Build the Half-Pack Transistor Receiver

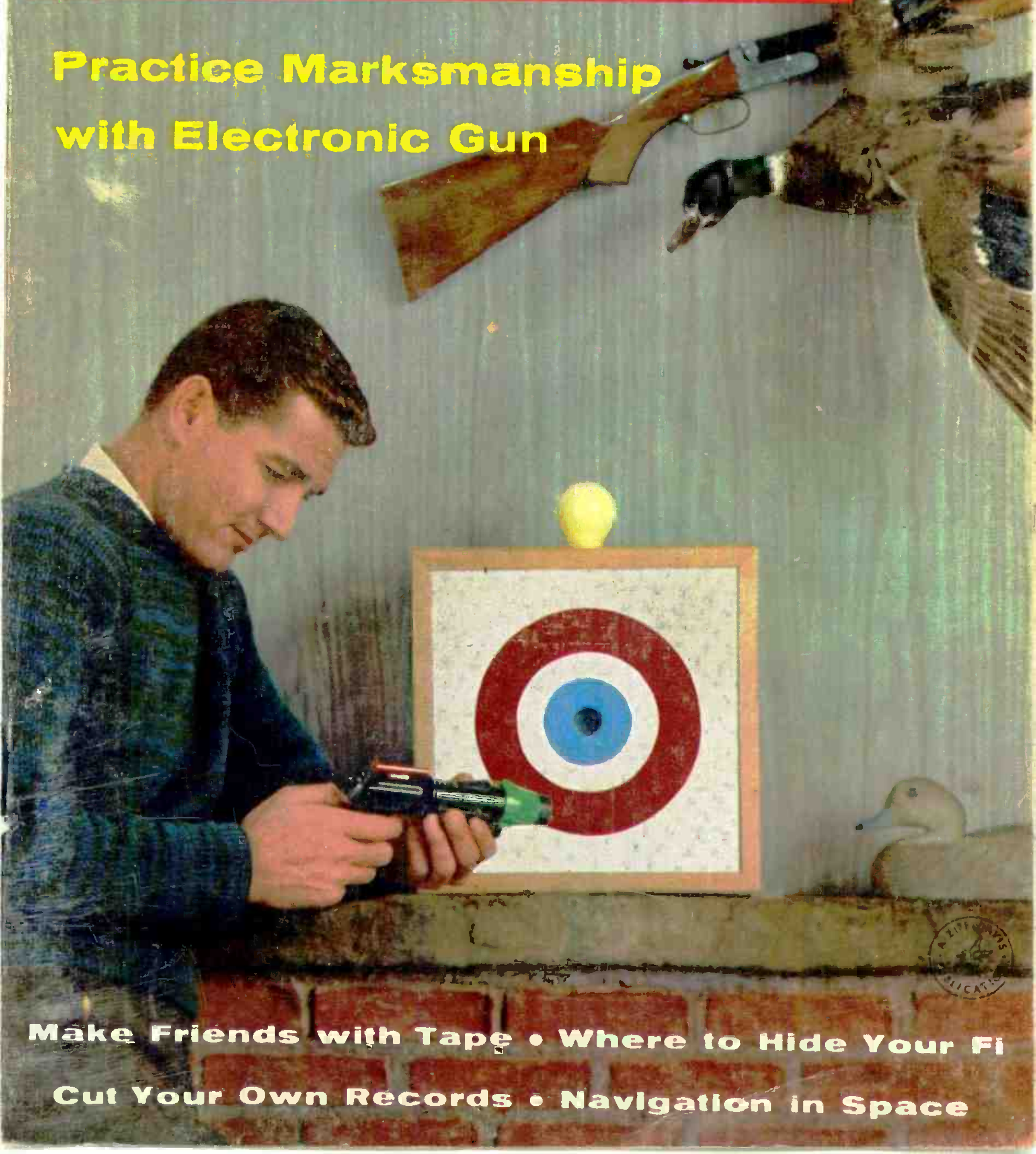
POPULAR ELECTRONICS

MAY 1958

35 CENTS

MAC 5

Practice Marksmanship with Electronic Gun



Make Friends with Tape • Where to Hide Your Fi

Cut Your Own Records • Navigation in Space

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POPULAR ELECTRONICS

VOLUME 8 NUMBER 5

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DEPARTMENTS

COMING NEXT MONTH (JUNE)

(ON SALE MAY 22)

Our June cover and accompanying article give the answer to a question a lot of readers have been asking—how to install a transistor radio in a car. Then it can be operated while mobiling or taken out for use elsewhere, at a picnic or in a motel, just like the de luxe transistor models available on some new cars. You should be able to finish the job in just a few hours.

Do-it-yourself articles will include: how to make a transistor-powered electronic flash unit for your camera . . . a one-tube hi-fi tuner . . . and a telephone secretary. There will also be features on analog and digital computers and how to choose a microphone.

IN THIS MONTH'S

RADIO & TV NEWS

(MAY)

Closed-Circuit TV Systems
3-D Color TV for the Future?
Microphones for Tape Recorders
Transistorized Code Oscillator
A Transistorized Electronic "Accordion"

By JOHN T. FRYE

Fish-Sniffing

JERRY was so busy looking at something in the small tub of water on the floor in front of him that he did not know his chum, Carl, had come into the basement laboratory until the latter suddenly blurted right in his ear: "What are you doing?"

Jerry took his hand from beneath the little aluminum capsule he had been gently supporting in the water and watched it sink slowly to the bottom.

"I'm adjusting the weight of this little sonic tag," he explained, as he mischievously flipped the water from his fingers onto the glasses of his friend.

"Sonic tag," Carl repeated, wiping the water from his horn-rimmed spectacles; "just what is a sonic tag?"

"Remember that story back in the February, 1958, issue of POPULAR ELECTRONICS about the little supersonic oscillators the Fish and Wildlife Service fastens to salmon to keep track of the movements of the fish? Well, that story stuck in my mind, and I wanted to know more about it; so I wrote to the Bureau of Commercial Fisheries. Mr. Parker S. Trefethen, the research biologist mentioned in the P.E. story, sent me back a whole mess of material that answered all my questions."

"Such as—"

"On what frequency does the supersonic tag operate? How long will it continue to oscillate? At what distance can you detect a fish wearing it? Exactly how is the tracking and ranging managed?"

"What did you find out?"

"The transistor oscillator inside the capsule drives a transducer—which is a device to convert electrical currents into sound waves and vice versa—at a frequency of 132 kc. This oscillation is interrupted at a frequency rate that can be adjusted but usually is in the vicinity of 2000 cps. In other words, we have a 'supersonic carrier' on 132 kc. modulated by a 2000-cycle audible signal.

"This 132-kc. signal is picked up by a cluster of four transducers, operating in pairs—one pair for right-and-left and another pair for up-and-down. The signal picked up by each transducer of a pair

Carl & Jerry (*Continued from page 8*)

passes through an amplifier, is detected, and then is combined with the signal from the other unit in a differential amplifier. The output of this amplifier goes through a servo amplifier and drives a servo motor that positions the transducer cluster."

"I get it," Carl broke in. "As long as the fish is right in the center of the transducer cluster beam, the signals are balanced and the servo motors don't operate; but when a fish swims up or down or right or left, the signals picked up by a pair of transducers become unbalanced, and the proper servo motor operates to bring the beam back on the fish."

"Exactly right! And a sonar echo-ranging system shoots a pulsed signal right along the center of the tracking beam that strikes the fish and is returned. This device, by measuring electronically the length of time it takes the pulse to go to the fish and come back, tells how far away the tag-bearing fish is. The battery inside the tag will keep the oscillator going for about seven hours. The presence of a fish can be detected at distances up to 2000 feet, but the ranging system is only reliable up to about 800 feet."

"All very interesting, but what's it got to do with us?"

"AFTER I got the information from Mr. Trefethen, I wrote to my uncle who is in sonar work for the Navy; and he sent me a barium titanate transducer so that I could make my own sonic tag. I've just been adjusting its weight so that it will barely sink in the water."

"But what are you going to do with it? I know you're not going to try to build up that elaborate tracking and ranging gear the Fish and Wildlife people use."

"No, but from the information they sent

... "I've been adjusting the weight of the sonic tag so that it will barely sink in the water" ...

Carl & Jerry (*Continued from page* 10)

me, I learned that they use a small portable receiver with a hydrophone pickup to detect the presence of a tag-bearing fish. When my uncle sent me the transducer, he also sent along a sensitivity hydrophone, which is merely a special microphone for detecting sound waves in water.

"I padded the oscillator and r.f. circuits of that surplus long-wave command receiver over there so it would tune down to the frequency of my sonic tag, and then I revamped the antenna circuit a little so I could use the output of the hydrophone in place of an antenna. Listen while I twist together these two wires that start the tag oscillating and barely dunk the hydrophone in the tub."

As Jerry did this, a loud musical tone came from the small speaker plugged into the output of the compact little low-frequency receiver.

"Holy Toledo!" Carl gasped, his eyes opening wide behind his horn-rimmed glasses; "that thing has possibilities. How far do you think we could hear a fish wearing that tag?"

"I don't know, but we're going to find out this afternoon. Mom's going to take us and Dad's electric outboard up to Crystal Lake. The battery will furnish power for the receiver. First we'll check and see how far we can hear the tag. If everything works out as I hope, we can give it a real try. You get your rod and some of those night-crawlers out of the box buried back of the garage and be ready to go right after lunch."

CARL NEVER NEEDED a second invitation to go fishing, and he was sitting in the station wagon when Jerry and his mother came out of the house. As Crystal Lake was only a 45-minute drive, within the hour the boys were in their boat heading away from the pier. The electronic tag was suspended from the pier with a piece of line so that it was about five feet under water. As Carl steered the silent little outboard, Jerry listened carefully to the signal he was picking up on a small hearing-aid type of earphone connected to the receiver. The hydrophone trailed over the bow.

Finally he said: "I can still hear it, but that propeller makes quite a racket. Stop the motor and let the boat coast. Ah, now I can hear it fine, although the signal is getting pretty weak."

"No wonder," Carl exclaimed, looking back at the pier. "We're almost a half mile away from the noisy little cuss. Let's go

Carl & Jerry *(Continued from page 12)*

back and get our little jewel before something happens to it."

The boys picked up the little aluminum capsule and headed up the lake to where they saw several other boats fishing for the huge bluegills for which Crystal Lake was famous. The standard method of fishing for these pan fish was to drift with the wind until a school of them was found. Usually two or three fish would be taken on one pass through the school. When the biting stopped, the motor would be started as quietly as possible, the boat moved four or five hundred yards into the wind, and an attempt made to drift back through the school. Sometimes this was successful; more often it was not. Starting the motor was likely to frighten the fish away, and once a school was gone it was hard to find.

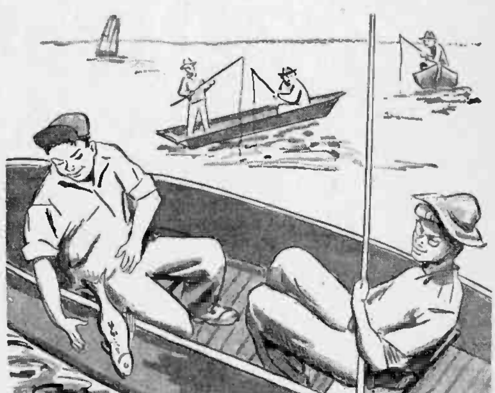
Crystal Lake was a real fisherman's lake, and the people who fished it were true-blue disciples of Izaak Walton. They viewed the arrival of the two boys with attitudes that ranged from mild contempt to crusty hostility. Carl and Jerry joined the little flotilla as quietly and courteously as possible.

Luck was with them, and before Carl could get his tackle ready, Jerry had hauled in a bluegill that looked as though it might go to a pound and a quarter. Carefully dipping his hands in water before touching the fish, Jerry quickly fastened the clip of the supersonic tag firmly to its dorsal fin. He sat up in the boat, held the fish up critically for a moment, and then spoke loudly to Carl: "I don't like the scale arrangement on this fish. What say we throw it back?"

"Go ahead," Carl said with a merry twinkle in his blue eyes.

Without another word Jerry nonchalantly slid the fish into the water and released it.

"Hey, Buster," a hard-bitten man in an



. . . Without another word Jerry nonchalantly slid the fish into the water and released it . . .

Carl & Jerry (*Continued from page* 14)

adjoining boat remarked: "I knew you modern kids were loopy, but I didn't know you were that crazy. That's the best fish I've seen caught in three days."

"Oh, we'll catch plenty more," Jerry answered brightly.

The man laughed a loud, scornful laugh that was quickly taken up by the fishermen in nearby boats.

Jerry, in the meantime, was listening carefully to the inconspicuous earphone he was wearing. As the signal became weaker, he suddenly stood up again and sniffed the air noisily.

"Carl," he announced, "I can't smell fish here any longer. Let's move, and see if we can find them again."

Obediently Carl started the motor, and their boat slid silently away from the others. Jerry kneeled in the prow sniffing this way and that like a coon dog that has lost the trail. Every now and then he would give a motion of his hand, and Carl would turn the craft in the direction indicated. Actually Jerry was listening to the signal in his earphone. Suddenly it became very strong, and he motioned for the motor to be stopped.

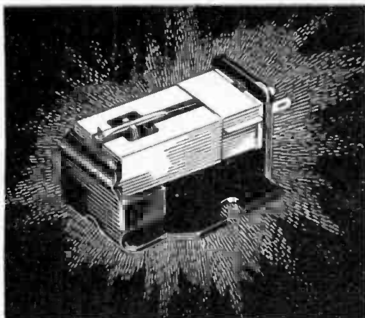
The boys dropped their baits over the side, and almost at the same instant each hooked a fish. They hauled these in quickly, and caught two more on the same baits. Carl took still another bluegill before the fish stopped biting.

The boys wasted no time. They started the motor and went through the elaborate routine of "smelling out" the fish. With practice, it became easier to locate the school again with the signal picked up by the hydrophone, and the boys *really* caught bluegills. In no time at all they were approaching their limit; so from then on they refused to keep any small fish unless it had swallowed the hook and would not live if returned to the water.

THE MEN who scoffed when the boys started to fish were now watching in amazement as they quartered back and forth across the lake, jerking in fish every time they shut off the motor. These men refused to believe the bait consisted of ordinary night-crawlers. One man tossed over a couple of the huge worms in a tobacco can and challenged: "Let's see if you can catch any fish with those."

Obligingly the boys stripped off their own baits and strung on the worms. They kept right on catching fish, and the man who had given them the worms just shook his head in bewilderment.

The boys were quite a little way from



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high fidelity phonograph cartridge until you've read this vital stereo report . . .

SPECIFICATIONS

RESPONSE:	20-16000 cps. ±2.5 db to RIAA
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OUTPUT:	(Westrex 1A) .5 volt rms.
COMPLIANCE:	2. x 10^{-6} CM/dyne
TRACKING FORCE:	6 grams
WEIGHT	2.4 grams
STYLUS:	.7 mil
MOUNT.	EIA (RETMA). Standard ½" and 7/16" centers
CHANNEL ISOLATION:	20 db

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Here are some of the answers to your questions concerning stereo:

Q How does the COMPATIBLE E-V Stereo Cartridge differ from CONVENTIONAL cartridges?

A It has the ability to play both the new type stereophonic discs and conventional records. Inherent in its design is an improved monaural performance. *Exclusive* design for rumble suppression of 15 db or better will permit the use of Electro-Voice's Stereo Cartridge *with any type of changer or transcription player!*

Q Are stereo discs compatible with conventional cartridges?

A Most cartridges damage the stereo record. DO NOT BUY STEREO DISCS UNTIL YOU HAVE AN E-V STEREO CARTRIDGE. You may then play monaural or stereo discs monaurally. Add a second speaker and amplifier, and you have stereophonic sound.

Q What about modification problems?

A Using an Electro-Voice Stereo Cartridge, which is constructed so that its output is already corrected to the RIAA curve, you will not require the equalization of the *second* amplifier. Inserting the cartridge is simple. It will fit virtually any standard tone or transcription arm. The addition of a second amplifier and speaker is not complicated.

Q What about record availability?

A Recordings by major record manufacturers will be available in mid-1958.

Q What effect will stereo cartridges and records have on your present equipment?

A Only your cartridge will be obsolete. All other components are compatible with stereo.

Q What if you don't have a HI-FI system now . . . should you wait?

A *No.* Proceed as before—with one exception: you should insist on a stereo cartridge initially. When you are ready for stereo, merely add a *second* speaker and amplifier.

Q How do you go about getting your Electro-Voice Stereo Cartridge?

A Visit your dealer. If you don't know the name of your nearest dealer, please write Electro-Voice. Ask for E-V Stereo Model 21 D with .7 mil diamond stylus or E-V Stereo Model 26 DST Turnover with .7 mil diamond Stereo tip and 3 mil sapphire tip for monaural 78 rpm records ($22.50).

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World's leading manufacturer of Microphones, Cartridges, High Fidelity Speakers and Enclosures, Professional Electronic Instruments and Public Address Speakers.

Carl & Jerry (*Continued from page* 16)

the other boats when Carl suddenly heard Jerry exclaim: "Well, what do you know?"

Carl looked at the fish hanging on Jerry's line and then broke into a laugh. Dangling from its dorsal fin was the little aluminum capsule of the electronic tag which Jerry had attached to that same fish such a short time before.

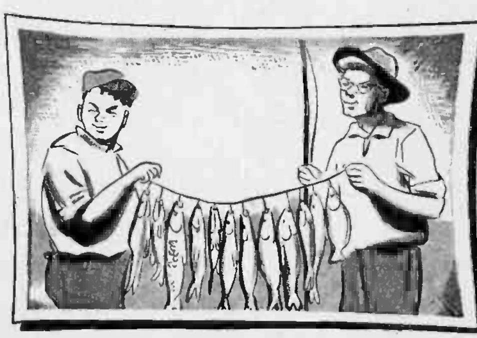
"Man, that fish must really be hungry!" Carl exclaimed.

"Yeah, and I guess this is a sign we'd better call it a day," Jerry said, as he gently pried open the jaws of the clamp that fastened the tag to the fin of the fish. "Both of us have caught our limits, and now we've got back our electronic tag. Let's return this Judas-goat of a fish to the water and head for home. I'm pretty sure we've made fishing history on Crystal Lake today, and I can just imagine how this story is going to grow and grow and grow."

"You can say that again. If those fellows ever found out we were pulling their legs with that business of smelling fish, they'd use us for cut bait. Fishing is a deadly serious business with them, and it's plain to see that they don't want any foolishness mixed in with it."

Gently Jerry slid the big bluegill over the side of the boat and released him. For a second or so the fish did nothing, then he gave a flip of his tail and disappeared down in the blue water of the lake.

CARL AND JERRY turned the prow of the boat toward the pier, and they both felt that deep-down contentment which comes to a man starting home from a highly successful fishing trip. In this case, though, the primitive satisfaction of a full creel was augmented by the knowledge of an electronic experiment that really worked. The boys were so happy they could hardly stand it! —30—



. . . And they both felt that deep-down contentment which comes after a highly successful fishing trip . . .

LETTERS FROM OUR READERS

Our Inventive Readers

■ In the August 1956 issue, you had an article by John A. Norman on an AM tuner. In that article, Mr. Norman states that a 75′ length of lamp cord will serve as an antenna. For us apartment dwellers 75′ of wire is quite a lot to string about the place, so I looked for a substitute.

In one of the back issues of POP'tronics I saw an idea for an antenna using an aluminum plate placed under the telephone. The article said that this formed a capacity coupling. I didn't have a piece of aluminum so I used a double piece of aluminum wrapping, connecting the antenna lead of the tuner to the foil with the small alligator clip supplied in the kit.

This antenna makes the tuner a pretty hot little outfit. I have no trouble picking up some of the stronger St. Louis stations with it—even in the daylight hours. St. Louis is about 125 miles from here.

R. B. Thomas
Columbia, Mo.

There's an idea for you!

"NIM" Poses Problem

■ I thoroughly enjoyed the article on "NIM" in the January issue of POP'tronics. I built it with just a few modifications, such as using 3-volt bulbs instead of 6-volt bulbs, batteries, and a different arrangement of parts.

However, there is just one difficulty. Several friends, who like POP'tronics just as much as I do, read the article and know the secret. What should I do about them?

Payne Freret, Jr.
Alexandria, Va.

You could make some new friends, Payne.

Half the Fun of Short Wave

■ I built the antenna tuner in the November 1957 issue of Popular Electronics and found that I had been missing half of the fun of short wave. The results are truly amazing. It brings those ten- and twenty-meter stations up out of the mud.

I also found that you can use several positions for different degrees of selectivity to eliminate QRM. My receiver is an S-76.

Jim Evans
Galena Par, Texas

Stereo Tape Possibilities

■ I'd like to pass on some interesting information as to what can be done with a stereo tape system. Recently I was re-winding a stereo tape on my recorder and by mistake had left my auxiliary amplifier on. As might be expected, everything came out four times as fast backwards. Here's where I got my idea. You wouldn't call this a stereo-recording but rather "bi-monaural."

I recorded a disc on tape with full treble boost and, instead of re-winding the tape, I placed it

Letters

(*Continued from page 20*)

on the machine so that it would play backwards. Since my system is a "stacked" playback unit with monaural record, when the reel is placed on the machine to play backwards, the recorded channel is the lower track of the tape and plays through the auxiliary amplifier. I then ran the output of the auxiliary amplifier into the input of the tape recorder, recording the lower track backwards at full bass on the upper track. Results . . . fantastic . . . not binaural, but what you can do with a record!

All this may sound confusing, so here's a breakdown of the steps: (1) Record a record on tape (with full treble); (2) Place take-up reel on feed side of machine and rethread through machine; (3) Play back tape through auxiliary system, at the same time, recording it on upper track (with full bass); (4) Take-up reel is automatically rewound forward—all you have to do is place it on the feed side of the recorder, warm up the controls and play.

My system includes a Revere tape recorder and a Fisher amplifier as the auxiliary unit.

JULIAN GOODMAN
Chicago 13, Ill.

From the DX Department

▪ Having been a regular reader of POP'tronics for over two years, I want to congratulate you on the success of your magazine in Israel. The number of electronic experimenters over here is not small and almost all proclaim POP'tronics as their main guide.

Your articles on ham radio, SWL'ing, v.h.f. communications, R/C and hi-fi provide us with highly interesting and informative material, which could not otherwise be obtained here. Some of us work with oscilloscopes, but very few of us use them efficiently; your series on "Oscilloscope Traces" is of much help in that field.

ARJEH WESTFRIED
Jerusalem, Israel

More on the "Ear"

▪ I read and enjoyed your article on coin-paper batteries. You can get as much as 15 ma. by sandwiching a piece of paper soaked in household citric acid between a silver dollar and an aluminum disc or piece of aluminum foil.

You say that the 16" antenna on the "VHF Ear" is resonant. Would not the "Ear," then, work just as well with an antenna 64", 96", 128", etc., long?

R. G. H. ROBERTSON
Hamilton, Ont.

Lengthening the antenna lowers its frequency. But since the "Ear" is very broadly tuned, you may pick up the desired frequency, together with a jumble af other frequencies. Since the sensitivity extends only a few hundred feet, this may not matter much to you.

For Some Lucky Novice

▪ I have a 2-tube, 30-watt input transmitter (homemade), ready to be put on the air with a long-wire ½-wave antenna coupling. I will give it to any licensed Novice on a first-come basis if

Letters (Continued from page 22)

he will just pay the freight cost. If there are too many applicants, I'll pick one off the basket. This is for a Novice only.

If any one around Corpus Christi needs help, just write me.

MIKE M. TREVINO (K5JZQ)
P.O. Box 3374
305 Shawnee
Corpus Christi, Texas

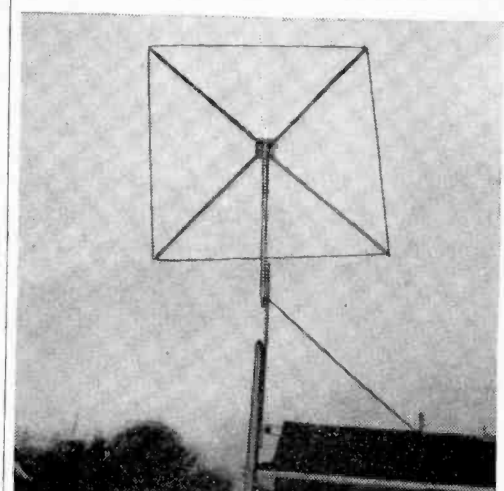
The D-Q Adds More QSO's

▪ I finished building the D-Q in your January '58 issue and it works great—in one week of operation, I bagged 13 new states. It is mounted on a 45' tower which I built from your November 1956 issue. Between the two I have been well pleased.

The signal reports have been fine business too. Within the D-Q's signal pattern, all the reports have been 599 and 589. Thanks.

BILL SPLAINE, KN5MPJ
Baton Rouge, La.

▪ Being a short-wave listener, I was very much interested in the D-Q antenna described in January '58 POP'tronics. I built the antenna, and the



results were amazing. During the first couple of nights I logged all the continents. I used 300-ohm twin lead for my lead-in instead of the 52-ohm coaxial line. Enclosed is a photograph of the antenna.

ALEX HUSICK
Grimsby, Ontario, Canada

You did such a good job, including the photography, that we just had to show the result of your work to other readers. —30—

PLEASE!

POP'tronics receives nearly 1000 letters a month from readers. Many request plans for special construction projects, analysis of service problems or opinions of commercial equipment. We wish it were possible to comply with individual personal attention but we do not sell plans, analysis or advice.

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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.

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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.

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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. Gradually, 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 troubles 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 on 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 Trouble-shooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

Unconditional Money-Back Guarantee

The Progressive Radio "Edu-Kit" has been sold to many thousands of individuals, schools and organizations, public and private, throughout the world. It is recognized internationally as the ideal radio course.

By popular demand, the Progressive Radio "Edu-Kit" is now available in Spanish as well as English.

It is understood and agreed that should the Progressive Radio "Edu-Kit" be returned to Progressive "Edu-Kits" Inc. for any reason whatever, the purchase price will be refunded in full, without quibble or question, and without delay.

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POP'tronics BOOKSHELF

"THE ULTRA HIGH FREQUENCY PERFORMANCE OF RECEIVING TUBES" by W. E. Benham and I. A. Harris. Published by McGraw-Hill Book Co., 330 West 42nd St., New York 36, N. Y. 173 pages. Hard cover. $6.50.

In line with the increasing use of the v.h.f. and u.h.f. bands, this new book offers a detailed description of the behavior of receiving tubes at ultra-high frequencies. As an introduction to the specialized high-frequency types, which are the main focus of the book, the conventional tube is analyzed as a circuit element. Once a clear picture of the standard types is presented, the author gets down to the cases of the special problems of high-frequency/low-noise amplifiers, oscillators and mixers.

Recommended: to advanced students who wish to increase their comprehension of this specialized field.

"INDUSTRIAL ELECTRONICS HANDBOOK" by R. Kretzmann. Published by Philosophical Library, Inc., 15 East 40th St., New York, N. Y. Second edition. 298 pages. Hard cover. $12.00.

Considerably enlarged and brought up to date, the first section of this second edition describes the principles and properties of the various classes of electronic tubes, together with applications and circuits, while the second section devotes a chapter to each of the main types of applications and contains a large number of practical examples.

Recommended: as invaluable to technicians working with industrial equipment and all those interested in the possibilities of electronic controls for industrial equipment.

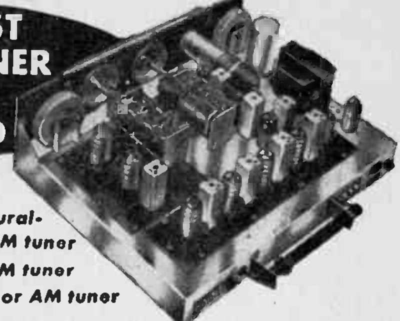
"MOST OFTEN NEEDED 1958 TELEVISION SERVICING INFORMATION" compiled by M. N. Beitman. Published by Supreme Publications, 1760 Balsam Rd.,

(*Continued on page* 30)

New! YEARS AHEAD!

Lafayette STEREO TUNER KIT

THE MOST FLEXIBLE TUNER EVER DESIGNED



Use it as a Binaural-Stereophonic FM-AM tuner
Use it as a Dual-Monaural FM-AM tuner
Use it as a straight Monaural FM or AM tuner

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- 11 Tubes + Tuning Eye + Selenium Rectifier
- Separately Tuned FM and AM Sections
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KT-500 74.50 IN KIT FORM
ONLY 7.45 DOWN
7.00 MONTHLY

More than a year of research, planning and engineering went into the making of the Lafayette Stereo Tuner. Its unique flexibility permits the reception of binaural broadcasting (simultaneous transmission on both FM and AM), the independent operation of both the FM and AM sections at the same time, and the ordinary reception of either FM or AM. The AM and FM sections are separately tuned, each with a separate 3-gang tuning condenser, separate flywheel tuning and separate volume control for proper balancing when used for binaural programs. Simplified accurate knife-edge tuning is provided by magic eye which operates independently on FM and AM. Automatic frequency control "locks in" FM signal permanently. Aside from its unique flexibility, this is, above all else, a quality high-fidelity tuner incorporating features found exclusively in the highest priced tuners.

The 5 controls of the KT-500 are FM Volume, AM Volume, FM Tuning, AM Tuning and 5-position Function Selector Switch. Tastefully styled with gold-brass escutcheon having dark maroon background plus matching maroon knobs with gold inserts. The Lafayette Stereo Tuner was designed with the builder in mind. Two separate printed circuit boards make construction and wiring simple, even for such a complex unit. Complete kit includes all parts and metal cover, a step-by-step instruction manual, schematic and pictorial diagrams. Size is 13¾" W x 10⅜" D x 4½" H. Shpg. wt., 18 lbs.

The new Lafayette Model KT-500 Stereo FM-AM Tuner is a companion piece to the Models KT-300 Audio Control Center Kit and KT-400 70-watt Basic Amplifier Kit and the "Triumvirate" of these 3 units form the heart of a top quality stereo hi-fi system.

KT-500 .... Net **74.50**

LAFAYETTE MASTER AUDIO CONTROL CENTER with BINAURAL CHANNEL AND DUAL VOLUME CONTROL.

KT-300 39.50 IN KIT FORM

- Self-Powered
- DC On All Filaments
- 24 Positions of Equalization
- Tape Head Input, High Impedance
- Dual Cathode Follower Output Stages

This is not only the finest hi-fi preamp characterized by unmatched features, but it has been functionally designed to keep pace with the conversion of your present hi-fi system to binaural (Stereophonic) sound. Incorporates an extra channel and dual volume control for binaural reproduction. Features include DC on all tube filaments, negative feedback in every stage, dual cathode follower output stages and latest printed circuit construction. Less than 0.09% IM distortion and less than 0.07 harmonic distortion at 1V. Hum and noise level better than 80 db below 3V. Uniformly flat frequency response over entire audible spectrum. 7 inputs for every type of phono, tuner or tape. Tasteful styling, brilliantly executed. Size 12¾" x 9⅛" x 3¾". Shpg. wt., 10½ lbs.

KT-300—Lafayette Master Audio Control Kit Complete with cage and detailed assembly instructions. ....Net **39.50**

LT-30—Same as above completely wired and tested with cage and instruction manual. ....Net **59.50**

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KT-400 69.50 IN KIT FORM
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- Conservatively Rated At 70 Watts
- Metered Balance And Bias Adjust Controls
- Inverse Feedback
- Variable Damping
- Available In Kit And Wired Form

Here's ultra-stability in a 70 watt basic power amplifier employing highest quality components conservatively rated to insure performance and long life. Features matched pair KT 88's and wide range linear Chicago output transformer, variable damping control, meter for bias and balance and gold finish chassis. Frequency response 10-100,000 cps ± 1db. Hum and noise 90db below full output. IM distortion less than 1½% at 70 watts, less than 0.3% below 30 watts. Harmonic distortion less than 2% at 70 watts from 20 to 20,000 cps ± 1db. Output Impedance 4, 8 and 16 ohms. Handsome decorative cage perforated for proper ventilation. Size 14½ x 10 x 7⅜" including cage and knobs. Shpg. wt., 40 lbs.

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LA-70—Same as above completely wired and tested with cage and instruction manual. ....Net **94.50**

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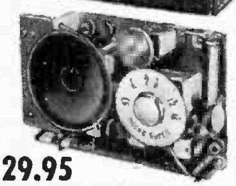
NEW! 6 TRANSISTOR SUPERHET RECEIVER with LATEST NPN-PNP TRANSISTORS



29.95
LESS CASE AND BATTERY

- GE 2N188A AUDIO OUTPUT TRANSISTORS
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- CLASS B PUSH-PULL AMPLIFICATION-PLENTY OF POWER.
- FOR GROUP AND PRIVATE LISTENING
- LABORATORY DESIGNED — SENSITIVE, SELECTIVE, STABLE!

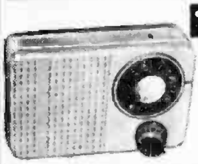
Superb Performance! Incomparable Value!

Transistor-wise Lafayette proudly presents its newly revised 6 Transistor Superhet Receiver Kit KT-119A. This improved model uses the latest GE NPN-PNP Transistors in an ingeniously engineered, laboratory tested circuit providing superb performance and an amazing superior commercial quality. The circuit features a specially matched set of 3 IF transformers, Oscillator Coil, High-Q Loop, Class B Push-Pull Audio Amplification and optimum Transformer Coupling in audio and output stages. Has efficient 2¾" speaker for exemplary reproduction and earphone jack for private listening. Complete with all parts, transistors, pre-punched chassis, but less battery and leather case. New 28 page easy-to-follow step-by-step instruction book. Size 6 x 3½ x 1½. Shpg. wt., 3 lbs.

KT-119A — Complete Kit-Less Case and Battery........Net **29.95**
BATTERY 9V BURGESS 2N6........Net **1.30**
MS-339A — Sturdy attractive brown leather case with carrying strap for KT-119A. 6 x 3½ x 1½". Shpg. wt., 1 lb........Net **2.95**
MS-366 — Sensitive matching earphone........Net **1.29**

3 TRANSISTOR SUPERHET POCKET RADIO KIT

- A TRUE POCKET SUPERHET RECEIVER-NO EXTERNAL ANTENNA!
- NO EXTERNAL GROUND



A remarkable sensitive, super-selective pocket superhet receiver with astonishing performance over the complete broadcast band. Uses 2 high-frequency and one audio transistor plus efficient diode detector and features 2 specially matched IF transformers for maximum power transfer. The components are housed in a professional looking beige plastic case. The receiver's appearance enhanced by attractive maroon and silver station dial. Sensitive built-in ferrite antenna eliminates need for external antenna. A designer's dream in a true pocket superhet receiver! Complete with all parts, transistors battery, case, dial and easy to follow step-by-step instructions. 4⅛"x2⅝"x1-1/16". Shpg. wt., 1 lb.

KT-116 — Complete Kit, less earphone........Net **16.95**
MS-260 — Super Power Dynamic Earphone........Net **3.95**

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COMPLETELY WIRED AND TESTED! ACCURACY AND QUALITY GUARANTEED!

22.50

- FREQUENCY 120KC to 260MC!
- 120KC to 120MC ON FUNDAMENTALS!
- 30 DAY TRIAL PERIOD! FULL REFUND IF YOU ARE NOT SATISFIED FOR ANY REASON

Completely wired and tested instrument. Do not confuse with kits sold in the same price range. Has the quality and accuracy of instruments selling for 3 to 4 times as much. Six overlapping ranges — 120KC to 320KC, 320KC to 1000KC, 1MC to 3.2MC, 3.2MC to 11MC, 11MC to 38MC, 37MC to 130MC — all on fundamentals — calibrated harmonics from 120MC to 260MC. Switch between internal modulation at 400 cps or any external source at other frequencies. 400 cps signal can be used separately. Outputs are unmodulated RF, modulated RF and 400 cps audio. RF output is in excess of 100,000 micro volts. Jacks are provided for high or low RF output.

Highly stable special circuit design. Fine adjust RF control. AF output 2-3 volts, input 4 volts, across 1 megohm. 5 inch etched dial plate — protected by clear plastic bezel. Common AF terminals for EXT-MOD input and INT-AF output eliminates need for special connectors. Gray metal case — carrying handle — complete with leads, line cord and plug. For 105-125V, 50-60 cycle A.C. Shpg. wt., 8 lbs.

LSG-10 — Signal Generator........ **22.50**

NEW! Dynamic Stereophonic Headphones

BINAURAL

- True Binaural Reproduction.
- Frequency Response 40-16,000 cps.
- Matched Magnetic and Crystal Transducers.
- Exceptionally Lightweight.
- Six Types — Monaural and Binaural.

MONAURAL

Take your choice of six stethoscope type headsets. Binaural or Monaural! High impedance or low impedance! Magnetic or crystal! Only Lafayette offers a complete selection. Binaural units are equipped with two separate and individual transducers and cord sets for true dual channel reproduction. Long the most widely accepted means of stereophonic listening. Both monaural and binaural units are extremely sensitive to insure the desired response. Sound is carried through crystal clear plastic tubes tipped with removable, plastic earpieces. Ingenious hinge device permits adjustment to any desired spacing. Less than 2 ozs. total weight for the utmost in listening comfort. Binaural sets may be used for monaural listening. Shpg. wt., 6 ozs.

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MS-431	Binaural-Magnetic-6 ohms impedance	2.65
MS-432	Binaural-Magnetic-5000 ohms impedance	2.95
MS-433	Binaural-Crystal-100,000 ohms impedance	2.25

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MS-429	Monaural-Magnetic-6 ohms impedance	1.75
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MS-369	Monaural-Crystal-100,000 ohms impedance	1.65

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Address .... CUT OUT AND MAIL
City .... Zone.... State..... TODAY

Bookshelf (*Continued from page* 26)

Highland Pk., Ill. 192 pages. Paper bound. $3.00.

The most recent of an extended series of publications, Beitman's new compilation includes service data from A (Admiral) to Z (Zenith). Relying on factory information, the new volume contains a cross section of the most popular of the early 1958 TV receivers and is meant to supplement, not replace, past editions.

Recommended: to the TV serviceman and technician, who will find it an inexpensive means of keeping abreast of the latest in television circuitry.

Free Literature Roundup

A new 288-page electronic parts and equipment catalog has just been released by Harvey Radio Co., 103 W. 43rd St., New York 36, N. Y. It contains special sections devoted to high fidelity, sound, broadcast, industrial and amateur equipment and components.

The first edition of Merit Coil & Transformer Corporation's new Catalog No. 5811 is now off the press. It contains technical and non-technical cross references and illustrations, and lists more than 900 items in the Merit line. If your distributor does not have it yet, write to Merit at 4427 N. Clark St., Chicago, Ill., for a copy.

Mark Simpson Manufacturing Company's new line of "Audiosphere" amplifiers is illustrated in Catalog #3000. The "Add-A-Unit" three-speed phonograph Model MP-3, which fits all amplifiers from the Audiosphere 18-watt to the 100-watt units, is featured in this catalog. Write to Masco, Department "D-1," 32-28 49th St., L. I. C. 3, N. Y.

A reference table in wall chart form has been published by Precision Equipment Co. This conversion chart is useful for hobbyists, shop men or anyone dealing with mechanics or electronics. Included are common conversions, such as inches to centimeters or watts to horsepower, as well as many that are difficult to locate in reference manuals. For your free Wall Chart of Conversion Factors, write to Precision Equipment Co., 4411 Ravenswood Ave., Chicago 40, Ill.

