this set by using a doorbell transformer as an output transformer.

—Maynard Kernahan



After Class



ELECTROMAGNETIC WAVE STRUCTURE

By HARVEY POLLACK

"ELECTROMAGNETIC WAVES" are more or less taken for granted by most radio enthusiasts. Like many such terms, this one is often used too freely (and sometimes thoughtlessly) without establishing a thorough comprehension of its *relationship* with the accompanying subject matter.

What *is* an electromagnetic wave? Is it merely a field of force around a magnet? What is polarization and how is it related to electromagnetic waves? What is the *physical* connection between these terms and the phenomena they describe?

Detected Fields. When an alternating current of low frequency flows through a coil, a magnetic field pulsates at the same frequency as the current, expanding outward and decaying back into the coil in synchronism with the current variations. The throbbing field that can be detected up to a few feet away is certainly not an electromagnetic wave because it is confined to the immediate area of the coil. It merely extends itself outward a short distance, then promptly withdraws.

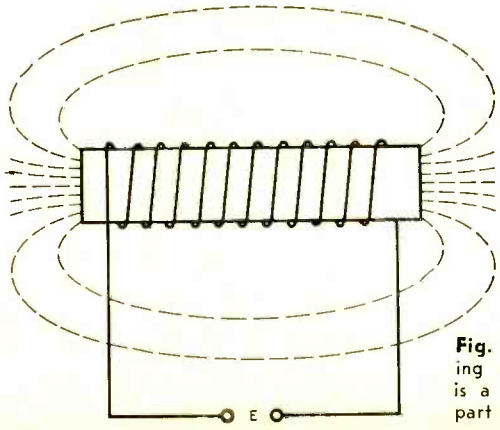


Fig. 1. The induction field surrounding a current-carrying coil. This is a short-range field which is not part of the electromagnetic wave.

Physicists call this effect an *induction field*. Its intensity falls off so rapidly with increasing distance that it cannot be called a *radiated* wave at all (Fig. 1).

When the frequency of the source is raised up to the true radio-frequency portion of the spectrum, say, 1000 kilocycles, the energy of the current in the coil can be detected out in space at very great distances. It can be trapped by suitable equipment and be made to reproduce the original fluctuations.

This is the electromagnetic wave. This

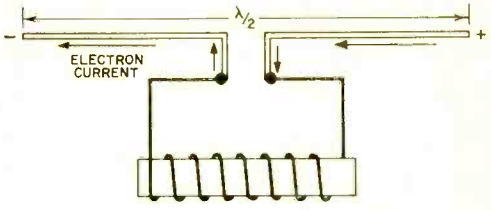


Fig. 2. A half-wave dipole energized by a transmitter tank coil. Each element of the dipole is a quarter-wave length, making a total length equal to a half-wave at $\lambda/2$. Arrows indicate direction of electron current at some arbitrarily chosen instant.

is the energy that has radiated away from the source to be forever lost unless it is detected and amplified for communication or radio control.

Wave Structure. Imagine that the coil we have been discussing is a transmitter tank coil and that connected to it are two lengths of straight conducting wires or rods. Assume that the frequency of the current flowing in the coil is 28 mc./sec. The wavelength of the sine wave in the

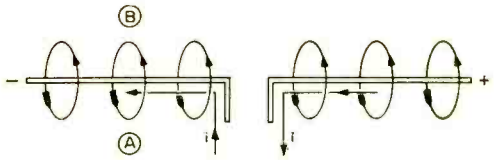
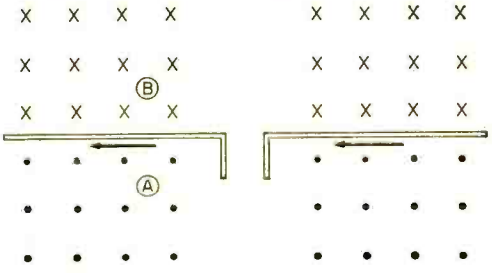


Fig. 3. Magnetic field surrounding the half-wave dipole takes the form of concentric circles lying in planes perpendicular to the conductor.

Fig. 4. A more convenient way to represent magnetic field direction. Dots symbolize heads of arrows coming out of the page; crosses indicate tail feathers of arrows retreating into the page away from the observer.



coil at this frequency is approximately 10 meters or 33 feet.

Let us now trim the conductors in length so that they measure half this distance when placed end to end (Fig. 2). This makes up what is known as a *half-wave dipole;* the total length of the conducting rod is close to half a wave. This length is usually symbolized as $\lambda/2$.

Consider the electrical conditions at a given instant when electrons are surging upward along the top half of the dipole *away* from the tank coil and upward in the lower wire back *into* the generator. At this instant there is an *electron current* flowing in each half of the wire ("i" in Fig. 3), giving rise to circular lines of magnetic force having the direction shown. The left-hand rule for wires is used to determine the direction of the magnetic field. (See *After Class,* October, 1958).

A more convenient way to picture the lines of force around the dipole is to show them as dots where they emerge from the paper in region *A* and as crosses where they re-enter the paper in region *B*. A dot

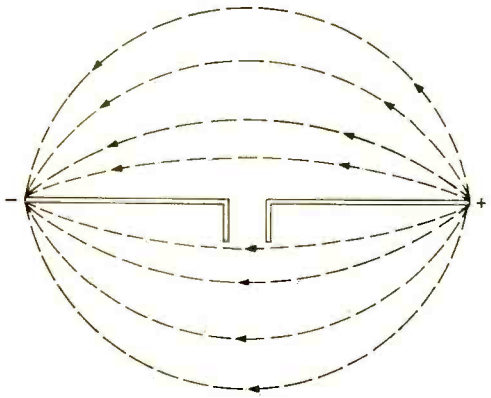


Fig. 5. Electric field around the dipole resembles earth meridians.

stands for the head of the emerging arrow and a cross for the tail feathers of a retreating arrow. This takes care of the instantaneous magnetic field due to the initial surge of electrons into the dipole (Fig. 4).

Something else of importance happens simultaneously. Electrons, moving up toward the end of the topmost wire, build up a negative *charge* at this end; similarly, as they move out of the lower end of the bottom wire, they must cause a positive charge to appear at this point. Thus, a difference of potential develops between

(*Continued on page* 114)

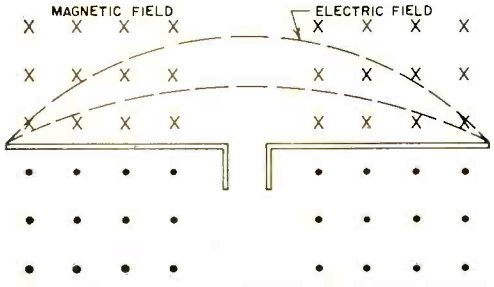
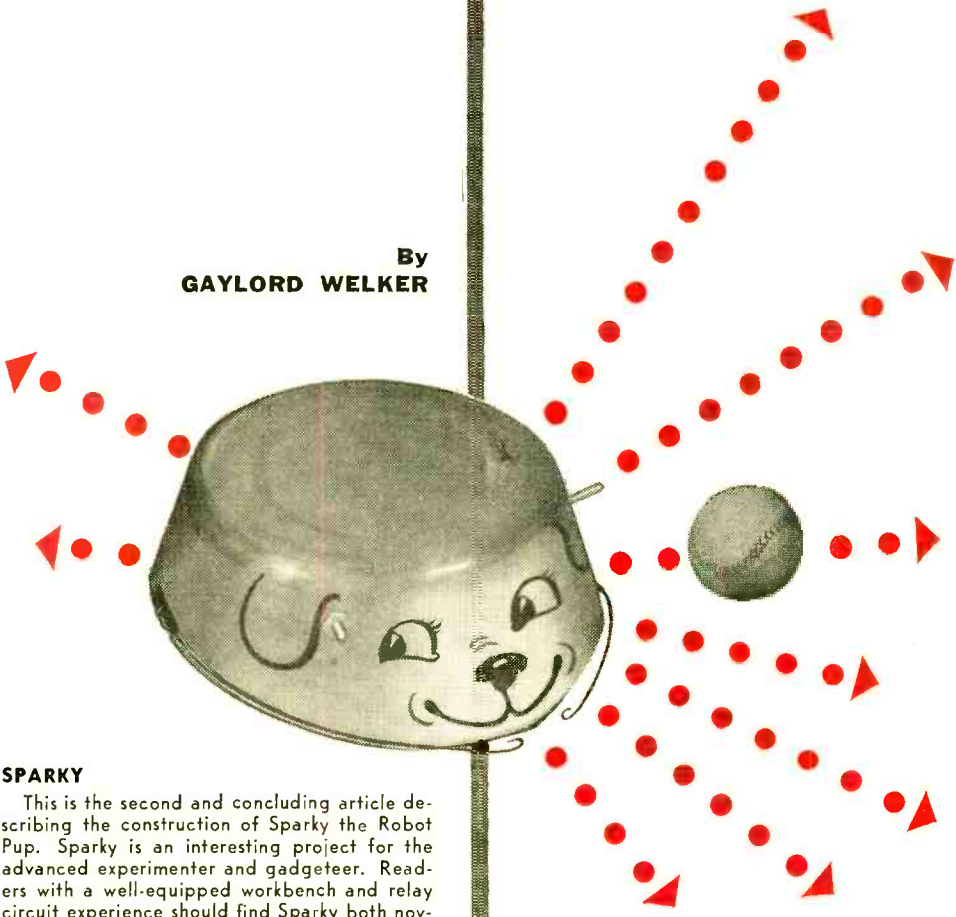


Fig. 6. Magnetic lines of force are always perpendicular to the accompanying electric lines of force.

SPARKY the Robot Pup

By
GAYLORD WELKER



SPARKY

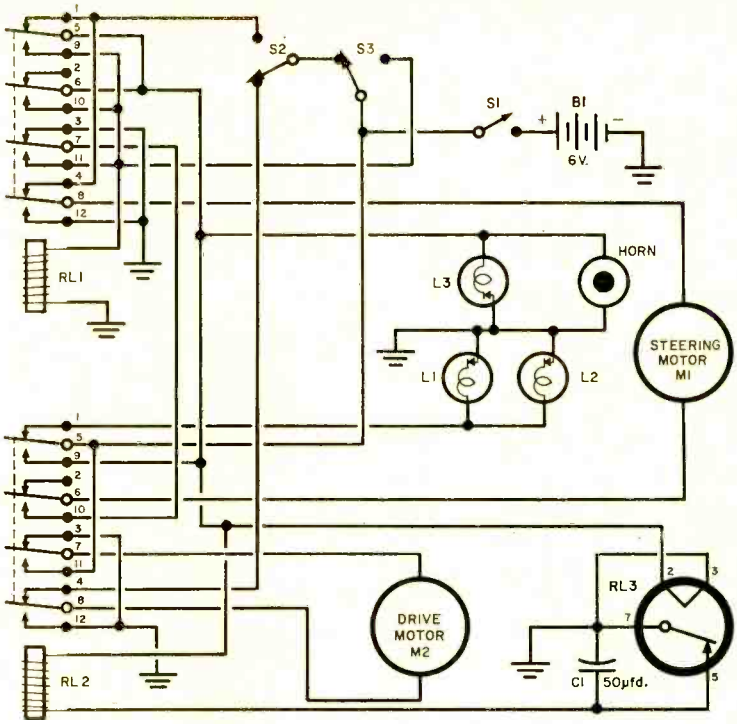
This is the second and concluding article describing the construction of Sparky the Robot Pup. Sparky is an interesting project for the advanced experimenter and gadgeteer. Readers with a well-equipped workbench and relay circuit experience should find Sparky both novel and challenging.

—The Editors

LAST MONTH we described Sparky's basic mechanical construction. Here are more details of his mechanics and instructions on how to assemble his "brain."

Thinking Mechanism. The chassis for Sparky's brain-works is shown in the overall view of Sparky's innards. A 3"x3¼" piece of aluminum will serve or you may wish to leave extra space for additional "brain cells."

The two 4-p.d.t., 6-volt d.c. relays (*RL1, RL2*) have two mounting screws on ⅝" centers, and are 1¼" high. The Amperite relay tube (*RL3*) uses a standard octal socket, or if a



The coding of Sparky's brain relays RL1 and RL2 corresponds to the relay contact pictorial shown in mechanical breakdown view on opposite page.

miniature relay is used, a noval socket is mounted on the brain chassis.

Mount the chassis on 1" standoffs to leave room for miscellaneous connections and parts. Be sure to allow adequate slack in the drive motor leads so it can swivel freely.

Body Shell. The robot's shell can be constructed of practically any material that can be shaped to fit. A large aluminum pan was warped into shape for Sparky. Holes for his "eyes" (*L1, L2*) and tail light (*L3*) were drilled slightly oversize and fitted with grommets.

The dial lamp sockets with leads soldered to them were then inserted in the grommets. The screw thread contacts of the sockets are connected to a common ground. Center contacts of *L1* and *L2* are connected to contact 1 of *RL2*. The remaining lug of *L3* is connected to contact 9 of *RL2*.

Main switch *S1* is installed on the top for easy access. The shell can now be mounted to the platform by three angle brackets.

Sparky Takes Off. With everything connected up properly, and the batteries fully charged, flip *S1* on. If drive motor polarity is correct, Sparky should take off for the nearest table leg.

Arriving at full tilt, one of his feelers will close Microswitch *S2* or *S3* and Sparky will immediately go into reverse, honking like a small bullfrog. His tail (*L3*) lights up and filament current is sent to *RL3*. When *RL3* opens, Sparky immediately goes about his business in some other direction, until he hits something else. Note that the batteries may not operate *RL3* unless they are at full charge.

One of the fascinating aspects of building this small robotic unit is the consideration of all the many ways that it can be put to use—both practically and for sheer fun. Body styles can be altered to fit the need, decoration can suit any fancy, and structural material can be anything at all that fills the bill. —30—

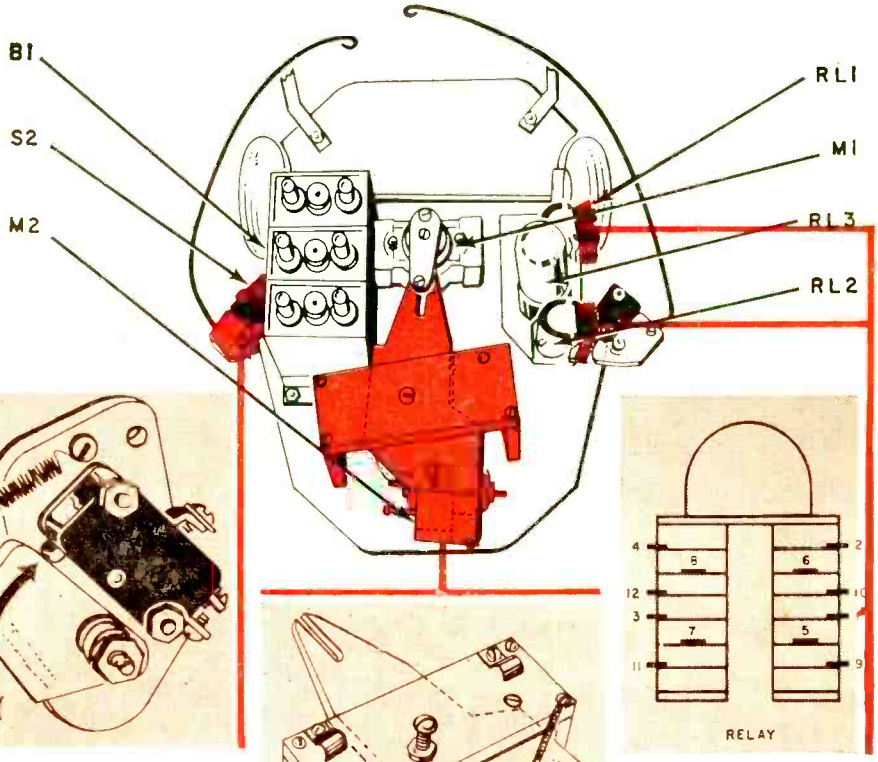
HOW IT WORKS

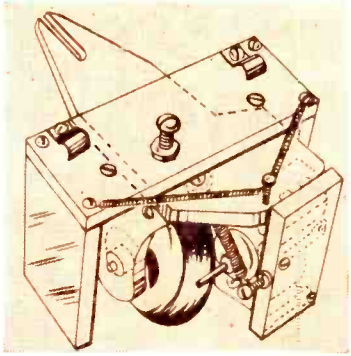
When main switch *S1* is closed, all relays stay in their unactivated position and power is supplied only to the drive motor *(M2)* and "eye" lights. The robot moves forward until one of the feelers contacts something with enough pressure to close switch *S2* or *S3*.

When the left feeler closes *S2*, the following sequence is initiated. *RL2* is energized and electrically locks in. Contacts 7 and 8 of *RL2* reverse drive motor *M2* and energize steering motor *M1*. The latter is polarized to turn *away* from direction of contact as Sparky rolls backward. *RL2* also disconnects *L1* and *L2*, turns on *L3*, and supplies heater current to *RL3*.

The other pole of *M1* is supplied from contact 4 of *RL1*. After three seconds, *RL3* opens, releasing *RL2*, so that the circuit reverts to the normal forward running condition.

When the other feeler arm closes *S3*, *both* relays are energized, causing *M1* to swing in a direction opposite to that of the *S2* closed condition. All of the other reversing operations are similar. Movement of the robot is really a random path determined by the heating time of *RL3*. If *RL3* is warm, turns and backing cycles are of shorter duration.



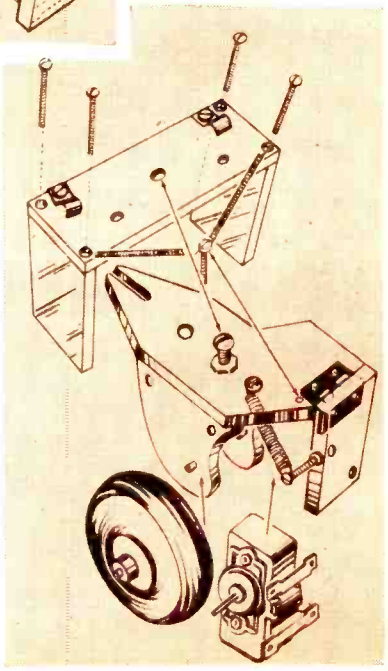


PARTS LIST*

B1—Three 2-volt wet cells (Aristo 23)
C1—50-μfd., 25-volt d.c. electrolytic capacitor
L1, L2, L3—6-8 volt blinker light
M1—Steering motor (Aristo No. 5 PM motor)
M2—Drive motor (Aristo No. 4 PM motor)
RL1, RL2—4-p., d.t., 6-volt d.c. relay
RL3—Thermal delay relay (Amperite 6C2 or 6C3)
S1—S.p.s.t. toggle switch
S2, S3—S.p.d.t. feeler switch (V3 Microswitch)
3—3" wheels with 1" aluminum hub, 1/8" bore (Perfect)
1—12" length of 1/8" drill rod (axles)
1—1" cabinet hinge
1—Shell (any container which conforms to robot shape—author used 14" thin aluminum dish-pan)
1—Electric horn (Aristo Edu-Kit B 1-35)
3—Dial light sockets
1—Octal socket
1—5-pin male and female socket for interconnection of shell and robot's innards
Misc. 1/4"-thick Plexiglas scraps; screws; springs; washers; hardware; and plastic metal or cement

Parts can be supplied by:
Berton Plastics, 79 5th Ave., New York, N. Y.
Gyro Electronics Co., 36 Walker St., N. Y., N. Y.
Microswitch Div., Minneapolis-Honeywell, 24-30 Skilman Ave., Long Island City, N. Y.
Polk Hobbies, 314 5th Ave., N. Y., N. Y.

** This parts list supersedes the list which was included with the "Sparky" article last month.*



Transistor Topics

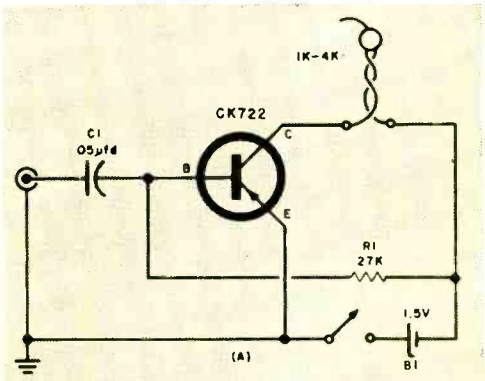
By LOU GARNER

WITH THE START of a new year, we like to tote up our "box score" on predictions made for the previous year. Let's see how we fared for 1958.

Last January we predicted . . . power transistors netting for less than $1.00—*zero*—the lowest priced power units are still slightly over a dollar . . . "experimenter's transistors" netting for less than 50 cents—*check*—at least one major distributor is offering units below this figure . . . increased use of transistors in hi-fi equipment and fully transistorized hi-fi amplifiers—*check*—Vico, Extron and Integrand all have transistorized amplifiers, and Regency and Madison-Fielding are offering transistorized preamps.

We also "foresaw" a portable transistorized receiver made by a large "standard brand" manufacturer retailing for less than $20.00—*check*—such sets are offered by Philco, Regency, and others . . . commercially available r.f. transistors operating to 1000 mc.—*check*—certain of Philco's MADT series can be used as oscillators up to 1000 mc., and u.h.f. transistors are available from Texas Instruments, Motorola, and Western Electric . . . power transistors handling loads up to 100 watts—*check*—G.E.'s 2N451, with collector dissipation of 85 watts, can handle loads well over 100 watts, and Delco has introduced types capable of switching kilowatt loads.

We prophesied the use of transistors in TV receivers—*check*—while there are no fully transistorized sets on the market as of this writing, several manufacturers have used transistors in TV consoles, principally as audio preamplifiers; and Motorola, Texas Instruments, RCA, Admiral and others



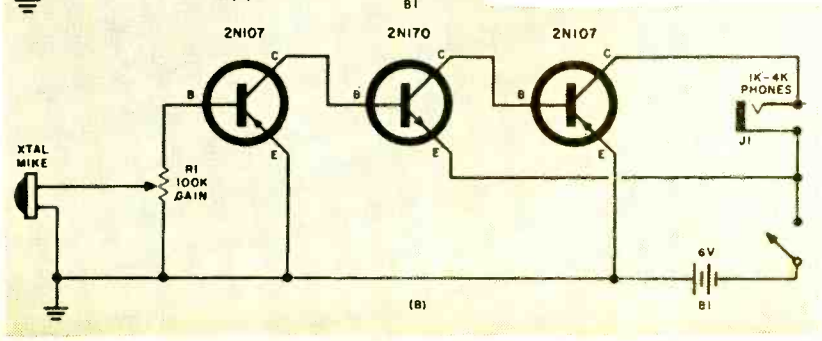


Fig. 1. Two useful transistorized audio amplifier circuits: Dave Harter's single-stage amplifier (A); and George Sollman's direct-coupled interphone amplifier (B).

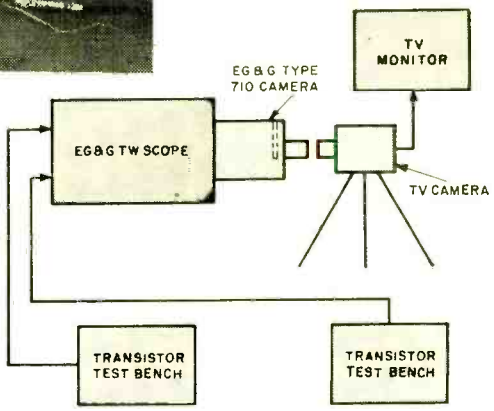
have demonstrated fully transistorized portable sets . . . transistorized short-wave receivers—*check*—such receivers are now available from Magnavox, Philco, Zenith, RCA and others . . . transistorized FM receivers—*check*—while no large manufacturer has introduced a fully transistorized FM set, such sets have been offered by several "custom" manufacturers, and Regency has been selling (quite successfully) a transistorized FM converter . . . an increase in transistors in toys and non-entertainment applications—*check*.

Also, as to power transistors capable of delivering over a watt at radio frequencies —*check*—Texas Instruments has just started to produce a unit which can deliver several watts up to 12 mc.

Things to Come. In 1959 you can look for . . . transistorized *short-wave receivers* retailing for under $100.00 . . . a continued drop in the price of transistors . . . new types of *special-purpose semiconductor devices* . . . a moderate-priced r.f. power transistor (hams should welcome this item) . . . high-current, low-to-moderate-voltage *power transistors* for inverter service . . . moderate-priced *high-efficiency* (10 to 13%) sun batteries . . . *sun-powered receiver* with rechargeable batteries for under $50.00 . . . moderate-power *v.h.f. transistor* (say 1-2 watts at 100-200 mc.) . . . transistorized receiver produced by a major manufacturer retailing for under $10.00 . . . transistorized *table-model* receivers . . . moderate-cost transistorized *test equipment* . . . portable transistorized color-TV system for industrial and military applications.

Readers' Circuits. Reader interest in various types of transistor circuits seems to run in cycles. One month, our mailbag will be "loaded" with simple receiver circuits; a little later, test equipment circuits will be submitted in quantity. In the past few weeks, we've received quite a few audio amplifier circuits. Two of the more interesting ones are shown in Fig. 1.