Supreme Publications has released a colorful circular describing its radio-electronics and television courses, which are intended for home-study and are issued in book form. Write to Supreme Publications, 1760 Balsam Rd., Highland Park, Ill., if you would like a copy. —30—

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Prices 5% higher in the West.
Home, car, TV appliance repairs: READI-TESTER #540 KIT $12.95 WIRED $15.95
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you build EICO KITS in one evening— but they last a LIFETIME! OVER 1 MILLION in use today!
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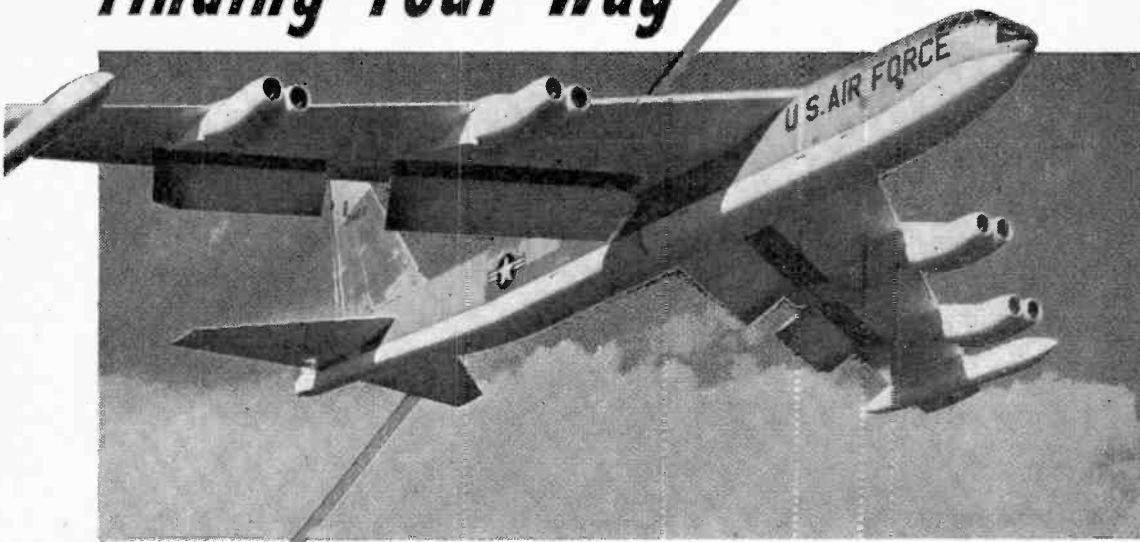
Finding Your Way in SPACE



By BROOKS CURREY, Jr.

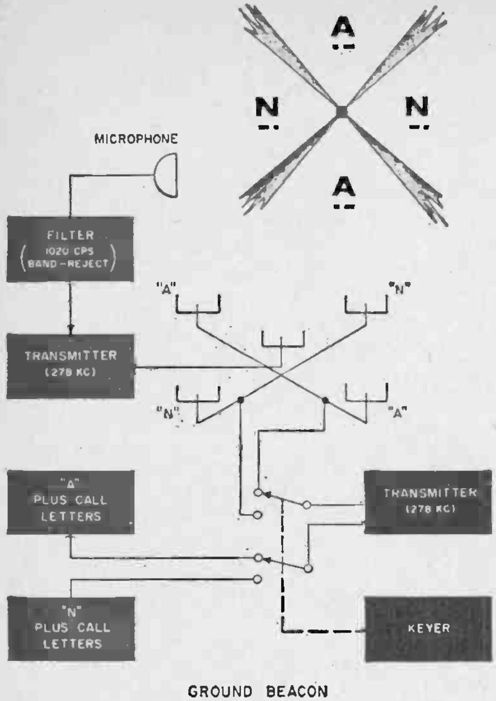
It's a long haul from the old sea dog to today's jet

THERE WAS A TIME WHEN a well-moistened forefinger was a man's only navigation instrument. The cool side told him the wind direction—and thus, his course. Today, man relies on the thin metal "forefingers" jutting from high-speed high-altitude aircraft to keep him informed on position, direction, velocity and other data so necessary to flight. And satellites circle some 300 to 400 miles above the earth—spring-loaded "forefingers" busily transmitting spatial information back to us.

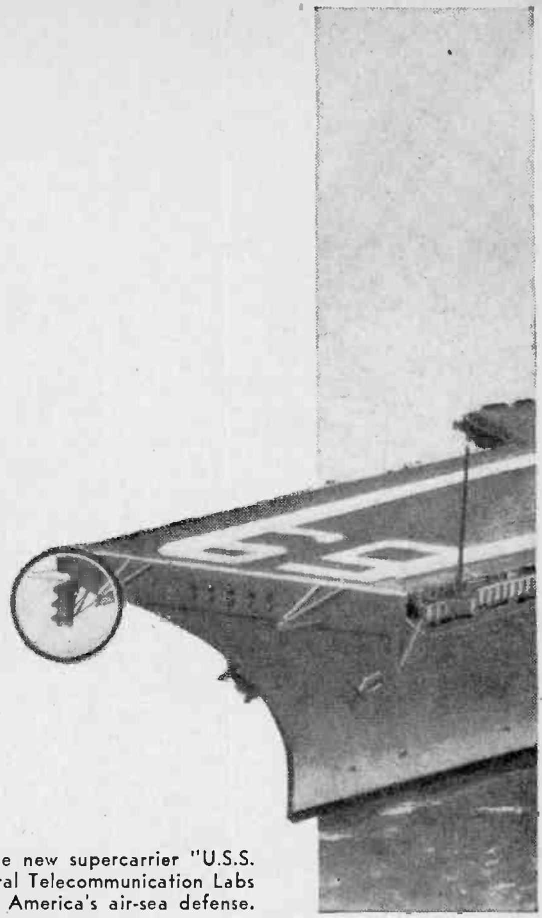
The evolution of navigation from an uncertain art to a specialized science has been long and arduous. Its basic principles have always existed—they only awaited discovery. By necessity, navigation has always tagged along in the wake of mathematical and astronomical development. The ancient Greeks, we know, taught that the world was round and that any position on its surface could be determined by latitude and longitude. Basic principles, therefore, did not mystify man so much as the instruments used to verify them.

Direction by Radio. The development of electronic aids to navigation begins within our present century—in the early 1900's when Marconi's wireless made radio direction-finding the first electronic aid.

Early shipboard direction finders were simple loop antennas, with a tunable receiver (100 to 1800 kc.), a set of earphones, and an azimuth indicator. To operate, the navigator simply tuned in a radio station of known position, rotated the loop to minimum gain, and then read the relative bearing on the azimuth indicator. By using several such stations—the more the better

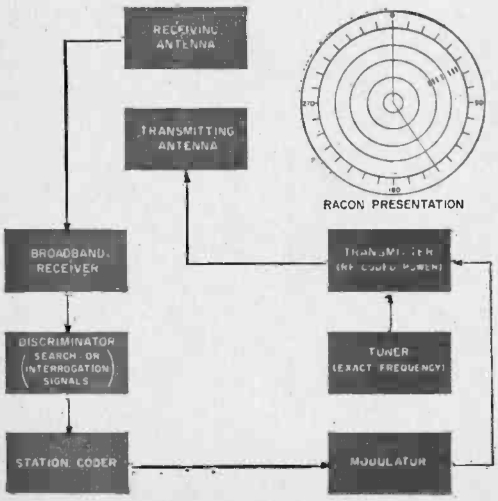


Block diagram above shows what's behind the "beam" that pilots fly on the CAA network of airways.



Tacan, shown atop the mast of the new supercarrier "U.S.S. Forrestal," and u.h.f. radio by Federal Telecommunication Labs (left circle) play important role in America's air-sea defense.

Simplified diagram below shows how the Racon (RAdar beaCON) operates. Note use of scope.



—and drawing the bearings on a chart, the ship's position was located at the intersection of the bearings.

As refinements were made on radio direction-finding equipment, the speed and range of aircraft were steadily increased. Aerial navigation amplified existing problems of navigation, and introduced many new ones. For instance, the time allowed to compute position decreased in direct proportion to the increasing flight speed. A part of this new problem was solved by the low-frequency radio range.

Now standard for nearly all airplanes, radio range equipment makes use of a network of ground stations and a receiver in the airplane. In operation, four radio beams of approximately 3° width are transmitted along the CAA (Civil Aeronautics Authority) airways—intercontinental "super-highways" 10 miles wide which are divided into 1000′ altitude levels.

Basically, the ground station has two pairs of transmitting antennas, each matched pair being placed at diagonal cor-

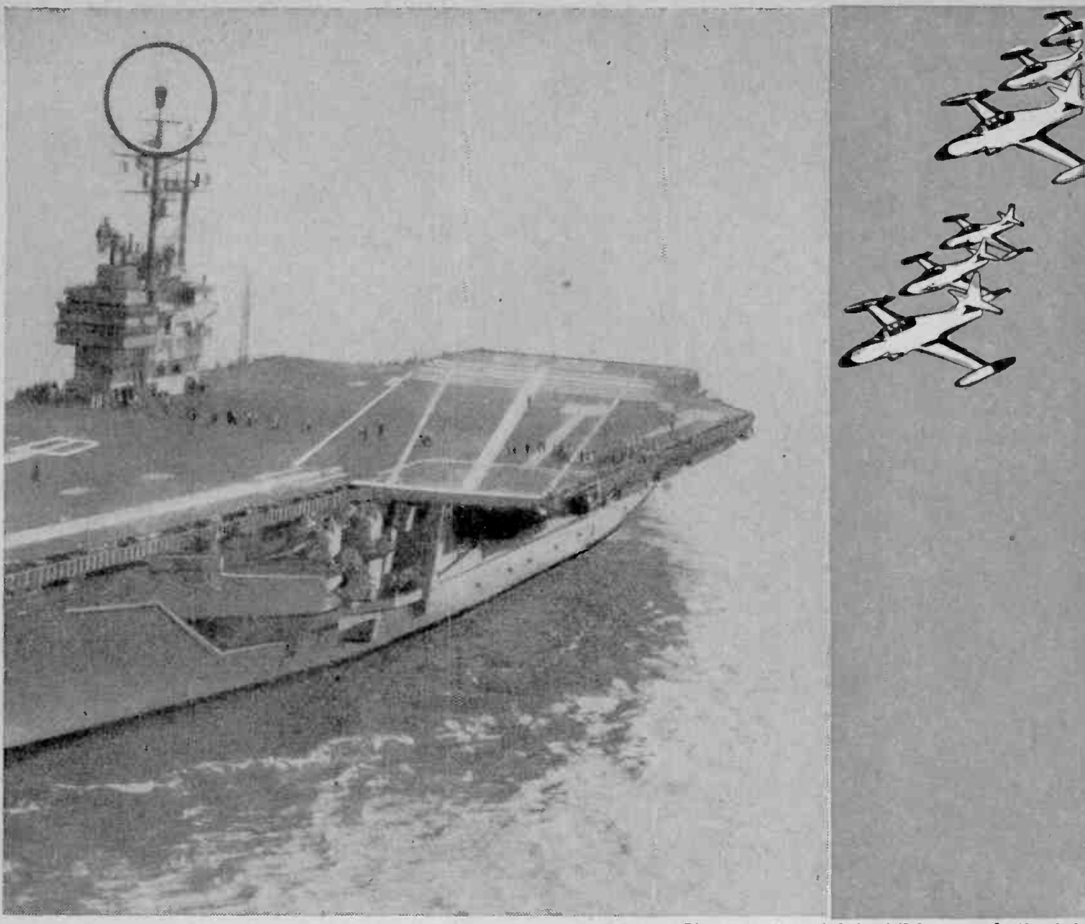


Photo courtesy of Federal Telecommunication Labs

ners of a square. One pair transmits "A" (dit dah), the other pair "N" (dah dit). The signals are transmitted in a figure-eight pattern. A and N signals overlap to provide equal signal intensity along the four 3° beams.

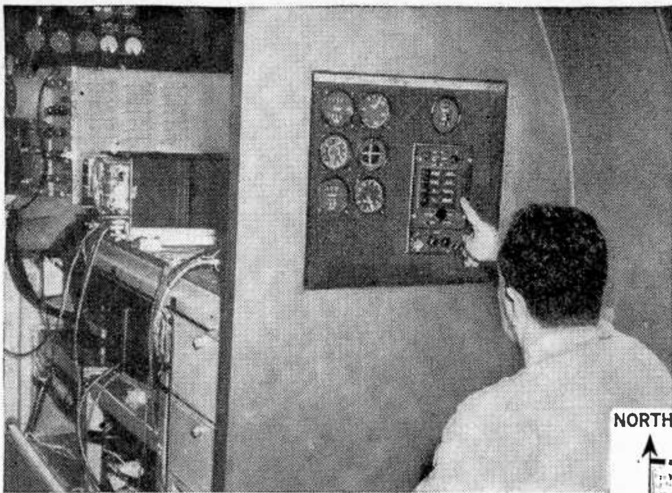
The pilot tunes his receiver to the proper station frequency, between 200 and 400 kc., and listens for the station's call letters, e.g., LGA for La Guardia Field, New York. Once identified, the pilot hears either A or N in keyed intervals. (The N signal is always assigned to the quadrant containing true North to minimize confusion.) If the pilot hears an N, he knows he is off the beam, and he turns left or right. In so doing, he notes that the original N grows into a steady tone where the dah dit and dit dah overlap. When the pilot cannot distinguish A or N, he is "on the beam."

Radar and Racon. The big impetus to electronic aids came during World War II, with the advent of radar. Using narrow beams of microwaves of 1 to 12 cm. in wavelength, radar measures the time it takes an energy pulse to travel out, echo off an obstruction and return. One mechanization of this effect is Racon (RAdar beaCON), which provides the air navigator with both distance and bearing information on a standard PPI (Plan Position Indicator) scope.

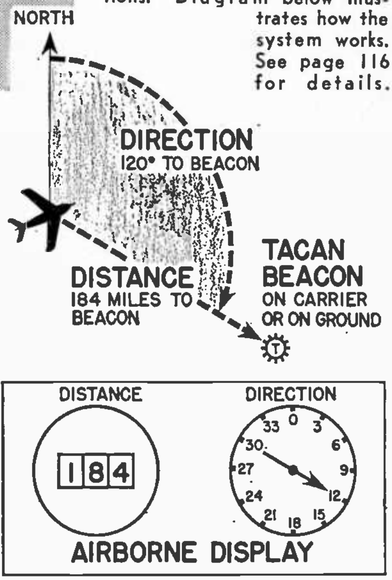
Airborne Racon equipment includes a primary radar operating on a frequency in the 200- to 10,000-mc. frequency range. The ground beacon consists of a secondary radar containing a receiver, time-delay unit and transmitter.

In operation, the navigator "interrogates" the ground beacon with a pulse from his radar. This triggers a coded pulse from the beacon which is transmitted in all directions. The navigator observes the beacon response on a PPI scope in much the same manner as he observes targets.

To differentiate between Racon signals and target echoes, the beacon signals are coded as a series of pips as detected by the PPI scope. Thus, bearings to the beacon



Flying laboratory of Federal Telecommunication Labs flight-tests Tacan under all conditions. Diagram below illustrates how the system works. See page 116 for details.



can be taken, and distance measured. Effective range of Racon operation is limited only by the horizon or line-of-sight distance.

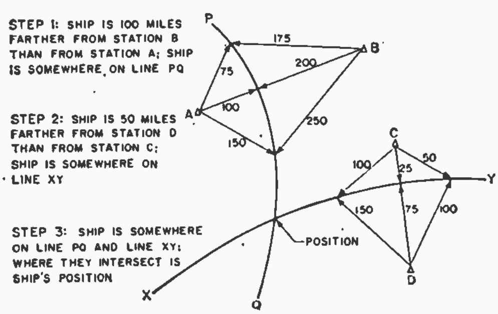
A more specialized system is DME (Distance Measuring Equipment), though bearings to the ground beacon are not given. Fundamentally, the ground equipment for DME is like that used for Racon. The airborne equipment, however, differs in that the distance is shown on a dial indicator instead of a PPI scope. Because this indicator is susceptible to beacon interrogation pulses by other aircraft, the airborne equipment contains a sweep-search circuit in addition to a tracking circuit. In operation, the airborne transmitter sends out a 936- to 986-mc. beam. A separate receiver antenna picks up the beacon and any other transmissions.

Airborne VOR. Should the navigator wish to determine course direction and not distance, he can use one of several omnirange systems: low-frequency, v.h.f. or u.h.f. The omnirange equipment provides the navigator with accurate courses either off or on the airways.

With the VOR system (V.h.f. Omnidirectional Range), the navigator or pilot selects a station from a chart published by the CAA. He next tunes in the frequency of the selected station by means of a dial, and checks the coded or voice call of the station with that given on the chart. The magnetic bearing of the station from the aircraft is set into the system by means of a selector wheel; the bearing of the station is thereafter retained at all times until changed to a new station.

Two other very essential parts of the airborne VOR system are the "left-right" and the "to-from" indicators. Once the magnetic bearing of the station has been selected, the pilot-navigator checks the "to-from" indicator to determine if his aircraft is flying toward or away from that station. The "right-left" indicator then

(*Continued on page* 116)



Plotting a ship's position by Loran (left) makes use of the intersection of two hyperbolas, which are obtained by tuning in two pairs of stations.

Check Your Marksmanship with Bullets of Light

By R. L. WINKLEPLECK

YOU WILL FIND this light-actuated pistol target range a real test of skill. A 30' range is entirely practical, and the photoelectric "bull's-eye" looks mighty small at that distance. The bull's-eye is one of International Rectifier's new silicon solar cells which imparts a high degree of sensitivity to the unit.

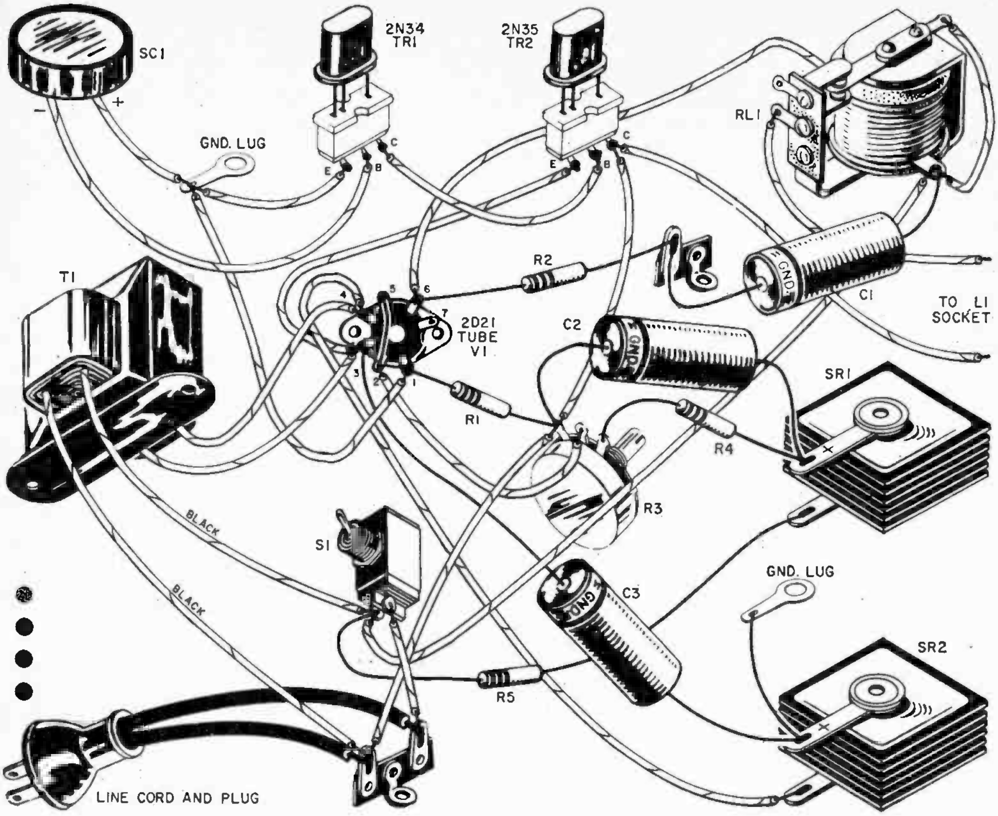
The "gun" design is responsible for making this a true test of your skill. For instead of shooting a solid beam of light with which you could hunt down the target, the gun produces only one brief burst each time the trigger is pulled. You have either a clean hit or a miss—and no weaving of the gun will produce an undeserved score.

Construction is quite simple. Parts layout is entirely non-critical and any arrangement is acceptable. A small sheet of aluminum folded into an "L" shape as shown works nicely, and all components—except the indicating light—can be mounted and wired before the chassis is installed in the target box.

The illustrations show a very satisfactory arrangement. An ordinary door bell can be placed in series with *L1* to provide both visual and aural bull's-eye signals. Be sure of the polarity of the transistor voltage. One wiring mistake here and you'll need a new transistor.

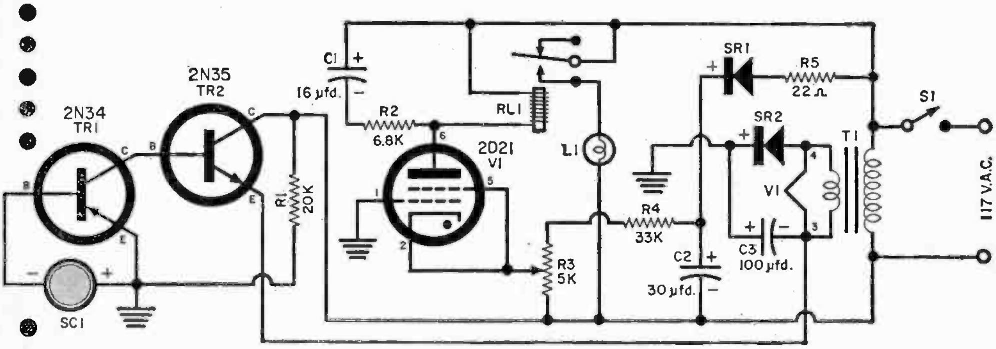
The gun can be built into a rifle or pistol, depending on what's available. Exact arrangement of the few components will be decided by what is used. The 45-volt miniature battery charges a 100-μfd. capacitor through the microswitch.

When the switch is actuated, the battery circuit is opened and the capacitor discharges through the 6.3-volt #47 type pilot lamp. This produces an intense, brief burst of light which, focused by the simple lens, is

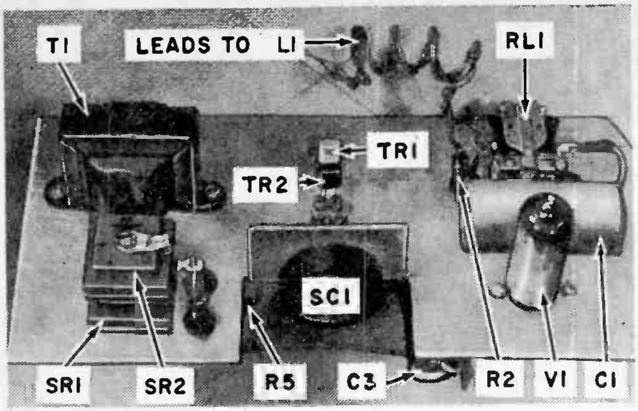


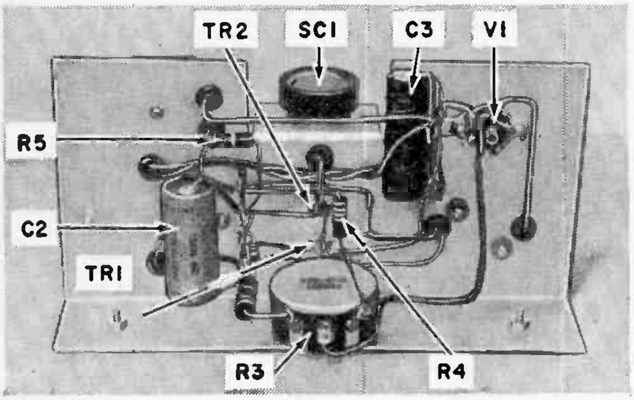
PARTS LIST

C1—16-µfd., 250-volt electrolytic capacitor
C2—30-µfd., 250-volt electrolytic capacitor
C3—100-µfd., 25-volt electrolytic capacitor
L1—40-watt, 117-volt lamp and socket
R1—20,000-ohm, ½-watt resistor
R2—6800-ohm, 1-watt resistor
R3—5000-10,000-ohm wire-wound control
R4—33,000-ohm, 1-watt resistor
R5—22-ohm, 1-watt resistor
RL1—5000-ohm relay (Potter & Brumfield Type RS5D or equivalent)
S1—S.p.s.t. switch
SC1—Silicon solar cell (International Rectifier SA5-M)
SR1, SR2—65-ma. selenium rectifier (SR2 may have lower current rating)
T1—6.3-volt, 0.6-amp. filament transformer
TR1—2N34 transistor
TR2—2N35 transistor
V1—2D21 thyratron tube



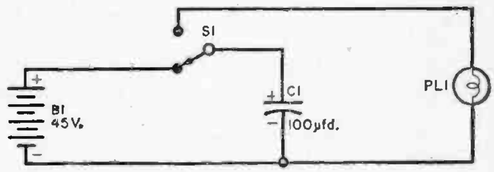
Pictorial and schematic diagrams of the light target. Several different makes of relays will operate properly. A 1N48 or equivalent diode may be substituted for the selenium rectifier (SR2) which is used as the low-current power supply for the two transistors.





Top and bottom views of the chassis of the photocell unit at left show the uncrowded parts placement. The solar cell (SC1) may have screw mounting terminals or pigtail leads; characteristics of both of these types are similar.

Gun construction is shown above, right. In the schematic directly at right, B1 is an RCA VS 086 battery, C1 an electrolytic capacitor rated at 50 volts, and PL1 is the 6.3-volt #47 pilot lamp. A s.p.d.t. spring return switch serves as gun trigger.



sufficient to actuate the target from a distance of well over 30 feet.

Only the bulb specified will work. One with a higher amperage rating would not produce sufficient light—a smaller one would be burned out with the first flash.

The bulb should be mounted vertically with the filament turned parallel to the line of sight. This produces the smallest possible spot of light on the target.

The lens should be a double convex type of 1"-2" focal length and of whatever diameter is needed to fit your gun. A simple "magnifying glass" is ideal. Either the lens or the bulb should be adjustable so that the spot of light can be focused to produce the smallest, brightest spot at shooting distance.

No reflector is required, but you will need to place a black paper diaphragm with a 1/8" hole just in front of the bulb in order

(*Continued on page* 111)

HOW IT WORKS

Light falling on the silicon cell generates a small current which flows into the two-stage, complementary-symmetry d.c. transistor amplifier. The no-light current is minimized by using a *p-n-p* transistor (*TR1*) in the input directly coupled to an *n-p-n* transistor (*TR2*) in the output stage with the zero-signal collector currents in opposition. Since the *n-p-n* and *p-n-p* collectors require voltages of opposite polarity, the power supply is connected in series with the output stage emitter and, through its base-emitter circuit, to the collector of *TR1*.

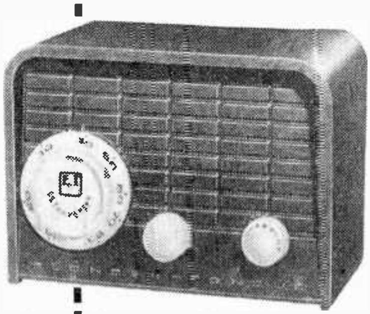
This amplifier provides a current gain of approximately 250 and a swing of several volts positive across its load resistor (*R1*) which is applied to the control grid of the thyratron "trigger" tube (*V1*). When this voltage swings positive, the thyratron conducts, the relay in its plate circuit closes, and a light flashes or a bell rings—indicating a bulls-eye.

Potentiometer *R3* applies bias to compensate for incident light and functions as a "sensitivity control." Alternating current is supplied to the plate of the thyratron (*V1*) so that conduction ceases when its grid drops below the firing potential. Voltage for the transistor amplifier is taken from the filament transformer (*T1*), rectified and filtered.

ALL-IN-ONE FLASH

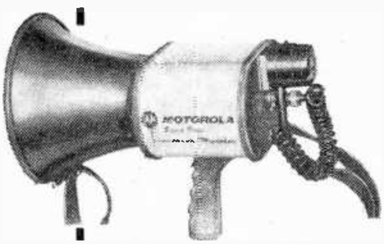
A new one-piece electronic flash unit eliminates the conventional separate power pack which is often bulky and inconvenient. The "Futuramic Strobonar" (Heiland Division of Minneapolis-Honeywell) incorporates within its lamp head and handle all necessary components for operation, including a two-transistor power circuit in the more expensive model. A second model uses a vibrator circuit. Operating from three D-size batteries, three rechargeable nickel-cadmium cells or ordinary a.c. current, the unit delivers a Kodachrome guide number of 35 and a 70° light pattern.

U.H.F. CONVERTER



The BTC-2R Ultraverter at left, a u.h.f. converter, now incorporates a tuner redesigned to new FCC standards. The device adds all channels from 14 through 83 to standard v.h.f. receivers. Some of the features of the Blonder-Tongue converter are a two-speed channel selector, double-tuned input, low-noise triode amplification and a precise 300-ohm match. Price is $39.95.

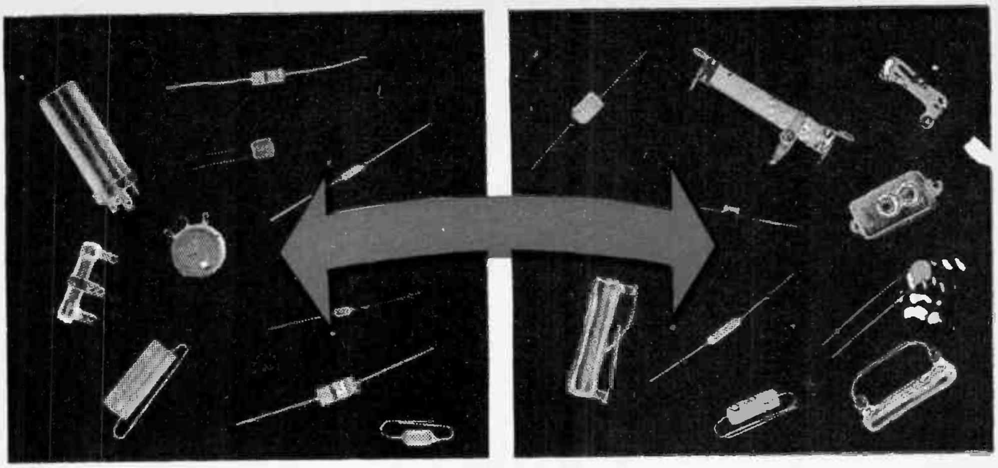
"HEARING" AID



Six ordinary D cells drive the "Power Voice" megaphone shown here to an effective range of three-quarters of a mile. This self-contained Motorola unit has a six-transistor circuit with an output of 15 watts. It weighs less than eight pounds, allowing it to be held to the mouth and activated by pressing the trigger on its pistol grip handle. For long periods of operation, the megaphone may be slung from the shoulder, with the mike detachable.

TINY TALKY

A two-way "Tiny Talky" transmitter-receiver 50% lighter than most units has been developed by Radio Specialists Co. of Denver with United Airlines engineers. Used to expedite passenger traffic to planes, the set weighs only 5½ pounds. It operates between 420 and 470 mc., and has a maximum range of four miles. The radio is carried in a leather case attached to a Sam Browne belt. A small plastic earpiece and a hand mike replace the usual telephone headset. The antenna, only six inches long, juts from a shoulder epaulet. This set is now being used in Oakland, Calif., and New York City airports.



How to Make PARTS SUBSTITUTIONS

Part 2 — Capacitors

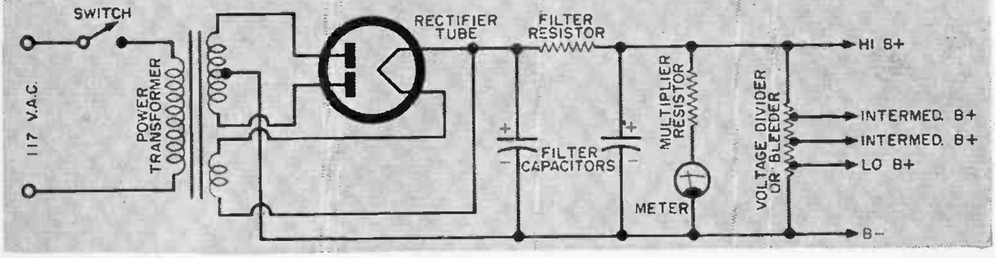
By EUGENE RICHARDSON

A CAPACITOR is made up essentially of two closely spaced conductors (such as metal foil) with an insulating material (dielectric) between them. Many different dielectrics are used, including glass, air, various plastics, mica, ceramic materials, chemical films, and oils. The capacitance increases as the opposing areas of the conductors is increased and as their separation is decreased. Capacitance also depends on the electrical characteristics of the dielectric.

As with resistors, there are three specifications which apply to all types of capacitors: capacitance, tolerance, and voltage rating.

Capacitance is given in either microfarads (μfd.) or in micromicrofarads ($\mu\mu$fd.). A micromicrofarad is one-millionth of a microfarad. Typical capacitor values range from a fraction of a micromicrofarad to as high as several thousand μfd., depending on the circuit. The two can be used interchangeably to specify the value of a medium-range capacitor. For example, units rated at 0.005 μfd. and 5000 $\mu\mu$fd. have the same value.

Except in critical circuits, a capacitor's *tolerance* is not nearly as important as a resistor's tolerance. Most capacitors have a tolerance of about 20%, although some bypass and filter units may have a dual rating such as −10%, +50%. This means that the actual value may range from 10%

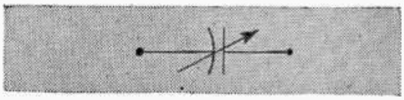


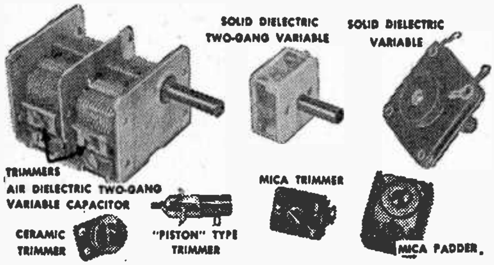
Basic power supply circuit, showing typical uses for components discussed in Part 1 and Part 2.

below rated value to 50% above the value.

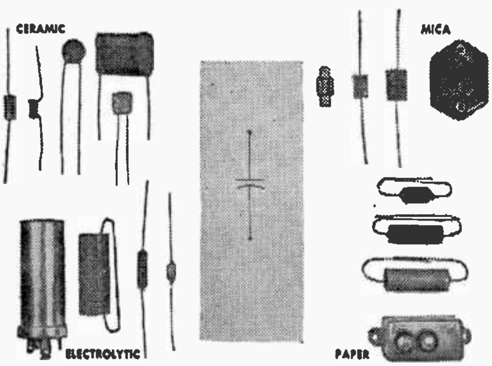
A capacitor's *voltage rating* is indicative of the maximum voltage that can be applied to it before the dielectric breaks down and permits a short between the two conductors (plates). It is generally given as d.c. working voltage, which is the average steady voltage that can be applied to it, but a peak (or maximum) voltage rating may be given as well.

Capacitors may be further identified by





Typical variable capacitors with the symbol used for them are shown above, while fixed capacitors and their symbol are shown below. At right are the capacitor symbols and their alternates.

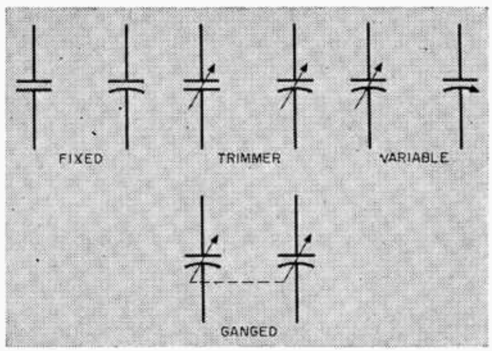


the type of dielectric material used in their construction. Popular types include ceramic, mica, paper and electrolytic (chemical film) capacitors. Of these types, mica and ceramic are encountered most often in r.f. and i.f. circuits, paper capacitors in r.f. and a.f. circuits, and electrolytics in a.f. and power supply circuits.

In some cases, the physical shape of a capacitor may be included in its description, and we may speak of a "disc ceramic," a "tubular ceramic," a "postage-stamp mica," a "tubular electrolytic," a "can electrolytic," a "tubular paper," or a "bathtub paper" capacitor. Such terms are descriptive only and generally are not too important when choosing a unit for a particular circuit.

Electrolytic capacitors have a comparitively high capacitance for their physical size and, except for special units, are designed only for d.c. circuits. Their connection leads (terminals) are marked with a specific polarity which must be observed. The positive lead always connects to the positive side of a circuit. In "can" type capacitors, the outer metal can is generally the negative terminal of a unit.

Most paper capacitors are put together by rolling up a "sandwich" made of two pieces of metal foil with one or more pieces of paper between them. Thus, one foil is on the "outside" of the completed roll. The lead to this foil may be identified by the words *ground* or *outside foil,* or by a ring around one end of the capacitor. In most cases, it is best to connect this



lead to the ground side of circuits—but don't confuse this with the polarity marking of an electrolytic capacitor.

There is one other specification you may encounter in dealing with critical r.f. circuits—*temperature coefficient.* It indicates the relative variation of the capacitor's value with changes in temperature. Ceramic capacitors with special temperature coefficients are used in some r.f. oscillators and amplifiers to compensate for the variations in the values of other components with temperature changes and thus to insure stable operation of the circuit.

Variable capacitors fall into two general classes: those designed for continuous adjustment with a control knob and used as tuning capacitors, and those designed for semi-fixed adjustment with a screwdriver. The latter are called *trimmer* capacitors if their values are small (up to, say, 100 $\mu\mu$fd.) and *padder* capacitors if their maximum value is fairly large (up to 1000 $\mu\mu$fd.). Both classes are rated as to minimum and maximum capacitance.

Tuning capacitors have a fixed set of

(*Continued on page* 112)

Make Your Own DISC RECORDS

For home use, discs provide convenient library of favorites

By E. EUGENE GARNES

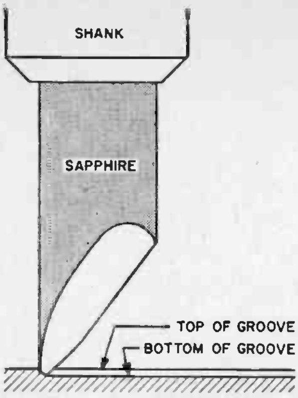
DESPITE the tremendous popularity of tape, manufacturers report that the demand for disc recording accessories and materials is increasing. This may be because discs are more versatile in some ways than tape. For instance, it is easier to locate a specific portion of a recording on disc than on tape. In addition, discs can be used on any phonograph of the proper speed, while tapes are limited to the less common tape recorder. And you will find that recordings made with a minimum of inexpensive equipment can be quite satisfactory.

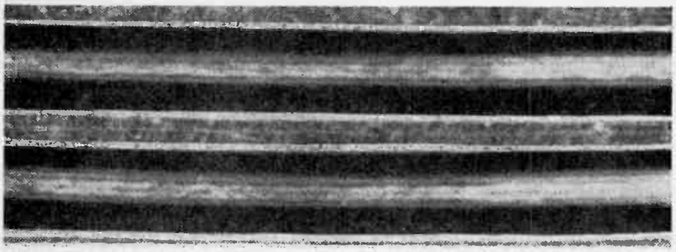
Recording Equipment. Many of you probably still own radio-recorder units, long since put aside (photo above). A cleaning job will help get that old unit going again. Bearings should be washed and cleaned with carbon tet and oiled during reassembly. Possibly a new idler wheel may be required and, in extreme instances, a new cutter cartridge. These items are not expensive and will prove worthwhile.

If you would like new equipment, disc recorder decks are available at reasonable prices. Many are three-speed units, a valuable feature.

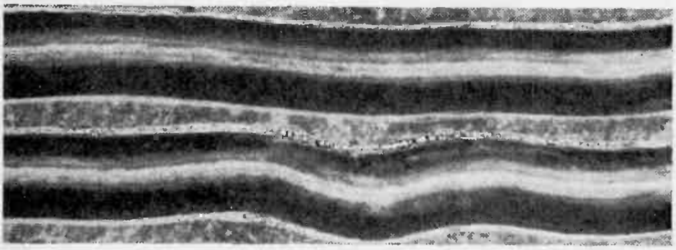
In buying a new deck, or when replacing an old cutter head, you have a choice of a crystal or a magnetic cutter. It should also be determined which type of work you prefer—standard or microgroove. Most units are available with feedscrews of different pitch to accommodate either type.

The only additional equipment needed is

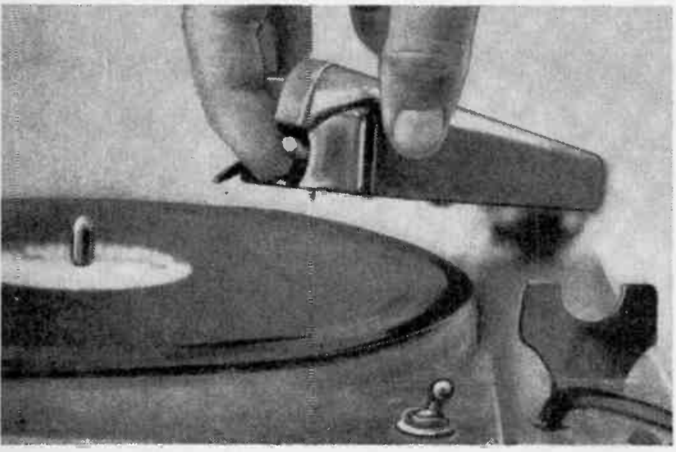




A



B



Like the cutting tool of a lathe, the stylus cuts the groove into the blank. It should be sharp, as shown (top). With no signal on cutter, grooves should be smooth and concentric as in photo A (center); in B, you will see "wiggles" cut by stylus as sound is applied to mike. The blank must be moving on turntable before stylus is placed on it. Start first cut 3/16" from edge of blank or previous recording, as shown in bottom photo.

a microphone, an amplifier, cutting stylus and recording blanks. Those who own a hi-fi rig can use its amplifier, eliminating a major expense. If you have a tape recorder, you can adapt its amplifier to render both tape and disc service. To get the most from your disc recorder, it is mandatory that a good grade of aluminum base blank be used.

Cutting styli come in several different grades. The steel styli cost less initially but are not satisfactory for quality work; they have a rather short life and cannot be resharpened. Stellite styli are in the professional category, have a life of about two hours cutting time, and are manufactured for standard groove use only. The most expensive in initial cost is the sapphire variety.

Used by major recording firms, sapphire styli cut the highest polished grooves of all. A cutting life of five to ten hours is common and they can be resharpened up to five times. When the initial cost is prorated over the life of the stylus, you will find that sapphire is economical. These styli are available in many grades and sizes. The most common for home use are called "routine" styli and manufactured with tip sizes of .001" (microgroove) and .003" (standard).

It is important to buy the correct stylus for the type of service required.

Elementary Theory. When examining the recording blank, you will see no grooves. Good quality blanks will display a flawless, mirror-like surface. The grooves, of course, must be made by the recorder.

Most disc recorder decks operate alike. After the recording arm is lifted from rest position, it will swing freely until lowered into position over the blank. At this point, the feedscrew becomes engaged, locking the arm. As the feedscrew turns, the arm moves slowly over the blank at a speed determined by the feedscrew pitch.

The stylus is very much like the cutting tool of a metal lathe, and it actually carves the groove into the blank. A sharp stylus cuts a polished, noiseless groove. Since the stylus is cutting material from the blank, a thread-like chip is thrown off.

When no signal is fed to the cutter, the grooves should appear to be absolutely concentric. As a sound signal is applied (modulation), the stylus vibrates sideways, in step with the signal reaching the cutter head. This causes the grooves to vary concentrically, resulting in a groove which possesses "wiggles" that correspond to the original sound received by the mike. During playback, these wiggles cause the pickup needle to vibrate as did the original cutting stylus.

Making a Record. When the blank is placed on the turntable, don't touch the surface. Acid from the hands will mar the smooth finish, causing surface disturbances during playback. Gently rotate the disc until the drive pin (located 1" from the center spindle) engages a drive hole.

Turn on the turntable, making sure it is revolving at the correct speed. Then place the recording arm into position. During this operation the stylus must be held up, away from the blank, thus preventing accidental breakage. *Never allow the stylus to contact the blank when it is not in motion. The turntable must be running.*

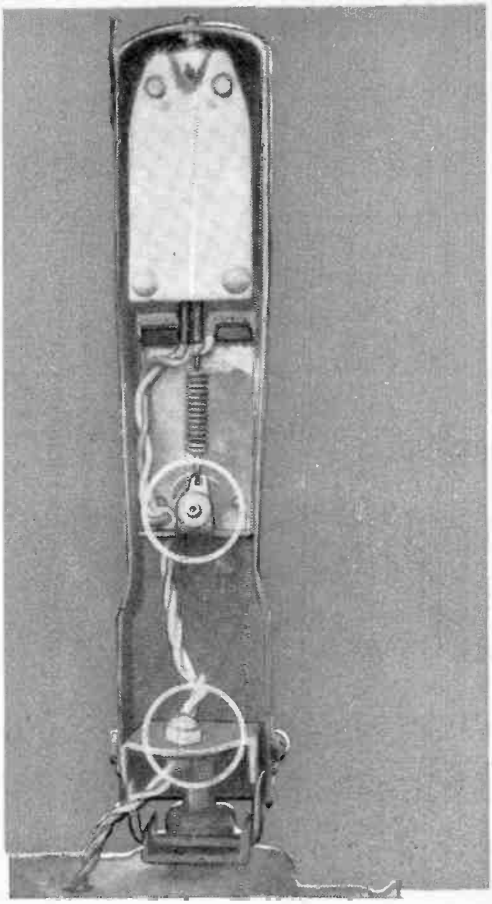
The correct stylus position when beginning a recording is 3/16" from the edge of the blank, or the same distance from the previous cut when making a disc containing two or more recorded segments. The stylus is then permitted to contact the blank and recording begins.

Adjustments. When using your machine for the first time, or changing brands of recording blank, it may be necessary to set up the cutter for correct angle and pressure.

Note that the cutter cartridge is allowed to "float" with respect to the recording arm. Cutter stylus pressure is controlled by a spring tension adjustment. The general location of this adjustment and the angle-of-cut adjustment screw are shown in photo above. The screw should be set up so the stylus lags in the direction of the blank rotation from 1° to 3°.

After the proper angle has been set, the depth of cut (cutter pressure) should be determined. Make a test cut with the adjustment screw turned all the way out to apply minimum pressure. Cut a few grooves and examine the chip thrown off by the stylus. It should have the consistency of a coarse human hair for standard groove work or a fine hair for microgroove.

The area between the grooves is known as "land." Professional standards call for a 60% land to 40% groove ratio. The finer the cutting pitch, the shallower the groove must be to maintain this relationship.



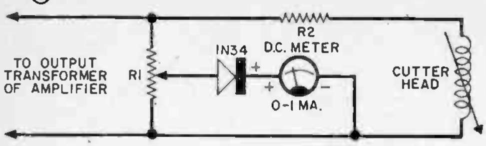
Adjustment for angle of cut (bottom circle) and depth of cut (top circle) are generally in the areas indicated in this underside view of the arm.

Several cuts will probably be necessary to reach the exact setting of spring tension. Be careful not to apply too much pressure since it is easy to cut through the coating and strike the metal base. This may dull the stylus beyond further use until it is resharpened.

It is suggested that the less costly styli be used for testing. Be sure the test stylus is the same length as the regular one so that your adjustments remain true.

Sound Level. Having determined the correct depth of cut, the next step is to set up the proper sound level to be applied to the disc. In practice, several factors determine the maximum modulation that can be used.

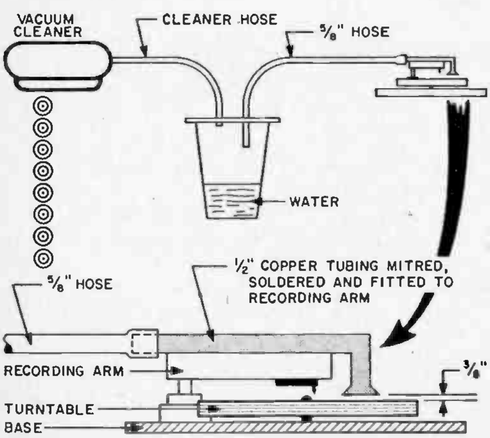
Too much audio level will result in distortion because of wide groove excursions that cannot be traced faithfully by the playback needle. If the groove varies too much, the cutting stylus will cut into the adjacent groove, causing severe distortion;



	CUTTER HEAD IMPEDANCE	
	15Ω	500Ω
R1	150Ω	5K
R2	15Ω	500Ω

This simple circuit takes the place of a costly vu meter for recording applications. R1 is an audio taper potentiometer used for calibration of the meter.

Chips may cause the cutter to skip, or be responsible for distortion. Proper method for brushing away chips is shown here. An old, soft brush will do nicely.



You can build this chip remover easily from a vacuum cleaner, inexpensive hose and copper tubing (details on p. 105).

in addition, this condition will encourage the playback needle to jump or repeat the same groove.

Maximum permissible level for 33.3- or 78-rpm standard groove work will be greater than for 33.3- or 45-rpm microgroove fine-pitch work. The level usually turns out to be about 8 db less for microgroove.

A properly modulated groove is shown on page 44. Close observation with a magnifying glass is satisfactory as far as modulation checks are concerned. Place the recording in a well-lighted area and focus so that the surface, not the grooves, reflects light to the eye. With the disc about six inches away from the eye, the groove land structure should be readily visible.

After determining the correct signal level by this method, you will need some means of measuring the signal while recording. Commercial recording companies use costly vu (volume unit) meters.

Shown above is a simple circuit that will work well with any magnetic cutter, and is reliable and inexpensive.

A radio program can be used to make the initial modulation tests. When the correct level is reached, note the position of the volume controls. Since radio stations maintain a fairly constant volume level, they make an excellent sound source for level checks.

With the radio station tuned in and adjusted as before, *R1* is adjusted so that the meter swings to 80% of full scale on loud peaks, such as orchestra chords. Placing nail polish on the shaft and bearing of *R1* will assist in keeping the calibration accurate, resulting in a reliable indication for future recordings.

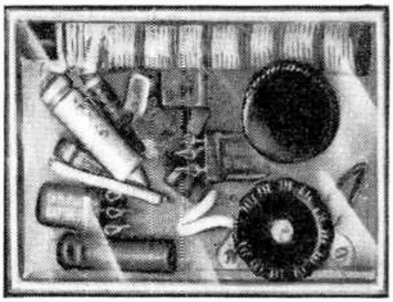
The purpose of *R2* is to help the low-frequency turnover characteristics of the cutter head. It should always be used unless you are specifically instructed not to do so by the manufacturer. This resistor also prevents overloading the amplifier at low frequencies since the magnetic cutter becomes almost purely resistive in this region.

Equalization. All cutter heads exhibit low-frequency attenuation called "turnover." In accordance with standard practice, the high frequencies must be emphasized. Standard RIAA pre-emphasis calls for 13.5-db increase at 10 kc. over that at 1 kc.

It is impossible to offer a simple circuit that would be universally acceptable for all applications. It is suggested that the treble control be advanced to about three-fourths of maximum boost during recording. In most cases, this will be close enough for nonprofessional applications. If the record-

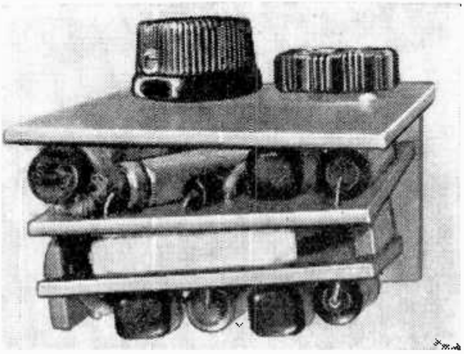
(*Continued on page* 105)

By **FRANCIS J. LEYVA**



BUILD a "Half-Pack"

Tiny transistorized receiver uses homemade printed circuits



Side view of the completed assembly. Note the small wooden spacers glued between the two printed-circuit chassis boards. The three sides and the bottom of the chassis are installed later.

WITH A POWER CONSUMPTION of about one milliwatt, and using the new miniature dynamic earphones, this receiver will deliver earsplitting volume on local stations. A little more than half the size of a king-size pack of cigarettes, its power supply is a single 1.3-volt mercury cell which is called on to supply about one milliampere of current at full volume. It needs no external antenna, although one can be employed in low-signal areas.

Two printed-circuit boards (*PC1* and *PC2*) are used (see parts list). Cut out the laminate to sizes shown in templates on page 49. Clean the two boards with steel wool until they are shiny. With a straightedge and compass, transfer the conducting lines to the laminate board. The width of the conductor strips should be about 1/16", and the connection points should be about 1/8" in diameter.

Use the dark areas on the templates as guides when applying the resist. To make the connection points for the transistors close together, draw a line about 1/2" long with a ball-point tube, or put down a strip of tape and divide it into three parts with a razor blade. These parts become the terminals for the transistor leads.

If you use liquid resist and a brush, or a ball-point tube, trim the lines with a razor blade after they have dried. This will improve the looks of the board, and minimize

HOW IT WORKS

The first transistor *(TR1)* is an r.f. type used as a grounded-base regenerative reflex detector. Antenna coil *L1* picks up a radio signal and induces an identical signal in the tickler coil *(L2)*. The latter feeds this signal to the emitter of *TR1*. The signal is amplified and passes through *L1*, which is in the collector (output) circuit. As a result, a large signal is induced in *L2* and the cycle repeats itself. This is what causes regeneration.

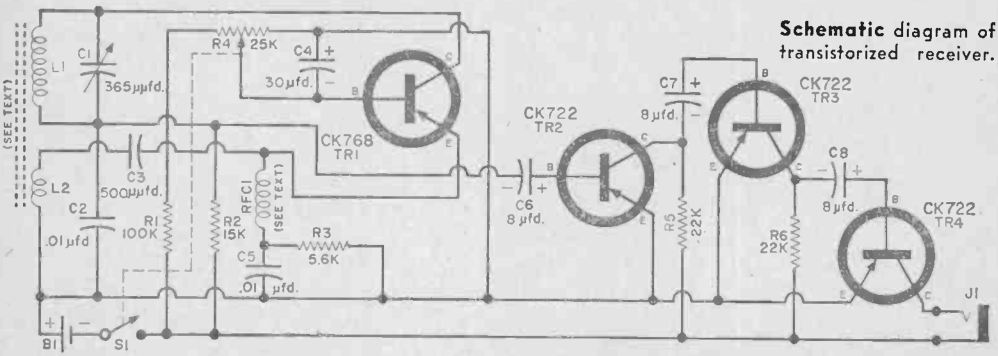
That part of the r.f. signal induced in *L2* is detected by the emitter and base junction of *TR1*. The audio voltage developed across *R3* and *C5* is reapplied to the emitter and base, amplified, and coupled to the CK722 transistor *TR2*.

TR2, TR3 and *TR4* form a simple three-stage audio amplifier. It differs from many other transistor amplifiers in that the bases have no bias resistors. The collector leakage current and the minute current leaking through the coupling capacitors is all the bias current that is needed for the small signals that are handled.

go along. They are all mounted on the non-etched side of the board with the exception of *C1, R1,* and the battery holder.

Soldering. If all parts fit well, solder them in place with hot, well-tinned, small-tip soldering iron or gun. Use a special printed-circuit solder such as Print-Kote because its low melting point reduces the danger of overheating the etched board and components.

When soldering the parts in place, always hold the leads close to the parts with long-nose pliers to dissipate excessive heat. Make sure that you *don't* have the transistors in place when soldering the flea clips to the conductors. After the parts are soldered in place, clip off the excess lead with end nippers or a nail clipper.



Schematic diagram of transistorized receiver.

the danger of accidental shorts between the closely spaced conductors.

Etching and Drilling. After the resist has dried, put the boards in the etching solution. They should be ready if you use the cold etching method.*

Next, drill the holes for mounting the components. All are made with a 1/16″ drill, except the mounting holes for the tuning capacitor (*C1*). Two of these holes are 1/8″ in diameter and countersunk from the non-etched side of the board. The hole for the shaft of the same capacitor is 1/4″ in diameter and countersunk from the etched side of the board. Although the flea clips are intended to be mounted in 3/32″ holes, it is better if only the smaller bottom part is fitted into the 1/16″ holes.

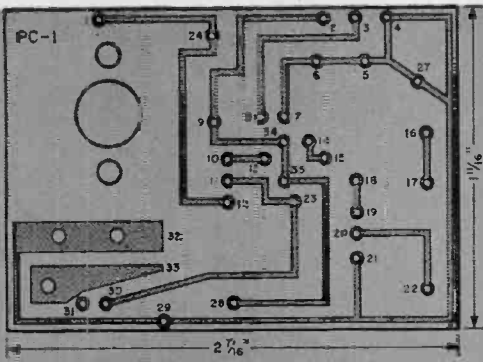
Follow the lists of connections (two numbers or letters indicate that a component should be connected between these two points, and a single letter designates a terminal such as one of the transistor electrodes or a battery terminal), and insert all the components in their respective positions but do *not* solder them in as you

---

* For detailed information on making printed circuits, see "'Printed Wiring' Techniques for the Experimenter," Part 1 in the August 1956 issue of POP'tronics, and Part 2 in the September 1956 issue. Also see "Simplified Etched Circuits" in the June 1957 issue.

PARTS LIST

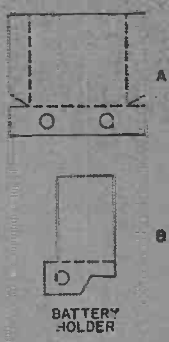
B1—1.3-volt mercury cell (Mallory RM-630)
C1—365-μfd., single-gang, midget variable capacitor (Argonne Poly-Vari-Con)
C2, C5—0.01-μfd. subminiature capacitor (Aerovox P832)
C3—0.0005-μfd. subminiature capacitor (Centralab DM-501)
C4—30-μfd., 6-volt electrolytic capacitor
C6, C7, C8—8-μfd., 6-volt electrolytic capacitor
J1—Miniature jack (Telex 9240)
L1—50 turns of #22 s.c.e. wire on 1/4″ x 2 3/8″ ferrite core (Lafayette MS-331)—see text
L2—Six turns #22 s.c.e. wire on same core
L3—R.f choke (winding from a discarded miniature i.f. transformer)
PC1, PC2—XXXP printed-circuit copper laminate board (one 2″ x 4 1/4″ section cut in two parts—1 11/16″ x 2 1/16″ for PC1 and 1 11/16″ x 2 5/16″ for PC2)
R1—100,000-ohm resistor, 1/2-watt resistor
R2—15,000-ohm, 1/2-watt resistor
R3—5600-ohm, 1/2-watt resistor
R4—25,000-ohm subminiature volume-regeneration potentiometer (Lafayette VC-45)
R5, R6—22,000-ohm, 1/2-watt resistor
S1—S.p.s.t. switch (on R4)
TR1—CK768 transistor
TR2, TR3, TR4—CK722 transistor
1—6-oz. bottle of etching solution (Lafayette PE3)
1—Roll of resist-tape or ball-point tube (Lafayette PRT-2 or PRTL)
12—"Flea" clips for soldering contacts
Misc. eyelets (0.062″ in diameter by 0.093″ long); tin, copper or brass for battery holder; plastic cabinet

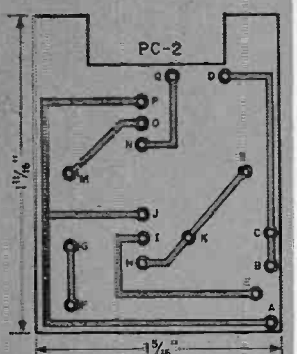


CONNECTIONS FOR PC1

1—Top of antenna coil
2—Bottom of antenna coil
3—Top of tickler coil
4—Bottom of tickler coil
5 and 15—R3
6 and 14—C5
7 and 34—C2
8 and 13—C3
9—Top terminal of C1
10—Emitter of TR1
11—Base of TR1
12—Collector of TR1
13 and 15—L3
15 and 18—R5
17 and 26—Jumper wire
18—2" wire to G of PC2
19—Collector of TR2
20—Base of TR2
21—Emitter of TR2
22—C6 (pos. terminal)
23—C4 (neg. terminal)
24—C1 (bottom terminal)
25 and 31—R1
25 and 35—R2
25—Wire to PC2, Point B
26—S1 (either terminal)
27—C4 (pos. terminal)
28—C6 (neg. terminal)
29—Wire to PC2, Point A
29—Right terminal of R4 (with prongs facing you)
30—R4 (center terminal)
31—Left terminal of R4 (with prongs facing you)
32—Positive terminal of battery holder (Part A) —see text
33—Negative terminal of battery holder (Part B) —see text
33—S1 (remaining terminal)

Printed-circuit boards PC1 (above) and PC2 (below) are assembled after components are mounted (right). The battery holder parts (A and B, below) are cut from sheet metal and bent as described in text; folds should be made on the dotted lines.





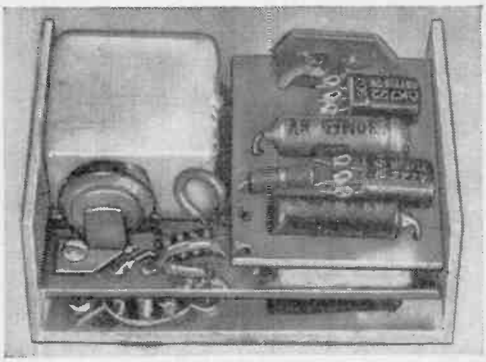
CONNECTIONS FOR PC2

A—Wire from 29 of PC1
B—Wire from 25 of PC1
C and K—R6
D—Wire to one terminal of J1
E—C7 (pos. terminal)
F—C7 (neg. terminal)
G—Wire from 18 of PC1
H—Collector of TR3
I—Base of TR3
J—Emitter of TR3
L—C8 (neg. terminal)
M—C8 (pos. terminal)
N—Collector of TR4
O—Base of TR4
P—Emitter of TR4
Q—Remaining terminal of J1

Antenna coil *L1* is wound on a piece of ferrite core which measures 2⅜" x ¼" in diameter. This coil consists of 50 turns of #22 single cotton enamel wire, and the tickler coil (*L2*) is made from six turns of the same kind of wire. Wind both coils immediately adjacent to each other and in the same direction; otherwise you won't get positive feedback and the detector won't oscillate.

The battery holder consists of two parts: part *A*, the positive terminal, connected at 32; and part *B*, the negative terminal, connected at 33. Trace the pattern of these parts as shown in the diagram (below, left) on brass, tin or copper; then cut them out. Bend them on the dotted line toward you while you hold the parts as shown. Mounting holes for the battery holder are also 1⁄16" in diameter, and terminals are riveted to the board using small eyelets or miniature screws and bolts.

Housing. Either a home-built or commercial cabinet may be used for the transistor radio. Pieces needed to construct your own cabinet can be cut from a clear polystyrene sheet. The front and back of the case shown measure 1⅞"x2⅝", the top

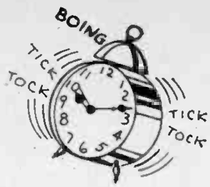


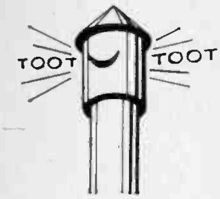
and bottom are 1"x2⅝", and the sides measure 1"x1¾". Glue the pieces together temporarily using household cement, but leave the back off.

Place the completed "Half-Pack" inside the case and mark the spots for the shaft of *C1* and the regeneration control (*R4*). Drill the ¼"-diameter hole for the shaft and another one for the starting hole of *R4*. With a ⅝" chassis punch, score a ⅝"-diameter circle in the plastic. Cut out the circle with a jigsaw and smooth the edges of the hole with a round file. The subminiature control specified in the parts list should fit snugly. Fasten it to the panel with small nuts and bolts through the on-off switch tabs.

The pieces of the box can now be cemented together permanently. Place the radio inside and drill the mounting holes for *R4* and earphone jack *J1*. —30—

TRICK TONES





from A.F. OSCILLATORS

A handful of parts makes novel sounds that imitate familiar objects

By FRANK H. TOOKER

SIMPLE audio oscillators are fascinating devices. Different circuits and component values will let you hear an almost infinite variety of tones—some high in pitch, some low—some of a pure, flat tone, others rich in harmonics—some pleasant, others harsh and irritating.

Practical applications are almost limitless. You can make a modulator for an r.f. signal generator or tone-modulated transmitter, a musical doorbell, electronic organs and other musical instruments. Other possibilities include code-practice oscillators, tone generators for audio equipment testing, and special electronic sound effects producers. You can obtain tones that sound like motor boat or airplane engines, train whistles, fog horns, ticking clocks or even a dripping faucet.

Such an audio oscillator usually works best with a small or inexpensive transformer, as larger and more costly units tend to produce only low tones. Try one of the little transistor transformers having a 3000- to 5000-ohm center-tapped primary and a 1000-ohm secondary. Half the fun comes from trying several sizes and makes of transformers, because different transformers give different results.

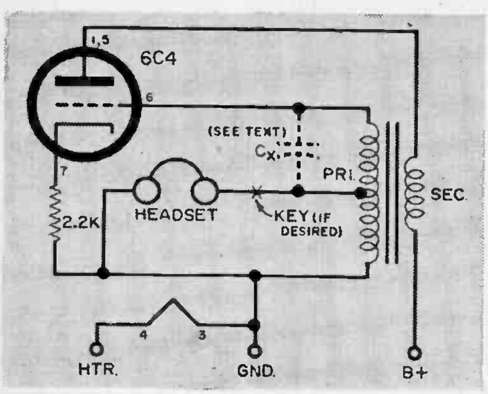


Fig. 1. "Whistler" circuit produces a variety of high-frequency audio tones.

The "Whistler." The circuit of Fig. 1 produces a high-pitched tone when the capacitor (*Cx,* shown dotted) is left out. When you want lower tones, put in the capacitor. Its value can be from 0.001 μfd. (which lowers the tone slightly) to 0.25 μfd. (which mellows the tone and brings the frequency down to a few hundred cycles).

If several capacitors are connected here, each with its own push-button switch, you have the beginnings of a musical instrument. To use the circuit for code practice, connect a key in series with the headset at the point marked "X" in the diagram.

The "Growler." For lower-frequency pulse-type sounds, try the circuit of Fig. 2. When resistor *R* is about 4.7 megohms and

(*Continued on page* 108)

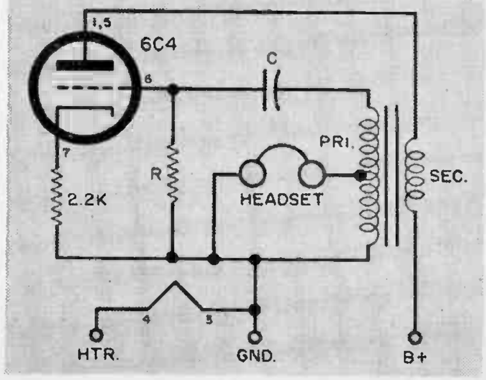
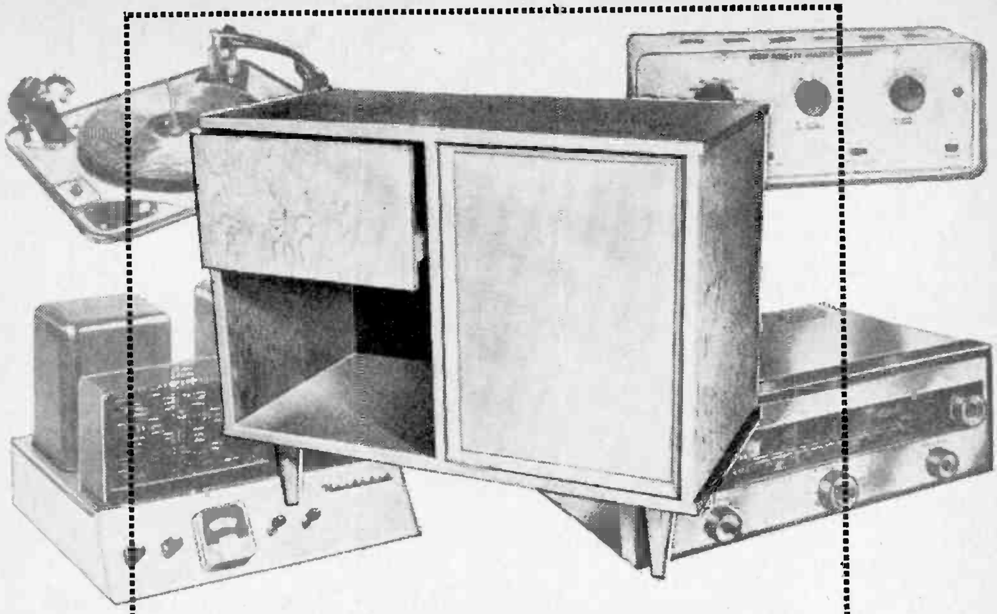


Fig. 2. Lower-frequency tones can be developed by this circuit arrangement.



Where to Hi-Fi

By JEFF MARKELL

Make an attractive enclosure for those scattered chassis

ALTHOUGH the general trend is toward smaller audio components, there is still a considerable need for equipment enclosures with reasonably large accommodations for electronic chassis. This is due to the growing popularity of higher powered amplifiers, which tend to increase in size in direct proportion to their higher power.

At the same time, many people are cramped for space and want to house their equipment as compactly as possible yet keep it in something that will look well and blend with their furniture. The cabinet shown here is offered as an answer to this need.

This unit is designed to "standard case dimensions" and should fit in with what you already have. It is easy to build with a minimum of labor and simple tools. All major joints are butts requiring no fancy milling.

The cabinet is made of ¾" plywood with the exception of the legs, control panel, back, control panel molding and facing strips. Depending on your requirements—and your pocketbook—it can be made either in a good-quality veneered plywood and furniture-finished, or in "utility" fir and painted.

Facing strips (¾"x¼") cover all of the exposed plywood edges on the front, and run back along the top and bottom edges of the sides. THey cover all of the visible plywood cores and all of the visible fastenings.

Basic parts can be cut from a stock 4'x8' panel, as shown in the cutting diagram, which can be bought at a lumberyard. You can also get the lumberyard to cut the panel for you. They may charge for this service, but it is usually moderate and will be well worth your while.

Glue and screw two of the ¾" x ¾" x 16" cleats to the inside top edges of the sides. If you first drill clearance holes for the screws, and countersink for the screwheads in the cleats, you'll find that the fastening goes quickly. The screws alternate, first one into the side, then one going up. Space your screws about 2" apart, and drill and countersink the holes for the ones going up at the same time. You'll need them later for fastening on the top.

Be sure that you fasten the cleats flush with the top edges of the sides, and also flush with the back—not the *front.*

Then attach the sides to the bottom. To do this, first drill and countersink for your screws on a line 3/8" up from the bottom of each side. Again space the screws 2" apart. Glue and screw the sides to the bottom, making sure that all three front edges are flush with each other.

If—through some minor error in cutting—the back edges are not quite flush, don't worry about it. Be certain that the bottom is flush with the bottom of the sides.

Handle this U-shaped assembly with care until you have attached the top, which is done by gluing and screwing through the cleats previously attached to the top of the sides. Again—be careful to line up your front and side edges. It may be easier to attach the top with the cabinet upside down on a large table.

Inserting the center partition comes next. As shown in the drawing on page 53, it is held at the bottom by screws coming up from underneath and at the top by a cleat. It is important that this partition be positioned accurately in the center, and aligned parallel with the sides, or you might come to grief when you fit out the cabinet for your equipment.

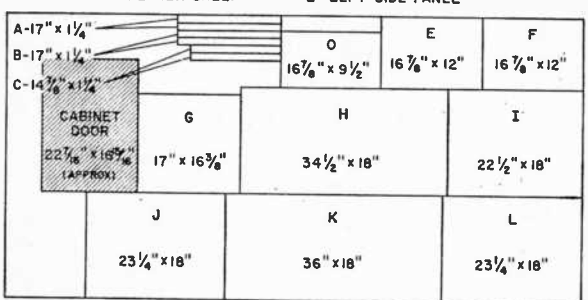
Except for the back, which goes on the left-hand side only, the basic case is complete. Before you put the back on, check your corners with a carpentry square to be sure they are right angles. If you were careful, the angles will be exact or pretty close. If they should be a bit off, you can force them into alignment and then use the back to hold them by screwing the back in place all around.

Now fit out the cabinet in accordance with the equipment you want to house. I started with the upper left-hand compartment which contains the record player.

Most record players come supplied with a template for the cutout to be made in the mounting board. After you have made the necessary cutout, assemble the rest of the drawer, except for the front. You will now have a four-sided frame with the mounting board, including its cutout, on the top.

Cutting pattern below gives exact dimensions, except for door.

A-DRAWER SLIDE CLEATS
B-DRAWER SIDES
C-DRAWER ENDS
D-DRAWER FRONT
E-TUNER SHELF
F-OPTIONAL AMPLIFIER SHELF
G-RECORD PLAYER MOUNTING BOARD
H-BOTTOM PANEL
I-CENTER PARTITION
J-RIGHT SIDE PANEL
K-TOP PANEL
L-LEFT SIDE PANEL



¾" x 4' x 8' PLYWOOD PANEL

You will see two cleats in the drawings that must be installed in the cabinet before the drawer can be mounted. Align these carefully before installing them so that they are both the same distance up from the bottom.

The drawer slides used to attach the drawer to the cleats are Grant Pulley & Hardware Type "A." If for some reason you can't find that particular brand, don't worry about it. Get as exact an equivalent as possible. The slides from different manufacturers don't vary much in size.

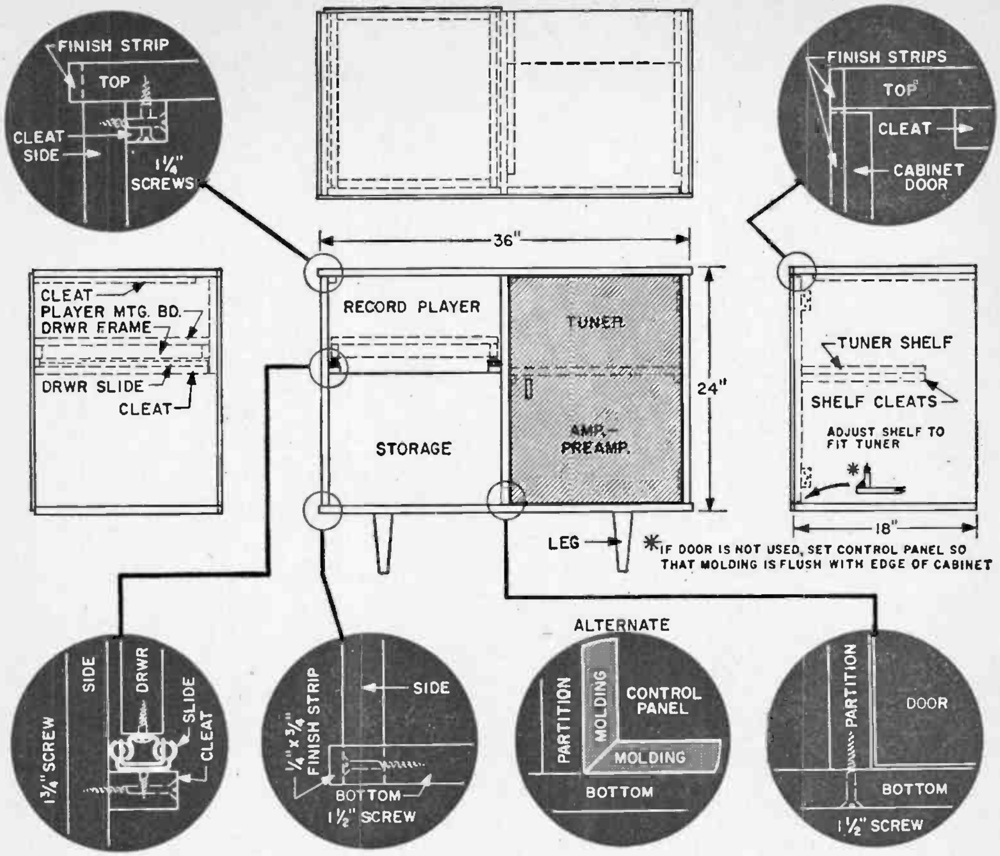
Using the slides, install the drawer on the cleats, with the drawer front still left off. It will probably need a little fitting, planing a bit here and there so that it goes nicely into the required opening, and does not bind as the drawer is moved in and out. It should then be attached by screwing through the drawer frame from the inside so that the screws won't show.

Dimensions of the drawer compartment above and below record player mounting level, as shown in the drawing, are for record changers. If you're using one of the single-play turntables, you may find that the mounting level should be raised by three or four inches. There is no problem here. Merely set higher the cleats to which the drawer slides are mounted.

Since the lower left compartment is open for record storage, the drawer can be pulled

BILL OF MATERIALS

1—4' x 8' panel of ¾" plywood (for basic parts)
1—22½" x 16⅞" section of ¼" plywood (back panel)
1—23¼" x 17⅝" section of ¼" plywood (control panel—optional)
3—¾" x ¾" x 16" clear pine cleats (top)
2—¾" x ¾" x 12" clear pine cleats (tuner shelf)
18—Feet of ¼" x ¾" facing strips (wood type to match ¾" panel)
7—Feet of ½" x ½" slant molding (wood to match control panel if used)
1—Pair of 16½-12½ Grant "A" door slides (or equivalent)
4—1¾" to ¾" x 6" round-taper wood legs (these may be any height, or wrought iron or brass may be used instead)
42—1¼" #8 flat-head wood screws
30—1½" #8 flat-head wood screws
6—1¾" #8 flat-head wood screws
8—¾" #8 round-head wood screws
36—¾" #8 flat-head wood screws
1—Box of ¾" #20 wire brads
Misc. glue, sandpaper, finishing materials.



Construction details above should be followed faithfully to obtain best results on the finished cabinet. Note the alternate detail shown for the use of a fixed control panel rather than a door; instructions are given in text for fitting either one. Also, bottom piece is butted inside the side pieces—finishing strips make it appear otherwise.

out from underneath. If you don't want to use it for records, a number of the more compact tape machines will fit there. You could either hang a door over that part and leave the tape machine in its present case, or make another drawer. You will probably have enough material left from your plywood panel to do as you please about this.

The right-hand half of the cabinet is intended to house the other components—tuner, amplifier, preamp, etc. To fit out this side with a solid control panel, start by installing the slant molding around the front. This is held in place with glue and small wire brads.

If you have some means of clamping the molding strips in place while the glue dries, you can eliminate the brads. If you use brads, set them below the surface with a nail set and fill the holes with plastic wood so they will be inconspicuous.

Behind the molding, mount your ¼"-thick control panel, and behind that your shelf, or shelves. Remember: you need cutouts for the control panel for your equipment controls, so don't fix the panel finally into place until you have made the necessary holes. See alternate detail on construction.

If you want to cover your controls with a door, it can be made from material left over from your plywood panel and will be $22\frac{7}{16}$"x$16\frac{15}{16}$".

It is preferable to mount such a door with pivot hinges because they are the least conspicuous type available. The only problem in adding a door is the fitting; it should be cut just a hair too large, then carefully planed until it fits the opening.

To complete the cabinet, apply the ¾"x¼" facing strips. These cover all of the exposed plywood edges on the front and also cover the top and bottom edges of the sides. They are held by glue and small wire brads. Set the brads and fill the holes for best appearance.