Fig. 2. Special setup used by Philco's Lansdale Tube Company Division to test ultra-high-speed switching transistors with very short rise time. The TW oscilloscope, made by Edgerton, Germeshausen & Grier, Inc., has an inherent rise time of only 0.1 millimicroseconds. Transistor waveforms are checked on television screen as shown in photo.



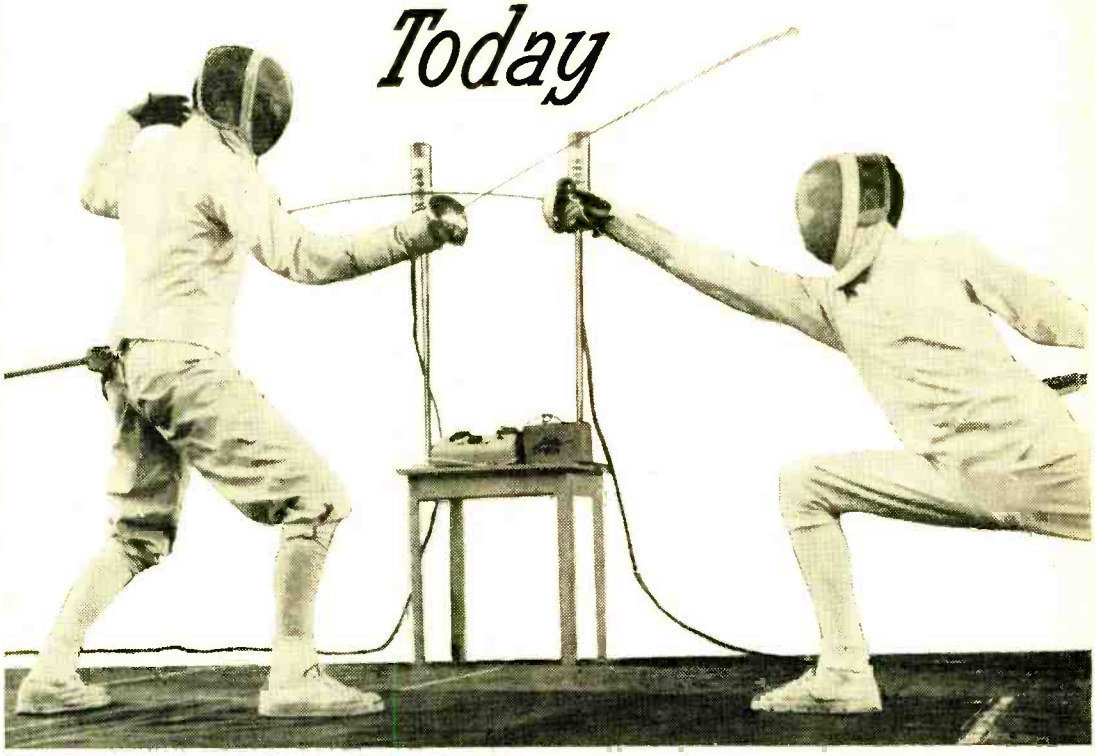
BLOCK DIAGRAM OF TW SCOPE-TV SYSTEM

The one-stage resistance-coupled amplifier in Fig. 1(A) was submitted by reader David Harter (820 South St., Corning, Calif.). Dave indicates that this circuit can be used for general-purpose audio work . . . with telephone pickups, as a headphone phonograph amplifier, as a preamplifier for wireless microphones, in simple signal tracers, and in similar applications.

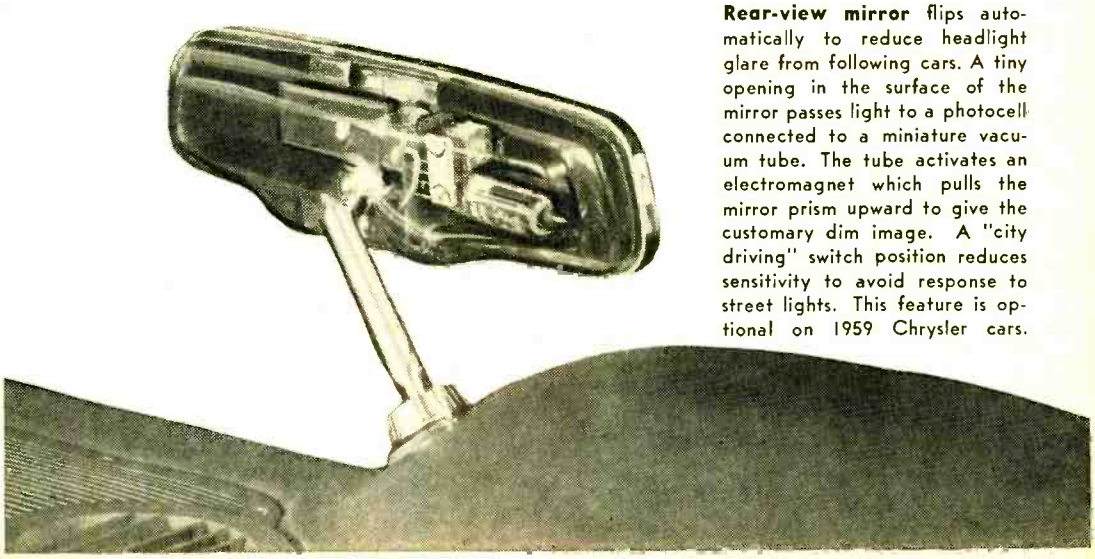
Although Dave used a CK722 transistor

(*Continued on page* 98)

Electronics Today



Electrified fencing keeps score in Olympic matches. Each fencer's weapon is wired to form a circuit powered by a storage battery. When an epee touches an opponent, a bell, buzzer, or light signal flashes. Wires to the epees are led through fencers' sleeves, attached to rear of uniforms, and led back to a spring roller.



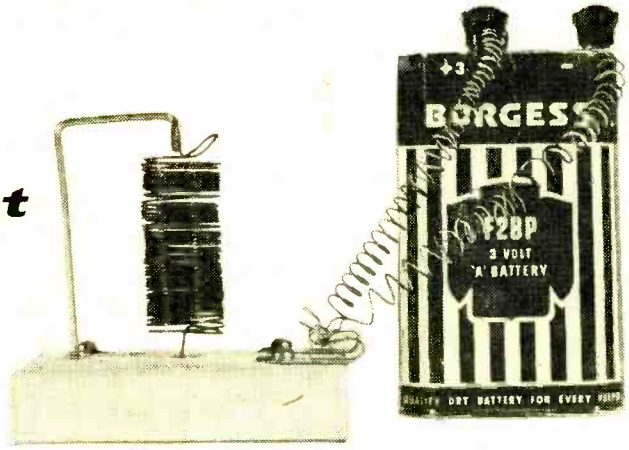
Rear-view mirror flips automatically to reduce headlight glare from following cars. A tiny opening in the surface of the mirror passes light to a photocell connected to a miniature vacuum tube. The tube activates an electromagnet which pulls the mirror prism upward to give the customary dim image. A "city driving" switch position reduces sensitivity to avoid response to street lights. This feature is optional on 1959 Chrysler cars.

Electronic bottle cooler-warmer, with no moving parts, plugs into car's cigarette lighter. Fifty thermoelectric junctions cool or heat the bottle instantaneously. The current that produces cold can be reversed to produce heat for cooking. This experimental Westinghouse device has vertical aluminum fins for air cooling or dissipation of removed heat.

Supersensitive TV camera operating through a telescope may be able to spot a rocket landing on the moon. Directly above is a conventional photo, while on top of it is a photo taken through the Westinghouse opto-electronic "Cateye" system. Operating as a closed-circuit TV system, the camera tube picks up the image through the telescope, and photographs are made from the face of the picture tube. The electronic photo is a composite of over 200 pictures.

Completely transistorized battery-powered TV set is not much larger than a toaster. This G.E. set uses 22 transistors and an 8" diagonal picture tube. Power comes from a rechargeable silver-cadmium battery with a power consumption of 7½ watts and a life of three hours before recharging. The present cost of transistors keeps the price of this experimental model too high for consumers.

Energy Transfer Experiment



With a block of wood, about 10 feet of enameled wire, a small blob of mercury, and a three-volt dry cell, you can demonstrate the transformation of an electric current into mechanical motion. Wind a coil of about ¾" diameter with about 45 turns of No. 20 (or thinner) enameled copper wire; it should be about 2" long with approximately 1/64" space between each turn. Bend a stiff wire (coat hanger wire is fine) as a support arm. To the end of the arm, solder one end of the coil. Bend the opposite end of the coil, scrape off the enamel, and leave a ⅜"-long stub pointing down.

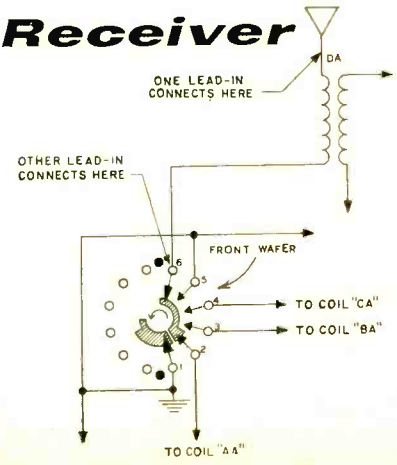
Drill a hole in a 4" x 2" x ¾" block of wood for the supporting bracket. Adjust the bracket until the free end of the coil touches the top surface of the wood block. After marking this spot, drill a hole just large enough to allow a copper wire to be pushed through from the bottom of the block. Countersink the top of this hole to provide a slight well. Then push in the wire, leaving a projection to contact the mercury. Attach the other end of the wire to a Fahnestock clip. Place a glob of mercury in the well and adjust the coil so that the free end just contacts the mercury. The coil support should be connected to a second Fahnestock clip.

Connect a 3- or 4½-volt battery across the two terminals. The coil will contact, pull away from the mercury, and thus open the circuit; then the coil will fall, make a new contact with the mercury, and start the action over again. The action will continue until the battery is exhausted. —*George P. Pearce*

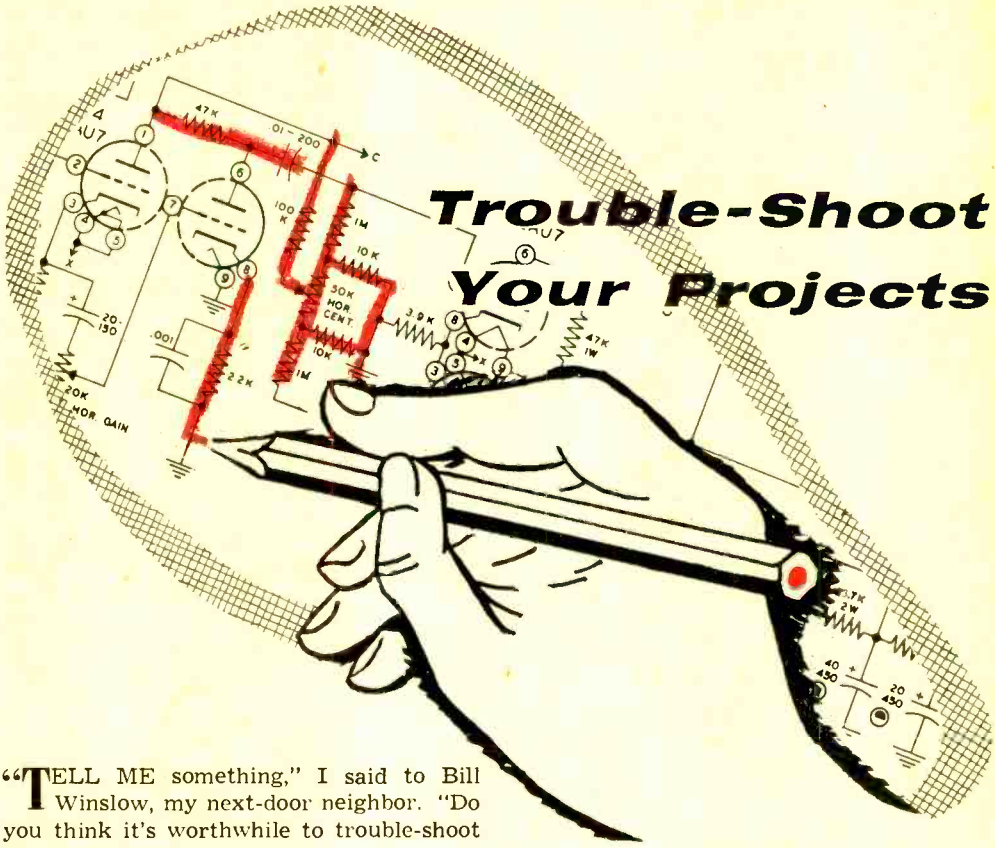
Doublet for AR-3 Receiver

The Heathkit AR-3 receiver can be modified to use a doublet antenna with just a small amount of rewiring. Connect one of the lead-ins to the antenna terminal. Then connect the second lead-in to lug 6 on the front wafer of the bandswitch; one end of the fine winding of antenna coil "DA" is connected to this point. Consult the Heathkit pictorial to avoid making a mistake.

With the doublet connected, reception is greatly improved on bands A, B and C. On band D, this point is grounded, so only half of the doublet is in use. But since band D covers higher frequencies, half is sufficient. —*Vic Commisso*



Trouble-Shoot Your Projects



By DAVID R. ANDERSON

How to find those hidden bugs with a red pencil

"TELL ME something," I said to Bill Winslow, my next-door neighbor. "Do you think it's worthwhile to trouble-shoot your own kit?"

"I sure do," he replied.

"Well," I said doubtfully, "it's okay for you to say that. You're a professional trouble-shooter. How about an average kit builder like me?"

"Let's put it this way. If you're willing to invest a little time and effort, you can save the cost of having the unit factory-serviced. And it should take less time than sending the kit back to the factory.

"That sounds logical." A gleam came into my eye. "The reason I asked is that I bought an oscilloscope kit the other day. Then after I got it together I couldn't get it to work. I've been knocking myself out over it, but no go."

"I suppose you were wondering if I could give you a hand?" Bill ventured.

"Right," I admitted.

"Well, I don't see why not," he said. "Where is the thing?"

"Right this way." We headed for my cellar. Downstairs we came face to face with the monster that had given me such a hard time.

"So this is it." Bill looked over the schematic. "It shouldn't be too hard. Have you got a colored pencil?"

I searched through the drawers and finally came up with one. "What, may I ask, do you want with that?"

"I'm going to trouble-shoot your kit."

"With a colored pencil?"

"That's right," he said.

"THERE are three major reasons," Bill continued, "why kits fail to work after they're put together. The first, and most common, is a wiring error."

"But I've already checked the wiring," I alibied.

"And you're positive everything is cor-

rect so far as the wiring is concerned."

"As sure as I can be," I insisted, a bit dubiously.

"Well, I'm going to make absolutely sure with this red pencil and schematic." He laid the schematic on the bench. "First we'll pick a likely starting point, say the rectifier cathode. Then we'll trace out each connecting wire and compare it with the schematic. If it's correct, we'll cover the line on the schematic with a colored line."

"I suppose if you come across a component in the line being traced you check it for proper value and rating?" The soundness of the idea had started to penetrate.

"Right," Bill answered. "If the value is correct, we place a small check mark next to it on the schematic."

I watched while he worked. He progressed steadily and soon the schematic was covered with colored lines and small checks. All but one line was finally covered. Bill looked up. "Suppose you take over from here."

A glance told me where the mistake was. The line not covered with red showed a connection to pin five of the vertical amplifier. I had made the connection to pin four.

Red-faced, I said: "That just shows, experience is what counts."

"That's not necessarily so," Bill said. "You could have done the same thing I did. As a matter of fact, this is the first time I ever saw that particular model scope." Bill looked closely at the joint I soldered when I had corrected the wiring error. He went on: "The beauty of this system is that it will work well on any kit the first time you attempt to make repairs on it."

"Okay," I said. "Let's plug her in and give it a try."

"WHOA. Not so fast." Bill held my arm. "Remember, I said there were three major causes of kit failure."

"That's right, you did," I answered. "But we found the trouble with this one, no?"

"We found *one* trouble. From the looks of some of those solder joints you may have more." He jiggled a wire going to a terminal to which several other wires were fastened. My jaw dropped as I saw it loosen. All that had been holding it was rosin.

"And there," he said, "you have the second major cause of trouble—a cold solder joint." He picked up my soldering iron and solder.

"I should know better," I moaned. "A good solder joint is a shiny one."

"Well, don't feel too bad," he said with a grin. "Even the pros make a mistake once in a while. The thing to remember is: a joint that is dull and full of rosin is probably cold-soldered and will give trouble."

He took the iron and applied it to the joint. When the joint was hot enough, he applied the solder to the spot where the iron met the joint, as should be done. When the joint cooled, it was shiny and free of rosin.

"That, my boy, is the proper way to solder."

I NODDED my head in agreement. I was about to plug in the scope when the thought struck me. "You said there were three major causes of kit failure, right?"

"Right," Bill answered.

"We've only checked two. What's the next thing?" I asked.

While the author deals with kit trouble-shooting, the method he uses is completely adaptable to any type of electronic project published in POPULAR ELECTRONICS. A professional trouble-shooter for a kit manufacturer, Mr. Anderson points out that the home builder should have no difficulty in following the suggestions he outlines for any type of circuit.

The Editors

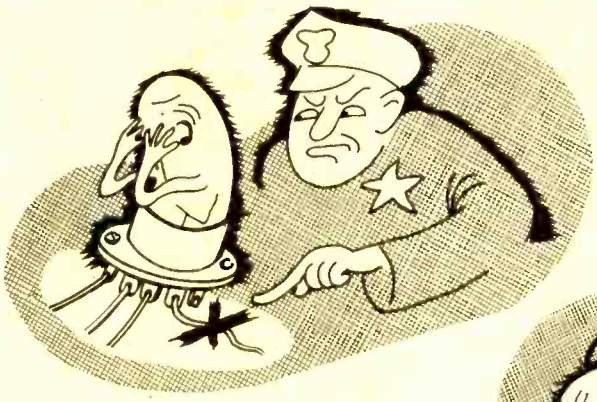
"I'm glad you asked. Shows you're coming out of the fog you've been in."

I ignored his attempt to be funny.

"So far we've found out that the wiring and soldering are correct. If the kit doesn't work now, the trouble will be a defective component."

"Then I might as well plug the unit in and see what happens," I said.

"Before you plug it in it's a good idea to check for shorts. You might save a part from burning up." Bill turned on my vacuum-tube voltmeter. He switched it to the ohmmeter section.



"I suppose you're going to check the resistance against the manufacturer's specs?" I asked.

"That's right," he answered.

"You'll remember to allow a margin of 20% in the readings?" That scored one for me.

Bill didn't bother to answer. Soon he was finished.

"Well, everything checks okay. Let's plug 'er in."

I plugged in the power cord and the trace swept across the face of the CRT. After a few adjustments it was clean and sharp.

"That's a pretty good trace," I said.

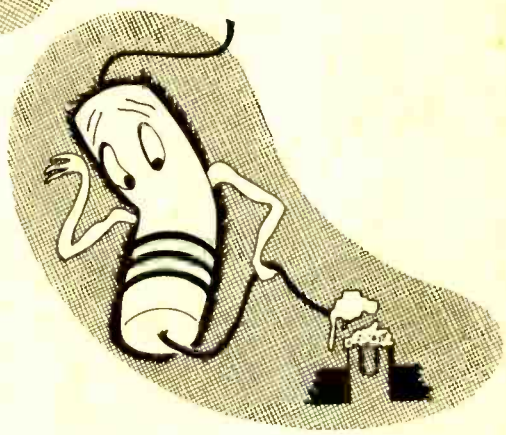
"It sure is," Bill agreed. "But I've got a question for you. If the scope hadn't operated when you plugged it in, then what?"

"Voltage checks, of course," I said.

"Allowing the usual 20% tolerance, right?" That scored one for Bill.

"Right," I said, and grinned. "You sure have a foolproof system worked out. I spent two days trying to find the trouble with that thing and you come along and have it working in less than an hour."

"Well, if there's one thing I learned the hard way, it's to be systematic in trouble-shooting a kit. I used to probe around and try to guess at what the trouble was, but I never got anywhere. The only way to tackle this type of problem is to start at the beginning. That means check the wiring and soldering first," he said seriously.

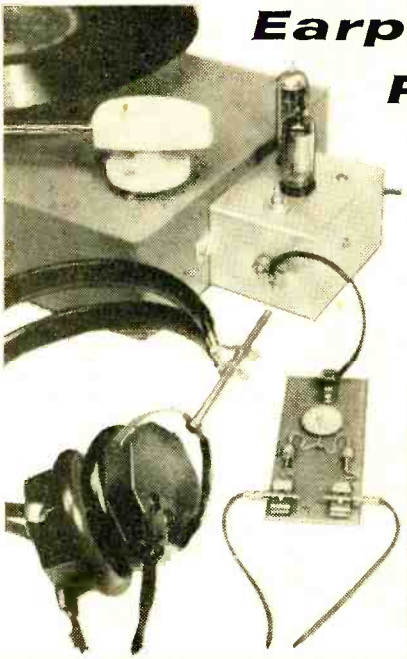


"LET'S SEE if I have this straight," I ventured. "First of all you should check the wiring with the colored pencil and the schematic to be certain it's correct. Then you check the soldering to make sure all joints are properly soldered. When this is done, you give it a resistance check to be sure there are no shorts. After that, if the unit still doesn't work, you give it a voltage check."

"Absolutely right," said Bill. "Of course, it's a good idea to have the tubes tested before you start the voltage check. It may save you some trouble."

I gazed at the sharply focused trace on the scope and said: "You know, Bill, you're right. It *is* worthwhile to trouble-shoot your own kit. It not only gives you confidence in your workmanship, but helps you to understand how the unit works." —30—

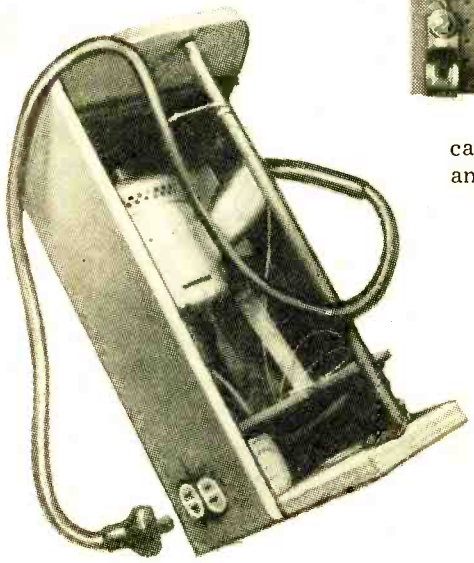
Earphone Listening to Phono Oscillators



Phono oscillators are handy because they allow you to play your records through any nearby AM radio without direct connection to the radio. However, late evening listening is a problem because it doesn't seem sensible to sit at the radio wearing earphones while the record-player is some distance away. Besides, why use all the tubes in the radio in order to listen with earphones? A simple detector will enable you to connect the earphones directly to your phono oscillator and you will not have to use the radio at all.

The various parts of the detector are mounted and wired on a piece of Bakelite or other insulating material. Use two general-purpose diodes of the same type, and wire them with the polarities shown. The leads can be bent to reduce the danger of damaging the diodes when you solder them to the capacitor. The 0.01-μfd. capacitor will eliminate any possible shock hazard.

—Art Trauffer



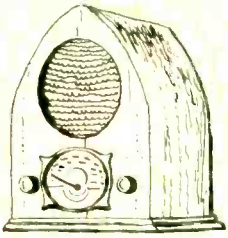
Electrify Your Tool Box

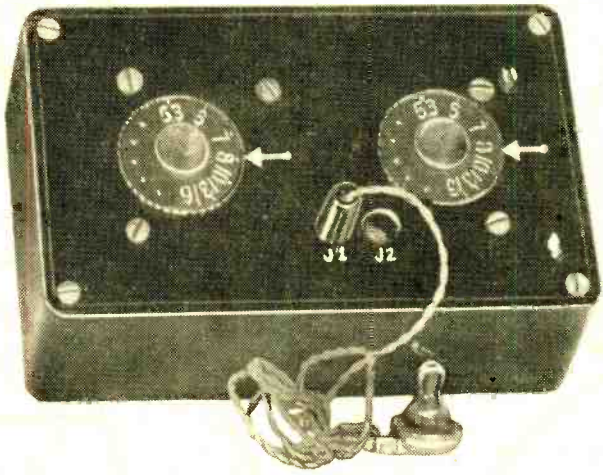
Portable electric power tools are found in nearly every home workshop, but such tools are seldom put to full use away from the workbench—usually due to the absence of a convenient electrical outlet. This problem is quickly solved through the use of a tool box that has been fitted with its own electrical outlet and extension cord. On the job, the householder or serviceman plugs in the tool box and then operates his power equipment from the electrical receptacles in the box.

It's a simple matter to install an electrical outlet in any existing tool box by adding an extra section to it. The added end should extend out far enough to permit the addition of a standard electrical outlet box. The extra room provided will furnish space for the storage of the extension cord.

—Glen F. Stillwell

By R. ZARR





Two-Transistor TRF

Old circuit uses new components for increased sensitivity

THE TUNED radio-frequency circuit, an old standby from the early days of radio, has been all but abandoned by transistor experimenters and radio constructors. Actually, the TRF is an efficient circuit, particularly if each stage is individually tuned, and is more stable than a regenerative or reflex circuit.