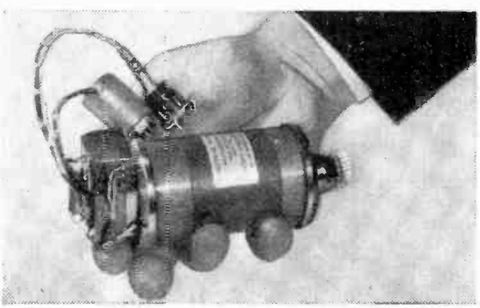
A thorough sanding of the entire cabinet with a fine grade of sandpaper should precede whatever finish you apply. —30—

"SENTRY" GUARDS UTILITY LINES

A fast-acting transistorized device has been developed to isolate faulty high-voltage lines. Such lines must be isolated within one-tenth of a second to minimize disruption of service and prevent damage. The circuit sentry shown at left sends out a tone signal which sets in motion a series of relays to actuate circuit breakers in twelve-thousandths of a second. Known as "Tru Trip," this RCA device can be used with wire line circuits or microwave radio facilities for system-wide transmission of safety-action signals. It takes up 75% less space than the usual equipment.

SPACE SPEEDOMETER

When teamed with gyroscopes, the ultra-sensitive accelerometer shown below forms an inertial guidance system for missiles, subs and aircraft. Said to be a radical departure from conventional accelerometers, its sensitivity is better than one one-hundred-thousandth of the force of gravity. It's in production at Sperry Gyroscope for the U. S. Navy and Air Force.

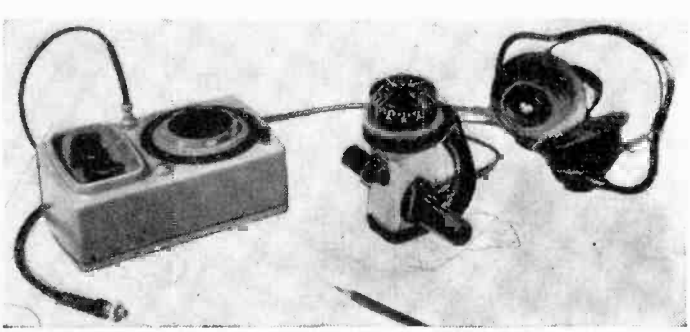


FOR SWL'S AND HAMS

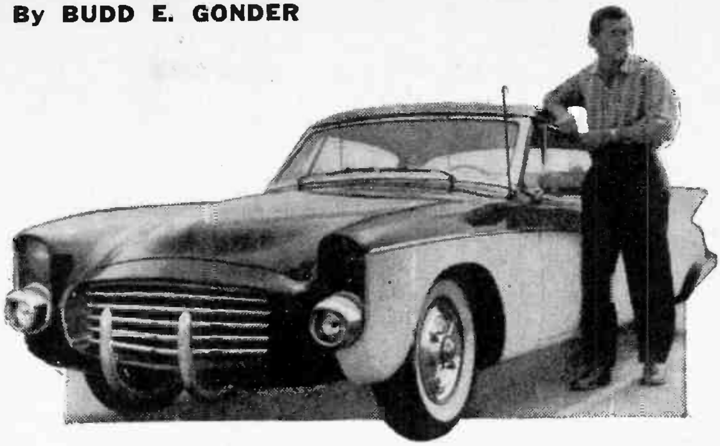
This new 13-tube general coverage receiver in the medium price field is said to give the ham or SWL all the operational advantages formerly found only in the highest price sets. The Hammarlund HQ-160 dual-conversion superhet covers the range of 540 kc. to 31 mc. in six continuously tunable bands. It has 14 tuned circuits in the i.f. to provide extremely clean side skirts. The second i.f. frequency is crystal controlled for optimum stability. A Q-multiplier is built into the unit.

LIGHTWEIGHT DIRECTION FINDER

The "Heron," an English-built radio direction finder which weighs only 1½ pounds, is accurate to within 1% (below, center). Used with the Heron is "Homer," a transistor receiver designed for receiving marine and air beacon broadcasts and weather reports (below, left). The system works by tuning the receiver to a beacon or range station, rotating the DF antenna to null point and homing on it. This equipment is made by Brookes & Gatehouse, Ltd.



By BUDD E. GONDER

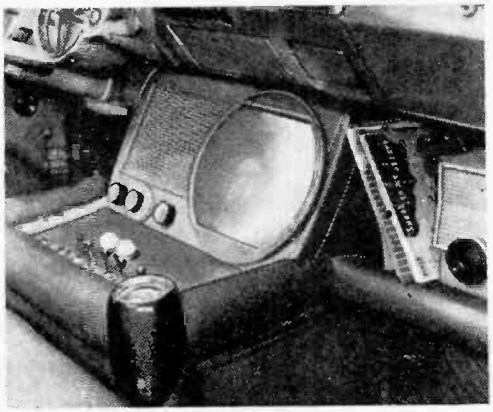


Tubes Control Car

Automatic steering and braking may be standard in future

ACCORDING to a California auto shop instructor, the "car of the future" will have: an automatic steering device which permits the driver to relax at the wheel on long cross-country trips; an automatic electromechanical braking system which will free him from giving constant attention to the road; and a ram jet flapper unit capable of propelling the car at high speeds by means of tubes—without using the main engine.

A demonstration ride in such a car with its inventor, James P. Butler, is frighteningly real. There is a frantic sensation in the pit of your stomach when Butler throws a few switches on his complicated control panel, turns loose the wheel, and sits back to watch his monitor set or listen leisurely to his hi-fi.



Control panel of car uses TV channel selector.

Electronic equipment monitors the crown of the road and controls two hydraulic cylinders located under the hood which transfer the pressure to another cylinder connected to the steering tie rods.

The inventor complains of only one thing: frequency interference. Police car transmitters and the like override the system, causing his car to veer slightly from its course. "Actually this is a minor problem," Butler said, "and can eventually be worked out."

Automatic Steering. Through the use of a secret, preset switching method, the car will turn a series of corners by itself without further attention from the driver. A push-button steering control is also offered for the squeamish who would hesitate to turn the car over completely to electronics. This is effected through two foot pedals, which are also used as emergency controls should the car fail to respond properly to the electronic controls.

The braking system employs an oscillator installed near the grille that projects ultrasonic sound waves which register on any object larger than a telephone pole and are reflected to a receiver. The receiver energizes the master brake cylinder to effect proper braking. In conformance with National Safety Council standards, the brakes are set to prevent collisions by activating at a ratio of every 10 feet for each five miles an hour the car is traveling.

Butler said that while his steering leaves room for improvement, his braking is foolproof. He drove toward a wall at

(*Continued on page* 115)

The Truth Detector

By CARL KOHLER

NO SOONER had my skilled fingers finished hooking up the modality tracers than I was fumbling for the intercom switch above the workbench.

"Hey, come in here a minute, and bring some coffee with you, will you?" I requested.

"Just as soon as I finish this fascinating chapter on 'Traumatic Shock,' " replied the Wife through the intercom.

"Listen, sister," I hissed evenly, "we're standing on the threshold of electronic history. In all probability this little item I've just completed may well change tomorrow's society. This is no time for you to keep your pretty nose buried in one of those ridiculous psychology books. Besides, I need your help."

"Did you know that 90% of our irrational fears are based upon childhood misinterpretations of fact?"

"*Schnell,* hurry," I growled crisply. "Don't come as you are. Bring coffee."

Five minutes later the door to the workshack creaked open and the delicious odor of fresh coffee preceded my spouse. I motioned her to a chair.

"Another faux pas, wired for chaos, eh?" she observed, bending a prolonged glance of instant dislike upon the newly built "Truth Detector."

"This fine instrument is genius' reply to the woeful lack of 1000% unflawed justice." I tapped the dial-panel meaningfully. "Once law organizations across the country avail themselves of my Truth Detector, crime will be erased from the face of the earth and innocent people safe from errors of investigation."

"Oh, a lie detector," she said brightly.

"No, a Truth Detector," I corrected her. "Down through the ages man hasn't sought lies. He's sought Truth. The lie detector was a definite step forward in the right direction, but my Truth Detector moves progress ahead by miles in comparison."

She studied the control cabinet with its several tracer cables in thoughtful silence, distrust in her eyes. "It looks like a nasty gismo."

"That's only because you insist upon trying to look at everything mechanical as though it possessed human or animalistic traits. A typically feminine fault." I patted her hand. "This is a harmless instrument, designed only to reveal the truth of any matter."

"What are all those wires for?" she inquired.

"Modality tracers. One each for heart, lungs, blood pressure, pulse and skin."

"Why?"

"Well, my instrument sort of gives the conventional method of determining a reaction from the person being tested a reverse-English touch. In short, this dial here only indicates reaction when a *truthful* answer is given. Otherwise, it doesn't move."

"Just backwards from a regular lie detector, huh?"

"That's one way of putting it," I agreed. "Now, if you'll just sit, perfectly relaxed, while I attach the skin electrodes, the pressure cuff and the modified pickups which I made from old stethoscopes—"

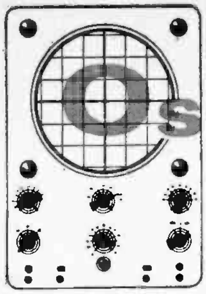
"You going to test *me?*" she yawped.

"Well, sure." I favored her with my best, winning smile. "After all, *I* have to run the instrument and it's never been tested. Surely, you aren't afraid?"

"The heck *you* say, Buster!" She leaped

(*Continued on page* 109)

. . . Swiftly attaching the tracer cables, I smiled calmly across the cabinet at my wife who sat tensely upright, obviously waiting for a searing jolt of juice . . .



Oscilloscope Traces Ignition Systems

Principles of testing ignition systems of autos or other gas engines with a C-R tube

By HOWARD BURGESS

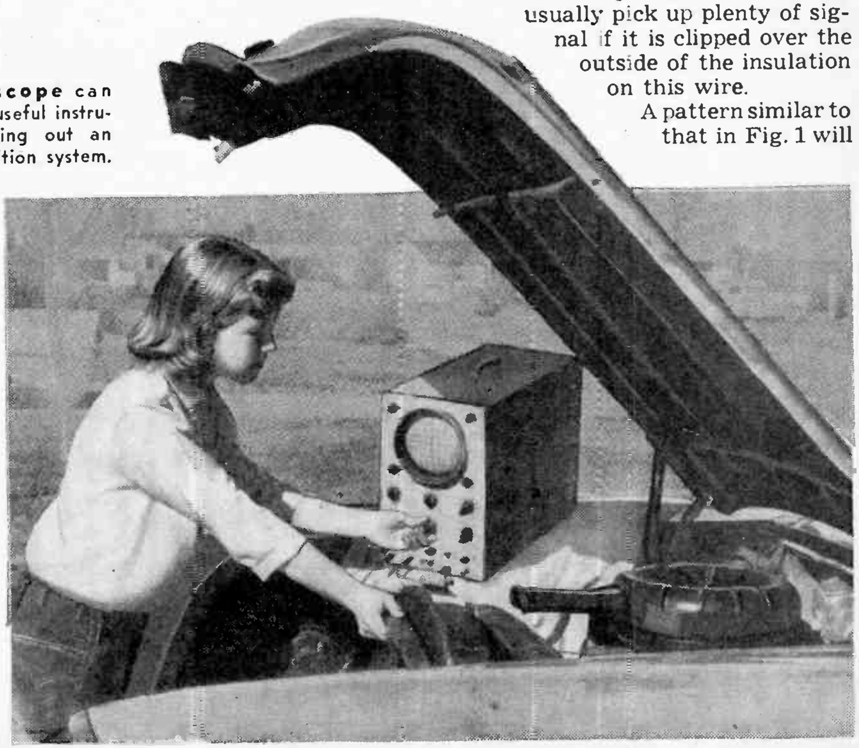
AT ONE TIME the oscilloscope belonged almost exclusively to electronic experimenters. New developments and modern merchandising methods have changed this, and scopes can now be found in very unusual places. One such application which shows great promise is in checking auto ignition systems.

The idea is not new, but only recently has the small automotive repair shop and hobbyist seen the inherent possibilities in scopes. Their sudden popularity has been due in a large part to special sweep circuits that have been developed for this work.

One of the limiting factors in using the ordinary instrument for ignition testing has been the inability of the sweep circuit to present an easily readable display of the waveform of all cylinders simultaneously. However, although the ordinary scope cannot do a complete ignition checking job, much information can be obtained with a little care.

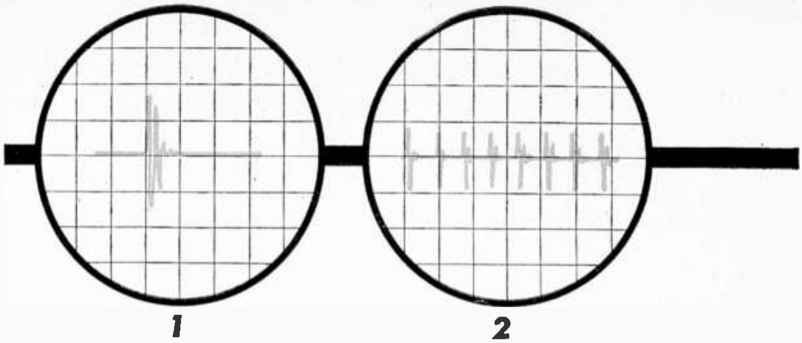
Shown in the diagram on the next page is the basic circuit of the average ignition system using a distributor, battery and high-tension coil. *C* is the high-voltage output of the ignition coil. A lead from the vertical input of the scope will usually pick up plenty of signal if it is clipped over the outside of the insulation on this wire.

A pattern similar to that in Fig. 1 will



The oscilloscope can prove to be a useful instrument in checking out an automobile ignition system.

Waveforms at check points. Figure 1 is spark plug pulse at high-voltage output of ignition coil, and Fig. 2 represents eight plugs traced on single sweep. Figure 3 shows circular sweep used on specialized instrument, while Fig. 4 indicates "dwell" time as shown by primary current. Figure 5 indicates too short dwell time, showing poor adjustment of points, and Fig. 6 shows how current waveform will indicate poor capacitor.



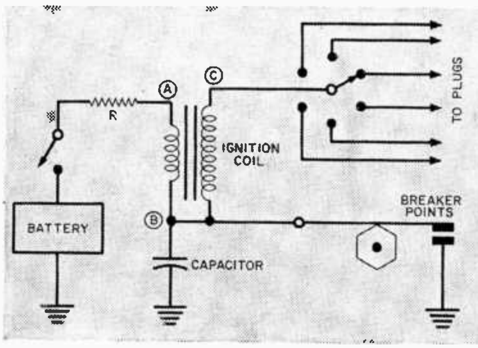


Diagram of the ignition system of the ordinary automobile. While this is a 6-cylinder car, the 8-cylinder models use the same layout. A, B and C are check points referred to in the text.

occur each time a spark plug fires. If the firing of all plugs of an eight-cylinder engine is shown on a single sweep trace (Fig. 2), conditions in each cylinder can be determined by the relative height and shape of each wave train.

Sweep Rate. It is at this point that the ordinary scope sweep can give trouble. On many scopes the slowest sweep rate is 20 per second. In Fig. 2, there are eight pulses per sweep, or 160 pulses a second. The engine will generate four pulses per revolution, which means that it must be turning over 40 times per second, or 2400 rpm, in order to give such a pattern. This is a little too fast for some types of tests.

As a substitute, the scope can be coupled to each spark plug, one at a time, and the patterns compared. (Do not clip the test lead directly to the spark plug, as the high voltage here can damage the scope.)

Variations in scopes and engines make it very difficult to set up a definite pattern as an ideal. For best results, the experimenter should observe the waveform of the spark plug in a properly operating cylinder, and any deviation from this pattern can be viewed with suspicion.

One commercial version of the engine test scope has used a circular sweep to solve the display problem. A pattern like that of Fig. 3 is the result.

Another test which is more successful with the ordinary scope is that of current waveform in the primary of the ignition coil. A very low value of resistance (0.25 ohms) can be inserted at *R* in the diagram. The voltage drop across this resistor will follow the pattern of the current and can be applied to the scope. In many cases the resistor can be omitted and a direct connection made from point *A* on the coil to ground. There will be enough voltage drop due to the resistance of the ignition switch and associated wiring to give a good pattern.

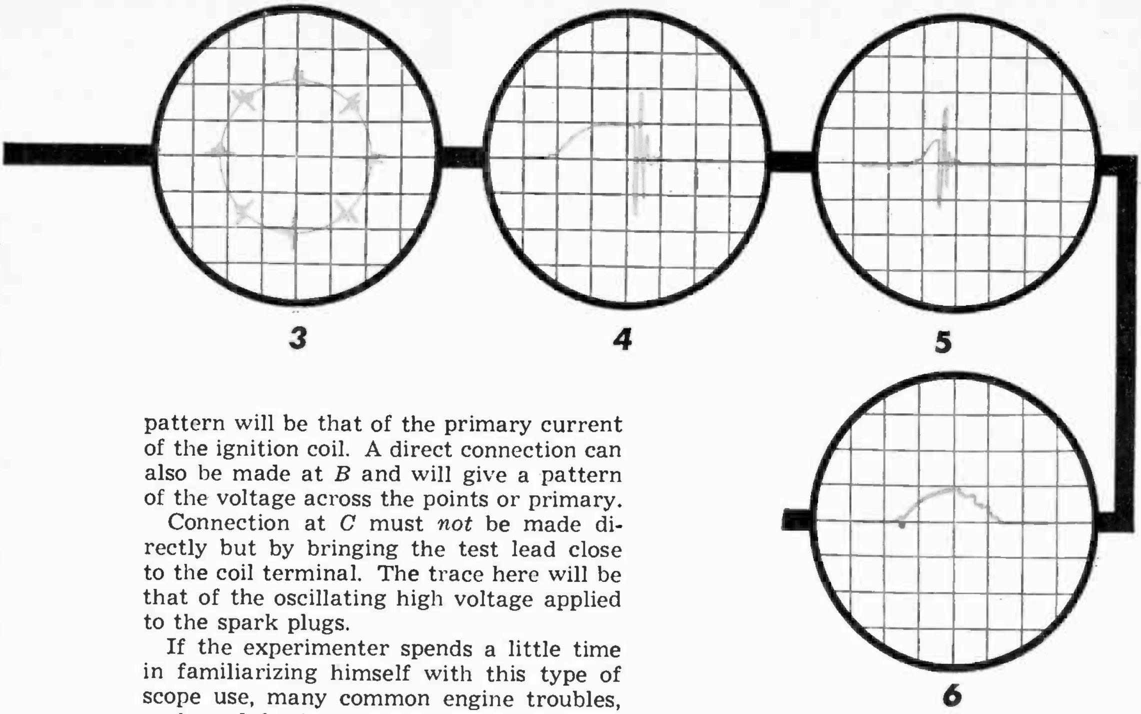
Dwell Time. For proper operation of an ignition system, the points should remain closed long enough to let a magnetic field build up in the coil. This period is called "dwell."

Figure 4 is a trace of the current as it builds up in a curve until it reaches a flattening-off point. This is followed by the opening of the points and the firing of the plug. For correct operation of the engine, the current must always reach the leveling-off area on the curve before the points open.

As the engine speed is increased, the flat portion gets shorter; and if the points are improperly adjusted, the firing time can shift so far back that the points will open during the steep portion of the curve. Such a pattern is shown in Fig. 5. When this happens, the efficiency of the engine is reduced due to poor spark.

A trace of the same primary current will show up other difficulties as well. Among them may be a trace such as that in Fig. 6. This waveform with the reduced spikes at the firing point indicates a poor capacitor across the points.

How to Measure. Measurements can be made at *A*, *B* and *C* in the diagram. A direct connection can be made at *A* and the



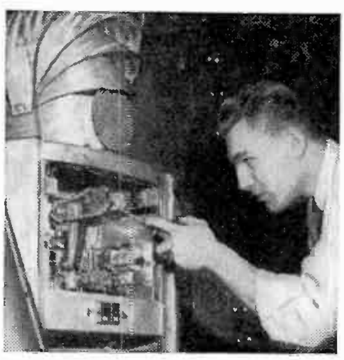
pattern will be that of the primary current of the ignition coil. A direct connection can also be made at *B* and will give a pattern of the voltage across the points or primary.

Connection at *C* must *not* be made directly but by bringing the test lead close to the coil terminal. The trace here will be that of the oscillating high voltage applied to the spark plugs.

If the experimenter spends a little time in familiarizing himself with this type of scope use, many common engine troubles, such as defective plugs, coils, switches and capacitors, can be spotted quite easily. In time, even such faults as bad timing, worn parts and valve trouble can be located because they all reflect back on coil operation and waveform.

The adventuring soul may find it quite profitable to try the high-voltage probe or even the demodulator probe in such work. This is one use of a scope in which success depends to a great extent upon the ingenuity of the operator. —30—

TAKE ME TO YOUR LEADER!



The startled expression on the face of the young lad at far right might be due to the command of the robot, Thodar, who seems to have escaped from his master and builder. A 23-year-old electronics expert from Brooklyn, Ronald Hezel is shown at right making interior adjustments on the 282-pound behemoth. He spent $1000 in building the radio-controlled robot, which walks and talks and will run for 28 hours on battery power. It took him years to finish the seven-foot mechanical-electronic man. Although Thodar has a cruising range of about a mile and a half, Hezel is not entirely satisfied. He is now at work on another robot.

SINGLE-STICK ANTENNA

TOMMY waved a piece of paper under my nose. *"Look at this!"* he exclaimed.

I sniffed the paper suspiciously. *"What is it?"* I asked. *"An autographed photograph of Elvis?"*

The young Novice laughed. *"No, but it's almost as good! It's a sales slip from the radio store. Guess what I bought."*

"Well, I guess you bought a . . . a . . ."

Tommy interrupted me before I could collect my thoughts. *"I just got a nice, shiny 55' crank-up tower! I saved all my Christmas money and bought a TV tower. As soon as I get my General Class ticket—ZIP! Up goes a beam antenna. Meanwhile, I want you to fix me up with a real dandy tri-band Novice antenna to go with the tower."*

"I suppose you want an eighty-meter rotary beam to put on the tower," I sighed, turning off my receiver. *"Seems as if every time the band opens for DX you come over here with some nutty idea."*

"Not at all," he replied, calmly sitting down and putting his feet on my desk. *"All I want is a simple, cheap, effective antenna for the 80-, 40-, and 15-meter Novice bands. It must be good, and it must be cheap to build. Above all, it must be cheap. You see, I spent all my money on this tower."*

"All right," I replied decisively. *"You are a lucky lad. My pal W6LGU just put up a three-band antenna that will fit you to a 'T.' If you treat me real nice, I'll fix you up with a good idea in a few minutes."*

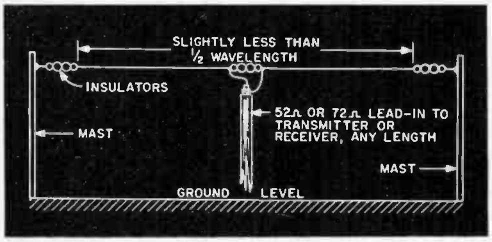


Fig. 1. "Old Faithful" dipole is large for the 80-meter band.

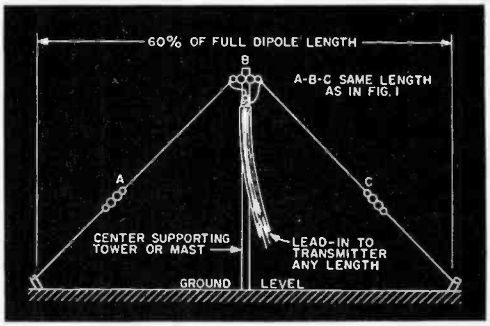


Fig. 2. Only one supporting mast is needed with this antenna.

Antennas are a continual problem, not only to the Novice but to the General Class amateur. They are big. They occupy room. Worst of all, when an attempt is made to miniaturize an antenna, or to crowd it into a restricted space, the efficiency of the antenna drops rapidly. The 80-meter Novice operator knows this sad fact only too well. His dipole antenna is about 125' long, and this is a mighty big antenna to place on a city lot!

The advent of television brought onto the market a large variety of inexpensive crank-up towers, ranging in height from 40 to 120 feet. The 100' monsters are relatively expensive, but their shorter counterparts are much cheaper, doubtless because they are purchased in much larger numbers.

A typical TV crank-up tower is a three-sided affair having two movable sections inside and concentric with the lower section of the tower. When the user cranks a winch at the base of the tower, the two upper sections raise majestically in the air, carrying the TV antenna aloft.

Such a tower requires two sets of guy wires. The first set is placed at the top of the tower, and the second set is placed at the center joint of the tower. Purchase of an unguyed tower is unjustified, since the tower must be made many times stronger to stand free with no external support.

"Great, great," said Tommy impatiently. *"But what's this palaver got to do with the tri-band antenna? Get to the point!"*

"Relax, little Toot. I am getting to the point. Just concentrate on those tower guy wires. Concentrate. . . ."

The simple dipole antenna (Fig. 1) is popular with many Novice operators. What is not so well known is that some unusual things can be done to the dipole without hurting its operating efficiency. In particular, the end sections can be bent about without harm to the antenna. The center section of the antenna does most of the work, and the end sections merely tag along for the ride.

SAVES SPACE

By WILLIAM I. ORR
W6SAI

For the 80-, 40- and 15-meter bands, this antenna requires only a single pole or tower, and a minimum of room

Now bend the dipole down upon itself, as in Fig. 2. This antenna will work almost as well, but the over-all length is much less.

If we continue this process, we will eventually end up with two sections of the antenna in a vertical position. At this point, we have out-foxed ourselves, since the energy fields of the two wires cancel each other and the radiated field about the antenna is almost zero.

However, if we bend the wires down at an angle of about 45° or so, the efficiency of the antenna has only dropped about 3%, but the length of the antenna is reduced almost 30%. In addition, the antenna may be supported at the middle and the ends can be tied off very close to the ground.

"I get it! I get it!" cried Tommy, hopping off the stool in his excitement. *"You use two of the TV tower guy wires for a doublet antenna! Run the feedline up the tower to the top and attach it to two guy wires! Insulate the guys at the bottom ends—"*

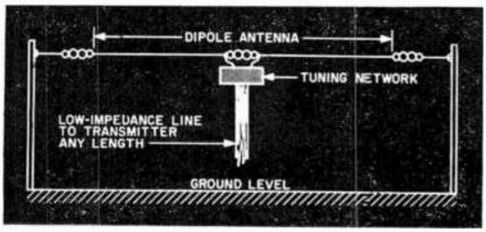


Fig. 3. Dipole antenna operates over a wide frequency span if an adjustable tuning network is placed between the dipole and the feedline.

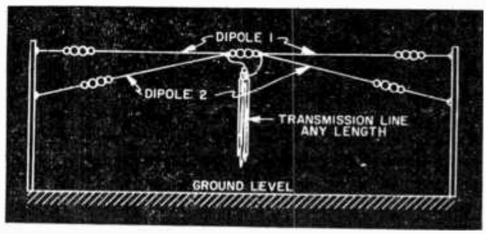


Fig. 4. Two dipoles in parallel must have widely different resonant frequencies for best operation.

"Hold on!" I interrupted. *"You're miles ahead of me. You wanted a three-band antenna system, didn't you?"*

Tommy sat down on the stool once again. *"Lets go,"* he said impatiently.

Any dipole antenna can be efficiently matched to a low-impedance coaxial line at the center point. It will then operate over a narrow span of frequencies, such as a single amateur band. To make the dipole work over a very wide band of frequencies, it is necessary to place some kind of adjustable network between the transmission line and the dipole, as shown in Fig. 3.

This frequency limitation of the dipole can work to advantage in that it is possible to attach two dipoles having widely different resonant frequencies to one transmission line (Fig. 4). When energy of one frequency is fed to the double dipole, only the dipole tuned to that frequency will be resonant. It will radiate power. The other dipole—being widely detuned—will do little or nothing.

When the frequency of the radio energy is changed to the resonant frequency of the second dipole, it will radiate and the first dipole will become inactive. If the two dipoles are cut so as to resonate in the 80- and 40-meter bands respectively, a two-band antenna is produced.

If the ends of the dipoles are allowed to droop, the antenna can be supported with a single pole. In effect, the double dipole becomes a set of top guy wires for the pole, or tower.

"Sounds fine," remarked Tommy, who had enmeshed his legs in the rungs of the stool and now resembled the statue of the Laocoon group fighting the serpents. *"Doesn't the parallel connection affect the operation of the dipoles? Seems to me that the unused one would gum up the works!"*

"Well, there is interaction between the dipoles," I admitted. *"However, it is of a very small order, and unless you have the proper instruments to measure the characteristics of the system, you could never tell from the operation that we have resorted to such a scurvy trick on the poor dipoles. I used a system like this for my skeds with Oakland, Calif., and the reports were as good as with my full-size dipole."*

Another interesting aspect of the center-fed dipole antenna is that it is self-resonant at the third harmonic of the operating fre-

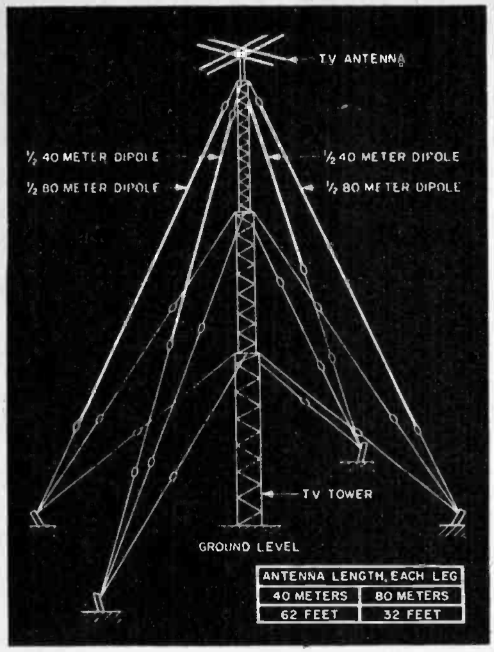
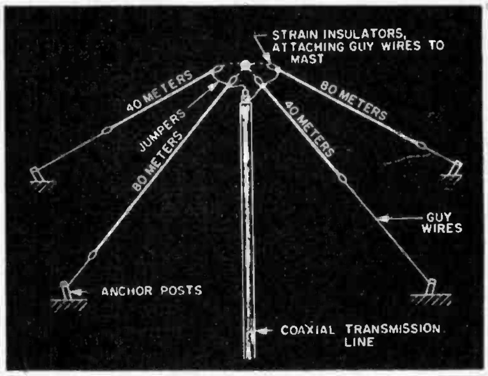


Fig. 5. The two dipoles can be bent down and supported from a single central tower. The antenna wires become guy wires.

Fig. 6. Schematic diagram of electrical elements of antenna.



quency. This means that a dipole cut to 3.7 mc. is again resonant and capable of good operation at 11.1 mc., and the 7.15-mc. dipole is resonant at the third-harmonic frequency of 21.45 mc. This is very close to the Novice 21-mc. amateur band. If the 40-meter dipole is cut a bit shorter than optimum, the third-harmonic resonant frequency will fall within the 15-meter (21-mc.) Novice band.

In this manner, the double dipole will work on three bands—80, 40, and 15 meters—with excellent efficiency on each band. Figure 5 shows the complete installation with all dimensions given. The two dipoles form the four top guy wires of an inexpensive 55′ TV-type crank-up tower.

Each dipole is made of a pair of guy wires spaced 180° apart. Place strain-type insulators at the bottoms of the "guys" to insulate the halves of the dipole. Attach the "guys" at the top ends to the tower with another pair of strain insulators. To prevent the leads from shorting out against the metal tower, make the portion of the antenna from the coaxial line to the top strain insulator out of a piece of insulated wire.

The diagonally opposite set of guy wires forms the other dipole. They are made up in the same manner and attached to the top of the tower with two more strain insulators. Connect the sections of the dipole to the coaxial transmission line with two more short pieces of insulated wire. Make sure that adjacent sections (that is, the adjacent 40- and 80-meter sections) attach to the same conductor of the coaxial line. Do not cross-connect the leads.

Electrical connections are shown in Fig. 6. The two half-dipole sections are attached to the inner conductor of the cable, and the remaining two sections to the shield. Use insulated wire for the top jumpers. Each jumper is approximately 8″ long. The guys are completed by additional lengths of galvanized wire placed between the bottom insulators and the anchor posts. When the assembly is done, tape the junction of the coaxial line and the antennas to prevent water seepage into the coaxial cable.

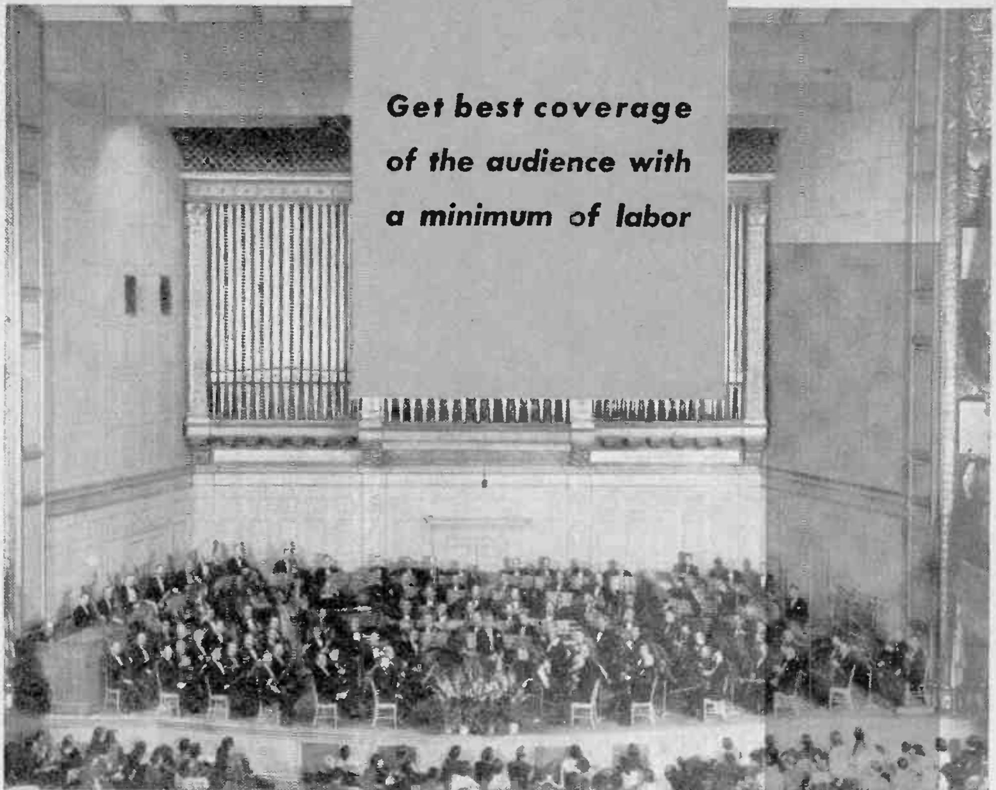
"Aren't strain insulators the same as egg insulators?" asked Tommy. *"I hear a lot of amateurs refer to egg insulators."*

"They're the same," I replied. *"The purpose of this little egg insulator is to prevent the wire from parting if the insulator happens to break. If you pop an insulator on a guy wire on a TV tower in a big windstorm, the whole works is liable to land in your lap. The strain insulator prevents that and allows you to sleep at night with a clear conscience!"*

As with any multi-band antenna system, there is a degree of impedance mismatch between the antenna and the coaxial line. This mismatch is not serious and might just as well be forgotten except for one thing: the length of transmission line required to reach from the antenna to your transmitter might present such a load to the transmitter that difficulty could be encountered in correctly loading the transmitter. This problem can be easily overcome by increasing the length of the transmission line. The added line length shifts the impedance point at the end of the line, permitting a more favorable match to the transmitter.

"Hey, wait a minute, wait a darn minute," cried Tommy. *"What's this deal about changing the length of the transmission*

(*Continued on page* 102)



Get best coverage of the audience with a minimum of labor

How to Install a P.A. System

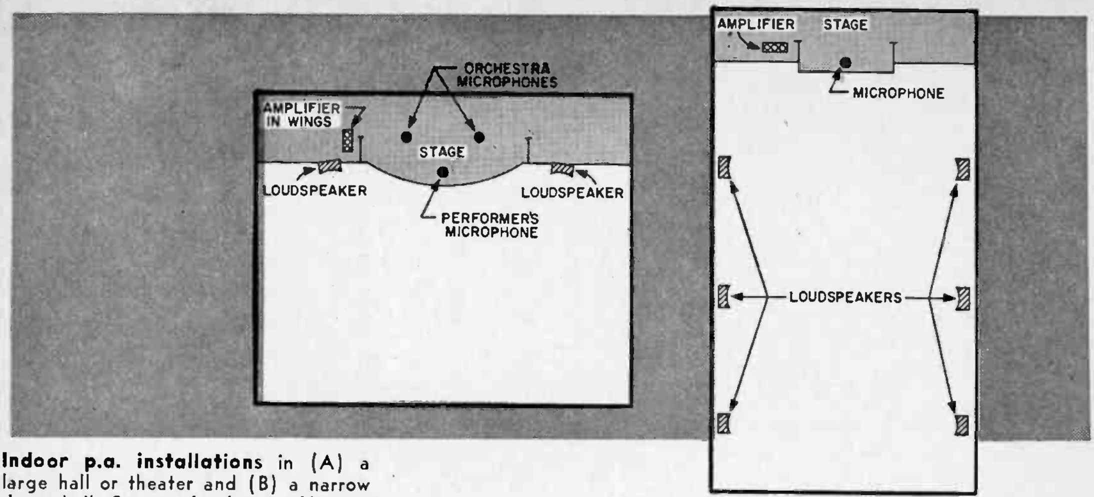
By
LOUIS E. GARNER, Jr.

LAST MONTH we discussed the basic principles of p.a. operation and reviewed the factors affecting the choice of the various components. Now, we will see how actual installations are made.

Public address installations can be divided into several broad classes: *temporary, permanent,* and *mobile,* with permanent installations further subdivided into *indoor* and *outdoor* systems.

Most temporary installations are made using a portable system. Such a system has essentially the same components as a permanent system, but all the equipment fits together in a case for ease in transportation. Often, the carrying case performs a dual function, also serving as the loudspeaker baffle.

The same principles control the layout and installation of all p.a. systems. For example, in a temporary job using a portable system, the microphone, amplifier and



Indoor p.a. installations in (A) a large hall or theater and (B) a narrow dance hall. See text for details of layout.

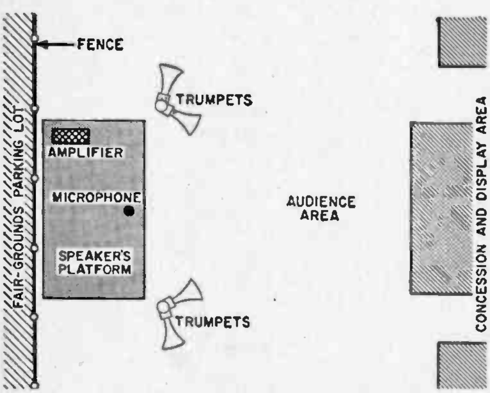
(A) (B)

loudspeaker placement would be approximately the same as for permanent installations in the same location. Instead of mounting the loudspeakers permanently, however, the speakers in their carrying case baffles are placed on the floor or hung from a wall bracket or nail.

Layout and installation can be carried out in three major steps: *loudspeaker installation, microphone placement* and *amplifier installation.*

LOUDSPEAKER INSTALLATION

Assuming that a satisfactory amplifier is used, the criterion by which a p.a. installation is judged is the "evenness" of sound distribution over the listening area. In an *ideal* installation, the sound should adequately override background noise, with no "hot" or "dead" spots anywhere over the entire area.



An outdoor installation (at a fair grounds perhaps) might be like the one above. Note the use of trumpets mounted at the speaker's platform to give the feeling that sound is originating at that spot.

Proper sound distribution is the function of the loudspeaker system, and the correct placement and wiring of individual speakers is probably the most important single consideration. Unfortunately, there is no hard and fast rule. Each installation is an individual problem to be solved by the designer-installer. The various techniques can be shown best by practical examples.

Indoor Systems. Probably the most common problem encountered indoors is that of a large square or rectangular room with a stage (platform) centered along one wall. This might be a theater or auditorium, but could also be a school gymnasium modified for use as a dance floor or playhouse. The solution is a pair of loudspeakers mounted in wall baffles. They would be placed on the short walls to either side of the stage and mounted from 8 to 12 feet above the floor, depending on the height of the room.

A different solution is required in the case of a long, narrow hall or theater, where the stage is at one end. Here, several speakers might be mounted along the side walls, spaced from 20 to 50 feet apart, depending on the length of the room and the number of speakers used. Again, the mounting height may be from 8 to 12 feet above the floor.

In this type of installation, the loudspeakers may be mounted either directly against the wall, facing toward the center of the room or at a slight angle to face the rear (away from the stage). The latter technique, while requiring a little extra work, will minimize acoustical feedback "squeal."

The technique of using multiple (more than two) speakers is also used in the case of odd-shaped or partitioned rooms and in areas where the background noise level may be high, as in a factory.

Outdoor Systems. While many outdoor installation problems are handled in about the same way as corresponding indoor problems, except for the use of higher powers, weatherproof connecting lines and weatherproof loudspeaker enclosures or trumpets, special problems might be encountered from time to time.

For example, at outdoor political and patriotic rallies, to create the maximum psychological effect on listeners, orators will want the amplified sound to appear to originate from the speaker's platform. This problem can be handled by mounting trumpet loudspeakers on moderately high masts at each corner of the platform. The mounting height may be from 10 to as high as 20 feet from the ground, depending on the area to be covered. The trumpets are adjusted to point down at a slight angle.

Trumpet speakers, while much more efficient than cone units, do not distribute the sound over as wide an angle. Typical dispersion angles are from 60° to 95°, compared to from 100° to close to 160° for cone speakers. This means that a cluster of two or more trumpets may be required at each loudspeaker location to obtain adequate coverage.

One method of determining the number of trumpets needed and their location is to make a reduced scale drawing of the area. A protractor is used to lay out the dispersion angles of the trumpets chosen, with different speaker locations picked until the best layout is achieved. The areas covered by adjacent speakers should be allowed to overlap slightly.

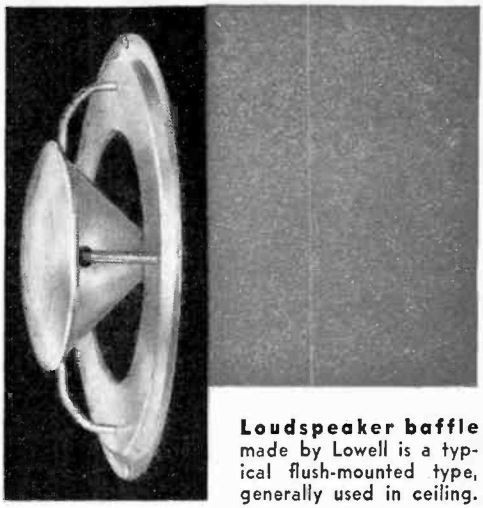
Where reasonably high fidelity is needed in an outdoor installation, trumpet loudspeakers are not entirely satifactory, even in the larger sizes. Instead, it is best to use outdoor (weatherproof) coaxial loudspeakers. Such units are available from loudspeaker manufacturers specializing in p.a. equipment.

Wiring. Whether outdoor or indoor installations are planned, wiring techniques remain essentially the same. The loudspeakers are connected in parallel across a two-conductor transmission line, unless special *impedance-matching* problems are encountered. Ordinary zip-cord may be used for indoor installations, while weatherproof cables are used outside. Proper impedance matching is extremely important to minimize power losses and distortion.

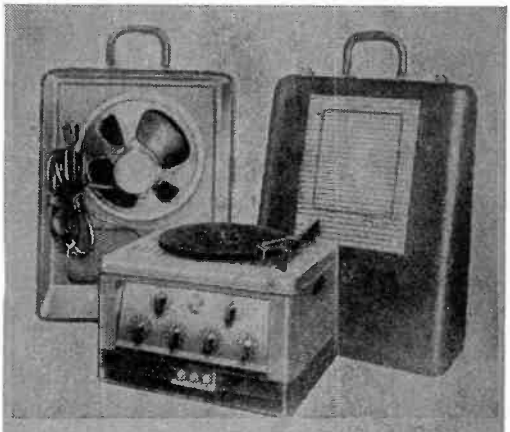
If a number of similar speakers or trumpets are connected in parallel, their total impedance may be determined by dividing the voice-coil impedance of a single speaker by the number used. For example, if four speakers are used, and each has a voice-coil impedance of 16 ohms, then the total impedance of the four units in parallel is 4 ohms. The speaker transmission line would be connected to the "common" and "4-ohm" taps on the amplifier.

Where a conventional parallel connection will not provide a good impedance match, a series-parallel connection may be used. For example, if we had four 8-ohm loudspeakers and connected these in parallel, the total impedance would be 2 ohms. Few amplifiers have an output tap at this value. In such a case, we would use a series-parallel connection, with two loudspeakers in series (providing 16 ohms) and the two series strings in parallel, giving a total impedance of 8 ohms. Most amplifiers have an output tap at 8 ohms.

Wherever several (two or more) loudspeakers are used, correct *phasing* is im-



Loudspeaker baffle made by Lowell is a typical flush-mounted type, generally used in ceiling.



Portable p.a. systems may be used indoors or outdoors. Note how carrying case doubles as speaker baffle in this Masco system.

portant. That is, the speakers should be connected so that the sound from each *reinforces* (rather than cancels) the sound produced by the other speakers. If identical speakers are employed, you can do this simply by connecting their corresponding terminals together.

Where different speakers are used, check each speaker by connecting a flashlight battery across its terminals temporarily. Note the direction of cone movement when the connection is made and broken. Connect the speakers so that all the cones move "in" or "out" together.

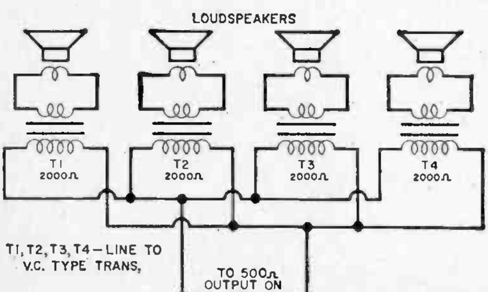
Loudspeaker *transmission-line losses* can be minimized by using heavy gauge wire. The line size will vary with the load impedance and the length of run. Standard zip-cord, generally consisting of a pair of No. 18 wires, may be employed for runs up to 200 feet at 16 ohms, or 50 feet at 4 ohms. If No. 14 wires are used, a run up to 450 feet at 16 ohms is permissible (125 feet at 4 ohms).

Where very long transmission lines are necessary, as in some outdoor installations, it is customary to use *high-impedance* lines. Here, individual *line-to-voice-coil* transformers are employed with each loudspeaker, providing typical impedances of 250, 500, 1000, and 2000 ohms.

Again, except for the values used, the transmission-line impedance (and amplifier output tap) is determined in the same way as for installations with low-impedance lines. For example, if four 2000-ohm loads are connected in parallel, the total impedance is 500 ohms.

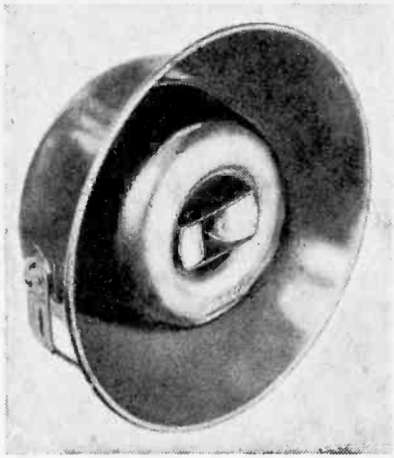
Using No. 18 wire, runs of up to 400 feet are permissible at 100 ohms, and up to 2000 feet at 500 ohms. With No. 14 wire, runs up to 1000 feet at 100 ohms or up to 5000 feet at 500 ohms are permissible.

In most installations, the loudspeaker transmission line may be stapled or nailed along the baseboard. Insulated wiring tacks may be used, or a stapling gun with a round cutout for wiring installation.



Line-matching transformers are necessary in some multiple speaker setups. This diagram shows such a hookup.

Full-range weatherproof coaxial speaker system (University) for outdoor use.



Outdoors, weatherproof cable can be strung from poles. In better installations, where the cost can be higher, the transmission line can be run through permanent conduit.

MICROPHONE PLACEMENT

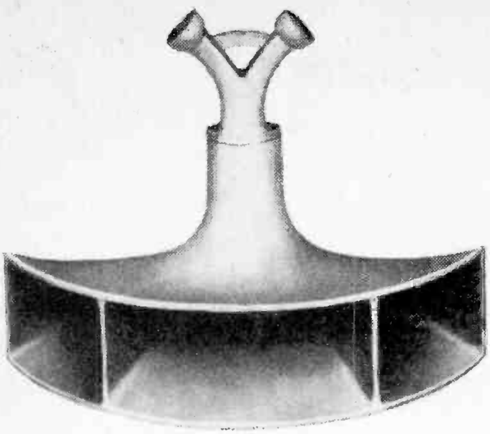
While the loudspeakers in a p.a. installation generally are mounted in permanent positions, the microphones seldom have a fixed location. Instead, mikes are set up each time the system is used, with their location depending on the nature of the program. The exception is a *paging* system or similar special-purpose installation.

In the case of talks, speeches or lectures, a single microphone is placed on a floor stand to one side or in front of the speaker. If a lectern, table or desk is used by the speaker, the microphone may be mounted on a desk or banquet stand.

Where a large group of performers are involved, such as an orchestra or a choral group, two or more microphones should be employed, placed on the stage or platform to insure approximately equal pickup from all sections of the group. An extra mike in front of the group is for the master of ceremonies or solo performers.

In any case, the microphone (or microphones) should be located to minimize pickup from any of the loudspeakers in the system. Otherwise, acoustic feedback will occur (output of loudspeaker is picked up by mike, re-amplified and fed through the speaker, and so on) and the system will howl or squeal.

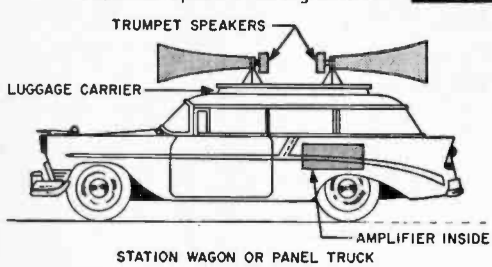
Shielded cable is used between the mi-



"**Cobra"-type** horn by Racon (shown above) is intended for outdoor installations where high power is needed with horizontal concentration.

In some semi-permanent set-ups, it may be necessary to tack wiring to a baseboard. Stapling gun with cutout such as the one at right is useful.

A mobile p.a. system is shown in the sketch below. See text for speaker arrangements.



crophones and the amplifier. These cables should be kept as short as is practicable, and should be arranged neatly out of the way to prevent tripping a speaker or performer. The mike cables should be kept away from heavy-duty power lines or other sources of noise and hum.

AMPLIFIER INSTALLATION

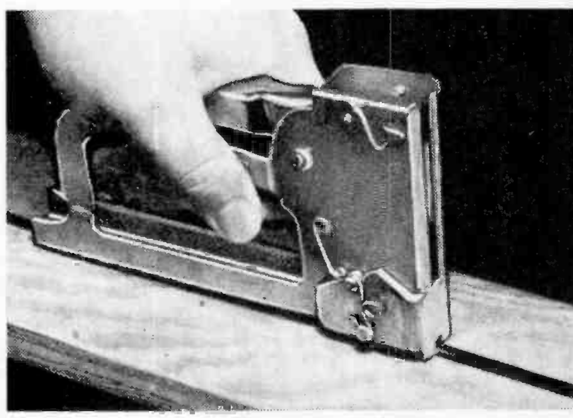
From the viewpoint of installation, the amplifier probably is the least critical of the components in a p.a. system. It should be in an out-of-the-way location, reasonably close to a power outlet.

In addition, it should be as close to the microphones as practicable to minimize the length of mike cable. The amplifier operator should have a clear view of the proceedings, to permit his *riding gain* and making necessary adjustment of amplifier controls for different performers.

In a theater, the amplifier could be placed in one of the wings of the stage. In semi-permanent outdoor locations, it is best at the rear or to one side of the speaker's platform. In a paging system installation, it is generally placed on (or under) the desk where the microphone is located.

MOBILE INSTALLATIONS

The familiar *sound truck* is a typical example of a *mobile* p.a. installation. A complete sound system is installed in a small panel truck or in an auto or station wagon



and is designed for use while it is moving.

Generally, from two up to eight trumpets are employed, mounted with brackets on the roof of the vehicle. In a "minimum" installation, there will be two trumpets, one facing the front, the other to the rear. In some cases, both will face towards the front to increase the angle of coverage. Where maximum coverage is desired, from six to eight trumpets will be mounted in a cluster to broadcast in all directions.

The amplifier should be designed for battery operation. Many manufacturers can supply especially designed *mobile amplifiers* which will operate from *either* an a.c. power line *or* from a 6- or 12-volt auto battery. Any small a.c. amplifier can be used in a mobile installation if a separate d.c.-to-a.c. *inverter* is provided.

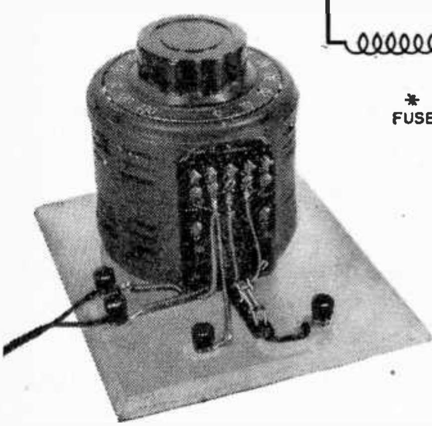
To minimize external noise pickup, the microphone should have a unidirectional characteristic and be designed for "close talking." Where the driver is also the p.a. speaker, the mike can be hung from a neck strap, resting on the driver's chest, or a specially designed "third-hand" mike

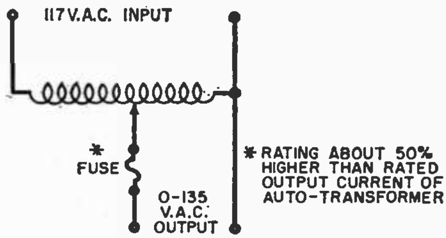
(*Continued on page* 104)

Variable A.C. Power for Your Workshop

Variable auto-transformers add versatility and flexibility to the home experimenter's equipment. A representative type can be used to provide any 60-cps a.c. voltage from 0 to 135 volts from the line at any current drain—up to the maximum rating of a particular model.

Such transformers suffer from none of the shortcomings of rheostats, potentiometers, and semi-variable slider resistors. They run cooler—since they don't waste power as heat—and they are fully adjustable for smaller, continuous change of output voltage. Best of all, a varying current drain throughout their rated range causes practically no change in output voltage. In effect, they offer the same regulation advantages as fixed voltage transformers.





The photograph shows one way to mount a variable transformer for convenience during use; binding posts are normally insulated with a piece of plastic. Problems that can be solved with one of these transformers include the operation of an amateur radio transmitter at reduced input power for "tuning up" purposes, finding out the exact pull-in and drop-out voltage of unmarked a.c. relays, calibration of a.c. voltmeters against a standard, and the choice of correct voltages for a.c. experiments. Other uses suggest themselves as one goes along.

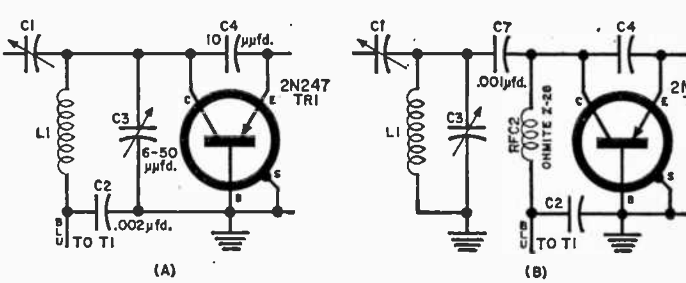
Inclusion of a fuse is recommended although these units will take short overloads without damage. The standard circuit is shown above. —*Paul Harvey*

Protect the Short-Wave "Two-Lunger"

A design refinement has been incorporated in the "Transistorized Short-Wave 'Two-Lunger'" (POPULAR ELECTRONICS, November, 1957, page 77) which should be of interest to constructors of this—and similar—receivers.

It was discovered (at the cost of a drift transistor) that an intermittent short in the collector circuit can ruin the semiconductor. You will note from circuit (A) in the diagram that the collector of the transistor is connected through coil *L1* and the primary of transformer *T1* to the 4.5-volt battery (see page 79 of the original article for complete schematic). If *L1* shorts to the chassis, or if tuning capacitor *C3* shorts out because of bent plates or solder between the plates, it places the battery directly across the primary of *T1*. When the short is cleared, the collapsing magnetic field around *T1* creates a "back e.m.f." that is many times the breakdown voltage of the transistor. This pulse of high voltage will arc through the germanium, creating a permanent short inside the transistor.

Modifying the "Two-Lunger" as shown at (B) in the diagram will lessen the possibility of destroying the transistor because of short circuits. Wired in this manner, *L1* and *C3* are at ground potential, d.c.-wise; and shorting either of these components to the chassis will no longer disturb the d.c. power supply voltages of the transistor and hence will tend to preserve the life of the component. —*Donald L. Stoner*



(A)

(B)

The Art of Tape Correspondence

By CAROLE F. HOOVER

How to make real friends out of tape pals by mail

THE FAMOUS Dr. Samuel Johnson once remarked: "A woman preaching is like a dog walking on his hind legs. It is not done well; but you are surprised to find it done at all." That describes exactly my attitude toward tape correspondence when Celia Webster's article "Voices In The Mail" in the August, 1956, issue of POPULAR ELECTRONICS started me in this fascinating hobby.

I was so entranced by the discovery that I could talk my thoughts onto the smooth little ribbon, send them halfway around the world, and get an answer back in the exact voice of my correspondent, that I gave scant thought as to how *well* I was using this new medium of communication. I was tape corresponding, wasn't I? That was all that mattered.

Little by little, though, I realized that tape-exchanging, just as is the case with letter writing or conversation, can give real pleasure to both parties involved or it can easily become a bore. Extra thought, imagination, careful preparation, and attention to small but important details make the difference.

The aim of this article is not to tell you how to join a tape club or operate your recorder.* A good tape correspondence requires something more than technical perfection to be interesting and satisfying. What I hope to do is to make some suggestions, based on hard-earned experience, that will enable you to give and receive the most pleasure in your tape correspondence.

Privacy Preferred. To begin with, of course, you must have access to a tape recorder; and if you are fortunate enough to have one of your own, you are off to a running start. Owning your recorder allows you to prepare your tape letters when you

are in just the right mood *and in private.*

Personally, I have to be alone to make a tape. Even without the presence of an amused kibitzer, I feel sufficiently ridiculous when I start babbling into a microphone; and a silent observer affects me much the same as a muzzle on a dog—I just clam up. This is in spite of the fact that I am considered by friends to be—well, shall we say—"talkative"?

Another advantage of solitary taping is the better control it usually affords over distracting and annoying background noises: doors slamming, people shouting, dogs barking, dishes rattling, blaring sounds from the radio or TV, etc. On the other hand, soft background music of the right sort often helps cover up small noises from outside, the creaking of a chair as you shift position, and breathing sounds.

Carefully selected records on a changer

* Celia Webster's story (August 1956) explains exactly how to get started in tape correspondence. "Do Your Tapes Sound 'Real Pro'?" by William O'Brien in the December 1957 issue of POPULAR ELECTRONICS shows you how to keep your recorder in tip-top shape. "How To Make Good Tape Recordings" by Jeanne Hickam in the July 1957 issue gives sound advice on improving your recording technique.

provide the best background. A radio or TV set cannot be trusted to furnish it. Just when you are creating a desired mood, you will find yourself trying to outshout an announcer bringing a message to his listeners—and yours.

Simple honesty forces me to confess that this distraction-free recording session is an ideal to be striven for but seldom achieved —at least not around our house. No matter how carefully I make plans to record in sweet peace and gentle quiet, I am sure to be plagued by repeated phone calls, door-to-door salesmen, and once even by a woodpecker drumming on a downspout!

But let's say you have made all preparations, and the little green eye of your recorder is blinking an invitation to go ahead. Grasp the microphone and have at it, but

. . . My problem is that I talk too fast and try to swallow the microphone . . .

for heaven's sake don't start with: "I haven't much to talk about this time." Chances are you'll make a liar of yourself by filling both sides of a 7" tape and running off on the leader. At any rate, if you have nothing to say, don't warn your correspondent; let him find it out for himself.

Sound Effects. A pleasant way to begin and end a recording is with a few bars of a favorite tune as a sort of theme. This can come from a record or a tinkling music box, and in time it will become closely identified with you in the mind of your correspondent. For just that reason, however, the music should be carefully chosen to stand repetition. Unless you are taping to Elvis, I would not suggest "Jail House Rock."

Novelty beginnings are always good, too. Alan and Daphne Wilson (pictured on page 44 of the June, 1957, issue of P.E.) are clever at them. I rate these two very highly as effective tape correspondents because they met each other through tapespondence; and Alan, in Singapore, wooed and won Daphne, in England, through the medium of spinning reels of tape. Their wedding cake was even baked in the form of a tape recorder!

On a recent tape they began by saying that they had set up elaborate equipment to record the sound the earth made turning on its axis, and I was privileged to be among the first to listen to this never-before-heard sound. Sure enough, I could hear a low rumbling, grinding noise that was repeated at intervals throughout the tape. Only at the end did I learn that the sound effect was authentic; I had been listening to the world turning on its axis. Alan had been holding the microphone close to a spinning globe! This sort of beginning is very effective when done properly, but of course it should not be overdone.

Do's and Don'ts. By all means have notes ready concerning the things about which you wish to talk. This will enable you to take up subjects in their best related order, and it will help avoid the universal habit of saying "Uh" to break an agonizing period of silence when an invisible hand seems to grab you by the throat and cut off your conversation.

My own worst habit is a sort of reversal of this "invisible hand" situation. I talk too fast and try to swallow the microphone. Even though I begin talking with the mike properly held several inches from my lips, resolving firmly to keep it there, I find myself practically licking it within minutes. Breaking this habit becomes easier, though, after listening to tapes made by other mike-swallowers. The slurping, breathy quality of the voices reminds me of the Big Bad Wolf huffing and puffing at the three little porkers.

Painting a word picture of the surroundings in which you are making the tape always helps remove the feeling that you are a disembodied voice coming out of a box; so before launching into your list of topics, do a little stage setting for your listener. He or she probably wants to know what you look like, too, but I find it is better to send a picture than to attempt self-description. The latter sets up too much of a tug-of-war between veracity and vanity!

What you talk about, of course, will depend upon what is of mutual interest. Let me warn you about one extremely dangerous pitfall: don't use up all your tape commenting on what your correspondent said on his tape. Answer his questions and acknowledge his comments sufficiently to let him know you listened to his tape, but do it quickly and then turn to new and

. . . An advantage of solitary taping is the control it affords over distracting background noises . . .

fresh material of your own. Fail to do this and you may find yourself ping-ponging the same old subjects back and forth until they are worn out.

Take Your Time. Another of my first and worst errors was attempting to make a tape in an allotted time. Take all day, if necessary; but take your time.

I tried to make tapes during my lunch hour for a while. I would rush home from work, dash to the recorder, and try to get the tape going in nothing flat. About every other time in my haste I would leave slack in the tape, and it would retaliate by snapping. When I tried to splice it in a hurry, I became all thumbs; so when I finally was ready to record, I had forgotten what I intended to say, and it was time to go back to the office anyway.

After a session such as this, I felt no spirit of warm comradeship toward my tape pal. My only desire was to rip the reel from the recorder, unroll the unruly ribbon into a pile on the floor, and jump up and down on it with both feet like a wine presser treading out the grapes of wrath!

Mutual Pleasure. One thing I have learned is that the less your tape correspondent knows about your country and the less you know about his, the easier it is to sustain interest. When his surroundings, customs, and way of life are entirely different from yours, almost every detail of daily living becomes interesting.

What you eat, wear, or do for entertainment . . . how you earn your living, entertain your friends, or spend your vacation . . . the way you buy your groceries, the kind of car you drive, the church you attend . . . these things will be of consuming interest to many of your correspondents who never have been in your country. I know one of my English correspondents was fascinated by an account of attending a drive-in theater, and I was equally enthralled by her description of nearby Dartmoor where the Hound of the Baskervilles may still be roaming.

Now let's face up to a rather disagreeable problem that may arise in tape correspondence: how do you break loose from an unsatisfactory tape correspondent? This can take some tact, imagination, and some real doing.

. . . I wanted to rip the reel from the recorder and jump up and down on it . . .

(*Continued on page* 116)

Short-Wave Report

By HANK BENNETT

THE NEW Vatican Radio Broadcasting Center, replacing the station which had been built by Marconi in 1931, is located at Santa Maria di Galeria, about 14 miles from Rome.

In the center of the area, the main hexagonal building houses an underground electric substation for the transformation and distribution of electrical power, as well as the cooling system for the transmitters. Four transmitters are now located on the upper level: a Philips 100-kw. short-wave transmitter, two Brown Boveri 10-kw. short-wave transmitters which can be used in parallel, and one Brown Boveri 120-kw. medium-wave transmitter.

Above the transmitters, in a sort of gallery, the antenna commutator is installed. In a few seconds, this commutator is capable of "branching" up to six transmitters on six antennas. There are 29 antennas in all.

Outside of the main building there are 24 towers of metal pipes that support 21 short-wave antennas. Three axes, each at an angle of 120° from another, point to West, North-North-East, and South-South-East, respectively. They are horizontal dipole curtains for 49, 41, 31, 25, 19, 17, 13 and 11 meters.

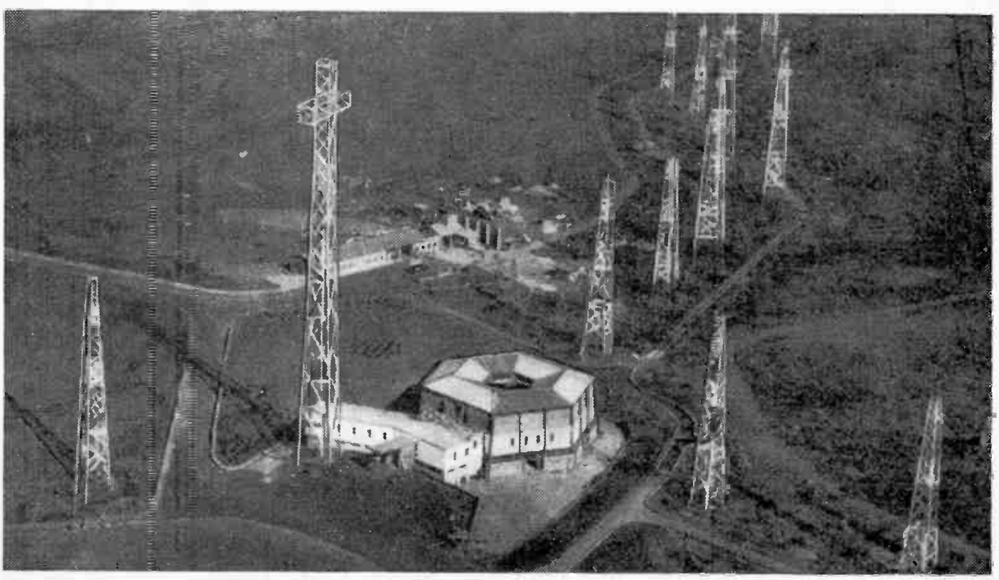
About 1200 meters to the southeast stands an anti-fading mast antenna. It is 98 meters high and guyed to nine posts on the ground. The mast is mounted on a single steatite insulator which is capable of resisting 150 tons of pressure. Connected to a 130-kw. transmitter, this antenna radiates on the medium wave (European) of 196 meters.

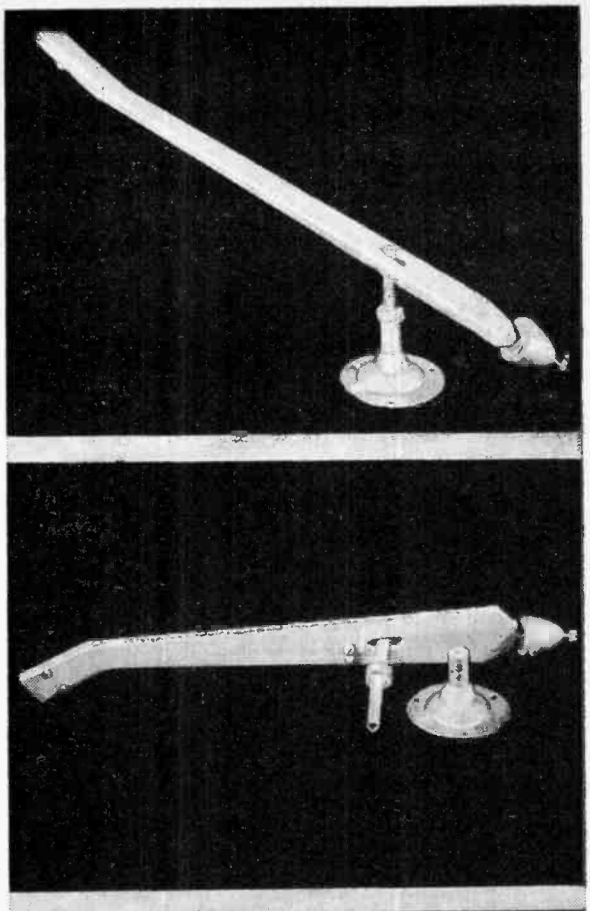
At the side of the main structure is a 78-meter high pylon in the form of a cross. Besides its symbolic value, this pylon has a distinctly practical function: it bears the antennas of the radio connection which links the transmission center with the broadcasting studios in the Vatican.

Special thanks are due Mr. Tibor Gasparik, of Cleveland, Ohio, for his assistance in the preparation of the above material.

(*Continued on page* 123)

Aerial view of the antennas and the transmitter building at the Vatican Radio Broadcasting Center.





Completed pickup arm shown at right requires the addition of thin, flexible, shielded lead to carry the signal from the cartridge to your hi-fi amplifier.

MAKE YOUR OWN ARM

. . . for high-fidelity results at low cost

By LEONARD C. HOLZER

HERE is a phonograph arm which is simple, has few moving parts, and is remarkably well adapted to use with hi-fi turntables designed for playing single records. It has a more or less conventional head angle which tracks well with most cartridges, standard mounting holes for cartridges, and better-than-average resonance characteristics.

The arm can be made of hardwood, Lucite, or aluminum, and the fittings required can be obtained at most electrical supply houses for a few cents. Outside of your own labor, which is not much at all, the whole assembly will only cost between $1.50 and $2.00!

All finished dimensions are shown on the next page. They should be adhered to as closely as possible, especially the location of holes for mounting cartridges in the head, and the mounting hole for the arm. It would be a good idea to make your own template actual size from the diagram showing the top view and trace this directly onto the material you are using.

If wood is used, smooth one face with sandpaper for clear tracing. If aluminum is used, polish one side with ordinary steel wool to clean it. In cutting out the material, keep a bit outside the tracing lines so you can finish it off to size later with a file or sandpaper. This should be done before drilling the holes.

Drill hole "B" (at back end of the arm) and holes "D" and "E" (for cartridge mounting) with a No. 31 drill, and thread them with a *4-40* tap. Holes "D" and "E" are drilled clear through, but hole "B" need only be about ½" deep. Hole "A" should be drilled clear through parallel to the thickness of the material marked X in the diagram on page 74 (top view), with a 3/32" drill.

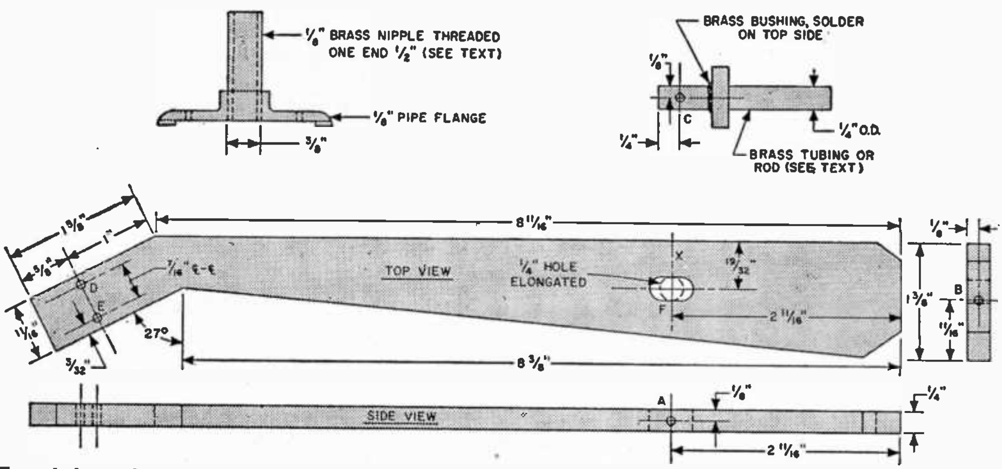
The arm mounting hole "F" is made by drilling two ¼" holes, one ⅛" to the left of the center line and one ⅛" to the right of it. Carefully file out the "flat" portion to complete the elongated hole.

This completes the arm part itself. It can be polished and the edges rounded for a smooth finish. If wood is used, a light coat of model lacquer may be desirable.

The piece of ¼" tubing should be drilled with a 3/32" hole at "C" as shown. Make the mounting base before the tub-

BILL OF MATERIALS

1—¼" x 1½" section of hardwood, Lucite or aluminum, about 12" long
1—3" length of ¼"-o.d. brass tubing
1—3" length of ⅛" brass nipple, threaded on one end
1—⅛" electrical pipe flange (Leviton or equiv.)
1—Brass bushing, ¼" hole, 3/16" thickness (approx.)
1—2" length of 3/32" brass rod



Template and construction details of the home-made arm are given above. A choice of material is available for the body of the pickup arm. The lettered points in the diagram refer to specific construction details which are covered in the text.

ing part is completed. The pipe flange has an inside thread of ⅜" which matches the outside thread on the threaded brass nipple. Screw these two parts together firmly, noting that the nipple does not extend below the base of the flange part.

To get the correct height of the nipple and assembled parts, insert the brass tubing into the arm mounting hole, and slip through the 3/32" rod. It should fit smoothly but not loosely, so that the arm can hinge up and down (through the hole in the side of the arm).

With your motor and turntable mounted on its baseboard, set the flange with its center about 7⅛" from the center of the spindle of the turntable. Slip the brass tubing with arm mounted into the brass nipple which has about a ¼" inside diameter (ream out with ¼" drill if necessary).

Mount the cartridge in place on the arm. Its needle should be about ⅛" beyond the spindle center when it is swung over this point. With a record on the turntable, place the needle in the groove and note the position of the arm. It should be parallel with the turntable surface. If it is not, note the position of the nipple and brass tubing. About ¾" of the brass tubing must show above the nipple to allow the arm to move up and down, so mark the nipple to be cut off to permit this dimension.

Cut off the tubing (if necessary) to extend within only about ¼" from the bottom of the nipple in the flange. The tubing must not touch the mounting board surface or it won't turn freely. Remove the tubing and arm from the nipple and cut both parts to size (after disassembling arm part first).

Smooth the top of the nipple as squarely as possible and polish it with fine emery. Slip it over the brass tubing to the ¾" mark, and put on the brass bushing from the other end. Holding nipple and tubing firmly in this position, apply solder to the top of the bushing (end away from nipple) all around to join it solidly to the tubing. Now remove the nipple, and polish the tubing and undersurface of the bushing with fine emery or steel wool.

Reassemble all parts, check to see that the arm moves freely up and down as well as in a circular direction, and apply some silicone oil (from an auto store) or Lubriplate to the surface of the tubing, the inside of the nipple, and the 3/32" rod where it contacts arm surface and tubing. This completes the arm.

To counterbalance the arm to proper cartridge weight, note the weight prescribed by the manufacturer and, using a 4-40 screw (in hole "B" at the back of the arm), attach a brass washer to which you can apply solder until the arm counterbalances to the proper stylus weight at the other end. You can also use a small lead weight which can be soldered to the screw head or washer, or threaded to move along the screw to any desired balance point. —30—

AFTER CLASS

Special Information on Radio, TV, Radar and Nucleonics

ANSWERS TO TECHNICAL QUESTIONS FROM READERS

HUNDREDS of letters are received each month which contain questions of all varieties. Many of these questions are technical in nature and sufficiently general to be of interest to other readers. So we decided to devote *After Class* this month to answering some of them. While we cannot do more than scratch the surface of our monthly mail bundle, we have tried to select subjects that will be of value to most of our readers. Let us know your reaction to this use of *After Class* occasionally.

FM Tuner in Automobile. Reader William Welch of Los Angeles, Calif., has recently installed an FM tuner in his automobile. The installation makes provision for using the audio amplifier of the radio already there. Mr. Welch has added a separate folded dipole antenna to his existing antenna to feed the FM tuner and installed two large speakers to improve the fidelity. He complains that ignition noise from his own and passing cars is often quite annoying and wants to know if he can install a filter to eliminate it. An important clue Mr. Welch gives is that the noise from his own engine ceases when he disconnects the shielded wire from the receiver.

It is evident that most of the noise is being picked up by the antenna directly. The r.f. signal radiated from an ignition system is very close to what engineers call "white noise." Just as white light is a composite of all the spectral colors, ignition noise contains thousands of different radio frequencies up and down the r.f. spectrum. When it is heard superimposed on an incoming radio signal, it means that some of these myriad frequencies match those of the station being received. Unfortunately, any filter that would remove the disturbing noise frequencies would also remove the signal. Thus, filtering is impractical.

We might suggest, however, that careful trimming of the antenna by means of the antenna trimmer capacitor in the receiver may improve the signal-to-noise ratio sufficiently to reduce the annoying disturbance to the point where it can be ignored. If possible, the length of the dipole should be experimented with to bring it into resonance with the center of the FM band.

"Simple" Digital Computers. From Saginaw, Mich., comes a letter written by Ronald Roeser in which Ronald says that he would like to see an article devoted to the construction of a simple digital computer of the "add-a-unit" type. Such a construction project would permit the experimenter to add new sections to his computer each time he gets a financial bonanza.

Free evening classes on radio theory and code are being given by Allied Radio in Chicago. Two 14-week courses are offered each year.

A digital computer requires, among many other things, some kind of read-out device such as an electromagnetic counter, a set of Nixie numerical glow tubes, or rows of indicator lights. Even for the simplest operations, such as addition and subtraction, a relatively large number of relays are needed. Add to these the cost of the power source and minor components such as capacitors and resistors, and it becomes evident that the expenditure will not be figured in pennies.

This is unfortunate because the digital

computer field is a fascinating one and attracts many people who might develop new methods and techniques if they had some extra cash available for parts. We are always on the lookout for new, simplified approaches to all phases of electronics, and you may be sure that we will publish a story on the construction of a low-cost computer if one comes our way.