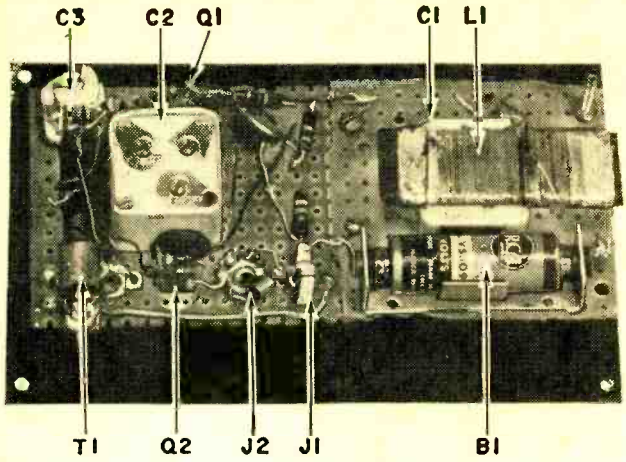
Using a recently announced type of transistor, a two-transistor TRF was designed that will pick up stations 25 miles away and more with its own built-in loopstick. Powerful local stations will even drive a loudspeaker if fed through an output transformer.

Construction. All components fit on a 5¾" x 2½" perforated phenolic board. The miniature Poly-Vari-Con tuning capacitors (*C1, C2*) are mounted with the screws supplied. A second winding of 25 turns of #26 enameled wire must be wound immediately below the main winding of *T1*. (If your loopstick has an extra winding of a few turns with a free end, it should be removed.)

Observe the polarity of the added winding on *T1*. If the collector lead begins a clockwise winding, the diode lead must begin a counterclockwise winding. This assures that the neutralizing voltage (through *C3*) will be *out* of phase with the voltage into transistor *Q1*.

L1 and *T1* are positioned at right angles and opposite ends of the phenolic board, to avoid unwanted coupling. The tapped side of *L1* (the flat non-adjustable loopstick) is near the edge of the board. See Fig. 1 for *L1* connections.

After the receiver is completed, orient



HOW IT WORKS

The tuned r.f. input stage is followed by a diode detector and audio stage. Two separately tuned circuits are used for maximum gain and selectivity. Stations within range are tuned in by setting both dials to the approximate frequency desired, then peaking for optimum reception.

The 2N544 transistor *(Q1)* is base-fed from the secondary of antenna coil *L1*. The primary of *T1* functions as a tuned collector and couples the amplified r.f. signal to the special secondary winding. Crystal diode *CR1* functions as a standard detector and the 2N217 *(Q2)* as an audio amplifier.

Calibration and tracking can be made almost perfect by adjusting L1 and the trimmers of C2. The battery shown above supplies 9 volts at 2 ma. In the schematic at right, jack J1 is a **closed-circuit** type so as to permit the collector current of Q2 to flow with no plug in the jack.

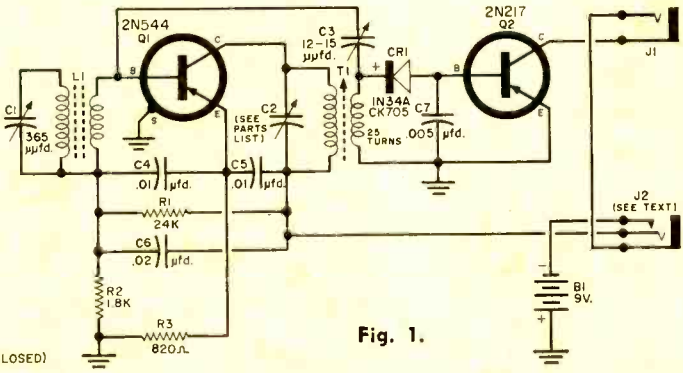


Fig. 1.

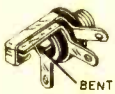


Fig. 2.

PARTS LIST

B1—9-volt battery (VS309 or equivalent)
C1—365-μfd., single-gang variable capacitor (Lafayette MS274)
C2—3-gang variable capacitor (Lafayette MS345)
C3—12-15 μfd. trimmer or miniature variable capacitor
C4, C5—0.01-μfd. disc capacitor
C6—0.02-μfd. disc capacitor
C7—0.005-μfd. disc capacitor
CR1—1N34A or CK705 diode
J1—Normally closed midget jack
J2—Normally closed midget jack (modified as per Fig. 2)
L1—Flat loopstick, approximately 2⅜" (Lafayette MS330)
Q1—2N544 transistor
Q2—2N217 or 2N109 transistor
R1—24,000-ohm, ½-watt resistor
R2—1800-ohm, ½-watt resistor
R3—820-ohm, ½-watt resistor
T1—Adjustable loopstick (2¼" long with extra winding—see text)
1—Perforated phenolic board
1—6¼" x 3¾" x 2" Bakelite cabinet
2—Tuning dials for C1, C2 (Lafayette KN-24)
1—Earphone (1500-2000 ohms impedance)
2—Transistor sockets

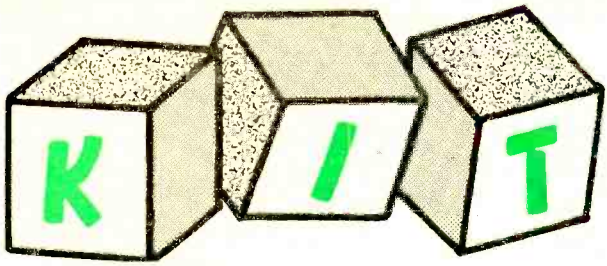
L1 for minimum feedback; then cement it to *C1*. *T1* is held in place by leads passed through the phenolic board and soldered to the terminals. The resistors, capacitors and diode are similarly mounted.

Use ½" spacers to mount the phenolic board on the panel. This allows room between panel and board for the transistors.

Operation. When *C1* and *C2* are tuned to the same frequency, the receiver might oscillate. Adjust neutralizing capacitor *C3* until the instability disappears. Neutralize at the high end of the band, for the correct setting here holds throughout the band.

Since *C3* needs only an initial setting, it is not provided with a knob. Miniature phone jack *J2* is modified (see Fig. 2) to switch on the set when the earphone plug is inserted. Jack *J1* is wired as a closed-circuit type.

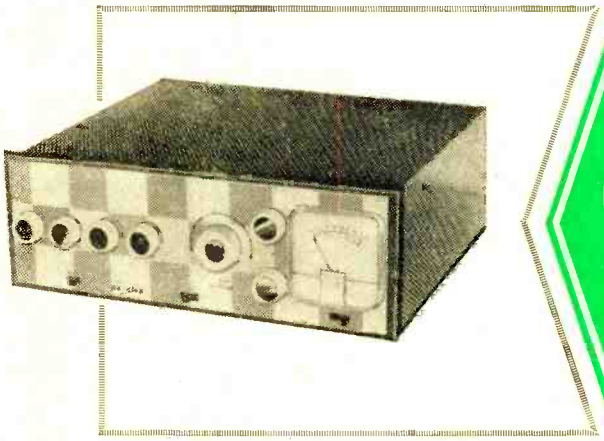
A d.c. milliammeter plugged into *J1* will function as a "poor man's" direction finder. This is due to the highly directional characteristic of *L1*. Relative signal strength will be indicated also if you want it. —30—



BUILDER'S KORNER

PROBABLY one of the more flexible kit amplifiers is the Precise AM-40, which uses four EL-84 tubes in a power circuit with a rated output of 40 watts.

Some of its features are: a separate front panel control to adjust output level to a tape recorder; a front panel meter that can be switched to measure wattage output to the speaker or voltage to the tape recorder; and a switch to permit feeding the output to two speaker systems either individually or simultaneously. Another switch permits you to insert loudness compensation in the volume control when desired, for low-level listening.



PRECISE AM-40 Amplifier

An amplifier kit with so many features cannot be expected to be a one-night wiring job. Building the AM-40 requires patience and attention to detail, but the finished unit is one that will fit into any sound system and be able to keep up with changes and additions.

Putting It Together. Before starting on the assembly of your AM-40, check the additional instruction sheets that come with the kit for changes that may have been made. Often an improvement will be incorporated and supplied as a correction. To keep your amplifier up to date, be sure to enter any of these changes in the construction manual *before* you start wiring.

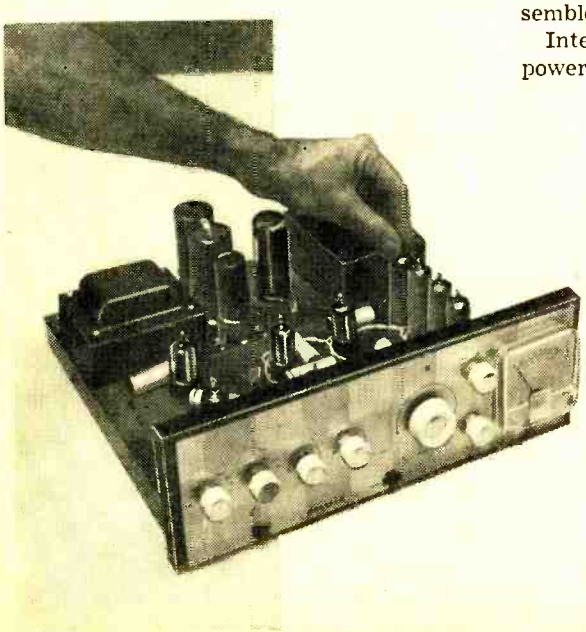
The first step is mounting the components on the printed-circuit board. This is a relatively easy job, but it does require a lot of attention and cross-checking between the printed-circuit diagram and the photograph of the completed board.

In the construction manual, the holes are shown on the board with each one numbered. The instructions read, for example, "Insert 100-ohm resistor, R32, in holes 3 and 8."

This is easy enough to follow when the holes are near the edge of the board and can readily be identified in relation to one of the corners or sides. However, we found it slow going when we got out to the center of the board and tried to transfer the numbered hole on the diagram to the holes in the board. We found ourselves murmuring

Printed-circuit board is wired as a unit and is installed on chassis when power supply has been completed.

After inserting the last of four EL84 output tubes, you are ready to switch on the AM-40 and try 'er out.



"let's see, it's three holes up from the bottom and two holes up from the center of tube socket *V2*."

This problem was easily solved by numbering the holes on the board with pen and India ink, using the diagram as a guide. Once this was done there were no further problems with the printed circuit, and assembly proceeded at a rapid pace.

The next step was to assemble the power supply section which uses a conventional metal chassis. This went very quickly and the instructions were quite clear. A few hours work took care of the whole thing including mounting the printed circuit on the main chassis with the power supply.

Wiring. The instructions have you pre-wire the front panel control switches before mounting them on the panel, thus avoiding a lot of close wiring later on.

The only place where we ran into trouble was with a connection from the printed-circuit board to switch *S2*. Rather than try to get in under the printed-circuit board, it was much easier to remove the switch from the panel and make the connection, then replace the switch.

After pre-wiring, the switches are mounted on the front panel and the panel assembled on the main chassis.

Interconnection of the printed circuit, power supply and switches comes next. Here a good deal of care is needed. Checking and rechecking each wire can save you a lot of trouble-shooting later.

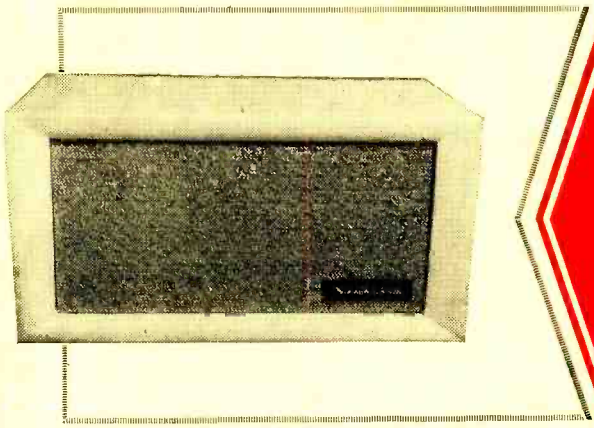
Comment. A voltmeter and milliammeter should be used for output stage adjustment before the amplifier is put into operation.

The completed amplifier has a professional appearance and its specifications are good. It is also available factory-tested and wired. The metering and special tape provisions make it an attractive buy for the tape recording fan; and the hi-fi enthusiast will find a lot for his money packed away in the Precise AM-40. —30—

UNTIL about a year ago, stereo was a rich man's hobby. It was possible only with tape which tended to be priced on the high side. Now, however, with the emergence of the stereo disc, a stereo system comes within the economic range of every one of us.

All we need is a stereo phono pickup, and a second amplifier and *speaker system.* And since two gargantuan speaker systems aren't necessary to reproduce stereo satisfactorily (although they undoubtedly help), we obtained one of the Heath SS-2 speaker system kits for trial use in a stereo system.

The SS-2 is a bookshelf-type system, measuring roughly 2′ x 1′ x 1′. The speakers are an 8″ woofer and a compression-type tweeter. A ducted port, bass reflex type, the enclosure is said to extend the bass response down to 50 cps, not bad for a speaker system in this price range.



HEATHKIT SS-2
Speaker System

The tweeter comes in around 1600 cps and takes the treble range on up to 12,000 cps. Heath provides a simple hi-pass crossover (a 2-μfd. capacitor) and an L-pad for controlling the level of the tweeter.

Putting It Together. Assembly of the SS-2 is divided into two parts: the construction of the cabinet; and mounting and wiring of the speaker components. Cabinet construction went along very smoothly, with everything cut precisely to size and fitting together perfectly.

The only minor problem encountered was in making the corner joint connection. Take it slow and easy when you drive the special nail. If you're not careful, it is liable to turn sideways in the slot. A little extra caution here will assure a clean, strong corner joint.

Instructions for fastening the grille cloth were carefully followed, and the neat look of a properly aligned grille cloth resulted. Nothing can ruin the looks of a speaker installation like a grille cloth that doesn't run parallel with the trim molding.

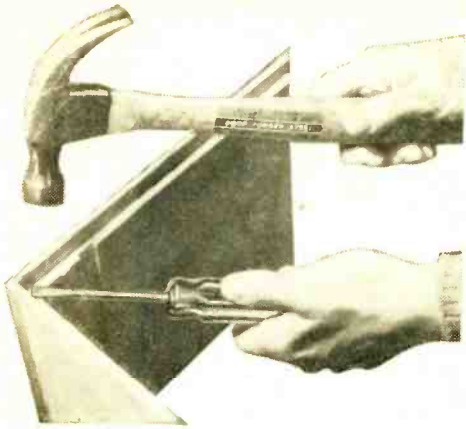
Construction was simplified by the use of a Phillips screwdriver which, believe it or not, was furnished with the kit—as were glue, sandpaper, and speaker hookup wire.

Mounting the speakers is a quick and easy job. We followed the instructions on wiring procedure to assure "in-phase" operation, and everything went along smoothly. The crossover and tweeter level control are recessed into the cabinet back to allow flush mounting against a wall if desired. There are even recessed slots for the wires to the amplifier.

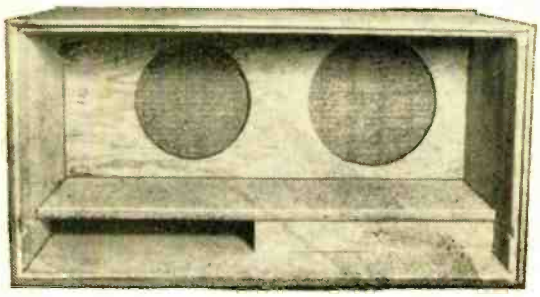
Testing. After preliminary tests of the SS-2, we "A-B'ed" it against our present speaker system, a 15″ job in a bass reflex enclosure. Unsurprisingly enough, the results favored the big system.

To our ears, the bass response from the SS-2 didn't sound quite up to par, so we tried taking out the acoustical padding tacked inside the enclosure. The instruction book covers this situation and recommends that each person try the speaker both with and without padding.

In our living room, the removal of the



Enclosure corners are joined with wood glue and flat nails. Extra care in driving nails will assure a good fit.



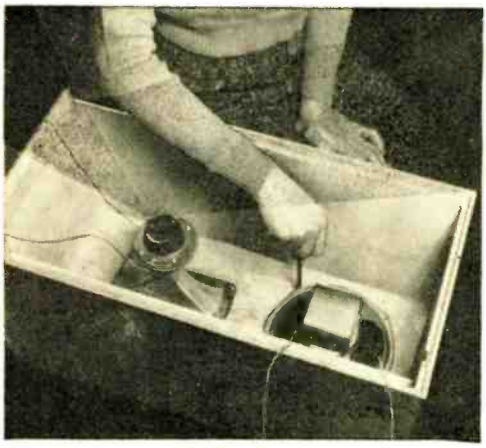
Internal view **at left shows enclosure just prior to the installation of the loudspeakers. The design of the interior helps to "load" the woofer and provide optimum low-range performance.**

acoustical lining made a big difference both in the bass and over-all naturalness of sound.

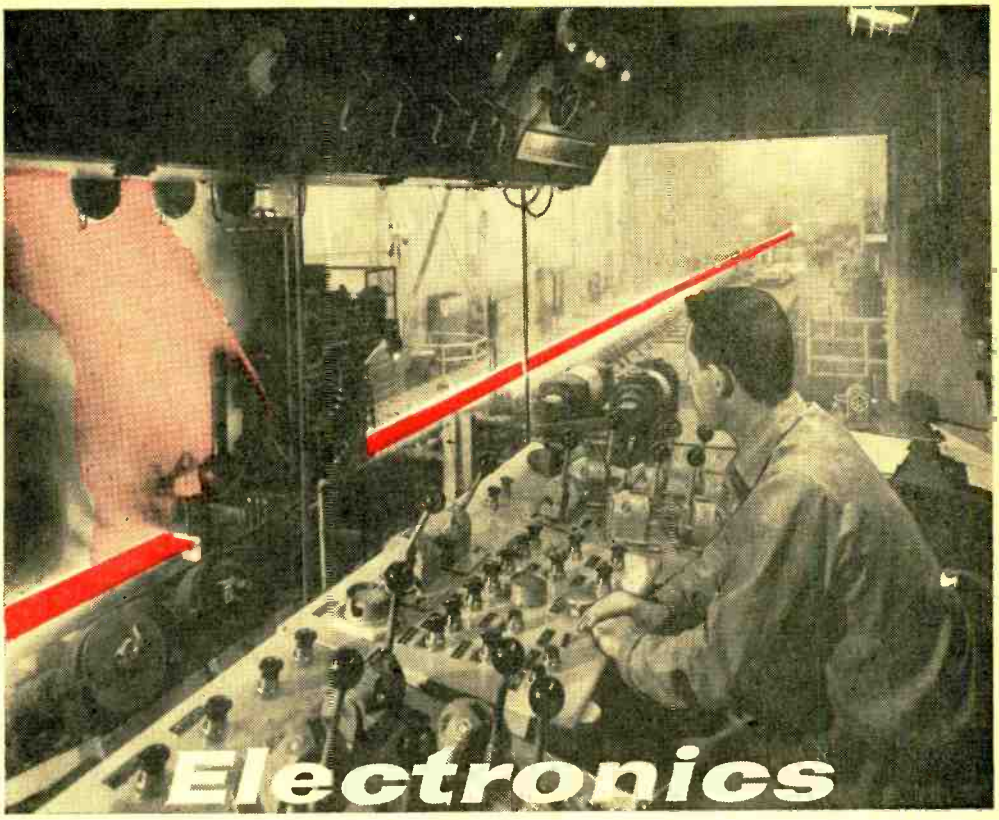
Stereo Operation. The SS-2 and our main speaker were hooked up in a system using two ten-watt amplifiers and the Electro-Voice 21D stereo pickup. After the necessary phasing adjustments, results were truly impressive.

All the effects of good stereo were evident—the "3-D" effect, the wide sound-source, the subtle differences between the two speakers. After a little experimentation with speaker placement, the main body of sound seemed to originate at a point halfway between the two speakers.

On the basis of our listening tests, the Heath SS-2 speaker system seems to be a good choice for a low-priced stereo setup, an auxiliary speaker, or a beginner's main speaker system. At the price of $39.95, it should not be compared with larger and more expensive systems. It is our feeling, however, that you will get more than your money's worth from the SS-2. —30—



Speaker installation is quite simple. Tweeter is mounted on adapter and then is screwed down to the inside of the enclosure.



Electronics in the Steel Industry

"YOU CAN LEAD a horse to water, but you can't make him drink." This old adage pretty much sums up the experience of the electronics industry with the nation's ultra-conservative steelmakers.

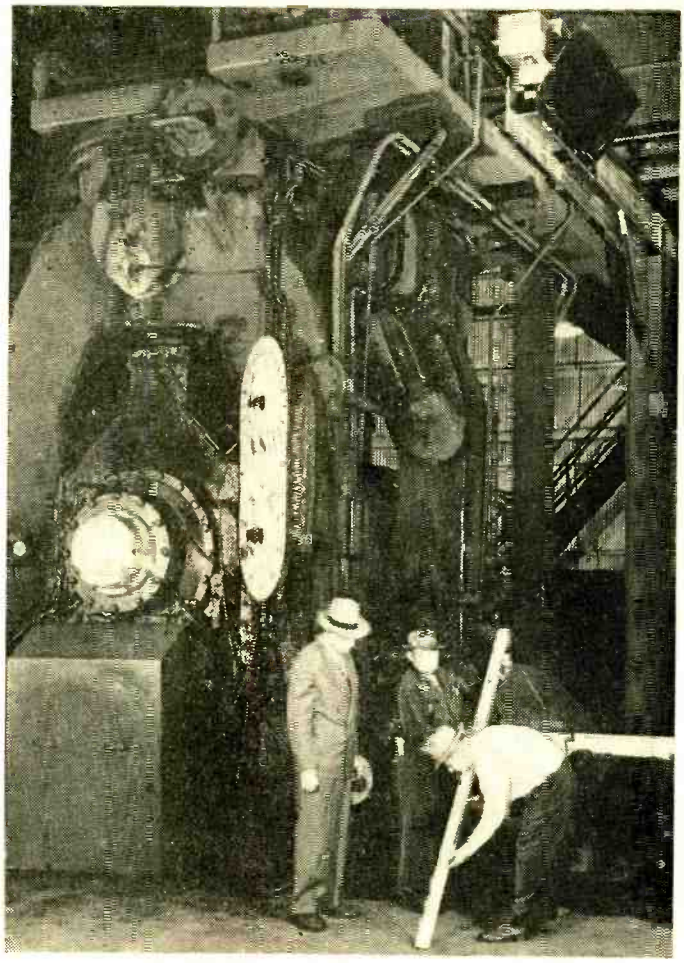
The steel industry's collective attitude is well illustrated by a $250,000 control that has never been put to work.

Punched-Card Control. A few years ago one of the giant steel companies commissioned a leader in electronics to design and build a punched-card control for its latest reversing-roughing mill, which flattens a hot block into a long strip. The control system was built, installed and tested in actual operation. But it has never been put to work because of some early difficulties, not at all unusual in a new type of equipment.

The punched-card reader, which was designed to feed information to computers in vibrationless, air-conditioned rooms, couldn't stand up under the heat and pounding in the mill. Instead of replacing or beefing-up the weak link, the steel men disconnected the whole shooting match. This

By MEL MANDELL

Some of the ways in which electronics is gradually being put to work in the giant steel-making plants



YARDSTICK. These men are checking the accuracy of an infrared width gage located 17 feet above hot strip which slides under it at 4000 feet per minute. The system is made by Industrial Gauges.

particular mill is still controlled by a skilled operator, who admittedly can't match the electronic control in uniformity of product and speed.

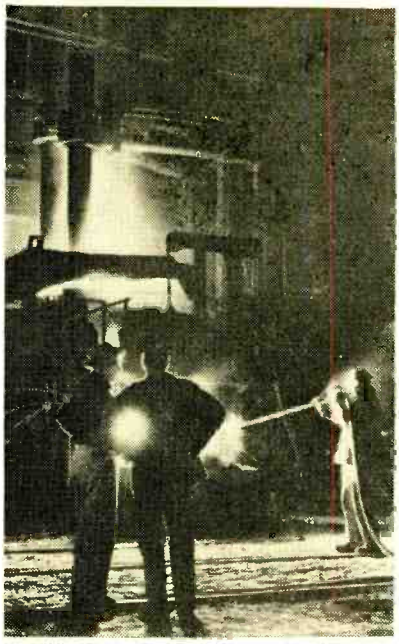
Since that time another steel company, Jones & Laughlin, has installed a similar punched-card control, this time made by Westinghouse, and it is working. As shown in the photo on page 77, the operator of this reversing-roughing mill just monitors the flattening of the hot steel as a computer directs the job.

It isn't too surprising that electronic manufacturers have often run into roadblocks in dealing with the steel industry, because even the steel companies' own engineers have trouble getting their fellow workers to accept electronic gear—and they're working from the inside.

Electronic Thickness Indicator. Listen to the story of an automation engineer, one of that small, brave band in the steel industry which does believe in electronics. Working in a steel mill in Ohio, he tells of all the resistance he met while installing an electronic thickness indicator on a rolling mill. From the plant manager on down to the operator, he was regarded with suspicion, even though the indicator would make the operator's job easier—and had nothing to do with replacing any workers.