Rejuvenating Batteries. Bob Rivas of Hobbs, New Mexico, describes a method he uses to rejuvenate flashlight batteries. He places the cell in a pan of water over a gas or electric burner and "cooks" it for about twenty minutes. He adds that the method works very well with batteries that are not wax- or tar-coated. Since we have received many questions about battery rejuvenation, let's answer these and discuss Bob's method at the same time.

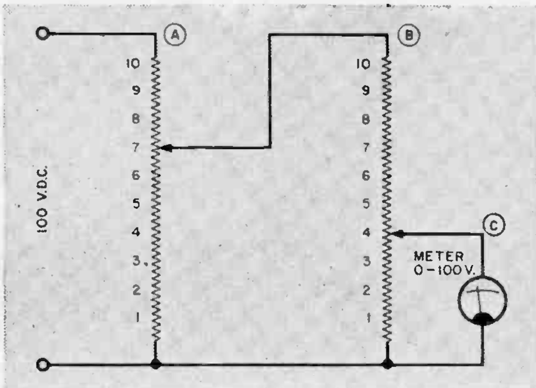


Fig. 1. Circuit showing connection of two standard potentiometers and a sensitive meter for basic arithmetical calculations. See page 118 for details of technique.

That "wax or tar" clause is interesting because it indicates that the heat in itself is not responsible for the rejuvenation of the cell since the heat can penetrate such thin layers of insulation easily. It would seem, therefore, that the water in the pan is seeping into the cell case through minute cracks or holes. This makes sense because dry cells often go bad due to loss of hermetic seal; the electrolyte in a dry cell is not really dry at all and if evaporation can occur through a fault in the amalgamated zinc case, the cell will go dead even though its chemical agents are not exhausted.

Only the so-called *storage cell* operates on a chemistry that permits real rechargeability or rejuvenation. Of all the storage cell types, the most popular probably are the lead-acid variety used in automobiles, Edison cells often found in the battery banks used in factories and schools, and nickel-cadmium types also employed in industrial batteries. All of these are recharged by passing d.c. through them in the right direction.

Dry cells contain a paste electrolyte composed of ammonium chloride (sal ammoniac), manganese dioxide, and powdered carbon mixed with water. Although they are not intended for recharging, it is often possible to extend the life of a B battery by passing a current through it in the reverse direction. This current must be very small—of the order of a few milliamperes—and must be carefully controlled to prevent battery damage. Several such battery rejuvenators have been described in past issues of P.E.

Single cells, such as flashlight cells or A batteries used in portable radios, can be brought back to life temporarily by puncturing a small nail hole in the bottom of the case and standing the units in a shallow bath of saturated ammonium chloride for several hours. (Sal ammoniac can be purchased in most hardware stores.) After soaking, the puncture is wiped dry and resealed with a good grade of sealing wax or by means of hot solder.

This brings us back to Bob Rivas' method. Anyone who wants to rejuvenate dry cells should remember that all the procedures described are more in the nature of emergency measures than cures for battery ills. The best remedy for a dead dry cell is replacement.

Oscillators and Transducers. We received an interesting letter from a physician a while back in which the writer expressed the desire to see more articles on "oscillators and transducers." Since these are very general terms, it required some deductive reasoning to determine just what the reader had in mind when he asked this question. It finally dawned on us that he was probably referring to "ultrasonic generators" since these words are most often linked together in this particular phase of electronics. So—let's have a look at the words "oscillator" and "transducer."

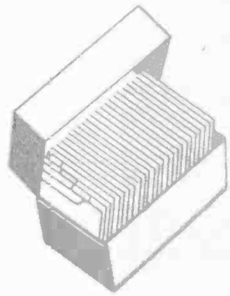
In its broadest sense, an *oscillator* is one type of device that generates a pulsating electricity. To make the definition more useful to the electronic worker, it should be narrowed down somewhat as follows: an oscillator is an electrical device, generally making use of an electron tube or transistor, which converts d.c. power into a.c. power.

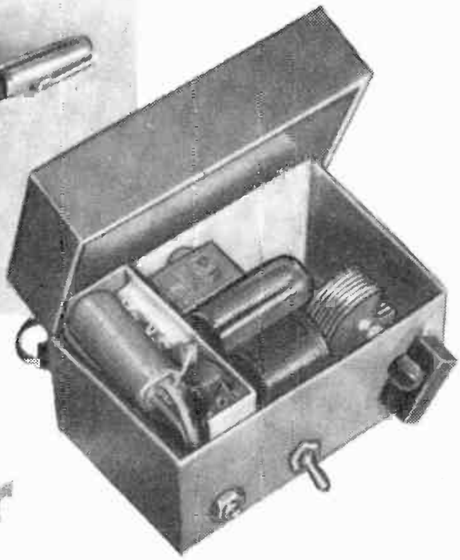
Oscillators may be classified in terms of the frequencies they produce, as audio oscillators, r.f. oscillators, microwave oscillators, etc. Or they are often described on the basis of the waveforms they generate,

(*Continued on page* 118)

By DONALD A. SMITH

Completed transmitter mounted in file case. Note horizontal mounting of its single tube.





Card File Transmitter

Build a hideaway transmitter for standby and local use

THIS LITTLE FILE BOX contains more than just file cards. Enclosed please find one transmitter, complete with power supply! It will operate on both the 80- and 40-meter bands, and is crystal-controlled.

Power input of the "Card File" transmitter is about 6 watts. The rig has a jack for the key; when it is not in use, the key can be unplugged, leaving what appears at a glance to be an ordinary file box.

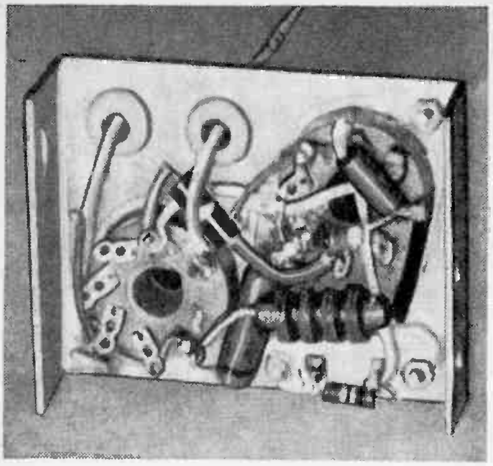
The oscillator is a modified Pierce circuit, which is easy on crystals. The plate circuit is tuned to the fundamental frequency, or can be tuned to the second harmonic. A 3.5+ -mc. crystal, for example, could be used on 40 meters by tuning the plate-antenna circuit to the second harmonic.

Tube *V1* is a 117P7-GT which contains both a power amplifier and a rectifier section. A 117L7-M7-GT-G tube can be used instead if the difference in pin connections is observed. Both have a 117-volt filament, which can be connected directly across the a.c. power line.

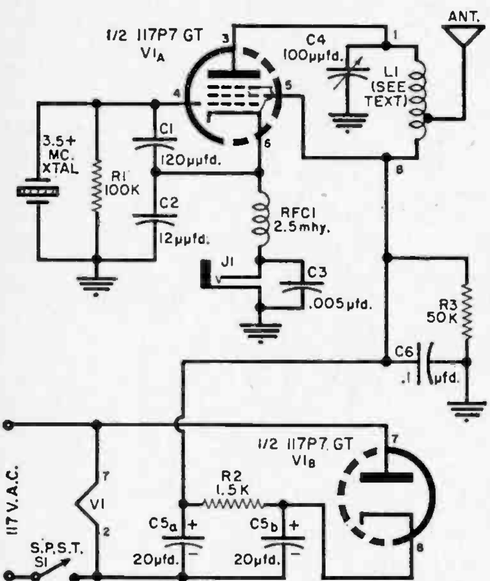
Drilling and Bending. Secure a 2½" x 4¾" piece of aluminum either 1/32" or 1/16" thick. The chassis should be drilled *before* bending. (See Fig. 1 on page 78.)

Mark the location of the holes, and center-punch them. Using a small bit, drill all holes. You will then have a guide or pilot hole for the larger bits. A 5/8" tapered reamer may be used to make the holes larger. For the two octal sockets, drill and ream the holes to 3/8" and then use a socket punch to finish them.

To bend the chassis, place two pieces of



Simplicity of wiring is shown in bottom view of transmitter (above). Note "hot" ground in schematic below. Precautions are given in text.



PARTS LIST

C1—120-μμfd. ceramic capacitor
C2—12-μμfd. ceramic capacitor
C3—0.005-μfd., 600-volt capacitor
C4—100-μμfd. variable capacitor (Bud 1855)
C5a/C5b—20/20 μfd., 250-volt dual electrolytic capacitor
C6—0.1-μfd., 600-volt capacitor
J1—Midget phone jack
L1—Coil (see text)
R1—100,000-ohm, ½-watt resistor
R2—1500-ohm, 1-watt resistor
R3—50,000-ohm, 1-watt resistor
RFC1—2.5-millihenry choke
S1—S.p.s.t. switch
V1—117P7-GT tube
1—Crystal and socket
2—Octal tube sockets
1—Index file card box (see text)
1—2½" x 4¾" piece of 1/16" or 1/32" aluminum
3—⅜" rubber grommets
1—Line cord and plug

wood in a vise with the chassis between them. Adjust the wood so that one piece has its edge across the top and along the line where you wish to bend the chassis.

Bend the metal with your hand as far as you can, then take a rubber or plastic mallet and hammer the chassis until it is bent 90° while still in the vise.

Remove the chassis from the vise, turn it around, and bend the other end in the same manner. Both bends are in the same

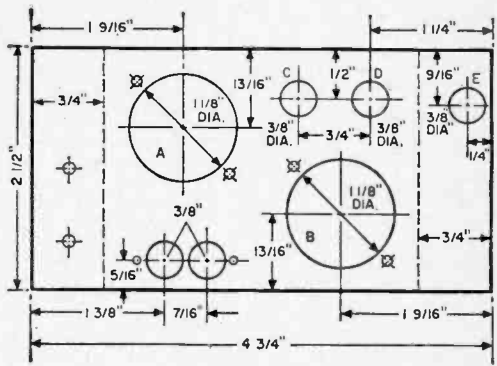


Fig. 1. Chassis template, top view. See text for explanation of details.

direction, the chassis forming a U shape.

Try the chassis in the cabinet for fit. If it does not fit well, adjust the bends.

Follow layout in Fig. 2 (p. 106) for the cabinet holes. The lower left-hand side of the cabinet with the hole for key jack *J1* lines up with hole *E* in the chassis. Line up *J1* through both holes. This secures the front of the chassis to the cabinet. The two holes in the rear apron are used to secure the rear of the chassis to the cabinet. However, do *not* install the chassis yet, and do *not* mount *J1*.

Mounting and Wiring. The parts on the chassis include tube socket *A*, coil socket *B*, the crystal socket, and two ⅜" rubber grommets (holes *C* and *D*). Begin the wiring *before* the chassis is installed in the cabinet. Use pins 1 and 8 of socket *B* for the coil.

Drill a ⅜" hole in the lower rear of the cabinet on the side that the chassis will be placed. Put a rubber grommet in the hole and push your line cord through it. Knot the cord about 5" inside the cabinet to keep it from pulling through.

Installation. Mount the toggle switch in its hole. Slide the chassis into the cabinet and install two *6-32* screws from the back of the cabinet through the chassis. Place key jack *J1* through the holes in both the chassis (hole *E*) and the cabinet. Before

(*Continued on page* 106)

Among the Novice Hams

By HERB S. BRIER, W9EGQ

BEFORE continuing our discussion of fundamental electronic theory designed to give the student a clear idea of how radio equipment works and to prepare him to pass the General/Conditional/Technician class examination, let us review briefly the theory that we have covered in previous columns.

Preceding Theory. First, we defined electric current, electromotive force (voltage), and resistance, and we learned that Ohm's law ($E = IR$, $I = E/R$, $R = E/I$, where E is electromotive force in volts, I is current in amperes, and R is resistance in ohms) expresses the relationships between the three quantities in a resistive circuit (October, November, 1957). Next we covered the differences between direct and alternating currents (December issue of POP'tronics.)

Then, we studied capacitors and capacitive reactance (January, 1958), and inductors and inductive reactance (March). We learned that capacitive reactance equals: $Xc = 1/(2\pi FC)$, where Xc is capacitive reactance in ohms, π (*pi*) is 3.14, F is frequency in cycles per second, and C is capacitance in farads; and that inductive reactance equals: $X1 = 2\pi FL$, where $X1$ is inductive reactance in ohms, π is 3.14, F is frequency in cycles per second, and L is inductance in henrys.

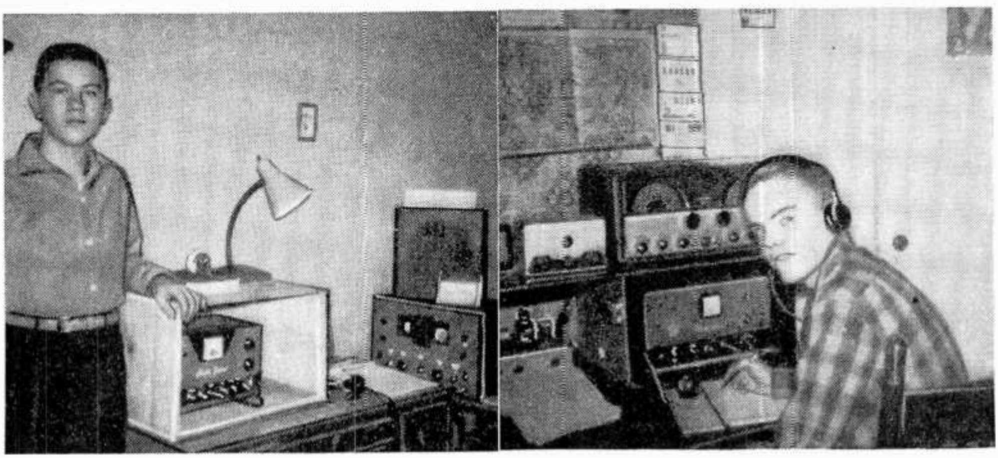
From these formulas and our discussion of them, it is obvious that, in many ways, capacitive reactance and inductive reactance are opposite to each other. Capacitive reactance decreases in value as capacitance and frequency increase, while inductive reactance increases with frequency and inductance.

We also learned that the difference between reactance and resistance is that *power* is required to force current through resistance, but the current that flows into a capacitor or an inductor during ¼-cycle flows back out of it the next ¼-cycle. Therefore, neither consumes power.

With these facts in mind, let us see what happens when we connect capacitance, inductance and resistance in series across an a.c. generator, as in Fig. 1 on page 81, and vary the generator frequency.

Series Circuits. As we start at a low frequency and gradually tune the generator higher in frequency, more and more current flows into the circuit until a certain

Leo, KN1DPO, and Roland, KN1DQU, (left and right, respectively), are close friends and neighbors in Manchester, N. H. See News and Views for details of their equipment.



HELP US OBTAIN OUR HAM LICENSES

Prospective amateurs requesting help and encouragement in obtaining their licenses are listed here. To have your name listed, write to Herb S. Brier, W9EGQ, c/o POPULAR ELECTRONICS, One Park Avenue, New York 16, N. Y. Please print your name and address clearly. Names are grouped geographically by amateur call areas.

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frequency is reached. Beyond that particular frequency, the current starts to decrease again.

At the lowest frequency, the reactance of the capacitor is high; little current can flow into the circuit, even though the reactance of the inductor is low at this frequency. As the frequency is increased, the reactance of the capacitor gradually decreases and the reactance of the inductor increases until a frequency is reached where the two reactances are equal, but opposite, to each other. Consequently, they cancel each other, leaving only R to oppose the flow of current in the circuit. The current increase will take place at only one frequency.

As the generator frequency is further increased, the capacitive reactance continues

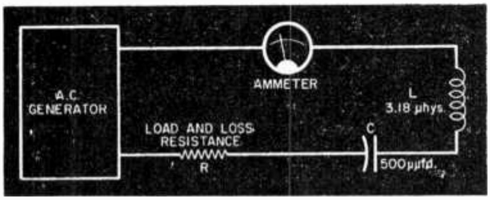
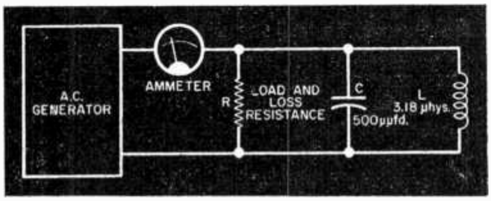


Fig. 1. Series resonant circuit.

Fig. 2. Parallel resonant circuit.



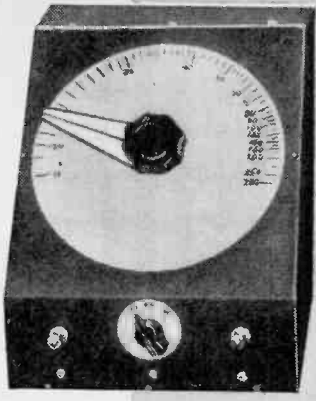
to decrease and the inductive reactance to increase. Thus, they no longer cancel each other completely, causing the current to decrease again.

Resonance. The frequency at which the inductive and capacitive reactance of a series circuit equal and cancel each other is its *resonant frequency*. At this frequency, $Xl = Xc$ or $2\pi FL = 1/(2\pi FC)$. For the values of inductance and capacitance shown in Fig. 1, the resonant frequency is 4 mc., where the two reactances equal 80 ohms.

By a series of algebraic manipulations*, the equality $2\pi FL = 1/(2\pi FC)$ is converted into the standard formula for calculating the resonant frequency of an inductive-capacitive circuit: $F = 1/(2\pi \sqrt{LC})$; where

(*Continued on page* 120)

*These algebraic manipulations are: $2\pi FL = 1/(2\pi FC)$. Multiply both sides by $2\pi FC$, giving $2\pi FC \times 2\pi FL = 2\pi FC/(2\pi FC)$. But $2\pi FC/(2\pi FC) = 1$: therefore, $2\pi FC \times 2\pi FL = 1$. (These steps are often called "transposing.") Combine terms: $4\pi^2F^2LC = 1$. Divide both sides by $4\pi^2LC$, giving $F^2 = 1/(4\pi^2LC)$. Finally, take the square root of each side, getting $F = 1/(2\pi\sqrt{LC})$, the desired equation.



NOTCH YOUR Hi-Fi

THE EXPERIMENTER often wants to filter out a particular frequency. This is especially true of unwanted 60-cycle a.c. pickup. Stray 60-cycle pickup can be especially annoying when you are trying to use an oscilloscope or check a sensitive amplifier. What is needed is a "stop-band" filter.

The simple resistor-capacitor network shown in Fig. 1 will do an admirable job. This circuit is also known as a "notch" filter, because of the shape of its "stop-band" curve (see Fig. 3). While not a filter in the true sense of the word, it will sharply null out any given frequency when the proper values of components are used.

With a few additional components, this circuit can be utilized as a combination filter and audio frequency meter (Fig. 2). The model to be described here operates from 19 to 28,000 cycles in three steps.

Circuit Details. One condition necessary for the circuit to null is that the ratio of the resistances remain constant. This is accomplished by using multigang carbon potentiometers. It was found, however, that inexpensive pots did not track accurately enough. To compensate for this, and to provide a means of adjustment, separate series pots are used. The capacitors can be non-precision to minimize expenses.

Multiganged potentiometers are not assembled when purchased; follow the instructions included with each unit. These pots should be wired so that the arms are at maximum resistance when rotated fully counterclockwise.

The circuit wiring is not critical and any convenient layout will do. After assembly, an ohmmeter should be used to adjust *R1* and *R4* to 11,100 ohms and *R6* to 1100 ohms.

Cabinet size is up to the builder. A large cabinet will allow for a large calibration dial with greater reading accuracy.

Earphones, an oscilloscope, or a low-range a.c. voltmeter can be used for null detection. For very low input signals, it may be necessary to amplify the output for voltmeter null detection.

Calibration. Because the potentiometers are not linear over their entire range,

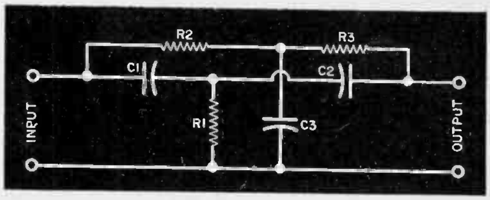
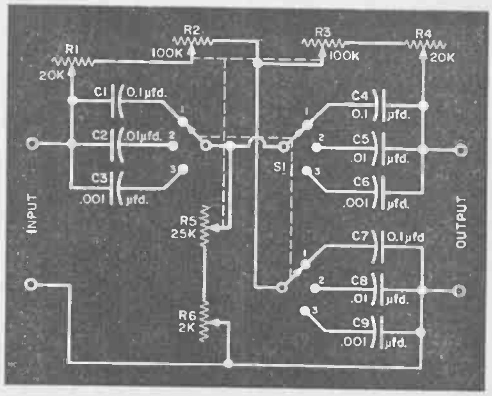


Fig. 1. Schematic diagram of the basic notch filter. Parts values for a 60-cycle filter appear on p. 108.

Fig. 2. Variable frequency filter circuit uses three-gang potentiometer.



Simple filter measures or knocks out certain frequencies

By
R. WAYNE CRAWFORD

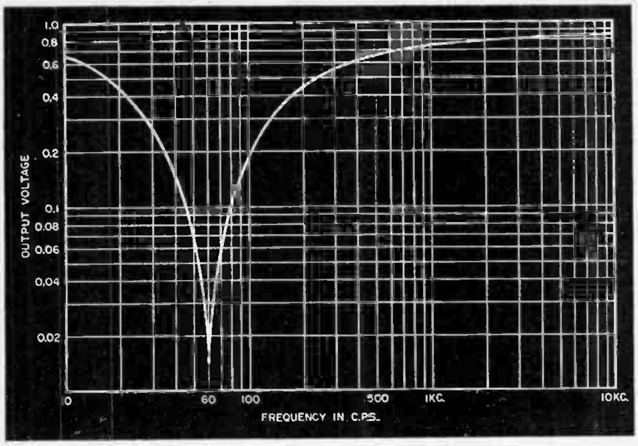
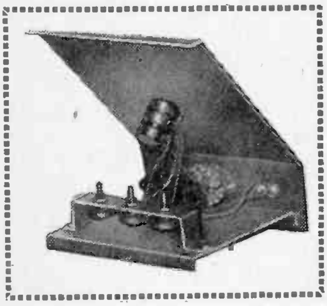
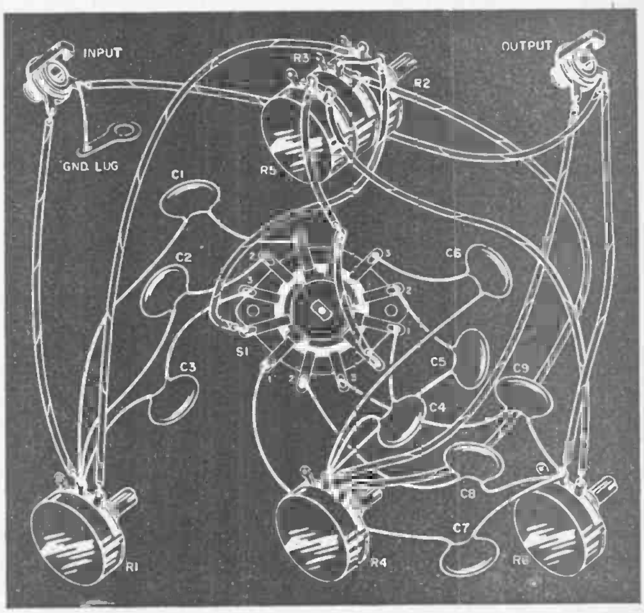


Fig. 3. Sharp attenuation of notch filter circuit tuned to 60-cycle line frequency is shown in graph form.

Inside view of filter (below, left) shows mounting of potentiometers for convenience. Slant panel provides easy reading of scale markings.





an audio oscillator is needed to calibrate the unit. Place a disc of heavy white drawing paper of the desired size into position. Pencil a mark at the bottom of the disc and another 30° counterclockwise from the bottom, as per photograph of instrument face on page 82. Tighten the pointer knob on the shaft at this mark. Now rotate the pointer another 30° counterclockwise.

Set the audio oscillator at 280 cps, and make certain the selector switch is in the number 1 position. Readjust *R1*, *R4* and *R6* for maximum null. Pencil in a mark at 280 cps. Then set the audio oscillator to 250 cps and rotate the pointer knob counterclockwise until a null is reached and mark it. Continue this procedure until you have reached 19 cps.

Reset the pointer on 280 and turn the

(*Continued on page* 107)

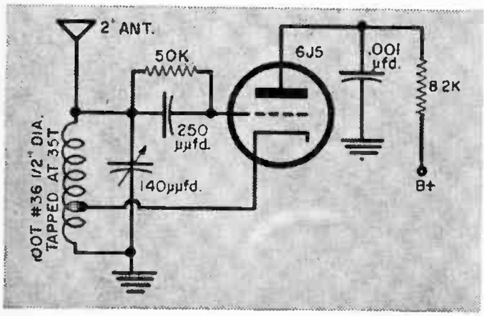
PARTS LIST

- *C1, C4, C7—0.1-µfd. capacitor*
- *C2, C5, C8—0.01-µfd. capacitor*
- *C3, C6, C9—0.001-µfd. capacitor*
- *R1, R4—20,000-ohm carbon potentiometer*
- *R2—100,000-ohm carbon potentiometer (IRC Type PQ)*
- *R3—100,000-ohm carbon potentiometer (IRC Type M)*
- *R5—25,000-ohm carbon potentiometer (IRC Type M)*
- *R6—2000-ohm carbon potentiometer*
- *S1—3-gang, 3-pos. rotary switch*

Poor Man's Theremin for the Musically Minded

The "Theremin" is an electronic instrument that can play music or emit unearthly shrieks and whistles. Its pitch is controlled by hand movement. As the hand moves towards or away from its antenna, the sound frequency varies.

With the usual Theremin, five or more tubes are required for speaker operation. It is about as complicated as a radio. However, an inexpensive adaptation can



be made that uses a radio receiver having a beat-frequency oscillator (BFO). You will also need a simple r.f. oscillator (as shown in the diagram) whose output signal can be tuned in on the receiver. About 100 volts is okay for B+.

Tune the r.f. oscillator to an unoccupied channel, in the broadcast band, for example, and resonate the receiver to the same frequency. Switch on the BFO and set it to zero-beat the oscillator. Either the fundamental or a harmonic can be picked up. As your hand approaches the antenna of the oscillator, the audible pitch will change, and you have to experiment a lot to learn how to play a tune.

Many broadcast receivers do not have a BFO. Usually, however, one stage of a receiver can be made to oscillate and generate the required beat. For example, grid and plate circuits of an i.f. stage can be coupled together. Removing a screen bypass capacitor of an i.f. stage, shorting the i.f. cathode resistor, or removing the shield from a glass-type tube are other methods that generally produce oscillation.

Whichever type of oscillator you use, let it warm up for a few minutes so that drift will be minimized. Tune the receiver to zero-beat with the hand well away from the antenna. Then, as the hand approaches, its pitch will rise.

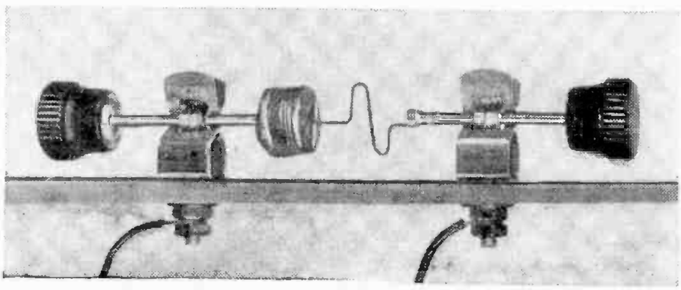
Volume control is accomplished as follows. Tie a short length of wire to the antenna post of the receiver. As your left hand approaches this wire, pickup is increased and the signal becomes louder. The right hand plays the melody in conjunction with the oscillator antenna. Of course, the volume control of the receiver is also effective on the Theremin output.

This simple adaptation can provide a good introduction to actual Theremin playing. It's fun at parties, and even the children will want to try it. Don't expect sweet music right away, though. Since the Theremin is not key-operated, it isn't easy to play, and will give forth nothing but horrible squeals in the hands of an unskilled or non-musical person. —*R. Zarr*

Make a "Cat-Whisker" Crystal Detector

Germanium diodes are nice to have, but beginners and crystal set hobbyists will enjoy making this novel crystal detector which is reminiscent of "the good old days" when most people were tickling chunks of galena or silicon with "cat whiskers." Panel-mounted, the unit is simple, rugged and economical to construct.

The cat whisker is made of No. 24 gauge copper wire or brass wire which is bent and soldered to the end of No. 22 copper or brass rod as shown in the photo. File the end of the wire to a point. The lead-mounted crystal and two Fahnestock clips can be bought for about 13 cents. (Most radio mail-order houses still sell crystals for 6 to 15 cents each, some of which have spots on them that are nearly as sensitive as germanium diodes.)



You will note that both the cat whisker and the crystal can be rotated; when they are mounted a little off-center, a wide range of adjustment is possible by rotating the two knobs. The Fahnestock clips should be adjusted so that the rods will slide up and down easily without pressing on the clips. —*Art Trauffer*

Transistor Topics

By LOU GARNER

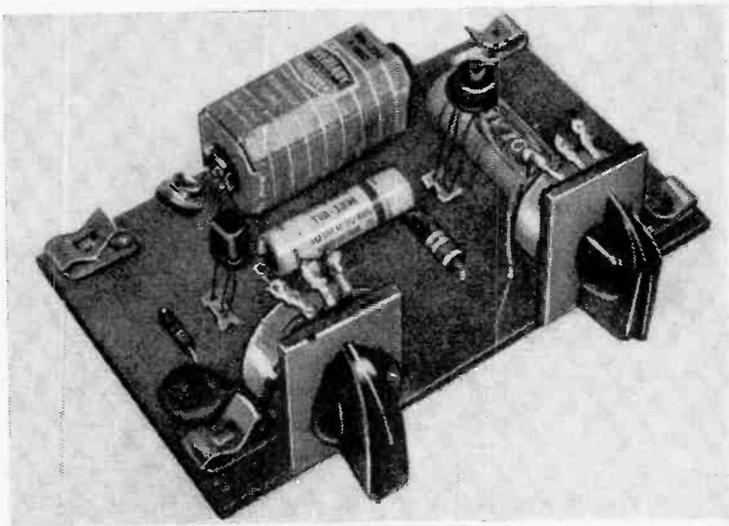
LOOKING TO THE FUTURE, there's a good chance that a majority, if not all, of the newer satellites, American *and* Russian, will use transistorized circuitry. Transistors are, of course, ideal for such applications. Their power, weight, and space requirements are low, their efficiencies high, and their operating life exceptionally long. In addition, with their great resistance to shock and vibration, they can stand the acceleration of a rocket take-off.

As of this writing, both Russian and American satellites have used conventional batteries as their sources of electrical power. However, future satellites probably will be powered by a combination of long-life nickel-cadmium storage batteries and high-efficiency silicon solar cells.

Reader's Circuit. Transistorized audio amplifiers are popular projects with novice experimenters as well as more advanced workers. Such circuits are easy to build, generally do not require expensive parts, and, in most cases, are easy to trouble-shoot. In addition, most audio circuits are extremely versatile . . . they can be used in radio receivers, hi-fi equipment, ham gear, and in some types of test instruments.

Reader Albert T. Brooks, of 421 W. Germantown Pike, Plymouth Meeting, Pa., submitted the two-transistor audio amplifier circuit shown in Fig. 1. The amplifier consists of two resistance-capacity-coupled common-emitter stages. The second stage is transformer-coupled to a PM loudspeaker. Al has used *p-n-p* transistors in both stages—a Raytheon Type CK722 in the first and a G.E. Type 2N190 in the second stage.

In operation, audio signals applied to the *Audio Input* terminals are coupled through d.c. blocking capacitor *C1* to the base-emitter circuit of the first stage which receives base bias current through resistor *R1*. The amplified audio signal appearing across collector load resistor *R2* is coupled through electrolytic capacitor *C2* to the base-emitter circuit of the second—or output—



Two-transistor audio amplifier submitted by reader Albert Brooks is assembled on plastic base.

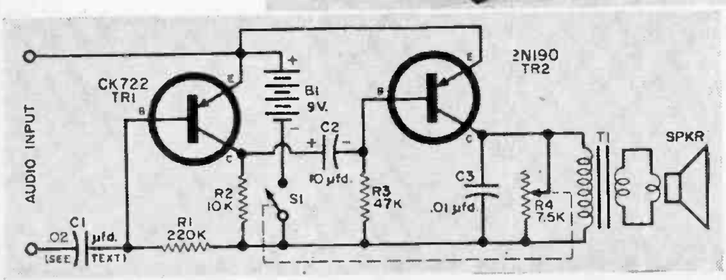


Fig. 1. Schematic diagram of the audio amplifier.

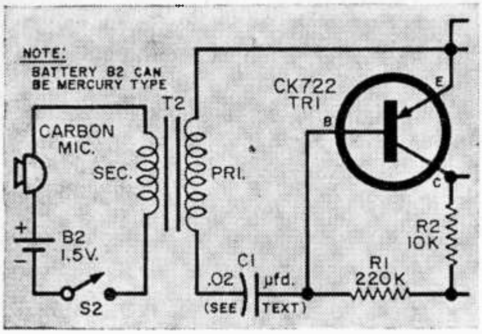
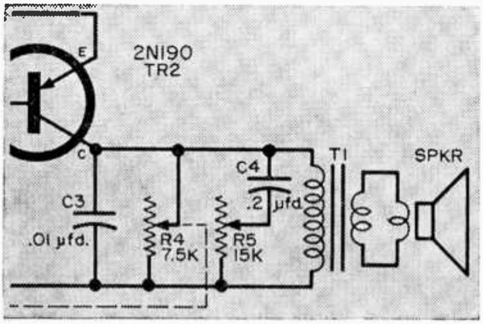


Fig. 2. How to connect a carbon microphone to the amplifier shown in Fig. 1.

Fig. 3. A tone control is incorporated in basic amplifier by adding C4 and R5.



stage; bias current for *TR2* is furnished through resistor *R3*.

Capacitor *C3* bypasses higher frequency audio signals and minimizes harmonic distortion effect. Volume control *R4* operates as a variable shunt across *T1*'s primary winding. Operating power is furnished by a single 9-volt Eveready 226 battery (*B1*) controlled by a s.p.s.t switch (*S1*) ganged to the volume control.

Only standard, readily available components are used. All fixed resistors are half-watt units; *C1* and *C3* are disc ceramic capacitors with a d.c. working voltage rating of at least 25 volts; *C2* is a 25- or 50-volt electrolytic capacitor. To lower cost, Al chose a standard *vacuum-tube* output transformer designed to match a 50B5 or 50L6 power output tube to a loudspeaker voice coil (Stancor A-3332).

Since the circuit is reasonably non-critical, you can follow your own inclinations regarding layout and wiring. Al assembled his amplifier on a piece of Lucite measuring ⅛" thick by 3" wide by 5" long. (Polystyrene, Bakelite, insulating fiber board, or similar materials would do as well). Although he used conventional wiring, Al patterned his layout after those used in etched circuit construction. He mounted all electrical parts above his plastic "chassis," with all wiring on the reverse or bottom side.

With the wiring completed, recheck all connections for accidental shorts and possible wiring errors *before* installing the transistors or connecting the power supply battery.

Modifications. Al has suggested a pair of interesting modifications to his basic circuit. These are shown in Figs. 2 and 3, respectively.

A carbon microphone can be added to the amplifier by using the arrangement shown in Fig. 2. A separate 1.5-volt battery (*B2*) with its own s.p.s.t. "on-off" switch (*S2*) is provided for the microphone. For maximum battery life, Al suggests that a mercury cell be used for *B2*.

The microphone input transformer (*T2*) is a standard 6.3-volt filament transformer connected "backwards," with the low-impedance (6.3-volt) secondary winding connected to the microphone and the high-impedance (117-volt) primary winding connected to the amplifier's input circuit.

A *tone control* can be added to the basic amplifier by using the arrangement shown in Fig. 3. A 0.2-µfd. capacitor (*C4*) and a 15,000-ohm control (*R5*) are connected in series across the output transformer (*T1*) primary winding. As *R5*'s resistance is reduced, *C4* acts to bypass more and more of the higher frequency audio signals.

Applications. The completed audio amplifier described above can be employed with any PM loudspeaker having a 3-4 ohm voice coil. For best results, use it with as large a loudspeaker as you have available. A larger speaker will provide greater output and better tone quality.

You can use the completed instrument as a general test amplifier around your home workshop (or laboratory) or you can add it to an existing headphone-operated radio receiver. When it is added to a crystal receiver, for example, you should obtain good loudspeaker volume on all stations which formerly gave you adequate headphone volume. With some crystal sets, best results are obtained when the input capacitor (*C1*) is omitted.

This amplifier does not have sufficient gain to operate a loudspeaker when driven by a low-output phonograph cartridge. However, you can use it as a test amplifier in such applications; simply replace the output transformer (*T1*) with a pair of moderate-impedance magnetic headphones (500 to 2000 ohms).

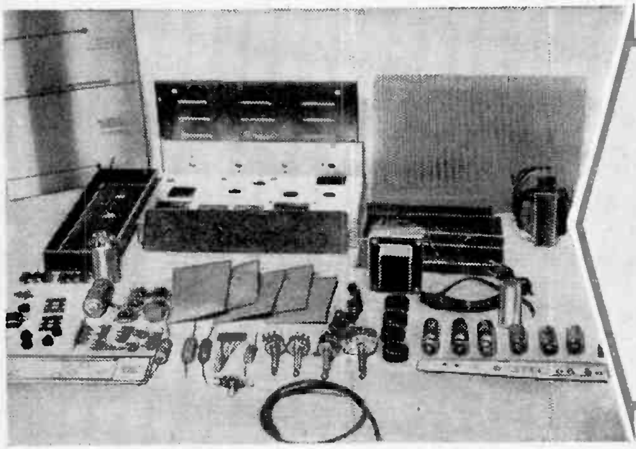
Transistors and TV. By now, you may have read about Motorola's experimental all-transistor (except for the picture tube)

(*Continued on page* 114)

KIT BUILDER'S KORNER

A N INTEGRATED AMPLIFIER, the Eico HF-12 12-watt amplifier kit comprises preamplifier, equalizer, control section and power amplifier and supply on one chassis. It is intended for any low or medium power hi-fi application.

Some critics hold that integrated chassis run the risk of induced hum because of undesired coupling between preamp and power stages. The design of the HF-12 overcomes this possibility by using a "low silhouette" construction with a horizontal chassis, and by using d.c. bias on all filaments, thus eliminating cathode-heater leakage as a source of hum. The result is that the noise level is way down (below 12 watts). Technically, it is: for magnetic phono input, 60 db; for tape head, 50 db; for tuner and auxiliary inputs, 75 db.



EICO Model HF-12 Amplifier

While there are not as many inputs or equalizations as higher-priced amplifiers offer (for example, this amplifier on phono does not equalize for American or European 78's, old London or old Columbia LP's), they are perfectly adequate for the present-day LP's and tapes. The older equalizations have been sacrificed in the interest of modernity at low cost.

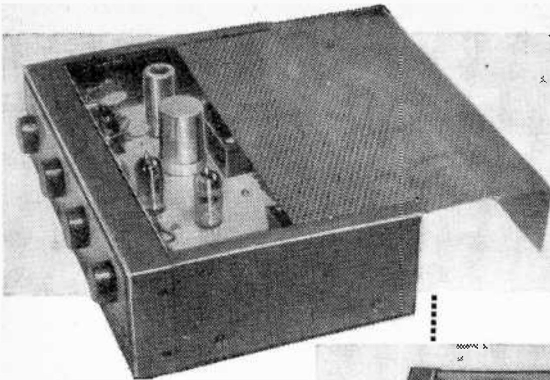
Putting It Together. In mounting the tube sockets, orient each with respect to its key, as in the pictorial diagram; this will keep your wire lengths to a minimum, which contributes to better over-all performance. Also note that tube XV-1 is a *shielded* tube socket to be mounted *above* the chassis. The other five tube sockets are not shielded and are mounted below the chassis.

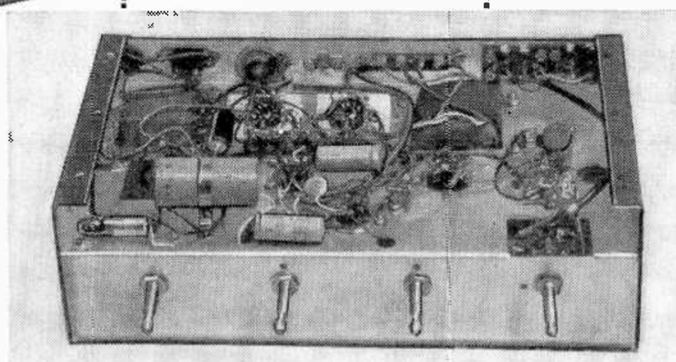
Wiring of the selector switch looks complicated, but is made simple through the designation of the front-layer lugs by the suffix "A" and the back or under-layer lugs by the suffix "B."

After you have completed the wiring, make the recommended resistance checks with a volt-ohm-milliammeter or vacuum-tube voltmeter. This checks out your power supply wiring and prevents accidental harm to such expensive components as the power transformer, electrolytic capacitor and EZ-81 rectifier tube.

You will find the step-by-step instructions clear. The pictorials help not only in the point-to-point connection of the parts but in their exact placement as well. This eliminates the introduction of hum and other spurious couplings.

Special Features. Output power is 12 watts continuous, 25 watts peak, with a frequency response of ±0.5 db, 25 - 20,000 cps, at 12 watts, and ±0.5 db, 12 - 75,000 cps, at 1 watt; intermodulation distortion is 1.3% at 12 watts, 0.55% at 6 watts, 0.3% at 4 watts; transient response shows excellent square-wave reproduction (4-microsecond rise-time) with negligible ringing





Note how perforated cover slides out (above) to allow for tube checking. At right is the completely wired amplifier chassis as it appears from the underside. Pictorials help in making point-to-point connections as well as placement of components to eliminate the introduction of hum and spurious couplings.

and rapid settling on a 10-kc. square wave; and transient distortion (60-cps tone burst) is less than 1% at 12 watts output power. These characteristics mean that both at full power and at ordinary listening levels the HF-12 delivers relatively undistorted response.

The preamplifier-control section provides two low-level inputs for magnetic phono (RIAA equalization) and tape head (NARTB equalization), and two high-level inputs for TV, tuner or crystal/ceramic cartridge, with unused inputs shorted at every position of the input selector switch to assure zero crosstalk. The preamplifier stage employs a low-noise dual triode (ECC83/12AX7) circuit with accurate low-distortion equalization.

For the separate bass and treble tone controls, a low-noise dual triode (an ECC-82/12AU7) is employed, in a low-distortion, variable crossover, feedback-type circuit. Large boosts and cuts at either end of the audio spectrum are made possible (at 10 kc., ±13 db; at 50 cps, ±16 db) without affecting the middle frequencies. Neither control interacts with the other, so that bringing up the drums, for example, will not cause a soprano to turn into an alto.

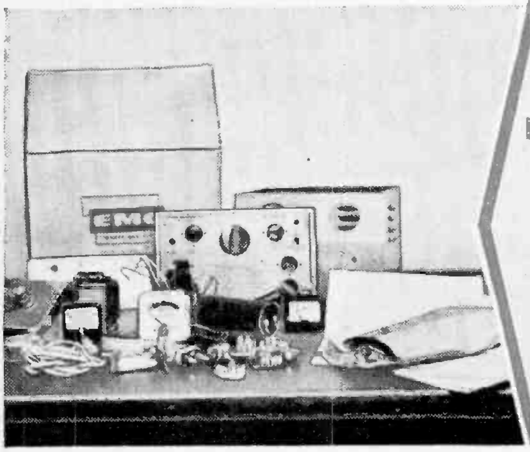
The amplifier circuit is of the Williamson type, using a 12AX7 and EL84 output tubes. This circuit permits use of a large amount of inverse feedback (20 db) with a good stability margin of 12 db. Good design practice has kept controls out of the feedback loop. Speaker connectors are 4, 8 and 16 ohms.

Comment. For all its compact size (3⅝"x12"x8¼"), the HF-12 packs a bigger wallop than is apparent from the specifications. This reviewer owns a low-efficiency speaker which most authorities recommend should be driven by at least a 20-watt amplifier. As an experiment, I connected this speaker to the HF-12. The result was excellent with the HF-12's volume control only at mid-position.

In addition to complete operating instructions, the instruction manual contains a trouble-shooting chart and a voltage-and-resistance chart, so that the purchaser can maintain and repair this amplifier with a VOM or VTVM as his only test instrument.

The HF-12 is adaptable to any panel thickness by simply removing its bezel, which exposes only the control shafts and thus leaves the amplifier completely shielded when placed in a console or out. To check or change a tube, you don't have to dismantle the entire cabinet; just unscrew two self-tapping screws in the back and the perforated cover slides out on the rails welded onto the side pieces.

EMC Model 905-6A Battery Eliminator, Charger and Vibrator Checker



EVER TRY to service your auto radio indoors, without the use of your car storage battery? The EMC Model 905-6A (Electronic Measurements Corp., 625 Broadway, New York 12, N. Y.) is designed primarily for bench testing of auto radio sets. It can also be used for battery charging, operation of relays, or any application requiring a filtered d.c. supply.

The battery eliminator and charger (Model 905) operates from a 117-volt, 60-cycle source and provides 10 amperes continuously or 20 amperes intermittently. The d.c. output voltage is available in two ranges: 0 to 8 volts and 0 to 16 volts. A self-resetting overload circuit breaker and a fuse prevent damage to the unit if it becomes overloaded.

Model 906 is a piece of test equipment which is designed to determine the quality of 6- or 12-volt auto radio vibrators. Its test circuit duplicates the electrical characteristics of a typical vibrator power supply, and when it is used with a suitable d.c. power supply (such as the Model 905), it will check the "starting" and other characteristics of most 6- or 12-volt interrupter or synchronous vibrators.

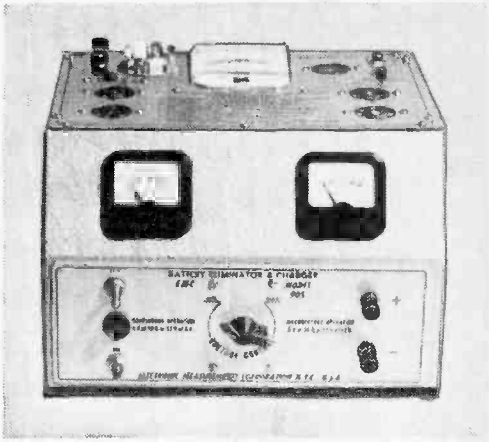
Putting It Together. A combination of the Model 905 and 906 kits is shown in the photographs. When assembled, it consists of one cabinet, having a voltmeter and an ammeter on the front panel and a "good-bad" meter and test sockets for plug-in vibrators on the top panel. Operating instructions are printed on the top panel for convenience.

Assembly instructions are given in a clear-cut and distinct manner, warning of small problems that may arise in the course of construction. The more-than-adequate number of pictorials follow right along with the individual steps, showing a clear picture of the assembly. Soldering must be done neatly; since the instrument is compact, loose bits of wire or solder might cause shorts and/or damage to the instrument.

Special Features. The vibrator testing function is simple to operate. A calibrated meter evaluates the condition of the vibrator in terms of "good" or "bad."

An outstanding feature of this model is that it can be built as a combination battery eliminator-vibrator test assembly or the separate units can be assembled individually.

Comment. A problem that arose during construction was quickly overcome. The variable transformer's mounting brackets didn't quite match the front panel holes. These were easily "repositioned" with a reamer.



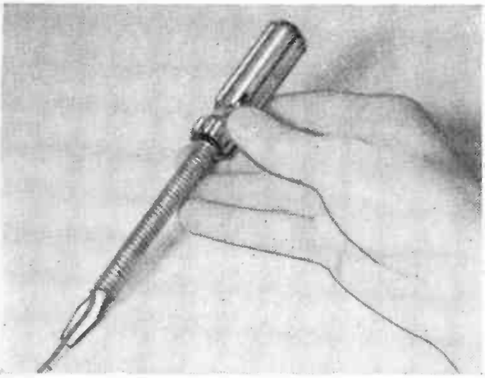
Completed Model 905-6A shows vibrator testing panel mounted in place. Battery eliminator is also available without the vibrator tester feature.

The EMC 905-6A represents a good buy for the money, particularly for those who experiment with low-voltage d.c. circuits as well as service auto radios. —30—

TIPS and TECHNIQUES

SCREWDRIVER DISPENSES SOLDER

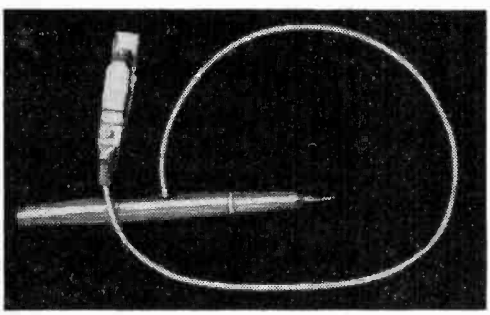
You can keep wire solder convenient and close at hand for soldering by spiraling a length of it around the blade of a screwdriver. When soldering in a deep, crowded chassis, the long screwdriver blade will ex-



tend the solder to the contact where it's needed. Solder carried this way in a tool kit will conserve valuable space, as well as keep it from getting lost. —*J.A.C.*

SPARK PLUG SAMPLER

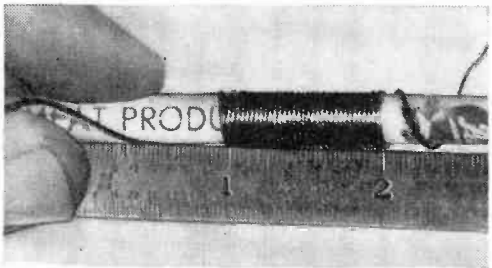
If you have an automobile in which the spark plugs are covered by a shield, it is inconvenient to determine just which plug is not firing properly. Here is an instrument requiring no external source of power



that will show the frequency of discharge at spark plug points and also the comparative strength of the fire—without removing the shield which is over the plugs. It consists of a NE-2 neon bulb, one 2-megohm, ½-watt resistor and a ground clip in series. A ball-point pen shell is a handy holder, and if the parts are assembled as shown, a valuable tool will be available to make the required checks. To operate it, merely clip the ground clamp to a convenient grounded part of the motor and sample the power in the plugs by inserting the sharp point into each spark plug cable. Bright, equally spaced flashes indicate satisfactory operation. —*I.C.C.*

STOP GUESSING WIRE SIZES

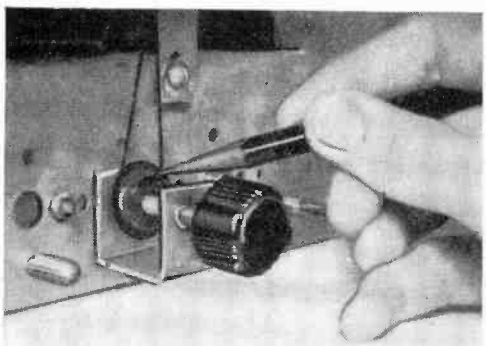
The exact size of any wire can be determined easily and quickly by the following method. With a knife blade, make two



indentations on a wooden pencil exactly 1" apart. Wind a single layer of the wire in question between the two marks, count the number of turns, then refer to the lineal turns per inch column of the copper wire table found in every radio or electrical handbook. For the smaller sizes, a ½" layer will give just as accurate results in less time. —*R. B. K.*

SLIPPING DIAL CORD

A slipping dial cord can be easily corrected with a rubber grommet of the type



used where a power cord passes through a metal chassis. Slip a tight-fitting grommet over the tuning shaft and restring the dial cord. If faster tuning is desired, cement a larger grommet over a smaller one as shown. It may be necessary to use a touch of Duco cement to fix the grommet to the shaft. —*J.A.C.*

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Model SS-1

$39.95

HEATHKIT RANGE EXTENDING HIGH FIDELITY SPEAKER SYSTEM KIT

Designed especially for use with SS-1 "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.

Shpg. Wt. 80 lbs.

Model SS-1B

$99.95

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.

Shpg. Wt. 23 lbs.

Model A-9C

$35.50

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!

Shpg. Wt. 8 lbs.

Model FM-3A

$25.95

(with cabinet)

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.

Shpg. Wt. 8 lbs.

Model BC-1A

$25.95

(with cabinet)

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.

Shpg. Wt. 7 lbs.

Model WA-P2

$19.75

(with cabinet)

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.

Shpg. Wt. 31 lbs.

Model W-5M

$59.75

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 5⅞" H x 5⅜" 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

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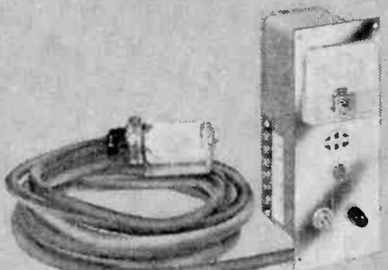
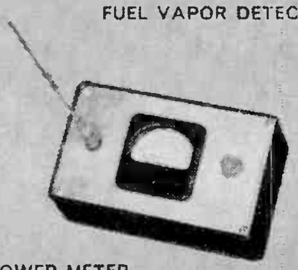
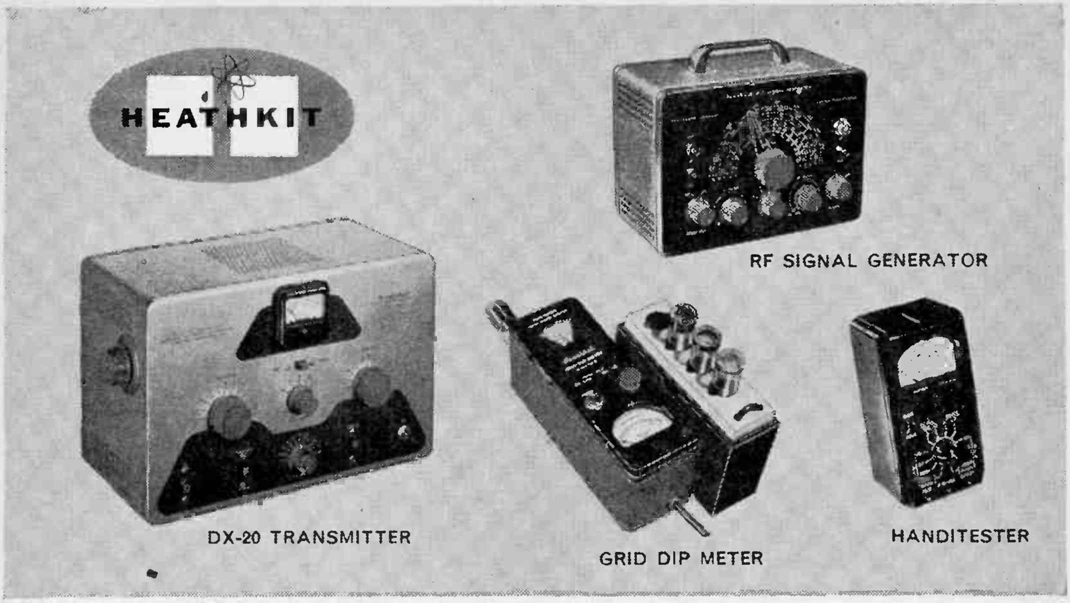


FUEL VAPOR DETECTOR

RADIO DIRECTION-FINDER



POWER METER



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.

Shpg. Wt. 18 lbs. **Model DX-20** **$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.

Shpg. Wt. 4 lbs. **Model GD-1B** **$19.95**

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.

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

Shpg. Wt. 3 lbs. **Model M-1** **$14.50**

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.

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

HEATHKIT ALL-BAND RADIO KIT

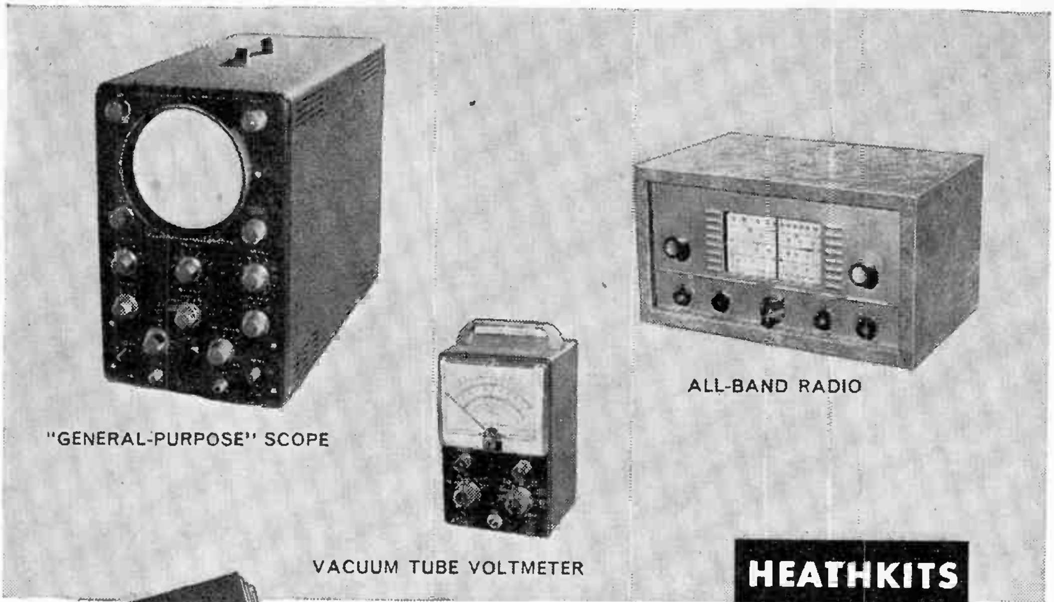
This receiver covers 550 kc to 30 mc in four bands, and is ideal for the short wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image projection. Amateur bands clearly marked on the illuminated dial scale. Employs transformer-type power supply—electrical 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.

Shpg. Wt. 12 lbs. **Model AR-3** **$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."

Shpg. Wt. 21 lbs. **Model OM-2** **$42.50**



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TOOLS and GADGETS

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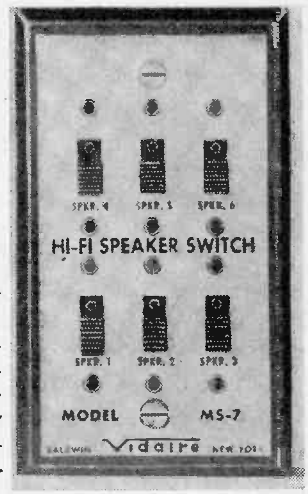
Model MS-7 is a six-position speaker selector which can be used with speakers of any size or impedance. Six slide switches are mounted on a polished brass embossed wall plate for installation on a standard wall box or panel. Any combination of six speakers may be selected with a constant impedance maintained at the amplifier by means of built-in compensating resistors.



Wiring instructions are included. (*Vidaire Electronics Mfg. Corp.,* Baldwin, N. Y.)

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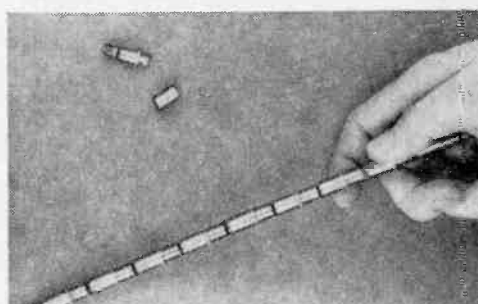
Inexpensive A750 silicon rectifiers can be quickly screwed together to form a series chain with inexpensive threaded bushings. A single A750 rectifier, threaded at each end, has a peak inverse rating of 400 volts and a forward current rating of 750 ma. A ten-unit assembly has a peak



inverse rating of 4000 volts. For higher ratings, additional rectifiers can be connected. Threaded units with current ratings up to 5 amperes are also available and can be similarly assembled. (*Audio Devices, Inc.,* 620 E. Dyer Rd., Santa Ana, Calif.) —30—

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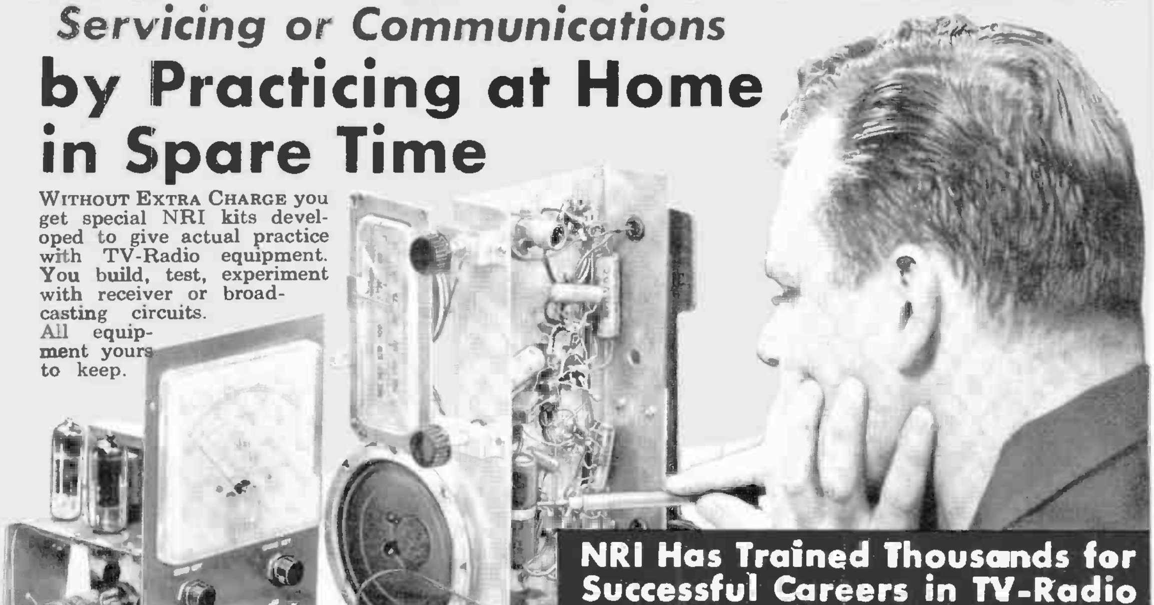

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Single-Stick Antenna

(*Continued from page 62*)

line? Sounds like you're trying to sell me a bill of goods! Why is it necessary to prune the length of the line?"

"Because the transmission line doesn't provide an exact match to the antenna at all frequencies," I replied. *"This mismatch is reflected down the line and appears at the end of the line. It may develop that your particular transmitter doesn't 'like' the impedance presented to it by the line. If that's the case, you might have a situation where you can't load the transmitter. Some transmitters are more tolerant of this situation than others, you know."*

"The transmission line isn't perfectly matched?" he asked dubiously. *"Isn't that bad?"*

"No," I said. *"As a matter of fact, the mismatch expressed in terms of the standing wave ratio (SWR) on the transmission line is just about 1.5:1 at the resonant frequency of the antenna. That's quite reasonable, and practically all amateur transmitters will work well with ratios up to 3:1 or so. I just wanted to emphasize that if the antenna doesn't seem to tune properly on a certain frequency, you can cure the trouble by adding another ten feet or so to the length of the coaxial transmission line. I just don't want you calling me up at 3 a.m. some morning and telling me you can't get on 15 meters because the antenna doesn't work. I know it does. So I'm just anticipating some of your questions."*

"Right-o," laughed the young Novice, gathering up the pencil sketches. He started to move toward the door.

As a parting shot, I said: *"Don't try and cheat on the antenna wire. Use hard-drawn copper wire. Soft copper wire might tend to break or snap, and you don't want that to happen."*

Tommy paused in the doorway and asked: *"Is there any reason why I can't put a regular TV antenna on top of the tower so we can get good reception? Dad is agitating for a good antenna, and it'll make him happy if the tower can serve two purposes."*

"No reason at all why you can't do just that," I replied. *"In fact, a TV antenna atop the tower is a perfect disguise. Nobody can guess that the installation isn't just a simple TV tower."*

"By the way—" I called after him, *"keep the ends of the 80-meter dipole about ten feet clear of the ground. There's a good amount of r.f. present at the ends of the wires, and some neighborhood kids may get 'bit' if they touch the wires when you're on the air."* —30—

Install a P.A. System

(*Continued from page* 67)

holder may be employed in this situation.

The record player (if used) should have a spring-loaded tone arm which will not jump grooves when subject to minor vibration. And all connecting cables or leads should have screw-on type connectors and plugs to minimize the chance of a connection lead pulling loose while the system is in operation.

ADJUSTMENT AND OPERATION

Compared to, say, a communications receiver or a hi-fi preamplifier, a p.a. amplifier has relatively few controls. However, these must be adjusted properly if the system is to give satisfactory performance.

First, where several microphones are used, their individual *gain* (or *fader*) controls should be adjusted for balanced pickup, except for the "solo mike," which is adjusted for individual performers. The *master gain* control is adjusted to insure adequate volume for the individual operating conditions encountered, and is used for over-all increases or decreases in volume. For example, a filled auditorium, with its higher background noise level, would normally require a higher setting of the master gain control than would an almost empty room.

The *tone control* (or controls) is generally set for the most natural reproduction of the amplified material, but may be adjusted to other settings under special conditions. Where acoustic feedback is a problem, this can sometimes be minimized by adjusting the tone control to reduce the treble range. When a particular speaker has a rough, high-pitched or raspy voice, the p.a. operator can often compensate by judicious use of the tone control, giving the amplified voice a better quality, even if not fully natural.

Before any p.a. installation is completed, the installer-designer should check its over-all performance, listening in various areas to insure that adequate coverage has been obtained. If there is any question concerning the location of a particular loudspeaker, a quick test may be made by using a spare general-purpose loudspeaker. (Commercial p.a. companies setting up expensive installations frequently use a "sound level" meter which provides a meter reading of sound reaching any one area.) The test loudspeaker may consist of a standard cone unit mounted in a wall baffle and equipped with a small handle and a roll of hookup wire. —30—

Make Your Own Disc Records

(*Continued from page* 46)

ing lacks highs during playback, introduce more treble boost while recording. If the recording is too brilliant, decrease the treble emphasis.

Chip Control. The hair-like chip thrown off by the cutting stylus should tend to pile up at the center of the disc. If it doesn't, the stylus will eventually tangle in it. The result is skipped grooves, distortion, plops and other disturbances. This can be prevented by the use of a small, soft paint brush. The operator simply brushes the chips to the center spindle as the recording progresses.

A more elaborate arrangement can be employed by the ambitious recordist. Note the mechanical setup on page 46. A vacuum cleaner supplies the power, and a large container such as a waste can, partially filled with water, serves as a receiver for the chips, allowing safe storage until disposal. The water is necessary to retard the highly flammable characteristics of the acetate chips.

A flat cover is fashioned to fit the container. It is important that the cover be smooth to insure a good air seal. As shown, two holes are drilled, one to receive the vacuum hose from the cleaner, one to accept the $\frac{5}{8}''$ hose from the recorder. The larger hose from the cleaner should fit snugly through the top for a distance not to exceed a half-inch. The smaller $\frac{5}{8}''$ hose should fit snugly also and should extend through the cover at least four inches but not so far as to create water turbulence, causing water to be drawn into the cleaner.

The length of hose from the cutter arm to the container should not be any longer than it need be, as a hose of this small diameter will load the vacuum cleaner excessively. The cutter arm is fitted with $\frac{1}{2}''$ i.d. copper tubing, mitered and soldered as illustrated so that the flared end will be positioned to the left, in front of the recording arm. In cutting position, the end of the tubing should be within $\frac{3}{8}''$ of the cutting surface of the blank.

The remaining end of the $\frac{5}{8}''$ hose is telescoped *over* the rear end of the tubing. All burrs should be removed from the copper tube upon completion so as not to encourage clogging while in use.

To use the chip remover, turn on the vacuum and begin cutting. It may be necessary to start the removal action by guiding the chips to the pickup tube with the paint brush. The majority of vacuum cleaners have sufficient capacity for the removal action to start at once. And once it begins, it will continue to the end. —30—

Card File Transmitter

(*Continued from page* 78)

tightening *J1*, make sure the lead coming from *RFC1* can be soldered to it.

The filter capacitor (*C5*) can be placed between the chassis and the cabinet. If *C5* has a metal mounting ring and lug, this must be removed to prevent it from shorting connections under the chassis.

The coil form is the base of an old octal-base tube. Some of these have a loose glass envelope that can be twisted off. If it is tight, place the tube in a bag and carefully break the glass envelope. Remove all the glass and glue from the inside of the base. Heat the pins and remove the wires in them. Then drill two small holes in the base to pass the wires from the coil to pins 1 and 8 in the base.

Use No. 20 gauge enamel wire for the coil (*L1*) and pass it through the hole nearest the pins. Then insert it into pin 8 and solder it. Looking at the pin end of the base, wind 30 turns in a counterclockwise direction. This should take you up to the second hole in the base.

Leave enough wire to reach through pin 1. Solder it as you did pin 8. To wind another coil for 40 meters, use 16 turns of wire.

Operation. To check out the rig, connect a 0-100 milliammeter across a plug which fits your key jack. Plug the meter in the key jack, plug in the line cord, and turn on the toggle switch.

During warm-up, the meter pointer will move up and you can read the amplifier current on the meter. Tune *C4* in either

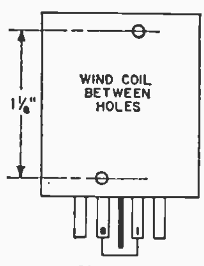
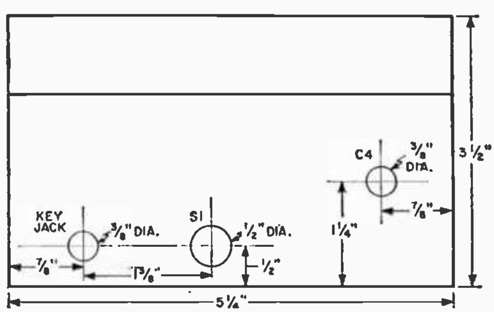


Fig. 2. The coil form should be drilled as shown at left. Front view of the file card box below shows the cabinet holes.



direction until you notice the current suddenly drop. Tuning further in the same direction will cause the current to go up again. When the tube is oscillating, the current is very low (without a load on the transmitter); and when we tune past the range, the tube stops oscillating and the current rises.

The cabinet is connected to one side of the line, and therefore must never be connected to a separate ground such as a radiator. Serious shocks can result if both the cabinet and a separate ground are touched at the same time. To avoid this, we recommend an isolation transformer. And make sure to polarize the line plug—to insure that the chassis will be at line potential.

Depending on the type of antenna used, there are several ways in which the transmitter can be coupled to it. One is to connect the antenna lead-in to an insulated screwdriver, and then scratch the tank coil one turn at a time until optimum coupling is obtained. A better way is to wind two or three turns of wire around the tank coil, and connect one end to the chassis and the other to the antenna. An antenna tuning unit can also be used. See the amateur handbooks for coupling methods if this is your first transmitter. —30—

Notch Your Hi-Fi

(*Continued from page* 83)

selector switch to the second position. Set the audio oscillator at 2800 cps. The meter should indicate a null. If it does not, readjust *R1, R4,* and *R6 slightly.*

Repeat the same procedure with the selector switch at position three, and with the audio oscillator at 28,000 cps. You can then remove the paper from the panel, taking care to mark its position, and ink in the calibration points.

There are approximately 30° at both ends of the dial that are unused. The reason for these unused portions is that at the end of the dial scale the potentiometers become nonlinear and might not give a proper null.

Operation. The unit is now ready for use either as an audio-frequency meter or as a stop-band filter. It will give a null of about 40 db (a voltage ratio of 100 to 1). Figure 3 shows the output voltage vs. frequency characteristic for a 60-cps setting.

If the unit is to be used as a filter, connect it in series with the circuit to be filtered and set the pointer to the desired frequency.

To use the unit as an audio-frequency meter, connect the unknown signal to the input and a detector (earphones, oscilloscope or a.c. voltmeter) to the output. Rotate the indicator knob until a sharp null is obtained, then read the frequency directly from the dial.

Single-Frequency Unit. If a filter for a single frequency such as 60 cps is desired, it can be built into a unit as small as a cigarette package. For such a unit, the wiring would be as shown in Fig. 1.

A 60-cps filter would require only three potentiometers. *R2* and *R3* should be 1 megohm and *R1* should be 250,000 ohms. *C1, C2,* and *C3* should all be 0.005 μfd.

The preliminary adjustment for *R2* and *R3* should be 750,000 ohms, and *R1* should be set at 187,500 ohms. When a 60-cps signal is applied, adjust *R1, R2,* and *R3* for maximum null.

Since these potentiometers are not ganged, a better resistance ratio can be obtained and the unit will give a 60-db null (1000 to 1 voltage ratio). When you eliminate stray 60-cps pickup with this filter, be sure to use a shielded cable from the output terminals.

For those who might like a filter for some other frequency, the design equations are given here (the components refer to Fig. 1): $R2=R3$; $R1=\frac{1}{4}\ R2$; $C1=C2=C3$; $R2=225{,}000/f \times C$, where f is in cps and C is in μfd. To obtain a null, all of the conditions of these equations must be met. —30—

Trick Tones

(*Continued from page* 50)

capacitor *C* is varied from 0.001 to 0.02 μfd., you can get the sound of a motor boat and other engines. The larger the capacitor used at *C,* the slower the engine sounds. If you have a wide range of capacitance values available, you can vary the speed of your "motor" to suit almost any condition from a slow idle to full speed ahead!

For the tick of an ordinary, spring-wound alarm clock, *R* is a 1-megohm resistor and *C* is a 0.25-μfd. capacitor. Put the headset in a hard-surfaced cardboard box to give the sound a little echo—and there you are! The slower tick of a pendulum clock can be

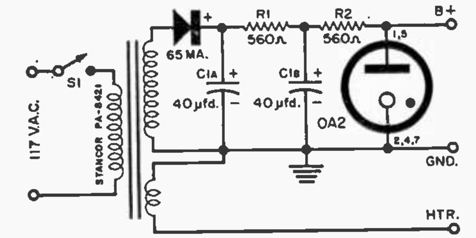


Fig. 3. Power supply for use with audio oscillator. Any supply delivering about 100 volts will do.

obtained by changing R to 2.2 megohms.

How about the sound of a dripping faucet? It's easy. Use 1 megohm at R and 1.0 μfd. at C. The click will now have just enough "beep" in it to make it sound quite realistic.

Other Circuits. These are just a few examples of what can be done. There are other basic oscillator circuits, other transformers, many capacitors and resistors—and changes in any of these will give you new and often entirely different results.

If you have an audio amplifier with tone controls, try hooking your audio oscillator to the input of your amplifier. Substitute a 2200-ohm resistor for the headphones, and connect a shielded cable from the amplifier "Tuner Input" across it. A whole new field of adventure opens up, as you try different speakers, volume controls, and settings of the tone controls. —30—

The Truth Detector

(*Continued from page* 56)

from her chair and bolted for the door.

"Well, I suppose I *could* ask that little redhead next door to assist me." I grinned broadly. "She's a very cooperative little thing and—"

"Her and her infrared hair!" snarled the Wife, instantly leaping back into the chair. "If anybody's going to get tested—it's going to be *me!*"

"I figured you'd see it that way," I admitted.

SWIFTLY ATTACHING the tracer cables, I plugged the instrument into the wall socket and smiled calmly across the cabinet at my wife who sat tensely upright, obviously waiting for a searing jolt of juice.

"Relax," I chuckled. "Just relax and answer these questions I'm going to ask."

"Ask away," she replied nervously.

"Are you over thirty?"

"Not yet and you *know* it!" she hotly denied.

The needle on the dial was motionless.

"Are you jealous of our little neighbor?"

"Of course not!" she tittered.

The needle stood stock-still.

"Would you like a mink coat?"

"Not especially," she said indifferently.

The needle didn't even quiver.

"How about me helping with the dinner dishes?"

"Crazy!" she agreed.

The needle swung wildly.

"It works beautifully!" I exclaimed. "Not a flicker while you were lying your head off, but the moment you told the truth—*bam*, how that needle reacted!"

"What a perfectly *insulting* thing to say!" she cried, her eyes blazing with fury.

"Nothing but the everloving truth, my dear," I assured her. "This instrument, unlike human beings, is completely dependable, entirely truthful."

"I refuse to believe it!" she muttered.

"For an allegedly enthusiastic student of psychology, you certainly find it convenient to retreat into plain old garden-variety stubbornness," I complained. "You can be very scientific—so long as it's *somebody else* whose emotional or mental innards are being examined; but just let one of *your* little—"

"What about *you*?" she demanded icily.

"Yeh, what about me?"

"Do you *really* have implicit faith in your old Truth Detector? *Do* you?"

"Of course I do!" I allowed. "Why shouldn't I? *I* built it, didn't I! I guess I ought to recognize an impartial, accurate piece of electronic ingenuity when I've put it together, component by component!"

Her smile was fetchingly evil.

"Okay, wise boy, then let's try it on *you* for size!"

I HAD WALKED right into that one with my big mouth wide open. But, then, it happens to the best of us.

"You want to try it on *me*?" I inquired weakly.

"Edison read by the light of his own electric lights, didn't he?" She began attaching tracer cables to me. "Sarnoff doesn't refuse to view his own contributions to visual electronics, does he?" She snapped on the switch with a competent air. "Where would the telephone be if Bell had hesitated to call his associate?"

"Yeh, but—"

"Well, then, there's no decent reason for you to be wishy-washy about letting *your* little triumph have at you, *is* there?" Her face glowed with malice.

And I saw her surreptitiously kick the plug out of the wall socket.

"Oh, ho!" I said to myself, "we're playing dirty pool!"

"Now, you stand right here where we can watch that little old needle together," she suggested, slyly; "and we'll see what kind of reactions *you* hand out."

I stifled my fat smile of amusement.

"Right!" I cooed naively.

"Do you think that little redhead is cute?"

"Sure!" I vowed eagerly.

The needle never wavered, naturally.

"Cuter than me?"

"Of course!"

The needle stood motionless, naturally.

"*Were* you planning to buy me a mink coat?"

"Shucks, no!" I snickered.

No needle movement . . . naturally.

"*Would* you like to help me with the dishes?"

"Don't be absurd!" I howled merrily. "No!"

Naturally, that needle never flickered.

THE WIFE began collecting coffee cups, her face the picture of a doll whose little scheme has backfired and confused her in the bargain.

"Kinda put yourself in a bind, didn't you!" I gloated. "By kicking that plug loose, now you don't know whether I was telling the horrible truth or gallantly lying in order to give you a rough time of it! Guess that'll teach you to play deceptive games, eh?"

"T-Then, you really d-didn't m-mean all those a-awful things you s-said?" She regarded me hopefully from behind the gathering tears.

"Of course not," I said comfortingly. "I'll be glad to give you a hand with the dishes after I get the Truth Detector put away."

"Are you *really* thinking of buying me a mink coat?" Fully recovered from tears, her greed was as good as ever.

"Well, your birthday is—" I began carefully.

"And that hussy next door!" she chimed, her entire face bright with confidence. "She's really an awfully gaudy little number, isn't she!"

"Oh, you know it!" I said.

We laughed derisively, in unison.

I'm a terrible liar. And just to be on safer ground, I think I'll rebuild the Truth Detector into something more practical, more technically advanced . . . like, say, an Alibi Tabulator? —30—

Check Your Marksmanship

(*Continued from page* 39)

to produce a bright, sharply defined spot of light. Possibly you have available an old flashlight "space" pistol of the type illustrated. This is easily modified as shown.