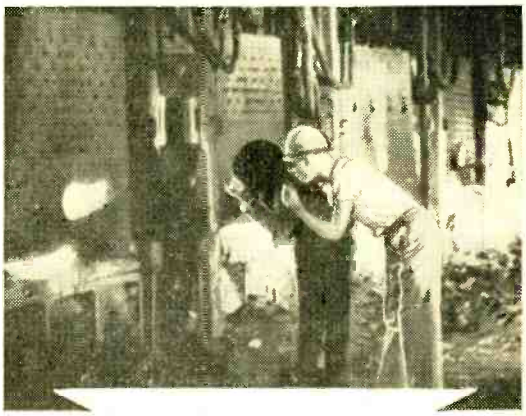
It took months of patient explanation and education before the men would watch the indicator instead of using the old-fashioned, hand-operated micrometer. The first time the engineer knew he was making any headway was the day he found the large clock-like face of the indicator dusted off. Now the operators greet him heartily whenever he visits; and the indicator face is brightly polished.

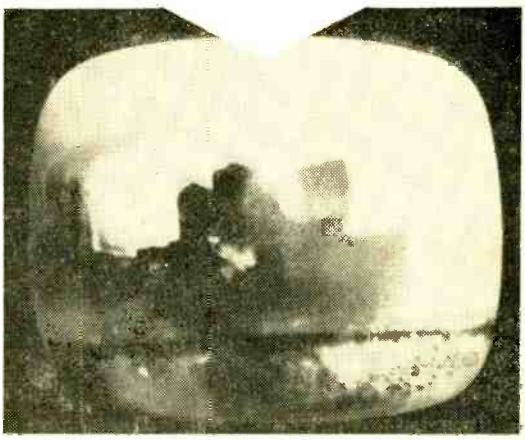
As this engineer puts it, the big problem



HOT STUFF. Electronic circuits control the temperature of giant carbon-arc electrodes sticking out of the top of the Sharon Steel electric furnace at left.

BEFORE and AFTER. The foreman of a block-long open hearth used to check melting steel by peering through tiny windows. Now he has a TV monitor in his control room. This General Precision Laboratory closed-circuit system is installed at U. S. Steel's Fairless Works.





with electronics in the steel industry isn't the equipment (they could do a lot more with presently available gear), it's the job of educating the plant operating crews to accept and use electronics.

To see what a big job electronics can do in helping the steelmakers, let's begin with the first step in producing steel, the conversion of pig iron into steel.

Heat Control. Electronic circuits have been working for years controlling the heat produced by carbon-arc electrodes in the electric furnace. This comparatively new way of making steel gained rapidly during World War II because it is best for making special steels.

However, the electric furnace can only boil a few tons of ingredients into steel at a time, while a small lake of raw materials can be cooked in the giant open hearth, which has displaced the older Bessemer converter as the major steelmaker.

To produce each different grade of steel in these great ovens, different proportions of pig iron, scrap steel and limestone must be mixed and heated. Each grade calls for a characteristic temperature and cooking time. Calculating the proper temperature and time for varying proportions of the raw materials is a snap for an electronic computer, and at least two companies are already working on special-purpose computers to program the open hearths for maximum efficiency.

Even before the computers go into action, electronics is already lending a hand to the steel industry in getting the most out of its enormously expensive open hearths. At U.S. Steel's Fairless Works, TV cameras,

cooled by air and circulating water, have been poked through the roasting hot walls of the open hearth to let the foreman standing before the receiver in a nearby control room see if the entire charge is melting evenly. Before he could only see a small part of the molten steel through tiny windows.

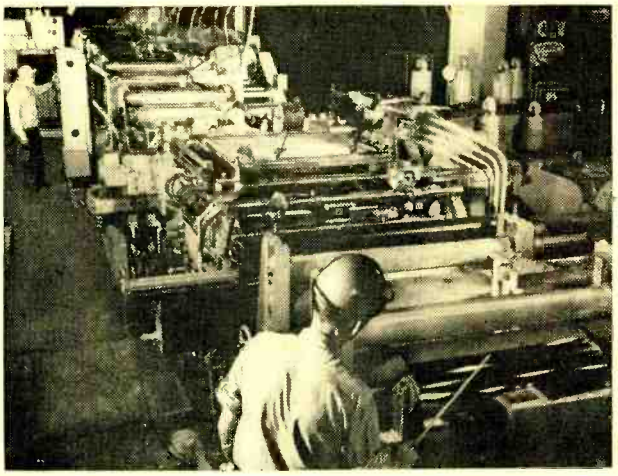
After the hearth is tapped (it's now done with an explosive charge), samples of the "heat" must be analyzed for alloy content. Fast-acting, direct-reading electronic spectrographs are replacing laborious, time-consuming chemical methods.

Electronic Weighing. Even before the open hearth begins to cook, electronics plays a vital role. At just a few mills, rugged load cells are now used to weigh accurately the various ingredients in the charge before they are dumped into the hearth. Electronic circuits convert the change in electrical resistance in a loaded cell into pounds, and they do the job much faster and neater than the cumbersome old mechanical scales they are displacing.

After the molten steel gushes out of the hearth into great ladles, it is again weighed by load cells as it is poured into the molds that form the one-story-high ingots. Load cells also weigh hot billet lengths before they drop under the forging hammer. Below-weight billets are automatically shunted aside after sliding down the weighing conveyor, which was built by Hill Acme Co., Cleveland, for a major steelmaker. When the steel is ready to leave the mill, it can also be weighed by electronic load cell.

A lot of steel goes through another heat treatment called annealing, a sort of homogenizing process. Annealing is done in special furnaces, which are frequently controlled by Leeds & Northrop infrared-electronic analyzers (see "Infrared: Jack of All Trades," POPULAR ELECTRONICS, Jan., '58). At the Bethlehem Steel mill, Sparrows Point, Md., infrared analyzers constantly check the atmosphere in the annealing furnaces for impurities.

Infrared devices are also used for maintenance and to check the width of hot strip as it squirts out of the rolling mill. Infrared instruments have a great future in an industry that is so completely dependent on heat.



PINHOLE DETECTOR. Mercury vapor lamps two-and-a-half times as bright as sunlight show up pinholes in tissue-thin steel foil rushing through a General Electric detection system at 22 mph.

Inspection. A variety of electronic gadgets inspect steel in the many forms in which it leaves the mill.

General Electric makes an automatic pinhole inspector for tissue-thin foil steel. Photoelectric cells pick out any pinholes that pass light from brilliant mercury vapor lamps. The foil was formerly inspected by girls, who often cut their hands on the sharp edges.

The thickness of steel pipe and tubing is checked by various instruments as the pipe is slipped through a magnetic gauge. If the pipe wall is too thin, the magnetic field is affected just enough for a sensitive meter to sound an alarm.

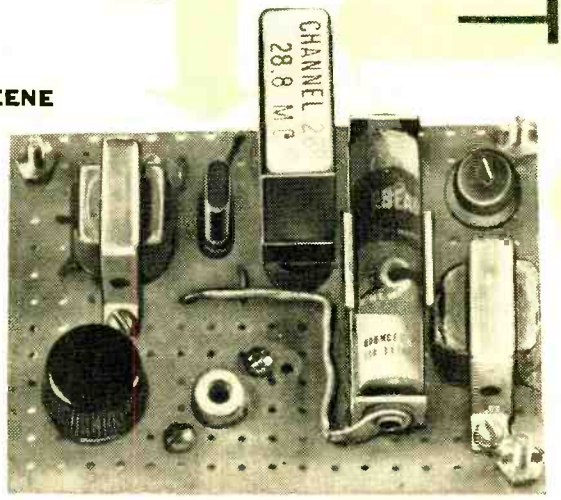
Huge forgings weighing many tons are checked ultrasonically for cracks and voids deep inside. If the forging is used in high-speed turbines, this inspection could save lives. Recently, a faulty turbine rotor disintegrated, killing two utility workers in Philadelphia.

A Foot in the Door. Long dependent on relays for the controls of cranes, charging machines and hoists, the steel industry is slowly accepting transistors, diodes and other solid-state devices instead. Semiconductors offer the promise of high reliability and long life. But the steelmakers rarely buy on promise alone.

With billions of dollars invested in its

(*Continued on page* 120)

By ERROL GREENE



Transistor Signal Generator

CRYSTAL CONTROL, a familiar feature of transmitters, can be put to work in other areas where stability and accuracy are needed. Crystal control of an r.f. signal generator, for example, is invaluable when calibrating and/or aligning receivers.

An extremely simple generator can be built that uses only two transistors and yet supplies an on-the-button r.f. signal with or without modulation. Depending on the crystal used, fundamental outputs from 370 kc. to over 3.6 mc. are possible.

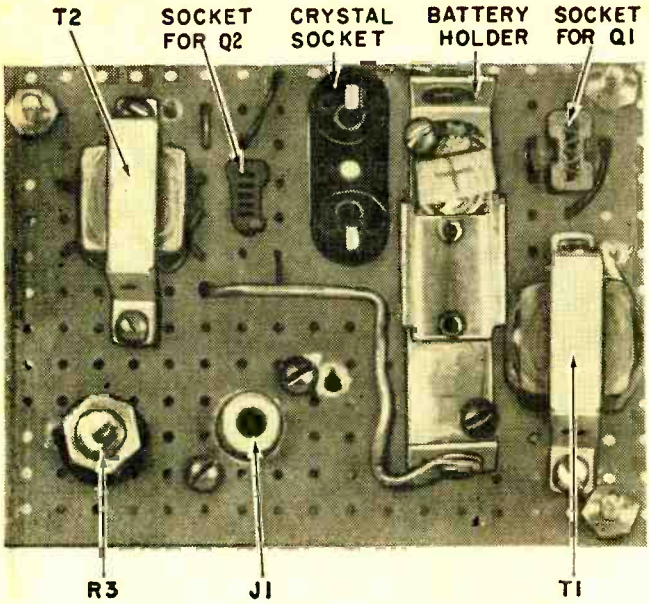
Crystals which will put out a signal in the broadcast receiver range are available from POPULAR ELECTRONICS' advertisers at low cost, often less than $1.00. They are identified in two ways: by a channel number and by a frequency (in mc.).

To find the *actual* fundamental frequency, proceed as follows. If the channel has one or two digits, divide the number of mc. by 54. If there are three digits, divide number of mc. by 72 to find the fundamental.

Construction. The specific manner of construction and packaging of the generator can be left to the builder's discretion. The author's model was built on a perforated phenolic board and left uncased. If you run into radiation problems, you can box the unit in an aluminum or steel cabinet.

To start the generator, simply slide a

On-the-button r.f. test signals are guaranteed by fixed frequency crystals



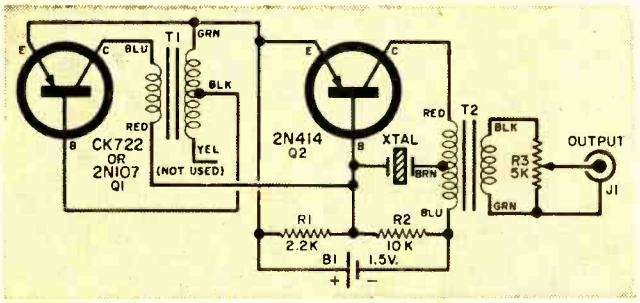
HOW IT WORKS

An Argonne AR-118 transformer (*T2*) is hooked up to provide the necessary feedback for oscillation and its low secondary impedance serves to isolate the output load from the generator.

The audio oscillator is powered by the low voltage across *R1*. The audio signal, which is about 4000 cps, is at a high enough level both to modulate the r.f. and to be used in audio testing, code practice, etc.

Either a CK722 or 2N107 will serve as the audio oscillator. The CK722 produces less output but its waveform is more nearly sinusoidal. Although the 2N107's output is higher, its waveform is rather peaked.

Note that the r.f. part of the generator consists of *Q2*, *T2*, two resistors and the crystal. The output control (*R3*) is optional.



PARTS LIST

B1—1.5-volt battery
J1—Phono jack
Q1—CK722 or 2N107 transistor
Q2—2N112 or 2N414 transistor
R1—2200-ohm resistor
R2—10,000-ohm resistor
R3—5000-ohm potentiometer
T1—Transformer; 10,000-ohm primary, 2000-ohm secondary (CT) (Argonne AR-109 or equivalent)
T2—Transformer; 500-ohm primary (CT), 16-ohm secondary (Argonne AR-118 or equivalent)
1—Crystal (see text)
1—Perforated phenolic circuit board
1—Crystal socket
2—Transistor sockets

penlight cell into the battery holder and plug in the crystal. Normally the output signal will be audible in a nearby receiver tuned to it without direct coupling to the antenna.

For maximum signal, connect the generator directly to the antenna post of the receiver, and then adjust the output control to the lowest level required. The maximum voltage is approximately 0.3 volt. To obtain an unmodulated r.f. signal, remove transistor *Q1*.

If you use a crystal in the i.f. range, you will hear its second or third harmonic on the broadcast band. For example, if you use a 400-kc. crystal, you will hear the signal at 800 kc., 1.2 mc., 1.6 mc., etc.

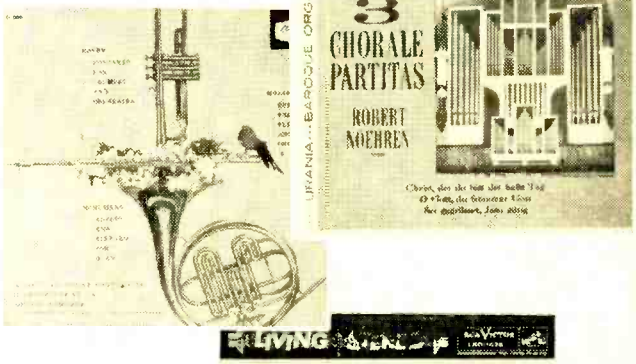
Crystal Selection. For calibrating broadcast and short-wave receivers, certain crystals are especially useful. Among those which have convenient harmonic frequencies are: 400 kc. (the crystal is marked 28.8 mc., channel 288); 375 kc. (marked 20.3 mc., channel 3) and 416 kc. (marked 30 mc., channel 300).

Another useful crystal is the one marked 21.0 mc., channel 10, which puts out a ninth harmonic at 3.5 mc. Thus it marks the beginning of the 80-meter band as well as higher bands (40, 20, etc.).

Crystals of up to 3.6 mc. will oscillate in this circuit without adjustment, which makes them useful for putting "pips" in the ham bands. To use the generator as an audio voltage source, remove the crystal. This will increase the audio output to a level usable for code practice or signal tracking by injection. —30—

INDEX

Your Records and Tapes



By ART ZUCKERMAN

HOW MANY TIMES have you had to flip through your entire record collection to find a disc you hadn't spun in a long while? And how often have you decided to pass up playing a short item because it wasn't worth going through a big stack of tapes to find?

Troubles of this kind can be banished forever with the aid of a simple, inexpensive indexing system. It can be made to cover everything on your discs and tapes, giving you a central reference for all your recorded music. And it can be made flexible enough to withstand any strain as you expand your music library.

The chief ingredients of a record-indexing system can be picked up at any stationery store. They consist of a small loose-leaf notebook (one approximately 4¼" x 6½" will do fine), a set of letter-indexed page dividers for the notebook, and a box of blank indexing tabs—the kind with two mucilaged flaps that can be anchored to both sides of a page. These tabs are for your records. Tapes can be indexed by marking the symbols on the edge of the tape storage box.

The first step is to set up an indexing code. Certain letter combinations should guide you to 12" LP's, others to 10" LP's. There also should be letters for coding 7" and 5" tape reels. If you have 45- and/or 78-rpm discs, you'll probably want to assign special index letters to them, too.

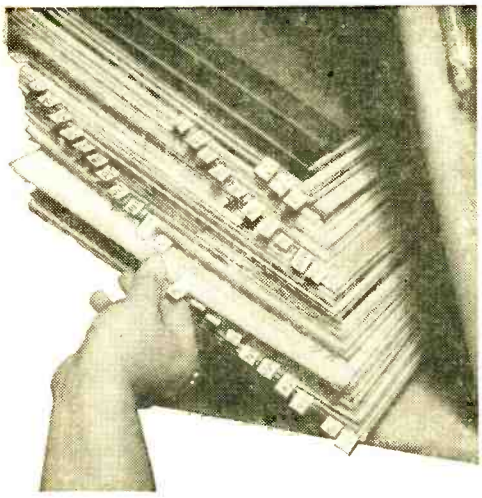
My own collection consists of 10" and 12" LP's of classical and show music and some 5" and 7" tapes. I also have a few tapes

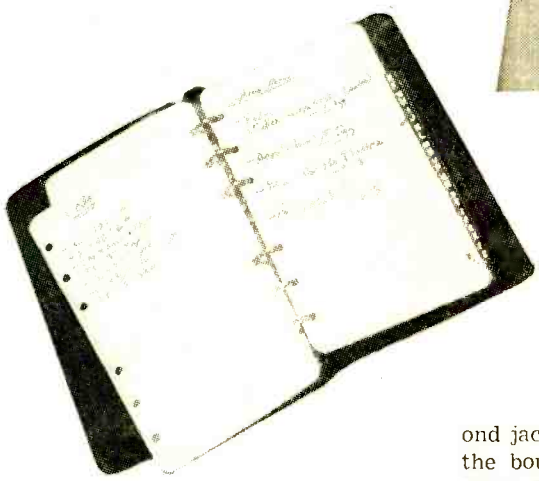
with home-movie sound tracks on them. Here's the way I've set up my index:

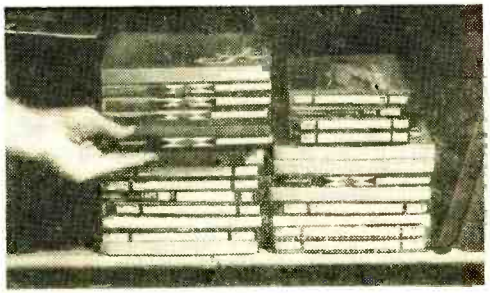
L = 12″ classical LP's
S = 10″ classical LP's
LT = 12″ show music LP's
ST = 10″ show music LP's
TL = 7″ tapes
TS = 5″ tapes
TM = movie tapes

You, of course, can set up your index to meet your own needs.

Here's how the individual coding works. Let's say you're starting with four 12″ classical LP's and two 7″ tapes. You would simply label the discs *L-1, L-2, L-3,* and *L-4,* and the tapes *TL-1* and *TL-2*. For simplicity, the numbers start at 1 in any given series, and the records and tapes are stored in numerical order.







An indexing system allows you to find any record in your collection quickly and easily. Master index book, at left, serves as the "brain" of the system. Records are located by code numbers fastened to record jackets. Tape code numbers may be marked on tape boxes.

Suppose you were to start with ten 12″ classical LP's. You would make out ten tabs, labeling them on each side from *L-1* through *L-10*. Then take the first record and affix the *L-1* tab to the top of the bound edge of the jacket.

The second tab is now affixed to the second jacket one space down from the top of the bound edge. Thus, when the two albums are placed together, both tabs are clearly visible, with *L-1* just above *L-2*. Going along, the third and fourth tabs should be attached one additional space down on their respective record jackets.

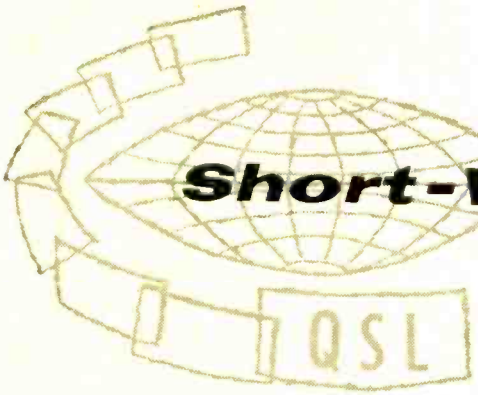
When all ten records are labeled and returned to the shelf, you will be able to see each tab, one below the other. Thus it is easy to single out any particular disc.

When you finally get to the point where an indexing tab is affixed to the bottom of an album, you simply put the tab for the next disc at the top of the album and start down all over again.

Tapes present a considerably easier problem because tape boxes usually have a space on the end of the box for indexing. Simply mark each box in sequence: *TL-1, TL-2, TL-3,* and so forth. Then store them in this sequence, either piling them one on top of the other or ranging them side-by-side, like records or books.

Now make up a master index. The obvious way to list classical records is in alphabetical order according to composer. Set

(*Continued on page* 121)



Short-Wave Report

By HANK BENNETT

ONE of the more important duties of the operator of a Short-Wave Listening Post is keeping an accurate log. While not required by law (except for stations having a transmitting permit), the log of an SWL can be considered an integral part of any monitoring station. It is secondary only to a receiver, a good basic source of station information such as the *World Radio Handbook*, and a monthly resume of station changes such as that found in this column and in the bulletins of the various radio clubs.

There is no set rule as to how a log should be laid out and maintained. It is doubtful whether any two DX'ers keep their logs in the same manner. Many keep a card-file log with stations listed by frequency or alphabetically; the former is preferable for the avid listener who tries to stay abreast of all frequency changes. Others record their loggings on loose-leaf notebook paper. A few may use the standard *Radio Amateur Logbook*, published by the American Radio Relay League. "Rough logs" are kept by many DX'ers who record information immediately upon hearing it and put it in their permanent logs at a later time and in a more presentable manner.

Regardless of how you keep your log, whether you make notations on a printed station list or list the stations heard on a day-to-day basis, you should also list certain basic information for use at a later date. This information is as follows, although not necessarily in this order: date and time, station name (call letters or slogan), location, exact frequency (if known), exact times heard, program details

(*Continued on page* 122)

19 METERS (15 MEGACYCLE BAND)

FREQUENCY	STATION	MAIN DIAL	BAND SPREAD	DATE	TIME	SIGNAL STRENGTH	READ ABILITY	INTER-FERENCE	PROGRAM DATA	OTHER INFORMATION
15,280	ZL4 WELLINGTON, NZ	15,300	45	11-14-58	2245 TO 2315	7-8	5	NIL	TALK ABOUT BIRDS OF NZ. IN ENG.	SLIGHT FADING AT TIMES
15,275	WARSAW POLAND	15,300	47½	11-15-58	2200 TO 2230	9+	5	NIL	NEWS, MUSIC, ENG.	TO N.A
15,257	FAR EAST NET WORK CAMP DRAKE JAPAN	15,300	66	11-16-58	1700 1710	3-4	4	JAMMER ON 15.255	POP. RECORDS ENG. ANNTS	VERY UNUSUAL TO HEAR AT THIS TIME OF DAY NOT HEARD SINCE

9638 4VEH, LAVOIX EVANGELIQUE CAP HAITIEN HAITI

9-22-58 NOTED 2230 WITH ENG. RELIGIOUS P9M

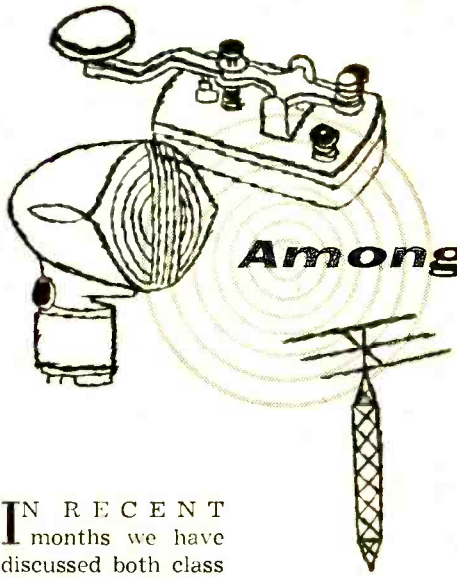
10-17-58 NOT HEARD-HAVE THEY CHANGED FREQUENCY

10-18-58 FOUND ON 9770 Kc.

(CARD TRANSFERRED TO NEW FREQUENCY

Samples of two different ways of keeping a log: listing stations by frequency (above); and the card-file method (right).

By
HERB S. BRIER
W9EGQ



Among the Novice Hams

IN RECENT months we have discussed both class A and class B vacuum-tube amplifiers. The third and last of the vacuum-tube types is the class C amplifier.

A class C amplifier tube is operated with a large negative d.c. grid bias voltage —approximately twice the bias voltage required to reduce its no-signal plate current to zero. Then the input signal fed to the grid circuit is raised to beyond the point where a further increase produces no more output from the amplifier. Class C operation has certain definite advantages.

Output Power. With Class C operation, 75 to 85% of the d.c. input power to the plate of the tube is converted into useful signal power output. The output signal waveform bears little resemblance to the input signal waveform. Only the positive peaks of the input signal are strong enough to overcome the high negative bias on the grid and thus allow plate current to flow.

Consequently, plate current flows and the tube delivers output power during only about one-third of each input cycle. An appreciable amount of input signal power is required to drive a class C amplifier since excessive grid current flows during the positive peaks. This input signal power is calculated as the plate voltage times the plate current.

Class C amplifiers are usually employed as radio-frequency oscillators and power amplifiers. In these applications, the pulses of output power from the plate of the tube are fed into tuned circuits. The selectivity and energy-storage properties of the tuned circuit converts the output pulses into virtually distortionless sine waves. These

(*Continued on page* 116)

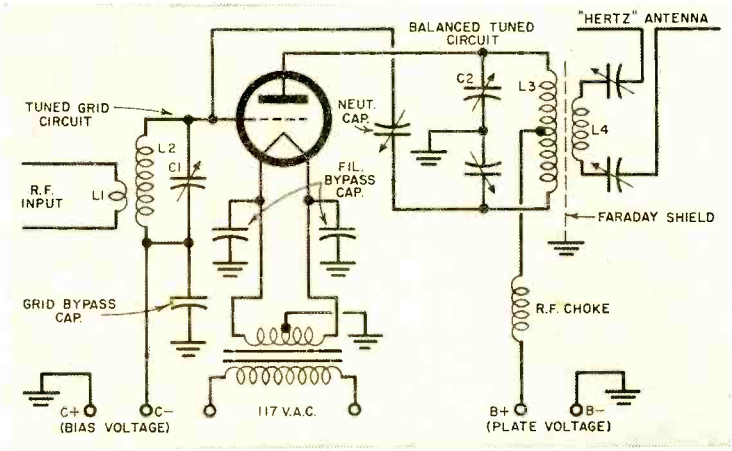


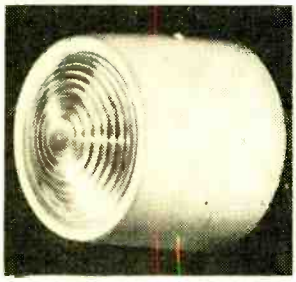
Fig. 1. Typical triode Class C r.f. power amplifier feeding a Hertzian antenna. Circuit is discussed in text.

SEE PAGE 118 FOR
list of those who request help in obtaining their ham licenses

NEW products

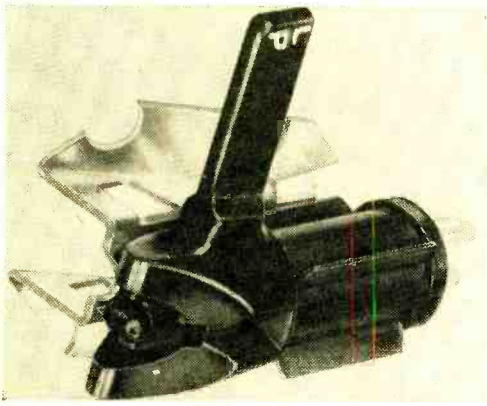
SWITCH OPERATED BY CAR LIGHTS

"Switch-A-Light" is an inexpensive device which mounts easily and quickly on your garage or car port wall at headlight level. The beam from your auto headlights activates a switch that turns on your overhead, yard or patio light. After a few minutes, the light turns off. (*OSOCO,* P. O. Box 7268, Fort Worth, Texas)



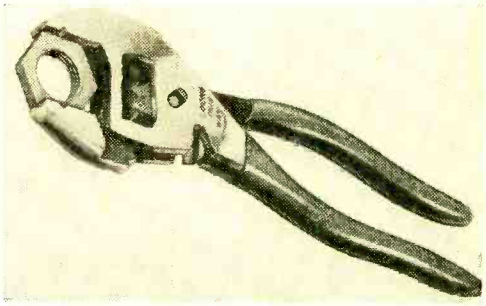
DUAL-NEEDLE CERAMIC CARTRIDGE

Sonotone's new phonograph pickup design is incorporated in the Model "4T" ceramic cartridge. It features dual 1-mil or 3-mil jewel needles. Price, $5.95, including snap-on mounting bracket. (*Sonotone Corporation,* Elmsford, N. Y.)



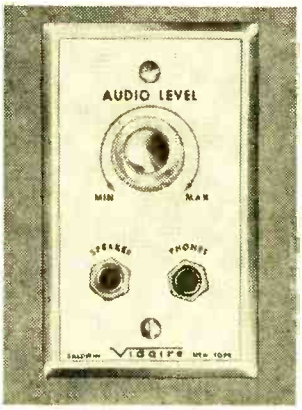
UNIVERSAL-GEARED PLIERENCH

New models of the Plierench in 8½" and 7" sizes have been released incorporating improvements in design and finish, and plastic handle covers. Called "a complete workshop in one tool," the Plierench features a 10-to-1 ratio jaw-to-handle leverage, a 1-ton gripping power, geared transmission, jaws that always remain parallel, automatic jaw lock, and split-second ratchet and gear shift jaw adjustment. List price for 8½" model, $8.50; 7" model, $7.50; both with universal jaw. (*Plierench Company of America,* 4615 N. Ravenswood Ave., Chicago 40, Ill.)



SPEAKER VOLUME CONTROLS

Vidaire has two new models, the JL-8 and the JL-16, which facilitate the use of extra speakers or phones with any audio system. The JL-8 includes an 8-ohm L-pad and the JL-16 includes a 16-ohm L-pad. Each has phone and speaker jacks mounted on a gold embossed brass wall plate. Both models are designed for constant impedance operation. (*Vidaire Electronics Mfg. Corp.,* Malverne, N. Y.)



CAPACITOR LEAKAGE PROBE

Checking for high-resistance leakage in electronic circuits, especially capacitors, is hampered because these leakages often occur only when substantial voltage is applied. An inexpensive leakage detector, known as the D-400 "Hi-Leak Analyzer," applies 100 volts d.c. to the capacitor under test. List price, $12.95 wired, $9.95 in kit form. (*Doss Electronic Research, Inc.,* 820 Baltimore, Kansas City, Mo.) —30—

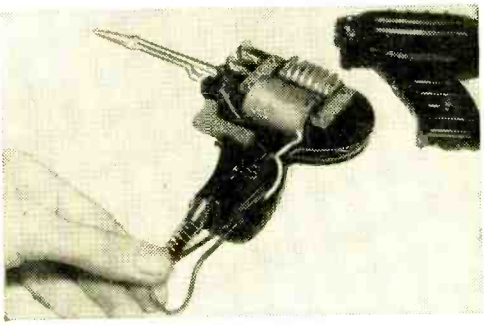
TIPS and TECHNIQUES

HANDY SOLVENT FOR TOOL KIT

A bottle of nail polish remover can be kept handy in the tool kit, and is valuable for small cleaning jobs where grease or paint must be removed. Such bottles are small and most of them are built strongly enough so that they will not break under the normal wear-and-tear conditions in your kit. —*H. L.*

HANG UP YOUR SOLDERING GUN

Your soldering gun can be conveniently hung up out of the way if you drill a ¼" hole in the bottom of the grip, remove half of the gun's outer housing, and fit a knotted loop of leather or stranded wire (insulated) into the opening as shown in the photo. The loop can be hung over most any type of



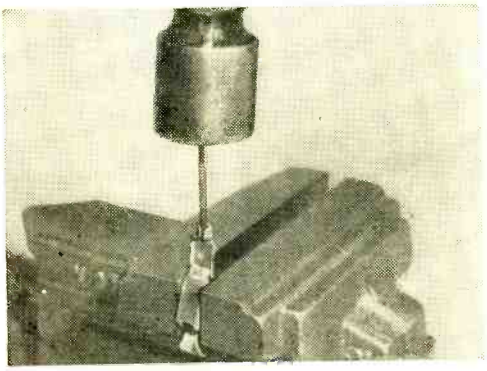
fastener and is especially handy if the gun is stored on a wall-mounted peg-board tool panel. —*J. A. C.*

COLORED TAPE LABELS LEADS

Have you ever unsoldered the leads from a defective power transformer and tried to install a replacement from memory of where each lead goes? Unless you have a photographic memory (and most of us don't), this can be quite a vexing problem. Here's how you can solve it. As you unsolder each lead, place a tab of colored Scotch gift-wrapping tape on the lead and one of corresponding color on the terminal from which the lead was unsoldered. Use a different color tape for each different lead and terminal. When you solder in the replacement, just compare tab colors for easy lead-terminal identification. —*P. D.*

OPENING CLIP'S WIRE SUPPORTS

After a test clip like the one shown has been used once, you probably find it extremely difficult to bend out those tiny "ear"-type wire supports at the rear of the clip without breaking them off. It can be done rather easily, however, if you use the



hammer and nail method shown in the photo. Clamp the clip firmly in a vise and take a sharp pointed nail and pound it gently into the opening between the supports. This will bend them out without causing damage and make the clip reusable. —*E. C.*

TAPE CODES TV-CIRCUIT TUBES

If you do it yourself when it comes to replacing defective tubes in your television set, here's a trick that will save you much time. Purchase several rolls of colored Scotch gift-wrapping tape at a five-and-dime store, and color-code the tubes in your set. This will enable you to determine by sight which tubes are in which circuit. Stick bands of blue tape to the bases of tubes used in the video circuits, green or red tape to those used in the audio circuits. —*J. A. C.*

OIL REMOVES FOG FROM TV

Does your TV picture appear foggy? If so, the plastic safety mask may need cleaning. Since plastic scratches very easily, don't trust a harsh, abrasive-like cleanser to do the job—it can result in serious scratches. Several drops of thin machine oil applied with a clean soft cloth will re-

Want To Double Your Pay

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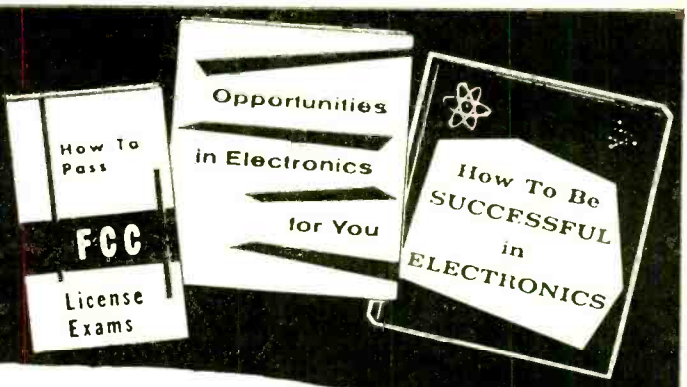

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RADIO OPERATOR: Capital Airlines (Ohio) is looking for a radio operator. A touch typing speed of 40 wpm is necessary. Must have at least a restricted operator's permit, but a radio-telephone 2nd or 1st class license is desirable.

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move the fog instantly. Thoroughly wipe away all oil remaining on the glass with a clean cloth. If you don't, it will collect dust rapidly and again need cleaning. —*C. A.*

CLAY "BLOCK" ACCESSORY STAND

You can make a stand for your electric drill's accessories quickly and easily from a "block" of modeling clay. Make holes in the block with the shanks of the various accessories and give the stand a couple of coats of lacquer so it will maintain its present shape. Keep the accessories in the stand and they will stay sharp and last longer—and be easier to find. —*J. A. C.*

SAVE ON TRANSISTOR BATTERIES

Many transistor circuits require 22½-volt batteries. If you want to save on the cost of such batteries, purchase an XX45 67½-volt battery and cut it open carefully. Inside you will find three 22½-volt batteries that would otherwise cost you about one-third more. All you will have to do is clip the wires running between stacks and solder on leads long enough to fit your needs. —*C. A. L.*

AMMONIA "UNFREEZES" IRON'S TIP

If your soldering iron has a screw-on tip or a setscrew that holds the tip in place, check it occasionally to make sure oxidation hasn't frozen it tightly in place. If it

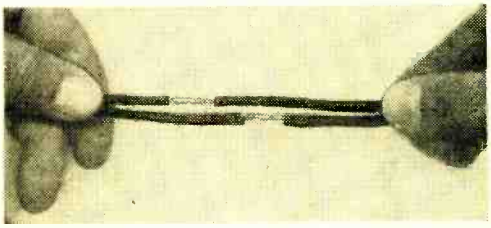
has, don't try to loosen it with pliers—you are liable to damage the tip. Instead, take a cotton swab or brush, dip it in ammonia, and apply it to the tip as shown. This will "unfreeze" the tip in a matter of minutes. —*P. E. C.*

TEST LEAD HOLDER

Too often test leads are stored in a drawer where they become snarled and tangled, making the selection of the desired lead a bothersome task. Ideal for test lead storage are the many varieties of men's tie racks. Some of the latter work on a lazy-tongs principle and occupy very little wall space when closed. —*D. D. V.*

SHORT-PROOF WIRE SPLICES

To prevent your electrical wire splices from short-circuiting, cut one leg of each pair of wires being spliced two inches shorter than the other. Next strip one inch of the insulation from each of the four leads, splicing one short and one long lead to-



gether. This method staggers the connections, thus insulating them from one another. When soldered and taped, the joint is a slender, neat-appearing one. —*P. B.*

EYE TO EYE

When measuring the distance between mounting holes for transformers, tube sockets, meters, etc., measure from the *inner* edge of one hole to the *outer* edge of the other. This will give you the exact distance between the two centers. —*P. B.*

TRANSISTOR SUPERHET FEEDBACK

Some builders of pocket transistor superhets may be bothered by positive feedback which causes audio distortion at low frequencies. The obvious cure is to use an output filter capacitor of 100 to 200 μfd. in the a.v.c. circuit, but this is usually impractical due to space limitations. A good way to eliminate this condition is to use as large a capacitor as possible, at least 30 μfd., and reverse connections to the secondary of the output i.f. transformer. You may have to reverse connections to more than one transformer. —*J. B. W.*

"Tips" Wanted

Did you know that POPULAR ELECTRONICS is very much interested in receiving your *Tips and Techniques* hints? One hundred words (approximately) and a clear photo fully illustrating the item could result in a five dollar check appearing in your mail. Why keep your pet ideas to yourself? Let everyone else in on them and profit by them.

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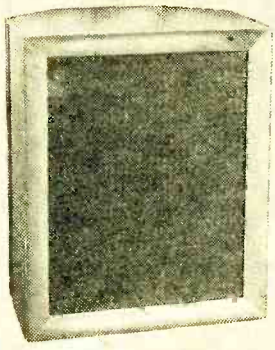
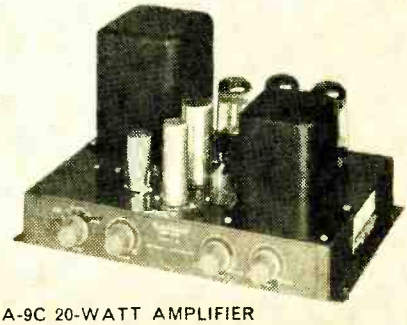
"BASIC" SPEAKER SYSTEM



RANGE EXTENDER



A-9C 20-WATT AMPLIFIER

HEATHKIT "BASIC RANGE" HIGH FIDELITY SPEAKER SYSTEM KIT

This amazing speaker system can fulfill your present needs and still provide for future expansion. Fine hi-fi performance the result of using high quality speakers in an enclosure especially designed for them. Features two Jensen speakers to cover 50 to 12,000 CPS within ± 5 db. Power rating is 25 watts, and impedance is 16 ohms. Enclosure constructed of veneer-surfaced plywood, ½" thick, and measures 11½" H x 23" W x 11¾" D. Precut and predrilled for quick assembly.

Model SS-2
$39.95

Shpg. Wt. 26 lbs.

HEATHKIT RANGE EXTENDING HIGH FIDELITY SPEAKER SYSTEM KIT

Designed especially for use with SS-2 "Basic" system. Contains 15" woofer and compression-type super tweeter. Extends basic unit to 35—16,000 CPS, ± 5 db. Impedance 16 ohms. Measures 29" H x 23" W x 17½" D, and is constructed of ¾" veneer-surfaced plywood.

Model SS-1B
$99.95

Shpg. Wt. 80 lbs.

HEATHKIT A-9C HIGH FIDELITY AMPLIFIER KIT

This model incorporates its own power supply and preamplifier. Plenty of power with full 20 watt rating. Four separate inputs, selected by panel-mounted switch, and separate bass and treble controls. Ideal for home or PA applications. Output transformer tapped at 4, 8, 16 or 500 ohms. Response within ± 1 db from 20 to 20,000 CPS.

Model A-9C
$35.50

Shpg. Wt. 23 lbs.

HEATHKIT HIGH FIDELITY FM TUNER KIT

Now you can have full-fidelity FM performance from 88 to 108 mc at reasonable cost. Features temperature-compensated oscillator—built in power supply, and beautiful cabinet. Components prealigned at factory!

Model FM-3A
$25.95
(with cabinet)

Shpg. Wt. 8 lbs.

HEATHKIT BROADBAND AM TUNER KIT

Tunes standard AM band from 550 to 1600 kc with fine sensitivity and broadband characteristics. Features include built-in power supply and low-distortion detector. All RF circuits prealigned for simplified construction.

Model BC-1A
$25.95
(with cabinet)

Shpg. Wt. 9 lbs.

HEATHKIT "MASTER CONTROL" HI-FI PREAMPLIFIER KIT

Provides extra amplification, selection of inputs, volume and tone controls, and turnover and rolloff controls, for Williamson-type amplifiers. Beautiful satin-gold enamel cabinet. Derives operating power from amplifier.

Model WA-P2
$19.75
(with cabinet)

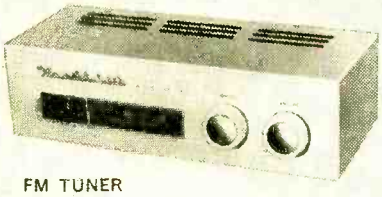
Shpg. Wt. 7 lbs.

HEATHKIT 25-WATT HIGH FIDELITY AMPLIFIER KIT

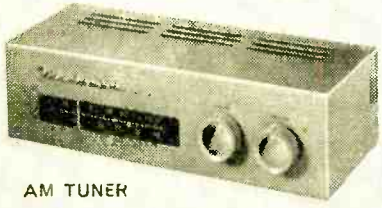
Outstanding 25-watt Williamson-type amplifier employs KT66 tubes and Peerless output transformer, tapped at 4, 8, and 16 ohms. A fine amplifier for the "deluxe" system. WA-P2 preamplifier required for operation. Express only.

Model W-5M
$59.75

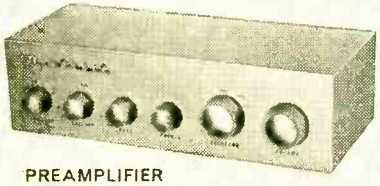
Shpg. Wt. 31 lbs.



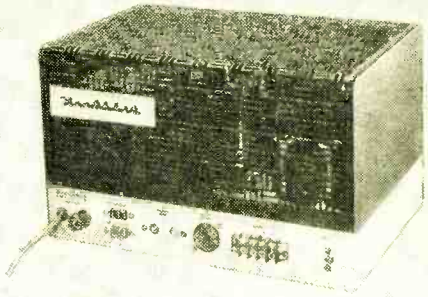
FM TUNER



AM TUNER



PREAMPLIFIER



W-5M 25-WATT AMPLIFIER

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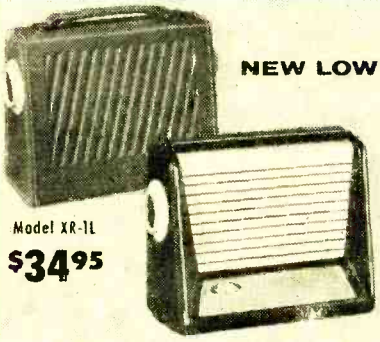


NEW LOW PRICE!

Model XR-1L **$34.95**

Model XR-1P **$29.95**

Note: Prices are with cabinet less batteries.

HEATHKIT MODEL XR-1P TRANSISTOR PORTABLE RADIO KIT

This easy to build transistor radio is designed for lifetime operation. Features 6 name-brand (Texas Instrument) transistors for extra good sensitivity and selectivity. A 4" x 6" speaker for "big set" tone, built-in rod-type antenna, and uses 6 standard size "D" flashlight cells for extremely long battery life (between 500 and 1,000 hours). Cabinet is two-tone blue molded plastic with pull-out carrying handle. Measures 9" L. x 7" H. x 3¾" D. Transformers are prealigned eliminating special alignment equipment. Shpg. Wt. 6 lbs.

MODEL XR-1L: Identical to XR-1P except in leather case. Carrying strap included. Shpg. Wt. 7 lbs.

HEATHKIT BROADCAST BAND RADIO KIT

Covers 550 to 1600 kc with good sensitivity and selectivity. Has 5½" PM speaker for good tone quality. Features transformer power supply and built-in antenna. Signal generator recommended for alignment. Cabinet, as shown, available separately. Shpg. Wt. 10 lbs.

Model BR-2 **$18.95** *(less cabinet)*

HEATHKIT CRYSTAL RADIO KIT

Features a sealed germanium diode to eliminate critical "cats whisker" adjustment. Employs two tuning condensers for good selectivity, and covers the broadcast band from 540 to 1600 kc. Requires no external power. Kit price includes headphones. Shpg. Wt. 3 lbs.

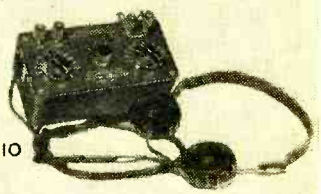
Model CR-1 **$7.95**

HEATHKIT ENLARGER TIMER KIT

The dial of this handy timer covers 0 to one minute calibrated in five-second gradations, so that the timing cycle of a photographic enlarger can be electronically controlled. Built-in relay handles up to 350 watts, and enlarger merely plugs into receptacle of front panel. Also provision for plugging in safe-light. An easy-to-build device that makes a fine addition to any dark room. Shpg. Wt 3 lbs.

Model ET-1 **$11.50**

TABLE-MODEL RADIO



CRYSTAL RADIO

ENLARGER TIMER

HEATHKIT FUEL VAPOR DETECTOR KIT

The FD-1 is a safety device to detect fuel vapor in the engine compartment or other sections of your boat. The detector unit mounts in the area to be checked, and the indicating meter and controls mount on the control panel. Will operate intermittently or continuously, and indicates dangers of fire or explosion to protect your boat and its passengers. Models FD-1-6 (6 volts DC) and FD-1-12 (12 volts DC) operate from boat batteries. Kit even includes spare detector unit. Shpg. Wt. 4 lbs.

6-volt FD-1-6, 12-vt. FD-1-12

$35.95 each

HEATHKIT RF POWER METER KIT

This handy device measures the RF field in the vicinity of a transmitter, whether it be marine, mobile, fixed, etc. Requires no electricity, nor direct connection to the transmitter. Provides a continuing indication of transmitter operation. Merely place it in proximity to the transmitter antenna and it will produce a reading on its 200 ua panel meter when the transmitter is in use. Operates with any transmitter between 100 kc and 250 mc. Includes a sensitivity control for meter. Shpg. Wt. 2 lbs.

Model PM-1

$14.95

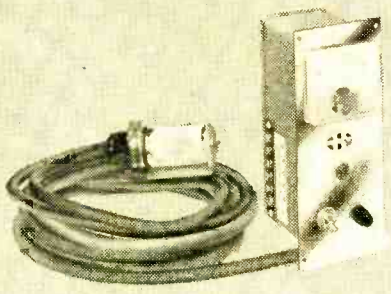
HEATHKIT TRANSISTOR RADIO DIRECTION-FINDER KIT

The Heathkit Transistor Radio Direction-Finder model DF-1 is a self-contained, self-powered, 6-transistor super heterodyne broadcast radio receiver incorporating a directional loop antenna, indicating meter, and integral speaker. It is designed to serve primarily as an aid to navigation when out of sight of familiar landmarks. It can be used not only aboard yachts, fishing craft, tugs, and other vessels which navigate either out of sight of land or at night, but also for the hunter, hiker, camper, fisherman, aviator, etc. It is powered by a 9-volt battery. (A spare battery is also included with the kit.) The frequency range covers the broadcast band from 540 to 1600 kc and will double as a portable radio. A directional high-Q ferrite antenna is incorporated which is rotated from the front panel to obtain a fix on a station and a 1 ma meter serves as the null and tuning indicator. The controls consist of: tuning, volume and power (on-off), sensitivity, heading indicator (compass rose) and bearing indicator (antenna index). Overall dimensions are 7½" W x 5⅜" H x 5¾" D. Supplied with slip-in-place mounting brackets, which allow easy removal from ship bulkheads or other similar places. Shpg. Wt. 4 lbs.

Model DF-1

$54.95

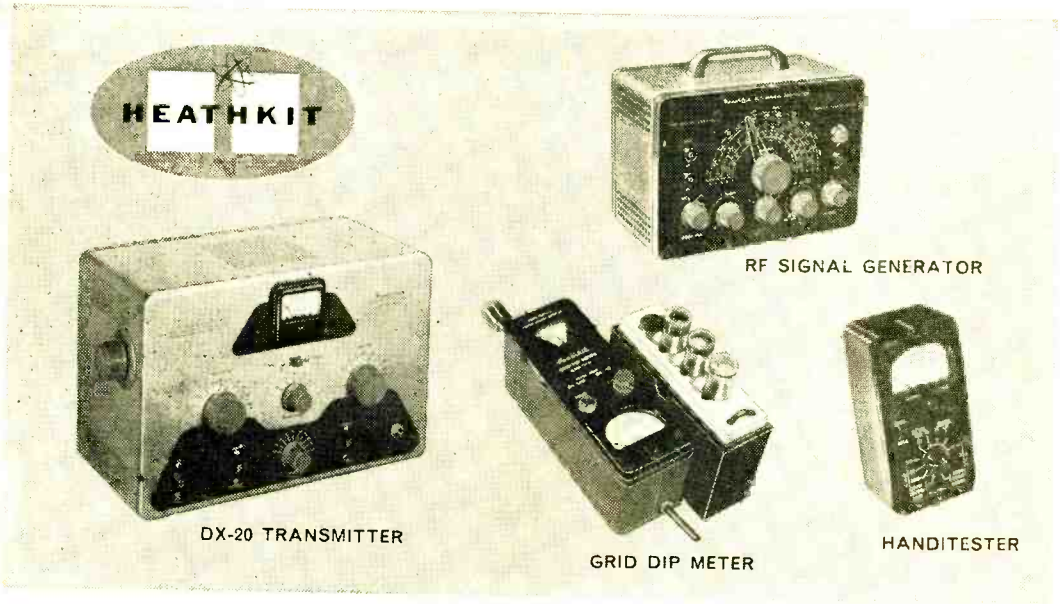
NEW! Heathkits for the boating enthusiast



FUEL VAPOR DETECTOR

POWER METER

RADIO DIRECTION-FINDER



HEATHKIT DX-20 CW TRANSMITTER KIT

This Heathkit straight-CW transmitter is one of the most efficient rigs available today. It is ideal for the novice, and even for the advanced-class CW operator. It employs a 6DQ6A tube in the 50-watt final amplifier circuit, a 6CL6 oscillator and a 5U4GB rectifier. Single-knob band switching covers 80, 40, 20, 15, 11, and 10 meters. The DX-20 is designed for crystal excitation, but may be excited by an external VFO. Pi network output circuit is employed to match antenna impedances between 50 and 1000 ohms.

Model DX-20
Shpg. Wt. 19 lbs. **$35.95**

HEATHKIT GRID DIP METER KIT

An instrument of many uses for the ham, experimenter, or service technician. Useful in locating parasitics, neutralizing, determining resonant frequencies, etc. Covers 2 mc to 250 mc with prewound coils. Use to beat against unknown frequencies, or as absorption-type wave meter.

Model GD-1B
Shpg. Wt. 4 lbs. **$21.95**

HEATHKIT RF SIGNAL GENERATOR KIT

Produces rf signals from 160 kc to 110 mc on fundamentals on five bands, and covers 110 mc to 220 mc on calibrated harmonics. Output may be pure rf, rf modulated at 400 CPS, or audio at 400 CPS. Prealigned coils eliminate the need for calibration after completion.

Model SG-8
Shpg. Wt. 8 lbs. **$19.50**

HEATHKIT HANDITESTER KIT

Measures AC or DC voltage at 0—10, 30, 300, 1000 and 5000 volts. Direct current ranges are 0-10 ma and 0-100 ma. Ohmmeter ranges are 0-3000 and 0-300,000 ohms. Sensitivity is 1000 ohms/volt. Features small size and rugged construction in sleek black bakelite case.

Model M-1
Shpg. Wt. 3 lbs. **$17.95**

HEATHKIT ETCHED-CIRCUIT VTVM KIT

Sensitivity and reliability are combined in the V-7A. It features 1% precision resistors, large 4½" panel meter, and etched circuit board. AC (RMS) and DC voltage ranges are 0—1.5, 5, 15, 50, 150, 500, and 1500. Peak-to-peak AC ranges are 0—4, 14, 40, 140, 400, 1400 and 4000 volts. X1, X10, X100, X10k, X100k, and X1 megohm.

Model V-7A
Shpg. Wt. 7 lbs. **$24.50**

HEATHKIT ALL-BAND RADIO KIT

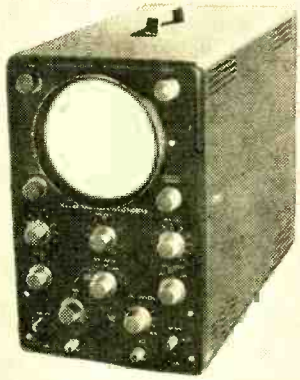
This receiver covers 550 kc to 30 mc in four bands, and is ideal for the short wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image projection. Amateur bands clearly marked on the illuminated dial scale. Employs transformer-type power supply—electrical band spread—antenna trimmer—separate rf and af gain controls—noise limiter and headphone jack. Built-in BFO for CW reception. Cabinet, as shown, available separately.

Model AR-3
Shpg. Wt. 12 lbs. **$29.95**
(less cabinet)

HEATHKIT "GENERAL PURPOSE" 5" OSCILLOSCOPE KIT

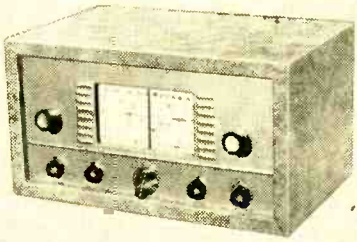
This oscilloscope sells for less than the previous model, yet incorporates features for improved performance. The OM-2 provides wider vertical frequency response, extended sweep generator coverage, and increased stability. Vertical channel is essentially flat to over 1 mc. Sweep generator functions from 20 CPS to over 150 kc. Amplifiers are push-pull, and modern etched circuits are employed in critical parts of the design. A 5BP1 cathode ray tube is used. The scope features external or internal sweep and sync, 1-volt peak-to-peak reference voltage, three-position step attenuated input, and many other "extras."

Model OM-2
Shpg. Wt. 22 lbs. **$39.95**



"GENERAL-PURPOSE" SCOPE

VACUUM TUBE VOLTMETER



ALL-BAND RADIO

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Just identify the kit you desire by its model number and send check or money order to address below. Don't hesitate to ask about HEATH TIME PAYMENT PLAN.

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- ☐ Freight
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MX Means Multiplex

(*Continued from page* 45)

tracting the A − B signal with the A + B signal yields full stereo. By adding/subtracting *less* than the full A − B signal, it is possible to vary the degree of separation between the left and right channels and fill in any acoustic "hole in the middle" resulting from poor program material or speaker placement.

The Madison Fielding MX-100 incorporates a "dimension" control which, when tuned fully counterclockwise, affords monophonic listening. Fully clockwise, it provides full stereo. In between, of course, you can achieve any degree of separation you choose.

Because of what the Crosby system can mean to FM and to hi-fi, it's a sure bet that more and more stations will go stereo with multiplex. As they do, broad new areas of listening enjoyment will open for the FM audience. And it all started when Murray Crosby scribbled some simple equations five years ago. —30—

Transistor Topics

(*Continued from page* 63)

in his unit, any equivalent *p-n-p* type can be used . . . such as the GT-222, 2N107, or R-66. And *n-p-n* types, such as the 2N229 and 2N170, may be used if the battery polarity is reversed.

Reader George Sollman (19 Chapel St., Cobleskill, New York) submitted the circuit in Fig. 1(B). He writes that this circuit is used as an *aircraft interphone amplifier* by the Cobleskill Flying Club, of which he is a member.

Featuring relatively high gain, George's amplifier circuit employs a direct-coupled complementary circuit. The two 2N107's are *p-n-p* units, the 2N170 is a *n-p-n* transistor. *R1* is a 100,000-ohm volume control with ganged on-off switch. *B1* is a Burgess 4Z . . . or four penlight cells connected in series. Use 1-4000 ohm magnetic headphones.

The average hobbyist should have little or no difficulty in duplicating George's amplifier. There is one important point, however. Since a direct-coupled arrangement is used, transistor leakage may prove a problem. Best results are obtained if the transistors in each stage are selected ex-

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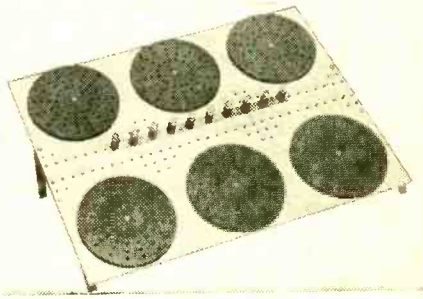

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TEXT PREPARED BY MIT SPECIALIST

Dr. Claude Shannon, known to the readers of **Popular Electronics** for his invention of the electronic mouse, that runs a maze, learning as it goes, formerly a research mathematician for Bell Telephone Laboratories is now a research associate at MIT. His books include publications on Communication theory and the recent volume "Automat Studies" on the theory of robot construction. He has prepared a paper entitled "A Symbolic Analysis of Relay and Switching Circuits" which is available to purchasers of the **GENIAC**. Covering the basic theory necessary for advanced circuit design it vastly extends the range of our kit.

The complete re-designing of the 1958 kit and the manual as well as the special book **DESIGN-O-MAT®** was created by Oliver Garfield, author of "Minds and Machines," editor of the "Gifted Child Magazine" and the "Review of Technical Publications."

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3) **"A Symbolic Analysis of Relay and Switching Circuits"** By Dr. Claude Shannon provides the basis for new and exciting experimental work by the kit owner who has finished book No. 1.

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We know the best recommendation for **GENIAC** is what is has done for the people who bought it. The comments from our customers we like best are the ones that come in daily attached to new circuits that have been created by the owners of **GENIACS**. Recently one man wrote: "**GENIAC** has opened a new world of thinking to me." Another who designed the "Machine that Forecasts the Weather" commented:

"Several months ago I purchased your **GENIAC** *Kit and found it an excellent piece of equipment. I learned a lot about computers from the enclosed books and pamphlets and I am now designing a small relay computer which will include arithmetical and logical units . . . another of my pet projects in cybernetics is a weather forecaster. I find that your* **GENIAC** *Kit may be used in their construction. I enclose the circuits and their explanation."*
Eugene Darling, Malden.

Oliver Garfield Co., Inc. **Dept. PE-19**
108 East 16th St., N. Y. 3, N. Y.

Please send me at once the **GENIAC** Electric Brain Construction Kit, 1958 model. I understand that it is guaranteed by you and may be returned in seven days for a full refund if I am not satisfied.

☐ I have enclosed $19.95 (plus 80c shipping in U. S., $1.50 west of Miss., $2.00 foreign). 3% New York City Sales Tax for N.Y. City Residents.

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perimentally so that you will get optimum performance.

TV Checks Transistors. Faced with the problem of checking a new ultra-high-speed switching transistor having a very short rise time, Philco's Lansdale Tube Company Division has found a new application for the EG&G traveling wave oscilloscope and a closed-circuit TV system. Made by Edgerton, Germeshausen & Grier, Inc. of Boston, Mass., the TW oscilloscope features an inherent rise time of only 0.1 *millimicroseconds*.

The basic test setup is shown in Fig. 2. The transistor test circuits are connected to the TW oscilloscope's deflection system, and the test waveform appearing on the scope is first magnified by an optical camera arrangement, then picked up by a TV camera. Further magnification occurs when the resulting image is reproduced on the screen of a 17" television monitor.

Two separate test benches are served by a single scope and TV system. The TW scope has a push-pull deflection system. Instead of feeding both sides of the deflection circuit with signals of opposite polarity, each side is connected to a separate test circuit. Thus, while one operator checks the rise time of one transistor, the second operator can prepare the next transistor for test.

Although the two waveforms are displayed in opposite directions on the TV screen, this does not affect either the accuracy or ease in reading the waveform, and has the added advantage of eliminating any confusion as to which transistor is under test.

Product News. Transistor Electronics Corporation (3357 Republic Ave., Minneapolis 26, Minn.) is now manufacturing the smallest transistorized panel display light in the industry. Assembled in an aluminum body measuring only ½" in diameter by 1¼" long, the unit includes a self-contained transistor circuit that requires only a 3.0-volt signal to control the lamp. Designed for mounting in a ⅜" panel-hole, the component can be mounted in 30 seconds without soldering.

Lafayette Radio's latest catalog features a unique crystal unit (MS-439) which can be used either as an earphone or microphone. This unit should be of particular interest to hobbyists who want to build miniature hearing aids, amplifiers, or detectophones. This useful, imported com-

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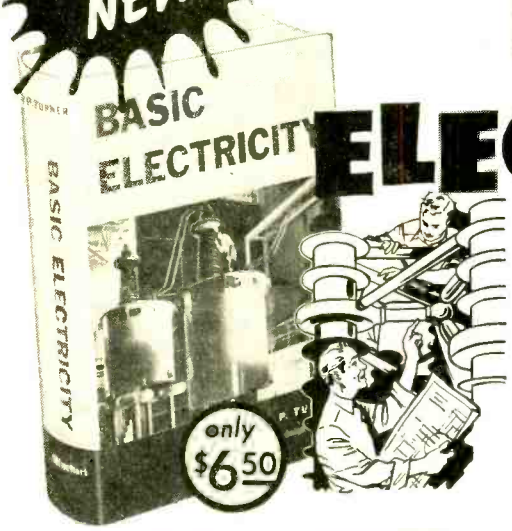

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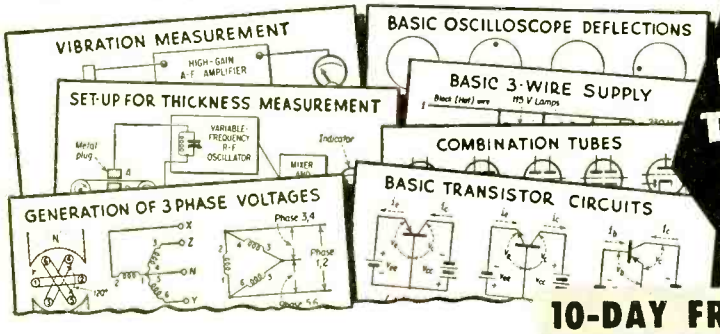

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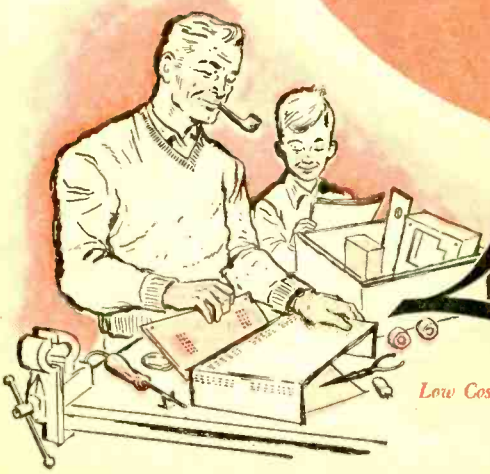

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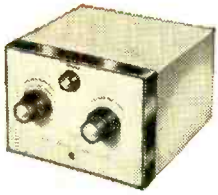

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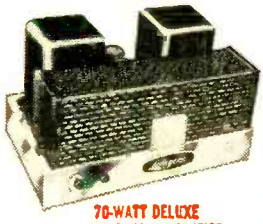

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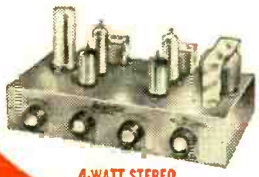

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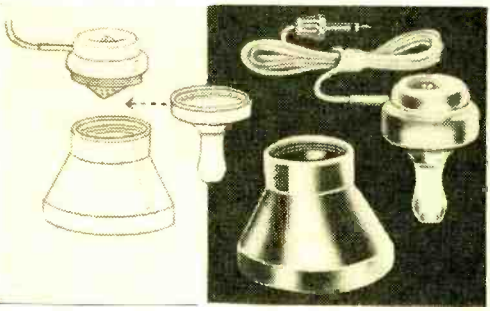
ponent sells for only $1.49 (plus postage), complete with a 5½′ flexible cord, miniature plug, molded ear insert, and microphone mouthpiece.

From England comes news that the Vickers Vanguard airliner is fitted with a fluorescent lighting system supplied by a transistor-oscillator inverter operating from the airplane's 22-28 volt d.c. power supply.

Tiny transistorized panel display light, the "Mini-Lite," made by Transistor Electronics Corporation.

High-output crystal unit, Lafayette MS-439, which can be used either as an earphone or a microphone.



The P. R. Mallory Co., Indianapolis, Ind., is now manufacturing a transistorized position-light flasher.

Clevite Transistor Products (241 Crescent St., Waltham 54, Mass.) is offering a Power Transistor Replacement Guide. This one-page table lists popular types of power transistors and suggested Clevite replacement types.

That covers the transistor front for now, fellows. See you next month . . .

Lou

VHF—AERO

(*Continued from page* 41)

ordering this booklet be sure to specify that you want an issue containing "Radio Facility Data."

Similar listings of aeronautical radio stations in Canada are found in "Air Navigation Radio Aids," issued every other month by Air Services Branch, Department of Transport, Ottawa 4, Ontario, Canada. This publication will be sent to you free of charge.

Overseas Facilities. The v.h.f. band is now quite popular overseas, and those interested in overseas aero stations will want to know about the following books which are distributed by The Secretary General, International Telecommunications Union, Geneva, Switzerland: *List of Radiolocation Stations* (beacons throughout the world); and *List of Aeronautical and Aircraft Stations* (control towers and communications stations throughout the world, and also most foreign aircraft, with names of owners). Prices of these books can be obtained from Geneva.

The CAA distributes a free weekly pamphlet called "International Notams." This contains notices to airmen of additions, deletions and changes in aero radio facilities throughout the world. To be placed on their mailing list, write to the Civil Aeronautics Administration, Washington 25, D. C.

Reception Reports. The primary purpose of all aero stations is to maintain the safety of life and property, and operators at aero stations are therefore interested in knowing how they are "getting out." As a result, QSL's are fairly easily obtained from such stations.

You may address reports of reception for control tower stations to: Air Traffic Control Chief, Control Tower, name of airport, city. Similarly, reports to ATCS stations should be addressed to: Supervisor of Communications, Air Traffic Communications Station, Civil Aeronautics Administration, name of airport (if any), city.

Airliners usually identify themselves by the company name, followed by the flight number, such as "United 505," "American 221." The only major exception is Pan American Airways, which uses the identification "Clipper" ahead of the number. Reports to airliners may be sent to: Aircraft Captain, flight number, airline name, care

of any airport where the flight makes a scheduled stop.

An invaluable aid in finding out the points flights operate between is the schedule folder all airlines give out at travel agencies, hotel lobbies and airports. Ground stations belonging to airlines can be QSL'd by addressing your report to: Supervisor of Radio Communications, name of airline, airport where station is located, city.

Be sure to include the following in your report: station contacted, frequency, time, signal strength and quality. The station you are reporting will greatly appreciate knowing the height and type of your antenna, and the type of receiver used.

It is always best to include a stamped reply card with your report to an aircraft station or control tower. Ground stations belonging to an airline have always been exceptionally good verifiers, and will almost always answer reception reports with a very nice letter.

Band of the Future. Why is the v.h.f. aero band the DX'er's band of the future? For one reason, the equipment is less expensive, less bulky than that used on the older low-and-medium-frequency aero bands. Antennas pose no problem, as they need not measure more than 20" long to give satisfactory results.

QRN (static) is non-existent, and stations are so numerous that even if you DX for several weeks you can log hundreds of stations without hearing the same one twice. Don't forget, aviation has a long way to grow before it reaches its peak. Every year sees more and more planes in the sky, and each one is a potential QSL for you. —30—

Popular Electronics Visits . . .

(*Continued from page 42*)

suring procedures, the rigid adherence to machining tolerances that are kept to within thousandths of an inch, and the general high standards of quality that are maintained vigorously. Every motor that goes into every individual turntable is completely checked and bench-tested before it is considered as an assembly unit for the turntable.

Q. Your ads say that some of your turntables have "hysteresis synchronous motors." Exactly what is meant by "hysteresis

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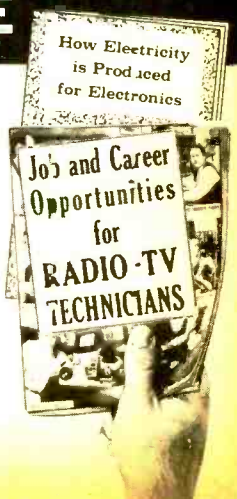

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As part of your NRI course you can get all components, tubes, including 17" picture tube, to build this latest style Television receiver; get actual practice on TV circuits

YOU BUILD Broadcasting Transmitter

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

YOU BUILD Vacuum Tube Voltmeter

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

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Be a TV-Radio-Electronic Technician

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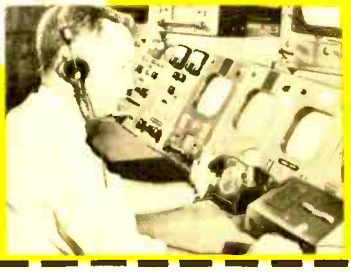

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Asstd. to 6", flat & round Hi-Q ferrite. 2 lbs. Reg. $5. **88¢**

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Built-in R/C circuits, incl. integrals. 1 lb. Reg. $7. **88¢**

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Finest porcelain. NPO's too! 1 lb. Reg. $6. **88¢**

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Mica-filled. For sub-mini tubes, too. **88¢**

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Chrome plated, drop-forged steel. Side or diagonal cutters. For fine precision work. 1 lb. Reg. $3. **88¢**

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Similar to famed B2M. 1" long. Reg. $2.50. **88¢**

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$8 value. Plastic handle, 3/16, 7/32, ¼, 5/16, 11/32, 3/8, 7/16" steel socket wrenches in plastic case. 1 lb. **88¢**

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synchronous motor," and what are its advantages and disadvantages?

A. To explain the electronic function of a hysteresis synchronous motor would require more time and involve a more detailed discussion than is possible now. Suppose we consider the result that is obtained from the use of such a motor. First, it has a much lower rumble level because of special rotor and stator design and it is manufactured to very close tolerances as far as bearings and other fittings are concerned. Secondly, the hysteresis synchronous motor is insensitive to voltage changes in the power line and maintains consistency of speed regardless of line fluctuations.

Q. Can you think of any cases where the less expensive four-pole motor would be as satisfactory as the hysteresis synchronous motor?

A. Yes. If a modestly priced amplifier is purchased, then the same quality level should be pursued in purchasing a speaker and turntable. Again, the link-of-the-chain analogy comes to mind. Operating a very fine amplifier in conjunction with a budget-priced speaker will, in effect, limit the performance to the results obtainable from that particular speaker. In other words, a fine amplifier will only sound as good as the speaker through which it is played. Our turntables are available in price ranges from $39.00 to $129.00. They have been designed and manufactured with the consumer in mind. We want to provide the purchaser with freedom of choice to select a turntable that will complement other units on any price level.

Q. Then, in a high-quality hi-fi stereo or monaural system, you would recommend a hysteresis synchronous turntable?

A. Yes, without qualification.

Q. To touch for just a minute on the old problem of a record changer vs. a turntable-tone-arm combination, do you honestly think that the forty-odd dollars that a person pays over the cost of a good record changer is really well spent when he chooses the turntable-tone-arm combination?

A. Such cost is fully justified when one considers the investment that the average consumer has made in records. With the advent of stereo, the need for carefully

48¢ ea. for any tube

$45.00 Per Hundred

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1A5GT	3AV6	5X4G	6BG6G	6SA7	7G7	12SG7	35A5
1A7GT	3BA6	5X8	6BH6	6SB7Y	7H7	12SJ7	35B5
1B3GT	3BC5	5Y3GT	6BH8	6SC7	7J7	12SK7	35C5
1CSGT	3BE6	5Y4G	6BJ6	6SF5	7K7	12SN7GT	35L6GT
1C6	3BN6	5Z3	6BK5	6SF7GSG7	7L7	12SQ7	35W4
1C7	3BU8	5Z4	6BK7	6SH7	7N7	12SR7	35Y4
1H4G	3BY6	6A8	6BL7GT	6SJ7	7Q7	12V6GT	35Z4GT
1H5GT	3BZ6	6AB4	6BN6	6SK7	7R7	12W6GT	35Z5GT
1L6	3C7	6AC7	6BQ6GT	6SL7GT	7S7	12X4	#37
1LA4	3CB6	6AF4	6BQ7	6SN7GT	7V7	12Z3	#39/44
1LA6	3CF6	6AG5	6BR8	6SQ7	7W7	14A7	#41
1LB4	3CS6	6AG7	6BS8	6SR7	7X6	14AF7	#42
1LC5	3DT6	6AH4GT	6BY5G	6T4	7X7	14B6	#43
1LC6	3Q4	6AH6	6BZ6	6T8	7Y4	14F7	#45
1LH4	3Q5GT	6AK5	6BZ7	6U4GT	7Z4	14F8	#47
1LN5	3S4	6AK6	6C4	6U5	8AW8	14H7	50A5
1N5GT	3V4	6AL5	6C5	6U8	12A8	14N7	50B5
1P5GT	4BC8	6AL7GT	6C8S	6V3	12AB5	14Q7	50C5
1Q5GT	4BQ7A	6AM8	6CB6	6V6GT	12AQ5	14S7	50C6G
1R5	4B58	6AN8	6CD6G	6W4GT	12AT6	17AX4GT	50L6GT
1S5	4BU8	6AQ5	6CF6	6W6GT	12AT7	17DQ6	50Y6
1T4	4BZ7	6AQ6	6CG7	6X4	12AU6	19AU4	50Y7
1T5GT	4CB6	6AQ7GT	6CG8	6X5GT	12AU7	19BG6G	#57
1U4	5AM8	6AR5	6CH8	6X8	12AV6	19C8	#58
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1X2	5AT8	6AU4GT	6CN7	7A6	12AZ7	25AC5	117N7GT
2A3	5AV8	6AU5GT	6CU6	7A7	1284	25AV5GT	117P7GT
2A5	5AW4	6AU6	6DG6	7A8	12BA6	25AX4GT	117Z3
2A7	5AZ4	6AU8	6DQ6	7B4	12BE6	25BK5	117Z4GT
2AF4A	5BK7	6AV5GT	6DT6	7B5	12BF6	25BQ6	117Z6GT
2B7	5BR8	6AV6	6E5	7B6	12BH7	25CD6G	807
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2D21	5BZ7	6AX4GT	6J4	7B8	12BQ6	25L6GT	9003
2E5	5CG8	6AX5GT	6J5	7C4	12BR7	25W4GT	9006
2X2A	5J6	6AZ8	6J6	7C5	12CA5	25Z5	
3A2	5T8	6BA6	6K6GT	7C6	12CU6	25Z6	
3A3	5U8	6BC5	6K7	7C7	12DQ6	#27	
3A4	5U4G	6BC8	6L6	7E6	12J5	#30	
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Thousands of TRADE-IN TVs

Please Specify Console or Table Model When Ordering

Reconditioned By Factory Trained Technicians! Guaranteed To Be In Working Condition When You Receive Them!

10"	$25.00	19"	$56.00
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below is our new price schedule of pix tubes. These famous make tubes contain all new parts with the exception of the gloss bulb which does not wear out.

Any 10" Tube	$ 9.95	Any 16" Tube	15.95
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Any 14" Tube	13.95	Any 19" Tube	20.29
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Only 48¢ ea.

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ANY TYPE

ANY QUANTITY

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machined turntables and free-moving arms is especially important. To my way of thinking, the appearance of stereo on the scene makes it more important than ever to utilize precision turntables and quality tone arms in order to realize the full range of musical material that is available on records today. Besides, with our turntable and tone-arm kits, the price difference is negligible.

Q. As with all fine equipment, I suppose turntables require periodic maintenance. Is there anything the home user can do to keep his turntable in top condition?

A. Yes, there are a few simple rules to be followed. The cardinal rule is to keep your turntable clean. Do not use it as an ash-tray or as a rotating base for a flower pot. Dust never does any piece of quality equipment any good. If cleaned as directed in the instructions and lubricated at the rare intervals that are required, a quality turntable will give many years of untroubled service. —30—

FM in Your Pocket

(*Continued from page* 36)

end of the band does not come through, spread the turns of the tuning coil *L1* slightly. Compress to obtain the low end of the band.

In order to increase sensitivity in very weak signal areas, place the receiver near any metal surface. This method of loose coupling utilizes the metal object as an antenna. —30—

HOW IT WORKS

Through the use of a superregenerative type detector, gain comparable to a full superheterodyne receiver has been obtained. The circuit utilizes two separate oscillators. The first, an r.f. ultra-audion type, is tuned by *L1* and *C1* to the incoming r.f. signal. The interelectrode capacitance of *V1* is used to provide the feedback to sustain the oscillation. A quench oscillator of the Hartley type, whose tank circuit is *L2* and *C4*, switches the grid circuit of *V1* on and off at a 30-kc. rate. Its only purpose is to interrupt the high-frequency oscillation.

An r.f. signal appearing in the tank circuit triggers the ultra-audion oscillator on before its normal period and keeps it on slightly after the quench frequency would normally kill it. The "extra" period of oscillation by the ultra-audion section results in a large plate current change. This change appears as the audio signal in the earphone. Since the incoming r.f. signal is used only as a trigger to fire the high-frequency oscillator, the over-all gain of the circuit is not dependent either on the strength of the incoming signal or the gain of the tube.

Power from the Sun

(*Continued from page* 34)

ciencies as high as 10% from regular production cells and 13% from laboratory-produced cells were developed in two years.

Solar Cell Applications. The areas where solar cells hold the most promise are those in which no other source of electricity is available. In general, solar cells will be employed in conjunction with a rechargeable storage battery to provide a continuous power source, day or night.

- Solar-powered flashlights are now under evaluation by both the Signal Corps and the Navy. These flashlights use rechargeable batteries that store up power for night use. Approximately five hours of sunshine provides enough power for one hour of continuous use at night. In addition to military applications, solar-powered flashlights would be valuable for campers, etc.
- Due to the low power drain of d.c.-powered clocks, solar cells are easily capable of keeping an electric clock operating continuously.
- A solar-powered radio is already on the market. Made by Hoffman, this radio holds solar cells in its handle. Containing four rechargeable batteries, it can be charged from sunlight or from an incandescent lamp. The charging-to-operating ratio is about one-to-one. The "Solaradio" can also operate directly from the solar cells.
- Bell Telephone Laboratories conducted successful experiments using solar batteries to power a rural carrier telephone system in Americus, Georgia. Although the solar-powered system was not economically competitive with other sources of power, the experiment was technically successful.
- The Vanguard satellite now circling the earth has six solar batteries, each containing 18 cells. These batteries supply power to the satellite's radio transmitter and should last for many years—depending on unknown factors such as meteorite bombardment, cosmic dust, etc. Unless the cells are damaged, they should outlast the radio transmitters which they power and the satellite itself.

Future Prospects. At present the limiting factor to widespread use of solar cells is their cost. Today, the cells cost about $100 for each watt they can produce. But even this figure is one-fifth of what it was

only three years ago. As the efficiency of solar cells increases and improved manufacturing techniques are devised, the price of solar cells will come down. They will then be used in many new applications.

Imagine a house shingled with solar cells! Enough electrical power could be provided to supply all household needs. And imagine great solar power plants far out in the desert providing power for entire cities! Solar power is only in its infancy, but its future seems truly limitless. —30—

After Class

(*Continued from page* 58)

the two remote ends, producing an *electric field* in the form of electric lines of force that stretch from one end of the dipole to the other (Fig. 5).

The shape of the field traced out by the electric lines of force resembles the Earth's longitudinal meridians. Since both the electric lines and the magnetic lines discussed previously are caused by the same fluctuating electron current, they must exist together at all times. Hence, an electromagnetic wave in space must *always* have two components: a magnetic component and an electric component.

The Two Components. It can be seen from Fig. 6 that the magnetic lines entering and emerging at right angles to the paper must always be perpendicular to the electric lines drawn *in* the plane of the paper. The magnetic component results from the *current* in the radiating antenna; the electric component is due to the *potentials* in the antenna. Furthermore, these two components are always at *right angles* to each other.

The current in a transmitter tank coil is generally a sine wave in form. Thus, the wave in space can be depicted as sinusoidal disturbances in the medium (Fig. 7). Since the wave has two components at right angles, two sine waves must be drawn in two perpendicular planes.

The whole "package" is the radiated wave that induces an electric potential in any conductor it happens to cut through. Two inducing actions occur simultaneously: (1) the cutting of the receiving antenna by the magnetic component, and (2) "push-pull" action of the electric component.

Polarization. Now the word "polarization" can be given real significance. A verti-

cal transmitting antenna causes a wave to be *vertically polarized* (Fig. 8), which means merely that the magnetic lines radiate outward in concentric circles which lie in *horizontal* planes, and that the electric lines move out in planes which are *perpendicular* to the surface of the earth (*vertical planes*).

This explains why a receiving antenna must be oriented in the same direction as the transmitting antenna for best reception. If the transmitting antenna is verti-

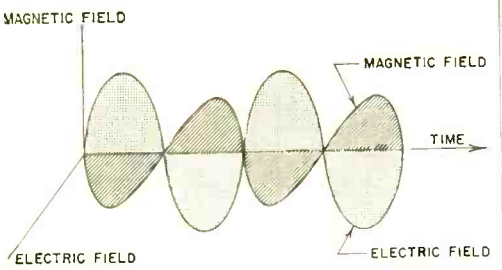
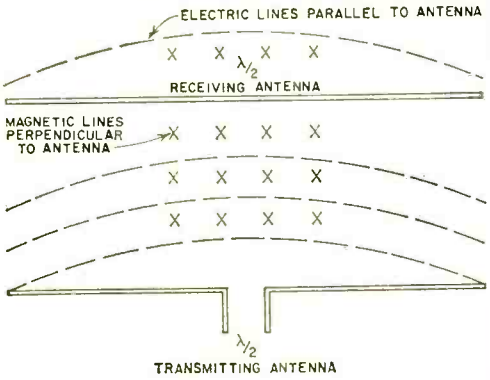


Fig. 7. An electromagnetic wave in space consists of two components lying in planes at right angles to each other.

Fig. 8. Two similarly oriented antennas are said to be properly polarized because the passing field can induce maximum e.m.f.'s for this condition.



cal, the horizontal planes of the magnetic component can cut through the vertical receiving antenna *at right angles*. This condition, as we know from elementary magnetic induction principles, causes the maximum induced e.m.f.

Similarly, for like orientations of antennas, the electric component passes the receiving dipole *parallel* to it—this time meeting the requirement for maximum electric induction. Any other orientation causes a decrease in both inductions and consequent loss in signal strength. —30—

Among the Novice Hams

(*Continued from page 86*)

waves are fed to the next stage of the transmitter or to the antenna system.

An important property of a class C amplifier is that, as its plate voltage is varied, its plate *current* will vary in step with the voltage. If the plate voltage is doubled, the plate current will double. If the plate voltage is halved, the plate current will also be halved. The power input will be quadrupled or quartered under these conditions. Furthermore, the power input and output of a class C amplifier varies as to the square of a change in its plate voltage.

Modulation. This property of class C amplifiers permits them to be plate modulated for amplitude-modulated (AM) radiophone operation by applying the modulating signal in series with the d.c. plate voltage to the amplifier. The modulating signal then effectively varies the plate voltage and hence the amplifier output.

A class C amplifier cannot be used successfully in applications where the amplifier output must be a true reproduction of the input signal. This is due to the "putt-putt" nature of its output signal and because a very large amplitude change in input signal to a class C amplifier produces a very small change in its output power.

Figure 1 is a diagram of a typical triode r.f. power amplifier feeding a Hertzian antenna. You may be required to draw a similar diagram as part of your examination for a Technician, Conditional, or General Class license. In operation, the incoming signal is fed to the grid of the tube via the tuned link-coupled input circuit. The signal is amplified in the tube and fed from its plate to the output tuned circuit. From there, the signal is inductively coupled to the antenna system.

The Faraday (electrostatic) shield between coils *L3* and *L4* eliminates capacitance coupling between them, thereby reducing the likelihood of undesired harmonic energy reaching the antenna.

Neutralization. The small capacitance between the control grid and the plate of a triode used as an r.f. amplifier couples part of the r.f. voltage on the plate back to the grid. This fed-back voltage acts on the grid exactly like an externally applied signal. Therefore, it is amplified by the tube, to appear again at the plate; from there it is once again coupled back to the grid by way

of the grid-to-plate capacitance of the tube.

Unless precautions are taken to combat this action, enough energy may be fed back from the plate to the grid circuit to cause the amplifier to *self-oscillate* and deliver output at a frequency determined by its tuned circuits without external excitation.

To prevent such oscillations, this circuit employs a balanced plate tank circuit (*L3*, *C2*). The plate of the tube is connected to one end of it, and a *neutralizing capacitor* is connected between the opposite end and the grid of the tube. The neutralizing capacitor is then adjusted until the r.f. voltage fed back through it from the plate tank circuit to the grid just cancels out that fed back from the plate to the grid through the grid-to-plate capacitance. The amplifier is then *neutralized*, and it will not self-oscillate.

Self-oscillation in an amplifier is undesirable. It can result in output on undesired frequencies, reduced efficiency, and generally erratic operation.

News and Views

Terry Rogers, WV2BFP, (15), 43 Cayuga St., Auburn, N. Y., pushes the output of his Heathkit DX-40 to a 40-meter folded dipole antenna via a set of balun coils, and he receives with a Heathkit AR-3. He has made 24 contacts in seven states in two weeks on the air. Terry believes (correctly) that many non-arriving Novice QSL cards are actually sent to a wrong or incomplete address, judging from the addresses on the cards he collects from his neighbors up and down the street. A young lady named "Terry," who received one of them, was "all shook up" by the remarks on it. . . . . **Mac Murray, KN4VNY,** 309 Waverly Way, Greensboro, N. C., thinks he lives in QRM Corner. There are seven hams, six of them Novices, within two blocks of his home, and there are at least ten new Novices in Greensboro. Mac's record is now 300 contacts in 31 states on 15 and 40 meters, as he waits for his General Class license to arrive.

Roger Ogden, VE2AYW, P.O. Box 414, Cowansville, Quebec, Canada, excites a 275' "long wire" antenna with a Heathkit AT-1 transmitter running 25 watts with the help of a Heathkit AC-1 antenna coupler. Rog receives on a Hallicrafters S-40B with an added Q-multiplier, and a "surplus" BC-224. In a year, he has made over 800 contacts in the 48 states, Russia, Roumania, Austria, Algeria, and many other foreign countries, but he still needs QSL cards from four states for his WAS.

Michael Greenspan, WV6AGO/WA6AGO, 10804 Plainview, Tujunga, Calif., made only 20 contacts in two months with his DX-40 feeding a WRL vertical antenna on 40 and 15 meters. Then he got a better receiver—a Hammarlund HQ-100. What a difference! In one week, he made over 40 contacts! Mike QSL's as close to 100% as he can and gets about 75% return. He offers help in obtaining licenses. . . . . **Joe Hester, KN5QJR,** (18), 142

HELP US OBTAIN OUR HAM LICENSES

K1/W1 CALL AREA

Steve Ewing (12), Bradley's Corner, Plaistow, N. H. (Selection of equipment)
Richard Gagnon, Parkview Dr., So. Hadley Ctr., Mass. Phone: JE 3-5695. (Code and theory)
Stephen Axelrod (13), 27 Wesley St., Newton, Mass. Phone: DE 2-4783. (Code, theory and selection of equipment)
Harvey R. Rosenfeld (13), 96 Ormond St., Mattapan 26, Mass. (General code and theory)

K2/W2 CALL AREA

Robert Kohn, 56 W. 54th St., New York, N. Y. Phone: CO 5-6297. (Code and theory)
Norm J. Krajkowski, 1127 Ferry Ave., Niagara Falls, N. Y. (Code)
Victor Farber (17), Box 70, North Brookfield, N. Y. (Code)
Jacob Godfrey, 2322 28th St., Astoria, N. Y. Phone: YE 2-0728. (Code, theory and selection of equipment)
Denis Bekaert, Box 426, Coram, N. Y. (Code, theory and selection of equipment)
Bernard Semmel, 1755 Weeks Ave., Bronx 57, N. Y. (Code, theory and regulations)
Walter Lide, 1000 Trinity Ave., Bronx 56, N. Y. (Code and theory)
Kalman Rothman, 41 Hutton Ave., Nanuet, N. Y. (Code and theory)
Joe Keller (14), 4 Assembly Pl., Huntington Station, N. Y. (Code and theory)

K3/W3 CALL AREA

Harris Chaess, 1414 E. Duval St., Philadelphia 38, Pa. Phone: WA 4-7107. (Code, theory and selection of equipment)
Thomas H. Beckerleg, Jr., R. D. #2, Mt. Pleasant, Pa. (Code, theory and regulations)
Joe Sparacino, 5603 Chillum Place, N. E., Washington 11, D. C. Phone: LA 9-1896. (Code and theory)
Vernon Leeper (15), R. D. #3, Mt. Pleasant, Pa. Phone: SC 2-065J. (Theory)
Avery Comarow (13), 1715 Mayhew Dr., Silver Spring, Md. (Code and theory)
Ken A. Clagett (15), 1811 Tilton Dr., Silver Spring, Md. Phone: JU 8-1939. (Code and theory)

K4/W4 CALL AREA

Cleason Stricklin, R. #1, Logan, Ala. (Code and theory)
A/1C Richard M. Lukacs, 306 F.M.S., Box 340, MacDill A.F.B., Fla. (Code and theory)
Tony Prevette (17), R. #1, Box 126, Union Grove, N. C. Phone: LY 2-2127. (Code, theory and regulations)
Tony Loffredo, 3044-A Fort Campbell, Ky. Phone: 4167. (Code and theory)
John Gonzalez, 418 W. Maple St., Johnson City, Tenn. (Code)
Paul Howell, 2610 15th Ave., Haleyville, Ala. (Code and theory)
Ronnie Maples, Route #2, Box 436, Morganton, N. C. Phone: HE 7-1956. (Code and theory)

K5/W5 CALL AREA

Gene McGahey, P. O. Box 206, Isola, Miss. (Code, theory and regulations)
Herschel E. Dwellingham, 1620 North Ave., Bogalousa, La. Phone: RE 5-1119. (Code, theory, regulations and selection of equipment)
John Cochran, 1800 Carl St., Fort Worth 3, Tex. Phone: JE 6-1253. (Code and theory)
Ivey Ray Cole (14), Rt. 1, Brookesmith, Tex. Phone: DU 2-3230. (General code and theory)
J. D. Sanford, 1750 Vogel Ave., Abilene, Tex. (Code)

K6/W6 CALL AREA

Michael Callaghan (14), 639 Rosemont Ave., Pasadena, Calif. Phone: SY 3-1811. (Code, theory and selection of equipment)
Frederick R. Washburn, 10645 Stanton Ave., Stanton, Calif. (Code)
Wayne Erickson (14), Army and Navy Academy, Carlsbad, Calif. (Code, theory and regulations)

K7/W7 CALL AREA

Bill Petredis, Rt. 2, Box 5375B, Issaquah, Wash. Phone: EX 2-3223. (Code, theory and selection of equipment)
Jim Hadlock, 15305 S. E. 42nd, Bellevue, Wash. (Code and theory)

K8/W8 CALL AREA

Tom Welch, Jr. (14), 900 Puritan, Birmingham, Mich. Phone: MI 6-5306. (Code, theory and selection of equipment)
Larry King, 3391 Jewell Rd., Howell, Mich. (Code and selection of equipment)
Eugene H. McAlister (14). 1916 Chaucer Dr., Cincinnati 37, Ohio. Phone: VA 1-7853. (Code and theory)
Robert A. Buck, 2363 West 14th St., Cleveland 13, Ohio. (Code, theory and selection of equipment)
Hal T. Weeter, Jr., 210 Front St., New Matamoras, Ohio. (Code and theory)
Jerry David, 4819 Mayfair Rd., North Canton 20, Ohio. Phone: TY 6-2732. (General code and theory)

K9/W9 CALL AREA

Ronnie Beddingfield, 241 West Hardin, Virginia, Ill. (Code and selection of equipment)
Ted Dragotta, 15105 West Froedtert Dr., Elmgrove, Wis. Phone: SU 2-7920. (Code and theory)
Dick Powell (14), 1936 So. Sunnyside, Westchester, Ill. (Code and theory)
Larry Gordon, R. R. #1, Marion, Ind. (Code)
John Lorentz (15), 8814 W. Coldspring Rd., Milwaukee 19, Wis. Phone: LI 1-5618. (Code and theory)
Steve Amrein, 339 Elm St., Batavia, Ill. (Code, theory and selection of equipment)
Jim Johnson, 1108 Grand Ave., Superior, Wis. (Code, regulations and selection of equipment)

KO/WO CALL AREA

Larry Minor, 410 S. Main St., Canton, S. D. (Code)
A. L. Shugar, RFD #3, Fort Dodge, Iowa. (Code, theory and selection of equipment)
Pete Cullum, 173 W. Randolph St., Marengo, Iowa. Phone: 2-0132. (Code and theory)
Louis Derby, Box 108, Kit Carson, Colo. (Code, theory and selection of equipment)
Jay D. Brown, 908 N. Greenwood, Eureka, Kansas. (Code, theory and selection of equipment)
Kenneth Hirst, Noel, Mo. Phone: GR 5-3242. (Code and theory)
Jay Joslin (14), Kit Carson, Colo. (Code, theory and selection of equipment)

VE AND OTHERS

Clyde Barrett, 442 Robie St., Halifax, N. S., Canada. (Code)
Dominique Lamoureux, 6 Rue Duquette, Ste. Therese de Blainville, Co. Terrebonne, P. Q., Canada. (Code and theory)
Winston Barnes, 1730 Woodland Ave., Montreal 20, Quebec, Canada. (Code and theory)
Jack Summerfield (26), 44 McKeough Ave., Chatham, Ont., Canada. (Code and selection of equipment)
Chall Lundgren, 10159 94A St., Edmonton, Alta., Canada. (Code, regulations and selection of equipment)
Neil F. D. Martin, 76 Church St., Weston, Toronto 15, Ont., Canada. Phone: CH 1-7864. (Code, theory, regulations and selection of equipment)
J. Barry, 22 Kendall Ave., Toronto 4, Ont., Canada. (Selection of equipment)
Alexander Nicholson, Box 340, Sturgis, Sask., Canada. (Code and theory)

Blossom Drive, San Antonio, Texas, runs nine or ten watts to a modified "Sandwich Box Transmitter" (POPʼtronics, March, 1956) on the 40-meter Novice band. In 3½ months on the air, he has made 225 contacts in 32 states and Hawaii. The secret of Joe's success is that he does most of his operating between 0100 and 0530 a.m., when interference is not too bad. He receives on a Hallicrafters S-40A, and he has a dipole 22′ high and a folded dipole 15′ high.

Jeff Walur, KN6RYF, (14), Galeta, Calif., took a 10-watt transmitter and his BC-348 receiver on a vacation into the Sierra Mountains. He put up doublets between trees for 80 and 40 meters about 40′ high and made over 200 contacts in 22 states, doing his best work around midnight. . . . . **C. S. "Steve" Meyer, KNØMZV,** P.O. Box 302, Sargent, Nebr., is a patient fellow. In his first three months on the air, he didn't make a single contact. Then he got a new DX-40 to replace his old 25-watter and made *one* contact. Next, six months after receiving his license, he obtained a Hammarlund HQ-110 receiver and worked 11 states in three days! And in less than a month, he had 22 states worked. Oh yes, his antenna is a 100′ "long wire," and he is open for skeds on 40 or 15 meters, the latter preferred.

Carlos G. Wilson, Jr., KN4ZKZ, 408 Greenfield Rd., Memphis 17, Tenn., got off to a little faster start. In just over a month on the air, he has worked 12 countries and 19 states, using a DX-40 transmitter, an HQ-110 receiver, and a two-element "catfish" beam. . . . . **Jeff Mack, KN9OMK,** 7312 W. Greenleaf, Chicago 31, Ill., (14), uses a Heathkit DX-40 transmitter and a Knight-Kit receiver. His antenna is a 40-meter folded dipole. Jeff's record is 100 contacts in 18 states, Alaska, Poland, and Puerto Rico on 40 and 15 meters. . . . . **Jim Foote, KN8KSN,** (18), Box 422, 356 East Main, Gnadenhutten, Ohio, hasn't worked many states—only nine confirmed—but he has a barrel of fun on the air every evening. Jim uses a National NC-100 receiver and an old Eldico TR-75 transmitter, for which he has only 80-meter coils that work. His antenna is an end-fed "long wire."

If you need a Delaware contact, and who doesn't, look for **Clay Spurrier, KN3CNH,** Dukes St., Selbyville, Del. He agitates the ionosphere with a Heathkit DX-20 running 50 watts and feeding a 40-meter folded dipole antenna. He receives with an S-40B with a Heathkit QF-1 Q-Multiplier added to it. His record is 15 states worked, 10 confirmed, in three months. . . . . **Ted Downing, KN5OPC,** Route 7, Tulsa, Okla., has been on the air a month and has made 126 contacts in 31 states, using a DX-20, a "Windom" antenna, and a National NC-125 receiver. In addition, he has passed his "General" exam and is putting up a 10-, 15-, and 20-meter tri-band beam. . . . . **Mike Lesniak, WV6BPE,** 368 Marlow Drive, Oakland 5, Calif., has made 185 contacts in 32 states with his WRL Globe-Chief 90A transmitter feeding 40- and 15-meter dipoles in six weeks on the air. He receives with a Hallicrafters S-38E.

Don't forget; we want to hear *your* News and Views. 73,

Herb, W9EGQ

Phono Motor Powers Amplifier

(*Continued from page* 38)

ing an additional small hole in the fiber winding support.

Coupling the amplifier power supply by transformer action to the phono motor provides the "on-off" switch. Should battery operation be more desirable, the switch in the record player is a common s.p.s.t. slide type that can be replaced by a double-pole type. The extra pole can then be used to switch the battery.

Components of the amplifier are wired to a standard eight-terminal tie-lug strip. The interstage transformer (*T1*) is simply taped to the chassis with a piece of masking tape. Keep it away from the motor coil.

There is ample room to mount a 2½" speaker in an average player. However, a separate plastic box is attractive and may be placed under a pillow. Further, the plastic box holds both the speaker and matching output transformer and can be easily disconnected for use with other devices.

The amplifier circuit proper is simple and typical of many published previously. Values of *R1* and *R2* are nominal and should be varied between 200,000 and 250,000 ohms to provide maximum gain from the particular transformer used and to fix the audio output to a suitable level for a child's room. —30—

Electronics in Steel Industry

(*Continued from page* 80)

mile-long plants, the steel industry is naturally leery about anything new. When the industry is operating at full capacity (nearly 150,000,000 tons of steel a year), even a one-day breakdown in a mill can cost hundreds of thousands of dollars. At the same time, even a tiny increase in efficiency can mean hundreds of thousands saved. For a comparative drop-in-the-bucket investment in electronics, the steel industry can gain much more than *tiny* increases in efficiency.

When the entire steel industry realizes this, it will jump into electronics with both feet. But because of its great size and age-

old customs, the steel industry just can't move very fast. As one experienced engineer puts it: "The only way to sell a new idea to a steel man is to convince him that it was his idea in the first place." —30—

Index Your Records

(*Continued from page* 84)

aside a page for each composer and head it with his name. Then list each musical piece as you obtain it. Should you acquire a whole raft of works by one composer, simply keep adding pages, with his name heading each one. You will appreciate the flexibility of the loose-leaf notebook.

Here's an example of how this works. I have four pieces by Aaron Copland, three on 12" LP's and one on a 7" tape. So my page for Copland looks like this:

COPLAND, AARON

Rodeo	*L-14*
Appalachian Spring	*L-17*
Music for the Theatre	*L-18*
Billy the Kid	*TL-5*

It is usually convenient to index musical personalities by their names. For instance, my four Danny Kaye albums are listed on a page headed by his name. Show albums can be grouped together or they can be listed under the names of the composers. Home recordings can be similarly indexed. A limited number of recordings can be indexed under "Home Recordings," a larger number under the names of the subjects.

If you want to go to the trouble, you might do a bit of cross-indexing. For example, I have a number of folk music records. So I have one page headed "Folk Song Artists," listing only the names of the artists. To look up specific discs, I check under the name headings of the different artists.

You probably won't find such cross-indexing necessary until you've accumulated a substantial collection under any given category and your collection becomes so large that you sometimes forget the names of some of the artists represented.

The beauty of this indexing system is the ease with which it can be maintained. It may take a little work to get it started, but it's no trouble at all once it's launched. Simply make a new entry every time you add a recording, and you'll always be able to find whatever you want, whenever you want it. —30—

Short-Wave Report

(*Continued from page* 85)

(matched to the times for each item), and logging scale or bandspread dial reading. Other data that can be included are: direction or beam of transmission, the languages used, and signal strength and readability readings. Some DX'ers also show dispatch and return dates for verification reports.

Some logs are kept by frequency in kilocycles, megacycles, or even meters. Other logs may show the location first, while a few DX'ers prefer to keep their logs by specified time periods.

It is a good idea to keep a logging scale or bandspread dial reading (provided that your receiver is so equipped) so that you can find the same station again at a later time or date.

Let your Short-Wave Editor know your preferred method for logging. We may discuss logs again from time to time, and the form that you use may be of interest to others.

Current Station Reports

Several of our reporters have asked us to compile a list of the harder-to-hear stations, so we are listing a number of stations this month that are rarely heard and reported. While many of these items were heard in the Mid-East, there have also been many times when these same stations have been noted in the USA. Try your skill at logging the following stations. All times are EST, and the 24-hour system is used.

Angola—*Radio Clube de Congo Portugues* has been found on 6135 kc. from 1300 to past 1530. Jamming takes over at 1530 when *Radio Gerianin* s/on on 6132 kc. Portuguese news is broadcast at 1330-1345 (Saturdays to 1400) and at 1435-1440. The location was reported to be Carmona; not verified. (*MEC*)

R. Angola, CR6RC, Luanda, has moved from 11,862 kc. to 17,790 kc. and is noted at 1720 with news and closing at 1730. (*420*)

Argentina—LRA, Buenos Aires, is scheduled as follows: to Europe on 15,345 kc. at 1400-2000 (Spanish to 1500, German to 1600, Italian to 1700, French to 1800, Eng. to 1900, Portuguese to 2000); to Eastern USA over 9690 kc. at 2100-2200 in Spanish and 2200-2300 in English; to Western USA at 2302-0000 in Spanish and 0002-0100 in English. (*477*)

Australia—VLW6, Perth, 6130 kc., has Eng. news at 0600; songs and piano music. (*226*)

Belgian Congo—*R. Congo Belge*, Leopoldville, is scheduled for Europeans and Africans at 0000-0130 (Sundays to 0200) on 9380 and 4760 kc.; daily at 0515-0730 on 11,720 kc., at 1030-1600 (Saturdays to 1700) on 9380 and 6295 kc.; and Sundays at 1000 on 4760 kc. There is French news at 0100, 0530, 0630, 1345, and 1550; news in Flemish at 0108, 0540, 0640,

1500, and 1554. The 6295-kc. outlet is rated at 250 watts. (*MEC, 44*)

R. Congo Belge, Elisabethville, has apparently moved from 6030 to 5940 kc. and is heard from 1115 to closing at 1410. French news is at 1345. *R. Congo Belge*, Stanleyville, is on the air on 6079 kc. daily at 1030-1400 with 3 kw. Languages: Swahili(Mondays and Thursdays), Zande (Tuesdays), Lingala (Wednesdays and Fridays), French (Saturdays and Sundays). Local news in French is at 1300-1305 on Mondays, Wednesdays, Thursdays and Saturdays and there is French news from the Leopoldville station which is heard at 1345-1400 daily. (*MEC*)

Bolivia—*R. Cruz del Sur,* CP38, La Paz, 9444 kc., has Eng. daily at 1645 and on Thursdays at 1830. (*486*)

Brazil—PRC21, *R. Gaucha,* Porto Alegre, 6135 kc., can be heard around 1840 with popular music. (*420*)

Burma—Rangoon has Eng. at 0200-0230 with news, talks, and American and Asian recorded music. This one, usually weak, is on 21,725 kc. and requires careful tuning. Other channels also in use, but not heard as yet, are 21,575 and 21,420 kc. Reports are wanted, but do not depend on a verification. (*61*)

Cape Verde Islands—*R. Clube de Cabo Verde,* Praia, is noted weakly on 3955 kc. from 1515 to 1700 s/off with "A Portuguesa." Portuguese news is aired at 1630-1650. The IS is a six-note chime. (*MEC*)

Ceylon—What seemingly is *R. Ceylon's* Native Service is observed on a new channel, 15,173 kc., at 2110-2130. Further checks are needed to determine if this is a permanent switch from 15,120 kc. (*420*)

Dahomey—*R. Cotonou,* still on 4900 kc., has been noted closing at 1535. (*MEC*)

Denmark—OZF, *R. Denmark,* Copenhagen, uses 9570 kc. in place of 9520 kc. at times to avoid QRM on the N.A. xmsn. (*44*)

Ecuador—HCHP5 (or HC5HP), *Ondas Ecuatorianas,* Riobamba, 250 watts, is heard on 4960 kc. at 2205-2232 with Latin music and Spanish anmts. The ID at 2229 is followed by commercials. (*396A*)

An Ecuadorian outlet, as yet unidentified, has been noted several times on 8899 kc. around 2115, all-Spanish. (*420*)

El Salvador—YSS, *R. Nacional de El Salvador,* San Salvador, 9553 kc., is noted at 2235-2355 with non-stop piano music. (7)

YSAX, *La Voz Panamericana,* San Salvador, 11,950 kc., is noted daily from 0715 with music and anmts in Spanish. This channel is usually clear. (*385*)

Ethiopia—Contrary to some reports, *R. Addis Ababa* continues to use 9608 kc., parallel to 6184 and 7294 kc., in Amharic to 1300. At that time the latter two channels close and the 9608-kc. outlet continues with Arabic and English. News in Amharic is at 1200-1220. There is also a Somali xmsn at 1100-1130 with news from 1115 on the three channels although 7294 kc. is then covered by *Springbok Radio,* South Africa. (*61A, MEC*)

France—Paris is noted on a new channel of 15,190 kc. at 1600 in French. Another xmsn runs on 17,785 kc. at 0932-1001, tuning with records and anmts in French. There may be

a French newscast at 0935-0945. (*23, 396*)

Germany—*Deutsche Welle,* Cologne, noted on 11,815 kc., is heard in German at 1450; ID at 1500, then choir music. Who knows the direction of this beam? (*384*)

Haiti—4VEH, *Evangelistic Voice of the West Indies,* Cap Haitien, has moved to 9770 kc. and is heard at 0630-0700 and from 0730 in Eng.; the 0700-0730 period is in Spanish. Also heard from 1830 in French and from 2030 in Eng., this replaces 9603 and 9635 kc. for the winter. Dual channels are 6100 and 11,850 kc. (*44, 59, 420*)

India—*All India Radio,* presumably Delhi, transmits on 4990 kc., an unlisted channel, to daily s/off at 1200. This channel does *not* parallel 4960 kc. (*MEC*)

Indonesia—A *Radio Republik Indonesia* regional xmtr, identifying only as *RRI*, is audible on 4840 kc. at 0915-1030. Indonesian network news is broadcast at 0930-0945. This may be the Djakarta outlet formerly on 4810 kc., which is no longer heard. Another *RRI* outlet, suspected to be in Menado, becomes audible on 5992 kc. around 0845 and closes some time after 1100. QRM from Madrid becomes strong after 1100. Network news in Indonesian is carried at 0930. (*MEC*)

Iran—An Iranian Air Force station in Teheran was recently noted on 11,290 kc. from 0745 to 1030 s/off with music interspersed with telephone conversations. This may be on Fridays only. Ahwaz was also noted on 7085 kc. from 1010 to 1025 s/off. (*MEC*)

Iraq—Baghdad, 6188 and 3297 kc., carries Kurdish programs at 0900-1200 daily. The 6188-kc. channel does not carry Russian at any time, despite some reports. English is presented at 1200-1300 on this channel. (*MEC*)

Jordan—The Hashemite Broadcasting Service at Amman should have new xmtrs on the air by the time you read this item. The schedule is for 2300-1700 daily on frequencies in the 25-, 31-, 41-, and 49-meter bands, but exact frequencies are not known at yet. The 31-meter outlet will be 100 kw., the 25-meter station 7500 watts, and the other two 5-kw. power. (*61A*)

Liberia—ELWA, Monrovia, is noted at 0033-0047 on 11,938 kc. with Eng. religious programs. (*396*)

Macao—An unidentified station, heard from 0005 to 0100 s/off on 17,785 kc., all Portuguese, may be Macao's *R. Vila Verde.* The ID has four descending chimes similar to that used by Mozambique, and many commercials. This bears further checks. (*7*)

Madagascar—*R. Tananariva's* French service has appeared on 5015 kc., apparently replacing 3232 kc. which is no longer heard; may vary as low as 5010 kc. French news is at 1300-1310 and station closes at 1430 with "La Marseillaise" and an IS consisting of a few bars of an African melody played three times. (*MEC*)

Malaya—BBC Far Eastern Station, Singapore, 11,995 kc., is heard at 1120-1134 with Eng. commentary and is relayed from the BBC, London. (*396A*)

Mauretania (French West Africa)—A station believed to be in Atar opens on 4950 kc. daily at 1600 with IS and French anthem.

News, commentaries, and French talks are carried at 1605-1645 and some Arabic music and speech is noted after 1645. (*MEC*)

Mozambique—*R. Zambezia*, the vernacular-language outlet of *R. Clube de Mozambique*, broadcasts at 0200-0400 and 1100-1400 on Sundays only, on 3405 and 7211 kc. (the latter may be at 0200-0400 only). (*MEC*)

New Zealand—The current schedule from Wellington reads as follows: to the Pacific Islands at 1200-1345 on 11,830 kc., 1400-0045 on 15,280 kc., and 0100-0345 on 6080 and 9540 kc.; to Australia at 1500-1730 on 11,780 kc., 1745-0045 on 15,220 kc., and 0400-0645 on 9540 and 11,780 kc. Call signs: ZL7, 6080 kc.; ZL2, 9540 kc.; ZL3, 11,780 kc.; ZL4, 15,280 kc.; and ZL10 (?), 15,220 kc. (*61A*)

Nicaragua—A station, believed to have the call YNMM, Managua, has been tuned on 7800 kc. (approx.) with s/off at 2300-2305. Further checks are needed to determine whether this is a new channel or a harmonic from the medium-wave band. (*54*)

Norfolk Island—If you want to log this Island, try for the Utility station, ZVNF, on 11,290 kc. This 300-watt station transmits weather information to Australia at 0150 and is fairly consistent. ID is given as *This is Norfolk* or merely *Norfolk*. A report was quickly answered by veri-letter and signed by P. R. Hoare. The address: Dep't. of Civil Aviation, Norfolk Island. (*286*)

North Vietnam—*The Voice of Vietnam*, Hanoi, is now on 4735 kc., dual to 9900 kc. and ends English at 1045. (*MEC*)

Peru—*R. Loreto*, Iquitos, 9588 kc., is heard in Spanish at 1930-2015 with religious programs (to 1945) and Latin-American records (to 2000). The ID is for *R. Loreto* and features the "Woody Woodpecker" call. (*61A*)

OAX4K, *R. Central*, Lima, 9541 kc., is heard from 2315 to 0000 s/off with L.A. records and many commercials. OAX1A, *R. Delcar*, 6700 kc., is good at times and has been noted from 2250 to 0003 s/off with L.A. records and commercials. (*7*)

Portuguese India—Goa is now down to 4795 kc. where it is heard closing daily at 1230 with "A Portuguesa." (*MEC*)

Sao Tome—*R. Clube de Sao Tome* is still using 4808 kc., where it is faintly audible at closing around 1600 daily. (*MEC*)

Sierra Leone—Freetown operates on 3316 kc. at 0145-0300 and 1145-1700 weekdays, and at 1145-1700 Sundays. It is heard in Western areas at 0215-0300 with news, weather, talks,

SHORT-WAVE ABBREVIATIONS

annt—Announcement
BBC—British Broadcasting Corporation
Eng.—English
ID—Identification
IS—Interval signal
kc.—Kilocycles
kw.—Kilowatts
L.A.—Latin America(n)
N.A.—North America(n)
QRM—Station interference
R.—Radio
s/on—Sign-on
s/off—Sign-off
xmsn—Transmission from station
xmtr—Transmitter used by station

light and semi-classical music, and Eng. anmts. The power is 5 kw. (to be increased to 10 kw.) and new frequencies are planned. Due to the limited staff, the station does not normally reply to foreign listeners. (*61, MEC*)

Somaliland Protectorate—*R. Somali*, Hargeisa, has dropped 7126 kc. and now operates on 9666 kc. (dual to 4765 kc.) from as early as 0930 to 1118 s/off. English is carried at 1015-1118 daily. (*MEC*)

South Vietnam—Saigon varies from 6012 to 6020 kc. and is noted at 0330-0400 with English and recorded music. (*61A*)

Sudan—*R. Omdurman*, Khartoum, has moved from 5008 to 5038 kc. and carries Home Service in Arabic at 2330-0030. A reported Eng. period at 1100-1130 has not been heard as yet. (*61, MEC*)

SHORT-WAVE CONTRIBUTORS

William Flynn *(7)*, Pittsburg, Calif.
Peter Risse *(23)*, Atlanta, Ga.
Anson Boice *(41)*, New Britain, Conn.
Jim Cumbie *(54)*, Sherman, Texas
Grady Ferguson *(59)*, Charlotte, N. C.
John Beaver *(61)*, Canon City, Colo.
John Beaver *(61A)*, via *DXplorers Radio Association*
William Bing *(226)*, New Orleans, La.
Maurice Ashby *(286)*, Wichita, Kansas
Riley Sundstrom *(384)*, Stockton, N. J.
Max Ovodock, Jr. *(385)*, Philadelphia, Pa.
Bob Palmer *(396)*, Spokane, Wash.
Bob Palmer *(396A)*, Loon Lake, Wash.
Bill Kahn *(418)*, Berkeley, Calif.
A. R. Niblack *(420)*, Vincennes, Ind.
Jerry Berg *(477)*, West Hartford, Conn.
Alex Parker *(486)*, Raleigh, N. C.
A Middle East Correspondent *(MEC)*

We are grateful to the many contributors who report regularly to this column and particularly to the above SWL's for the assistance that they have given in the preparation of this month's listing of the more difficult stations.

Thailand—A Thai station thought to be the Territorial Defense Station, Bangkok, is audible on 4840 kc. from 0945 to close at 1025 daily. This is not to be confused with the Thai National B/C Station on 4830 kc. (*MEC*)

Tunisia—A letter from *R. Tunis* states that they will have 50-kw. xmtrs in operation in early 1959. Languages to be used include Eng., Arabic, French and Italian, with programs beamed to North Africa and the Middle East. Exact frequencies are not known but they will be in the 16-, 25-, 49-meter bands. (*477*)

USSR—Khabarovsk, 7210 kc., was tuned in Russian at 0300-0315 with talks; opera music to 0330; ID; classical music to 0355. Russian anmts, ID and IS were heard to 0400 when time was given as six time pips. Light music followed to 0420. This was in parallel to the 9377-kc. outlet and replaces formerly used 9502 kc. The 4995-kc. transmission for Khabarovsk was noted at 0400-0500. (*61, 418*)

Venezuela—YVOM, formerly on 9570 kc., is now on 9578 kc. and is noted around 2000 but with interference from *R. Canada*. YVMO, *Radiodifusora Occidental*, Barquisimeto, 4940 kc., is tuned at 2240-2250 with L.A. music and Spanish anmts. (*396A, 420*)

Windward Islands—Grenada has been testing on 11.978 kc. at 2140, and on 15,075 kc. at 1615. (*420*) —30—

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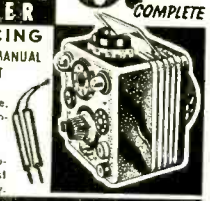

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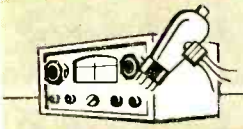

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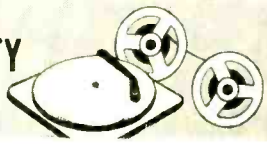

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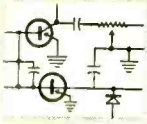
INSTRUCTION



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YOUR classified message placed right here will attract the attention of more than 265,000 purchasers. You'll get fast results. For full details, write to Martin Lincoln, Popular Electronics, One Park Avenue, New York 16, N. Y.

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A HANDY REFERENCE TO PRODUCTS AND SERVICES NOT NECESSARILY ELECTRONIC, BUT OF WIDE GENERAL INTEREST.

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RCA RADIATION COUNTER

MADE TO SELL FOR $160 – OFFERED FOR ONLY $47.50 NET

(Much less than cost of Manufacture.)

INDICATES RADIOACTIVITY IN 3 WAYS!

1–BY NEON
2–BY PHONE
3–BY METER

RADIOACTIVE SPECIMEN

- Employs the extra sensitive 6306 Bismuth Type Geiger Counter tube. Sensitivity is .015 Roentgens per hour (1 MR/HR = 6600 counts per minute).
- Three counting ranges: 0-200/2,000/20,000 counts per minute.
- Handy reset button.
- Ideal for survey work because the complete unit weighs only 5½ lbs.
- Sight and sound indications by neon flashes and headphone. Then when an indication is obtained you switch to meter reading for exact measurements.
- Decontamination easy with damp cloth applied to the weather-proofed aluminum case.
- A radioactive specimen is included for instrument checking and experiments.
- Included at no extra charge — U.S. Atomic Energy Commission booklet titled "Prospecting with a Counter."

Endless experiments and discoveries in the new exciting field of nuclear energy are made possible when you acquire this finely built and engineered device. In the past, a rugged counter which was suitable for the prospecting of radio-active ores such as uranium, thorium and radium, was unsuitable for laboratory work due to the inability of combining accuracy with ruggedness. Conversely, a laboratory counter, while being extremely sensitive, could not withstand use in the field where it would be subjected to abuse and abnormally hard knocks.

The Model WF-11AWB combines the laboratory and field counter in one rugged instrument. The use of phones and a visible lamp permits the operator greater freedom of operation as he no longer has to keep his eyes on a relatively small indicator.

In the laboratory where determinations of intensity (counts) of a reading are necessary, the WF-11AWB provides sensitivity far surpassing many laboratory counters.

SPECIFICATIONS

Three counting ranges are available:

0-200 counts per minute—used in cosmic ray and extremely low activity determinations.

0-2,000 counts per minute—used for average activity and normal work.

0-20,000 counts per minute — used for tracer and high activity determinations.

High accuracy is assured by the handy *reset button*, located on the front panel, which permits compensation for variations of battery voltages and background count.

A rugged weather-proof aluminum case houses this light economical unit. The batteries will provide over 200 hours of intermittent operation from the two 67½ volt batteries and 50 hours from the three flash light batteries.

Comes with complete set of batteries, carrying strap, headphone, radioactive specimen and A.E.C. booklet. Only ..... **$47.50 NET**

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SEE FOLLOWING PAGE FOR COMPLETE DETAILS

MOSS ELECTRONIC, INC. DEPT. D-540 3849 TENTH AVENUE, NEW YORK 34, N.Y.

PRINTED IN U.S.A.

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before you buy! ***then*** if satisfactory pay in easy, interest free, monthly payments. See coupon below.

Superior's New Model 82

A truly do-it-yourself type TUBE TESTER

TEST ANY TUBE IN 10 SECONDS FLAT!

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

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

Model 82—Tube Tester
Total Price $36.50
Terms: $6.50 after 10 day trial, then $6.00 per month for 5 months.

FEATURES:

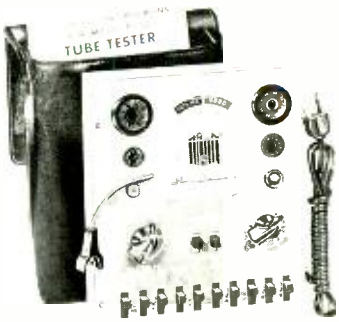
• Tests over 600 tube types. • Tests OZ4 and other gas-filled tubes. • Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings. • Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence. • Dual Scale meter permits testing of low current tubes. • 7 and 9 pin straighteners mounted on panel. • All sections of multi-element tubes tested simultaneously. • Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms.

Production of this Model was delayed a full year pending careful study by Superior's engineering staff of this new method of testing tubes. Don't let the low price mislead you! We claim Model 82 will outperform similar looking units which sell for much more—and as proof, we offer to ship it on our examine before you buy policy.

Model 82 comes complete, housed in portable, hand-rubbed oak cabinet with removable cover. Only **$36.50 Net**

Superior's New Model TD-55
STANDARD TYPE

TUBE TESTER



Model TD-55 — Tube Tester
Total Price $26.95
Terms: $6.95 after 10 day trial, then $5.00 per month for 4 months.

Speedy, yet efficient operation is accomplished by: 1. Simplification of all switching and controls. 2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

You can't insert a tube in wrong socket
It is impossible to insert the tube in the wrong socket when using the new Model TD-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

"Free-point" element switching system
The Model TD-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum.

Checks for shorts and leakages between all elements
The Model TD-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals.

Elemental switches are numbered in strict accordance with R.M.A. Specifications.
The 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

Complete with carrying case **$26.95 Net**

We invite you to try before you buy any of the models described on this page, the preceding page and the following pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

SEE OTHER SIDE

CUT OUT AND MAIL TODAY!

MOSS ELECTRONIC, INC.
Dept. D-540 3849 Tenth Ave., New York 34, N. Y.

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

- ☐ **RCA RADIATION COUNTER** Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ **Model 82** ..... Total Price $36.50 $6.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model TD-55** ..Total Price $26.95 $6.95 within 10 days. Balance $5.00 monthly for 4 months.
- ☐ **Model 76** ..... Total Price $26.95 $6.95 within 10 days. Balance $5.00 monthly for 4 months.
- ☐ **Model 77** ..... Total Price $42.50 $12.50 within 10 days. Balance $6.00 monthly for 5 months.

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All prices net, F.O.B., N. Y. C.

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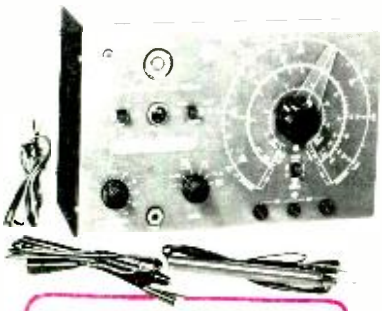

Model 76—All Purpose Bridge
Total Price $26.95
Terms: $6.95 after 10 day trial, then $5.00 per month for 4 months.

Superior's New Model 76

ALL PURPOSE BRIDGE

IT'S A **CONDENSER BRIDGE**
IT'S A **RESISTANCE BRIDGE**

CAPACITY BRIDGE SECTION

4 Ranges: .00001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad, .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. Will also measure the power factor of all condensers from .1 to 1000 Microfarads.

RESISTANCE BRIDGE SECTION

2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms.

SIGNAL TRACER SECTION

With the use of the R.F. and A.F. Probes included with the Model 76, you can

IT'S A **SIGNAL TRACER**
IT'S A **TV ANTENNA TESTER**

make stage gain measurements, locate signal lass in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc.

TV ANTENNA TESTER SECTION

Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? Locates a break in any TV antenna and measures the location of the break in feet from the set terminals.

Complete with R.F. and A.F. probes and test leads **$26.95 Net**

Model 77—Vacuum Tube Voltmeter
Total Price $42.50
Terms: $12.50 after 10 day trial, then $6.00 per month for 5 months.

Superior's New Model 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER

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

• 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 Net

TRY FOR 10 DAYS *BEFORE* you buy! *THEN* if satisfacto

pay in easy, interest free, monthly payments. See coupon inside.

We invite you to try before you buy any of the models described on this and the preceding pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate. (See other side for time payment schedule details.)

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

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