In use, the target should not be placed directly in a bright light nor in darkness. In subdued light, it can be easily seen, sensitivity is excellent and a "miss" is visible on the face of the target.

Life expectancy of the battery and bulb in the gun hasn't yet been determined. The gun shown has been "fired" thousands and thousands of times. —30—

Parts Substitutions

(*Continued from page* 42)

plates, called the *stator,* and a variable set of plates, known as the *rotor.* Air generally is the dielectric, except in the small sizes, where thin sheets of plastic (solid dielectric) may be used. Often, two or more tuning capacitors may be "ganged" together for operation with a single control shaft. Each section may have its own individual trimmer to adjust for minor differences in minimum capacitance.

Trimmer and padder capacitors use thin sheets of mica, ceramic materials, plastic, or glass as dielectrics.

Making Substitutions. In most cases, when choosing a substitute for a fixed capacitor, the two most important characteristics are capacitance and working voltage. Except in bypass and filter applications, the capacitance should be as specified in the original circuit, and the working voltage should be equal to—or higher than—that specified. The type of capacitor is not too important.

For example, if a 0.002-μfd. disc ceramic capacitor is specified for a particular circuit, a 0.002-μfd. tubular ceramic, mica, or paper capacitor of comparable working voltage will work as well.

If space permits, you can always use a capacitor with a working voltage higher than that specified. If a 0.1-μfd., 150-volt capacitor is called for, you can substitute units rated at 200, 400, 600 or even 800 volts. Don't use one with a lower working voltage than is called for.

In the case of filter and bypass capacitors, somewhat larger values may be employed if the exact size is not readily available. If a 0.05-μfd. bypass capacitor is used in an audio circuit, chances are that units rated at 0.06 μfd., 0.08 μfd. or even 0.1 μfd. will work as well. And in power supply circuits, it is common practice for a serviceman to substitute a 30- or 40-μfd. electrolytic for a 20-μfd. unit.

As with resistors, series, parallel, and series-parallel combinations of capacitors may be used to obtain special values. But remember that, with capacitors, a series connection reduces the total capacitance, while a parallel connection increases capacitance. Suppose you need a 0.002-μfd. capacitor in a fairly critical circuit. You could connect a pair of 0.004-μfd. units in series to obtain 0.002 μfd., or you could use a pair of 0.001-μfd. units in parallel.

There are two types of capacitors for which substitutions should *not* be attempted—a multi-gang (two or more) tuning capacitor and a temperature-compensating capacitor. —30—

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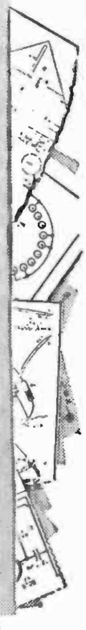

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Transistor Topics

(*Continued from page* 86)

battery-operated television receiver. Employing 31 transistors and a pair of rechargeable batteries, this set uses a 14" rectangular picture tube and gives a performance comparable to that of line-operated "portable" receivers. It may well be the prototype for future portable TV sets.

Although not transistorized, another recently announced portable television receiver depends on transistors for its operation. Developed by Oldsmobile engineers and the Delco Division of General Motors, it is designed for rear-seat viewing in automobiles. In addition, it may be removed for operation outside the car. Featuring a 9" screen and a collapsible V-beam antenna, this set is operated by a small transistorized power supply which converts the 12-volt d.c. power supplied by the auto's battery into the higher operating voltages required by the receiver.

The "Mail Bag." As you can imagine, your columnist receives a good deal of mail. Some of your letters and postcards ask questions about circuits published in past columns, others ask about sources of supply, others describe pet circuits, and still others tell of interesting experiences with transistorized receivers and other equipment.

All of your letters and postcards are read carefully . . . and, if the name and address are legible, a personal acknowledgment is sent. This may be a postcard or letter, depending on circumstances. However, it takes time to handle so much mail. So don't worry if you fail to receive an *immediate* answer when you write to *Transistor Topics*. Your letter or card will be answered as soon as possible.

Product News. The General Transistor Corporation is producing a new-style *p-n-p* phototransistor, Type 2N469. An improved version of the 2N318, this one is smaller and has greater optical sensitivity. It may be used in such applications as smoke density control, automatic machining operations, automobile headlight dimmers, and burglar alarm systems.

This firm has also announced a new line of *drift* transistors. The drift transistor differs from its germanium alloyed counterpart in that the emitter side of the base region has a greater impurity concentration than the collector side. This creates a built-in field which drives the charge carriers across the base region at a faster rate and enables the transistor to operate at higher frequencies.

Two new transistor brochures are available from General Transistor Corporation

(91-27 138th Place, Jamaica 35, N. Y.) A 12-page booklet on high-frequency transistors gives maximum ratings, cutoff and small signal characteristics, and includes charts showing the common-emitter output static characteristics for several *n-p-n* and *p-n-p* types. The other is an eight-page booklet showing the step-by-step operations in the production of a germanium alloy junction transistor from raw material to finished product; it does this with the help of 15 photographs and a flow chart.

The Radio Corporation of America (Somerville, N. J.) has announced the production of the 2N544, a new *p-n-p* drift transistor. It is especially designed for r.f. amplifier service in entertainment-type battery-operated receivers. It can provide a power gain of over 30 db at 1500 kc. in amplifier circuits utilizing a neutralizing network.

Clevite Transistor Products (Waltham, Mass.) is now producing high-frequency power transistors capable of handling the entire audio range. These units have a power gain cutoff of over 20 kc., and a large current-handling capability which makes possible direct coupling to loudspeaker voice coils without a special output transformer.

That's it for now, fellows. Before I sign off, one parting request . . . how about sending in more of your pet circuits. See you next month.

Lou

Tubes Control Car

(*Continued from page* 55)

50 miles an hour, and the car slid to as smooth a stop as any power braking system can offer.

Tubes Ignite Fuel. The ram jet flapper unit is a small adaptation of the type used in jet planes. A pressurized volatile fuel chamber located beneath the hood is triggered to force the highly combustible mixture into two 4" tubes. The spurting fuel is passed over a preheated spark plug in each tube. It ignites within the molybdenum steel tubing and provides the car with a combined thrust of approximately 1000 pounds. The main engine is then turned off as the heat of the tubes continues to ignite the fuel.

Also featured in the "car of the future" are rotary actuators which control the raising and lowering of the hood and deck lid. A hi-fi record player operates through front and rear speakers. But there is a catch to it all—Butler estimates that his car has cost him over $12,000 in parts and labor. —30—

Finding Your Way in Space

(*Continued from page* 36)

guides him to the station by means of "flying to the needle." If the needle points to the left of the correct course, the pilot should turn left until it centers once more; if it points to the right, he turns in that direction.

Loran. Another major electronic aid to navigation emerging from World War II was Loran (LOng RAnge Navigation). Though primarily associated with sea rovers, Loran is also used successfully for aerial navigation. It is the only method that does not rely on dead reckoning to compute position but rather on the hyperbolic functions of analytic geometry.

Assume that we are standing some distance from two mountains. We find that mountain A is 100 miles from us, and B is 150 miles away. The difference in distance is 50 miles. Now we can move so that the difference in distances always remains 50 miles, but only if we move in a hyperbolic path. This is the basic method used in Loran, the major addition being that there must be at least two pairs of "mountains." By using two pairs, two hyperbolas result, and the point at which they intersect is the ship's position.

In standard Loran, a pair of ground transmitters sends out pulses at the rate of either 25 or 33⅓ per second. Antenna output is about 100 kw. at frequencies between 1700 and 2000 kc. Another nearby pair of stations, on the same frequency, provides the navigator with the second hyperbola.

Aboard ship, the navigator has a conventional superheterodyne receiver with four broad channels which are fixed-tuned. The navigator selects any pair of stations, tunes in and reads the time difference between the two signals on a cathode-ray tube. He selects at least one other pair and repeats his computations. The intersection of the two hyperbolas is then found on a specially gridded Loran chart. A good navigator can obtain a fix in less than five minutes.

Range of Loran navigation varies from 700 miles during the day to twice that at night; reflection of waves from the ionospheric layer in the evening gives this range boost. Ground waves, of course, are primarily used because of their accuracy, though tables have been prepared to take into account any sky wave reflections during nighttime operation.

Tacan. Last and latest on the list of electronic aids to navigation is all-weather Tacan (TACtical Air Navigation). Tacan operates in the 1000-mc. band with 126 clear-frequency, two-way channels available, each channel being spaced 1 mc. apart. In the 1025- to 1150-mc. band, 126 frequencies are available for air-to-ground transmission; for ground-to-air transmission, 63 frequencies are available within the 962- to 1024-mc. band, and 63 more are in the 1151- to 1212-mc. band.

In operation, the plane transmitter sends a distance interrogation. This pulse is retransmitted by the beacon, and electronic measurement of the elapsed time interval is converted to distance in miles. Azimuth bearings are determined by measuring the phase difference of a periodic transmission of a main and auxiliary reference burst from the beacon. Identification of the station is made by keyed Morse characters at regular intervals.

We've come a long way in advancing the science of navigation to a safe, dependable means of traveling from here to there. There's always the chance that a tube can blow, or an amplifier can malfunction, and throw the whole system out. But we'll have to admit that it beats holding up a wet forefinger to the wind. -30-

Tape Correspondence

(*Continued from page* 71)

I have always operated on the premise that when I am being bored I am also boring the other person, but he is just too polite to say so, and this encourages me to be ruthless.

One girl I know quite well terminated a correspondence of this sort very abruptly by explaining that her recorder was broken and that her 200-pound bone-crushing boy friend was sure it would not be repaired very soon! Admittedly this is being rather extreme. However, a tape correspondence should give mutual pleasure, and there is little point to dragging out one that does not.

Master the Art. Tape corresponding does have some drawbacks. For one thing, it leaves you with no permanent record of what has been said. I find it very helpful to take rather copious notes as I listen to a tape and file these together with the notes I use in replying. Referring to such notes will prevent your telling the same thing twice, and it is flattering to your correspondent when you "remember" in detail something he told you several tapes back.

But the advantages of tape corresponding are many. Hearing the cozy sounds of a fire crackling on the hearth of your friend or the contented purring of the cat resting on his knee, shivering to the sound of a

winter storm roaring about his house, thrilling to the songs of the strange birds in his garden, getting to know his mood from the tones of his voice—these are beyond the power of words scribbled on a page. Learning to know and use these unique facilities to the fullest is to master the art of tape correspondence. —30—

After Class

(*Continued from page* 76)

as sine-wave oscillators, square-wave oscillators, and pulse generators. The oscillator to which our writer referred was probably of the ultrasonic variety; these produce oscillations of the sine-wave type, as a rule, in the frequency band from 30,000 cps up to 100,000 cps.

A *transducer* is an energy converter. Any apparatus that changes one form of energy into another can be called a transducer. For example, among the common transducers are microphones (sound energy to electrical energy), loudspeakers (electrical energy to sound energy), incandescent lamps (electrical to light energy), and quartz crystals (electrical to kinetic energy of vibration).

In recent years, transducers have become more intimately connected with the production of ultrasonic vibrations than heretofore. In this connection, a transducer is a device that converts electrical pulsations to ultrasonic vibrations which can then be transferred to the liquid or gas in which the vibrations are desired.

Most ultrasonic equipment is designed around either quartz crystal transducers or *magnetostriction* types. The latter employ a pulsing magnetic field that produces constriction and expansion of the core material, a vibratory motion that can produce ultrasonic waves.

Computation by Resistors. Frank Uxa, a high school student in Chicago Heights, Ill., has become intrigued by an idea he read about in a science project pamphlet dealing with computations by resistors. He requests some information on the subject.

Resistance computation is based upon voltage divider action in one form or another. For instance, using two potentiometers, a source of power, and a single voltmeter, one can build an electric slide rule that will multiply and divide. The precision with which it operates depends only upon the precision of its parts, including the dial divisions.

Referring to Fig. 1 (p. 76), say we apply 100 volts across potentiometer *A* which is equipped with a very accurate dial that reads from 1 to 100 in unit steps. The wiper of A is connected to the top of potentiometer B which is similarly equipped with a precise dial. Finally, the wiper of B is connected to one terminal of an accurate 0-100 voltmeter with a very sensitive movement, say 50 microamperes full-scale. (In this basic circuit, we want to assume that the meter draws negligible current, hence the sensitive movement. In fact, a vacuum-tube voltmeter would serve the purpose even better.)

Multiplication is accomplished by setting the multiplicand on dial A, the multiplier on dial B, and reading the product from the voltmeter. For instance, suppose A is set on 7, and B is set on 4. The voltmeter will then read 28, the product of the two numbers. This must occur because seven-tenths of potentiometer A taps off 70 volts which is fed to B; the setting of B then taps off four-tenths of 70 volts, or 28 volts.

More complex numbers are handled in the same way. As an illustration, consider the multiplication of 47 by 2.8. Dial A is set on 47, dial B on 28. (Note that the decimal point is ignored in this intermediate operation, just as it is on a slide rule.) If the voltmeter scale were fine enough, you would now read 13.16 volts. The decimal point is misplaced, however, since its position was originally ignored. This is easy to correct (it is handled in the same manner as with a slide rule).

We estimate the number of figures in the answer by saying: "47 is nearly 50 and 2.8 is nearly 3. Since $50\times3=150$, then the answer to the above problem must be 131.6."

The division process is easily derived. Since multiplication is $A\times B=C$, then division is just the reverse and is obtained by $A=C/B$. Thus, to divide 84 by 7, we would set B on 7 and then rotate the knob of potentiometer A until the voltmeter read 8.4 volts. We would find that the reading of dial A is then the quotient, in this case 1.2. Estimating decimal point position again leads to this reasoning: 84 divided by 10 (which is the nearest round number to 7) is 8.4. Hence, dividing by a smaller number such as 7 must yield a larger quotient—so the correct answer is not 1.2 but 12.

Manipulations of this kind require practice, of course. Furthermore, many circuit variations are possible to make such a device do the same operations as a slide rule, operations like square root, squares, ratios and proportions, and so on.

If the voltage reading instrument *does* take current, this must be considered in calibrating the dials; if a VTVM is used, the current is so small that the results can be considered identical with the dial calibrations on a linear scale. —30—

Among the Novice Hams

(*Continued from page* 81)

F is resonant frequency in cps, π is 3.14, L is inductance in henrys, and C is capacitance in farads. In r.f. work, the units of F (frequency in megacycles), L (inductance in henrys), and C (capacitance in microfarads) can be used.

Sample Questions. That is a very important formula in radio, and several questions in the examinations for all classes of amateur operator licenses, except Novice, are based on it. Examples are given below.

How would a shorted turn in the coil affect the resonant frequency of a tuned circuit and why? This is an easy one. The resonant frequency would increase, because a shorted turn in a coil decreases its inductance.

In a series resonant circuit, if the inductance is kept constant, what must be done to the capacitance to double the resonant frequency? The capacitance must be quartered in value. The answer is calculated in the following manner: From examining the formula $F = 1/(2\pi\sqrt{LC})$, we see that to double F, we must halve the value of $2\pi\sqrt{LC}$, but only by manipulating C. Now, by the rules of algebra, we can write $2\pi\sqrt{LC}$ in the form $2\pi\sqrt{L} \times \sqrt{C}$. Dividing $\sqrt{C}$ by 2, we get the new formula $2F = 1/(2\pi\sqrt{L}\ \sqrt{C}/2)$. But $\sqrt{C}/2$ can be written $\sqrt{C}/\sqrt{4}$, because $\sqrt{4} = 2$, and $\sqrt{C}/\sqrt{4}$ can be written $\sqrt{C/4}$. Therefore, the final form of the new equation becomes: $2F = 1/(2\pi\sqrt{LC/4})$.

In a series-resonant circuit, what must be done to the inductance-capacitance product to halve the resonant frequency? The inductance-capacitance product must be increased four times. After examining the formula $F = 1/(2\pi\sqrt{LC})$, we see that to halve F, we must double $2\pi\sqrt{LC}$ by manipulating $\sqrt{LC}$. This gives us the new formula: $F/2 = 1/(2\pi \times 2\sqrt{LC})$. We can write $2\sqrt{LC}$ in the form $\sqrt{4}\ \sqrt{LC}$, which is the same as $\sqrt{4LC}$. Therefore, the new equation becomes finally: $F/2 = 1/(2\pi\sqrt{4LC})$.

To check your understanding of these problems, try solving the original equation $F = 1/(2\pi LC)$ for different values of L and C, such as $L = 2$ and $C = 4$, and see what you must do to their values to double or halve the calculated values of F. In the actual FCC examination, the questions will be different, and they will be worded in the form of statements followed by four answers from which you must choose the correct one.

Parallel Tuned Circuits. Figure 2 (p. 81) shows a circuit in which the capacitor, the inductor, and the load resistance are all in parallel. The current through the inductance will be high when the applied signal is low in frequency, because its inductive reactance is low at low frequencies, but the current through the capacitance will be low, because its capacitive reactance is high at low frequencies.

However, as the applied frequency is increased, the inductive current decreases and the capacitive current increases until, at the resonant frequency of the circuit, the two currents become equal. As a result, as one draws current from the generator, the other one is returning an equal amount to it, and the two currents cancel each other; consequently, the only current drawn from the generator is that required to overcome the losses in the circuit or to supply power drawn by the load, both of which are represented by R in Fig. 2.

As the frequency continues to increase, the current through the inductance continues to decrease and that through the capacitance to increase; therefore, the current drawn from the generator again increases. Thus, a parallel-tuned circuit exhibits *maximum* resistance across its terminals at resonance. The series-tuned circuit exhibits *minimum* resistance at resonance.

In the next chapter of our discussion on fundamental theory, we will learn more of the properties of tuned circuits and how they are used in radio equipment.

News and Views

John, KNØMPM, does not let a low dipole antenna stop him. In seven weeks on the air, he has worked Alaska, a couple of Canadians, and 36 states. Thirty of the states are confirmed. John transmits with a Heathkit DX-20 and receives with a Hallicrafters S-85. He spends most of his time on 15 meters but gets on 40 meters a bit. . . . . **Bob, KN3CTC,** wants the world to know that W3HNP gave him his Novice test. In three weeks on 80 and 40 meters, he has worked 16 states with ten verified. His best DX is California and Florida. Bob feeds a 90′ "long-wire" antenna with a DX-20 transmitter running 50 watts, and he receives on a Hallicrafters S-53A receiver with an added Heathkit Q-Multiplier. . . . . **Tom, KN2GSK,** started slow, but in four months on the 80-, 40-, and 15-meter Novice bands he has worked 25 states, Canada and Puerto Rico. He receives on a Hallicrafters SX-99 and transmits with a DX-20. Tom hopes to have his General license by the time you read this.

Jeff, KN8HCI, blames inefficient antenna systems for his "poor" record of only five states worked in five months on the air. He thinks that a "long wire" is better than a 40-meter dipole. Jeff runs 75 watts to a WRL Globe Chief transmitter and receives with a Hallicrafters S-38D. That gleam in his eye is for the SX-99 receiver he hopes to get soon. Contact Jeff if you need a West Virginia contact with QSL sure. . . . . **Wayne, KN1DIE,** worked 13 states on 80 meters with a "Windom" antenna. He has just replaced it with a 40-meter dipole and hopes to add states and DX to his record on 40 and 15 meters. Wayne will be happy to help anyone obtain his license. . . . . **Del, KNØMZN,** has worked 25 states in only two weeks on the air with his Heathkit AT-1 transmitter which he has modified to use a 6146 tube as per my article in the July, 1957, issue of POPULAR ELECTRONICS. Del asked a question about the modification, but he didn't include his address.

John, K2VOZ, has just worked Wyoming for his 48th state, and he has worked 52 countries on 15 and 20 meters. A Globe Chief transmitter running 90 watts and feeding folded dipoles and an SX-99 receiver are the tools John uses. He credits W2FXA and W2PDB for teaching him how to use them properly. . . . . **Larry, KN3BWH/K3BWH** (Novice and Technician licenses) has an unusual QSL card to confirm his contacts. It is a postal-card size reproduction of his license, with the vital information on the contact put on the left half of the "address" side of the card. . . . . **Jerry, K4HPR,** worked 47 states—40 of them on 80 meters—as a Novice while running 10 watts to a 6L6 transmitter. Now, he is using a Heathkit DX-35 transmitter feeding a "long-wire" antenna and a National NC-98 receiver. Jerry QSL's 100% and will schedule anyone needing an Alabama contact, preferably on 15 meters.

HAM JAMBOREE

The International Bureau of the Boy Scouts, in Ottawa, Canada, has announced that a Boy Scout "Jamboree-on-the-Air" will be held starting at midnight on May 9 and lasting till midnight on May 11. Amateurs throughout the world who have an interest in scouting are invited to contact each other during that period to further international brotherhood and friendship.

Ed, KN4OLX/K4OLX, recommends a vertical antenna for hams with limited space. He practices what he preaches and has worked 20 states in the 80-meter Novice band. He chases r.f. energy up the stick with a WRL Globe Scout 680 transmitter and receives with a venerable National NC-240D receiver. . . . . **Ernie, VE3EGG,** now uses a DX-35 transmitter at 55 watts input, a Cush-Craft, 3-band vertical antenna, and a Hallicrafters SX-100 receiver. He has worked 35 countries and 47 states and would very much like a schedule with a Nevada station on 20 (preferably) or 15 meters for that 48th state. Ernie reports on the many Novices he hears on the 20-meter band. Most of them think they are on 15 meters, but, by mistuning their transmitters, are emitting on 20 and 15 meters *both*. If you operate on 15 meters, ask a local station to check on 20 meters (at twice your 40-meter crystal frequency). If he hears you and retuning the transmitter doesn't help, use an antenna tuner.

Julio, YV3BS, reports that in order to obtain a ham license in Venezuela you must be

21 or older and a Venezuelan citizen. There are two classes of licenses. For either, you must pass a written examination of about 35 questions, which Julio claims are not difficult. The class-A license requires no code examination and permits operation on the 10- and 80-meter bands. The class-B license permits operation on all amateur bands. It requires passing a 5-wpm code test! Power is limited to 1000 watts with either license, which must be renewed annually.

Charlie, KN5KXJ, has made 375 contacts in his seven months on the air. He uses a Globe Chief transmitter and an S-53A receiver. Charlie is now experimenting with a 40-meter vertical antenna. . . . . **Harry, K6VPB,** has been on 40 meters since last spring with his little 5-watter, a folded-dipole antenna, and 7-tube home-built receiver. So far, he has not worked outside of California. He'd like to sked a W7, to double his states-worked total. . . . . **Leo, KN1DPO,** and **Roland, KN1DQU,** live three doors apart and hold nightly schedules on 40 meters. Both use 40-meter folded dipoles. Roland uses a Globe Chief transmitter and an S-85 receiver, and Leo uses a WRL 680 transmitter and a Hammarlund HQ-129X receiver. Both boys hope to have their Generals very soon.

Contributors to News and Views: **John, KNØMPM** (15), 5619 Russell, Mission, Kansas; **Bob Miller, KN3CTC** (19), 267 Kalos St., Philadelphia 28, Pa.; **Tom Petuskey, KN2GSK,** 619 Green St., Elizabeth, N. J.; **Jeff Boyles, KN8HCI,** Box 191, Lumberport, W. Va.; **Wayne Waters, KN1DIE,** New Canaan Ave., Norwalk, Conn.; **John Zachwieja, K2VOZ,** 82 Rejtan St., Buffalo, N. Y.; **Larry Whitman, KN3BWH,** 2206 Audley Ave., New Castle, Pa.; **Jerry, K4HPR,** 1711, 65 Greenbriar Ave., Hampton, Va.; **Ernie Crump, VE3EGG,** 64 Barrie St., Galt, Ontario, Canada; **Julio Peña, YV3BS,** Avenida 20 No. 27-95, Barquisimeto, Venezuela, S. A.; **Charlie Murrell, KN5KXJ,** 6410 Wister Lane, Houston 8, Texas; **Harry, K6VPB** (16), 44 Conrad Street, San Francisco, Calif.; **Leo Le Bell, KN1DPO,** 504 Rimmon St., Manchester, N. H.; **Roland Bilodeaux, KN1DQU,** 480 Cartier St., Manchester, N. H.

We want to hear about *your* record and experiences as a ham. Include a picture of your station and yourself, if you have one available. Until next month, 73,

Herb, W9EGQ

Short-Wave Report

(*Continued from page 72*)

Here is a resume of the current reports. All times shown are EST, and the 24-hour system is used. At the time of compilation, all reports were correct.

Algeria—Stations believed to be from this country have been noted on 5978 kc. at 0100-0300 with French pop music and anmts, and on 6140 kc. at 0100-0125 with Arabic music and anmts. The 5978-kc. outlet closes at 0300 with "La Marseillaise." Another Algerian has been found on 8220 kc. signing on at 1500. (*RY, 7, 68*)

Angola—CR6RC, *Radio Angola,* Luanda, 11,862 kc., is heard at 1713-1731 in Portuguese with L.A. records. News in Portuguese at 1717 precedes the 1730 s/off and the station closes with playing of "A Portuguesa." (*RP*)

Bolivia—CP25, *R. Libertad,* Sucre, 9200 kc., is being heard in Western areas at 2004-2102 with programs of native jazz and tango music and anmts in Spanish. This one is difficult to hear due to the commercial press outlets surrounding the channel. (*7*)

Brazil—PRN9, *R. Voz de Policia Federal,* Rio de Janeiro, 9290 kc., rarely heard, has been tuned at 1600 with IS; s/on is at 1615, then into Portuguese. (*358*)

Other Brazilians heard infrequently include: PRB21, *R. Panamericana,* Sao Paulo, 6055 kc., at 1915; a station on 5975 kc. at 1915 that did not seem to ID for the listed *R. Guaruja;* and what is probably *R. Sociedad Farroupilha* on 15,335 kc. at 2100. (*AN*)

British Guiana—According to the station, ZFY, Georgetown, opens at 0415 (Sundays at 0445) on 5981 and 3255 kc., with 2 kw. The medium-wave outlet on 660 kc. opens at the same time and is 10 kw. Listeners in Southern areas *might* be able to tune in on that one. (*LK*)

British Honduras—British Honduras Broadcasting Service, Belize, operates at 1300-1350 and 1800-2245 on 3300 kc. The 4900- and 6100-kc. stations are inactive. Evening xmsn is often well heard with various Eng. programs. (*JH, 323*)

Bulgaria—*R. Sofia,* 9700 kc., has Eng. to N.A. at 2000-2030 and 2300-2330 with a mailbag session on Thursdays. (*DB, GP, 303*)

Canada—Two regional stations that are noted in the Midwest are CFVP, *Voice of The Prairie,* Calgary, Alberta, and VE9AI, Edmonton, Alberta. CFVP, 6030 kc., 100 watts, relays CFCN, 1060 kc., is scheduled at 1400-0200, and is heard best after 0000. VE9AI, 9540 kc., 200 watts, relays CJCA, 930 kc., is scheduled at 0800-0400 (from 1000 on Sundays) and can be heard whenever the channel is clear. (*MM*)

China—*R. Peking* operates to Eastern N.A. at 2045-2115 on 9665 and 11,820 kc., and to Western N.A. at 2200-2230 on 15,115 and 17,745 kc. Both xmsns, in Eng., feature music and dictation-speed news. (*SH, GP*)

Colombia—HJKH, *R. Sutatenza,* Bogota, 5070 kc., is heard at 1945-2015 daily with religious programs in Spanish. The ID is three gongs of a church bell. (*NR*)

Czechoslovakia—*R. Prague,* 6105 kc., is heard at 1700-1730. This xmsn, although beamed to England, is heard very well in Eastern states. (*348*)

Ecuador—A new station is *Ondas del Volante,* Azogues, 6140 kc., noted at 1900-2200 with native programs. (*AN, 100*)

Another new one is *R. Cultural de Machala,* Machala, 4725 kc., noted irregularly at 1900-2300 or later. Other tunings include: HC2GI, *R. El Telegrafo,* Guayaquil, 4710 kc., noted at 1900-2300; and HCRCX, *R. Catolica,* Quito, 5010 kc. (formerly HC1RP/HC1GP), heard at 1900-2330 relaying medium-wave HCRC. (*100*)

Heard in Western areas are: HC2AJ, *Radiodifusora del Ecuador,* Guayaquil, 4650 kc., from 2354 to 0004 s/off with L.A. records and Spanish anmts; and HC1NE, *R. Nacional Espejo,* Quito, 4680 kc., at 0003-0148 with all

Spanish and music from the Andean highlands. The latter signed off abruptly at 0148 with no closing anmt despite the fact that it is reported to be a 24-hour station. HC1NE suffered a lot of QRM from planes in the Pacific Northwest. (*RP*)

Egypt—Cairo, 11,991 kc., is noted in Arabic with music at 1500-1600 and in Eng. with news and pop music at 1600-1700, daily except Sundays. News at 1615. (*RB, 44, 59, 61, 104, 226*)

Another xmsn is at 0830-0930 on 17,915 kc. with news at 0845. They may start teaching Arabic by radio shortly. (*PM*)

French West Africa—*R. Dakar*, 11,895 kc., has an Eng. newscast on Saturdays at 1715-1725. A period in French follows. (*348*)

Haiti—*Evangelistic Voice of the West Indies*, Cap Haitien, is now on 11,850 kc. at 0430-0600, 0800-0930 (Sundays at 0515-0630 and 0730-0845), dual to 9635 and 6100 kc. Other xmsns include: Sundays at 1500-1715 on 21,-525, 9628, and 6100 kc.; Saturdays, Sundays, Mondays at 2000-2230 on 15,360, 9603, and 6100 kc. They are asking for reports. (*AN, 104, 163*)

4VHW, *R. Haiti*, Port-au-Prince, can be heard in Eng. with "Music Caravan" on Sundays and Thursdays from 2130 to 2230 on 6200 kc. (*104*)

Honduras—HROW, *R. Montserrat*, Tegucigalpa, has returned to 5880 kc. With HRN still on 5973 kc., there are two Tegucigalpa stations only 7 kc. apart. (*100*)

Hungary—*R. Budapest* is heard regularly on 9833 kc. at 1700-1730. They have a program for SWL's and will verify all reports received. (*CR*)

Liberia—ELWA, Monrovia, 15,200 kc., has an Eng. program on Tuesdays only at 1815-1950, dual to 21,535 kc. Another N.A. xmsn is on 11,986 and 21,535 kc. at 2000-2130. (*MS, 104, 226, 338, 358*)

Luxembourg—*R. Luxembourg*, Junglinster, carries a French Mailbag session on Sundays at 1520-1530 on 15,350 kc. (*313*)

Mauritius—V3USE, Forest Side, has been found as low as 14,980 kc. They continue having Eng. from 2300 to 2315/close. This one has been wandering and has been reported as high as 15,092 kc. (*48, 59*)

Mexico—One of the newer stations is XELUU, *R. Universidad*, Chihuahua, 15,300 kc. It is strong and clear at 1200-1700 and later with L.A. and N.A. music. Frequent ID and all programs are in Spanish. This has *not* yet been heard on Sunday. (*61*)

Mozambique—Lourenco Marques has moved to 15,100 kc. and is being heard fairly well at 1300-1515. (*AN, 100*)

Netherlands—Hilversum is operating on a new frequency of 25,610 kc. at 0400-0645 to Australia and New Guinea, and on Sundays at 2130-2300 in Eng. with the "Happy Station Program." They are very desirous for reports on this outlet. (*JA, AN, MO, 100, 163*)

Nicaragua—YNLU, *R. Managua*, Managua, formerly on 6846 kc., is now on 6040 kc. and is audible at 1900-0000 since HJLB is off the air. (*AN, 100*)

Pakistan—*R. Karachi* is usually well heard on 15,335 kc. to S. E. Asia at 2000-2015 with Eng. news and native music. Reports go to:

Directorate General, *Radio Pakistan,* 71 Garden Road, Karachi, Pakistan. *(279)*

Panama—HORT, *R. Balboa,* Panama City, 6060 kc., was noted at 0315-0430 with variety pop music and commercials, all-Spanish. A three-note gong sounds before the ID. *(61)*

HP5B, *R. Miramar,* 6030 kc., was heard at 0125 with L.A. music. This is the first time this one has been reported. *(27)*

HOH7, Panama City, is active again on 9685 kc. after a long absence and is being tuned well at 0600-0800. *(100)*

Peru—OBX4C, *Radio El Sol,* Lima, has moved from 15,192 kc. to 15,170 kc. and is heard at 1900-2200. *(100)*

Poland—*R. Warsaw* is broadcasting in Eng. as follows: at 0130-0200 on 7145, 6135, and 5955 kc.; at 1330-1400 on 6105 and 5975 kc.; at 1430-1500, 1530-1600, and 1630-1700 on 6115 kc.; and at 1730-1800 on 6025, 5975, and 5955 kc. *(265, 282)*

Portugal—Lisbon can be noted in Eng. at 0845-0930 on 21,495 and 17,880 kc. and at 1215-1300 on 17,895 kc.; in Portuguese to the United States and Canada at 1900-2300 on 11,840 kc. and at 2145-2300 on 9635 kc. *(SZ)*

Sarawak—*R. Sarawak,* Kuching, 5052 kc., has Eng. at 0800-0900, with Eng. news relayed from the BBC at 0800; Chinese from 0900. Power is 7500 watts and the signal is heard surprisingly well in Western states. They also operate on 6060 kc. *(61)*

South Korea—HLKA, Seoul, has a newscast, music, and talks in Eng. from 2330 to 0000 on 11,925 kc. This is *The Voice of Free Korea.* *(225)*

Sudan—The Sudan B/C Service, c/o Ministry of Social Affairs, P. O. Box 522, Khartoum, operates on 4972 kc. (7½ kw.) and 6200 kc. (500 watts) at 2315-0030 daily except Thursdays; also at 1030-1530 (to 1600 on Thursdays). It opens at 0900 on Fridays, 0930 on Sundays. Another xmsn is heard on Fridays at 0015-0430. English is broadcast at 1100-1130. New studios are being constructed here, with power to be increased to 20 kw., and eventually to 50 kc. The Eng. program will be increased to two hours daily. *(7, JB)*

SHORT-WAVE ABBREVIATIONS

anmt—Announcement
BBC—British Broadcasting Corp.
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/off—Sign-off
s/on—Sign-on
xmsn—Transmission from station

Surinam—AVROS, Paramaribo, 15,406 kc., has Eng. news on Mondays at 2000-2005; popular music with Dutch anmts before 2000. They have a program in Hindustani on Fridays only at 1920-1930. This station may also be on 4052.5 kc. *(RP, 126, 197, 348)*

Tangier—From the bulletin of the International SW League, it has been learned that the *Voice of Tangier* no longer uses the call-sign WTAN. No other information is avail-

(*Continued on page* 130)

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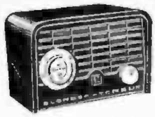

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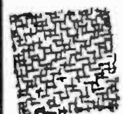

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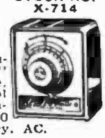

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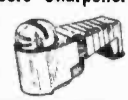

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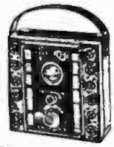

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able at the present time as to the call that will be used in the future, if any. (*CK*)

Turkey—Eng. programs from Ankara are as follows: to West Europe on 9465 kc. at 1600-1645 (Mailbag on Sundays) and 1315-1330 with a request program, on 7285 kc. at 0020-0105 (Mailbag on Sundays) and 1215-1230 with request program; to N.A. on 9515 kc. at 1315-1400 (Mailbag on Sundays) and at 1815-1900 (news at 1815); and to S.E. Asia on 17,830 kc. at 0830-0915 (Mailbag on Sundays). (*JT, 104, 348*)

United Arab Republic—UABS, Cairo, is noted on 11,919 kc. daily at 1530-1600 in German and at 1600-1700 in Eng. The Damascus outlet on 15,165 kc. operates at 1430-1530 with French at 1445 and Eng. at 1515. Both stations identify as the *Voice of the United Arab Republic*. (*DW, 348, 365*)

SHORT-WAVE CONTRIBUTORS

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Emmet Riggle *(48)*, Massillon, Ohio
Grady Ferguson *(59)*, Charlotte, N. C.
John Beaver *(61)*, Canon City, Colo.
Rolan Kunkel *(68)*, Redlands, Calif.
Roger Legge *(100)*, McLean, Va.
Ed Kowalski *(104)*, Philadelphia, Pa.
Bob Derabertis *(126)*, New Hyde Park, N. Y.
Walter Meeuws *(163)*, Nashville, Tenn.
Pete Baggerman *(197)*, Bridgeville, Pa.
Stewart MacKenzie, Jr. *(225)*, Long Beach, Calif.
William Bing *(226)*, New Orleans, La.
Gerd Janzen *(265)*, Ulm/Do, Germany
Don Davenport *(279)*, Monroe, Wis.
Bob Kapsch *(282)*, Roselle Park, N. J.
Hank Reixach *(303)*, Washington, D. C.
Denny Avers *(313)*, Keyser, W. Va.
Richard Miller *(323)*, Englewood, N. J.
Esther Cottingham *(338)*, Redwood City, Calif.
Glenn Cuthrell *(348)*, Maxton, N. C.
John Cobb, Jr. *(358)*, Cartersville, Ga.
William Donoghue *(365)*, West Chester, Pa.

USA—The only report on the first USA earth satellite was received from #23. He noted it shortly after it was launched, at 1634-1642 on 108,030 kc., but it took him eight hours to log it.

USSR—*R. Tashkent*, Uzbec SSR, is being noted on 11,690 kc. at 0730-0800 in an Eng. xmsn to India and Pakistan. (*PD, 197*)

Clandestine—*Huna Sawt al Haqq (Voice of Justice)*, Egypt, has moved from 7211 kc. to 7070 kc. and was noted at 1000 s/on in Arabic. *Sawt al Misr Hurrah (Voice of Free Egypt)* is good in Arabic at 1030. (*31*) —30—

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NO C.O.D.

Superior's New Model 76

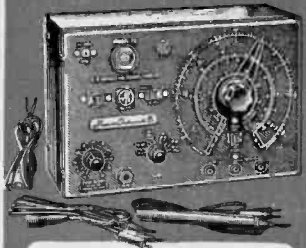
ALL PURPOSE BRIDGE

IT'S A **CONDENSER BRIDGE**
with a range of .00001 Microfarad to 1000 Microfarads (Measures power factor and leakage too.)

IT'S A **RESISTANCE BRIDGE**
with a range of 100 ohms to 5 megohms

IT'S A **SIGNAL TRACER**
which will enable you to trace the signal from antenna to speaker of all receivers and to finally pinpoint the exact cause of trouble whether it be a part or circuit defect.

IT'S A **TV ANTENNA TESTER**
The TV Antenna Tester section is used first to determine if a "break" exists in the TV antenna and if a break does exist the specific point (in feet from set) where it is.



Model 76
All Purpose Bridge $26.95
Terms: $6.95 after 10 day trial then $5.00 per month for 4 months.

✓ 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 make stage gain measurements, locate signal loss in R.F. and Audio 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**

Superior's New Model 70

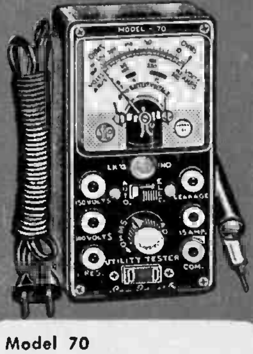
UTILITY TESTER®

AS AN ELECTRICAL TROUBLE SHOOTER

• Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Switches, Thermostats, etc. • Will test all TV tubes for open filaments, inter-element shorts, burned out tubes, etc. (Will not test TV tubes for quality. An emission type tester such as the Model TD-55, TW-11 or TV-12 is required to test tubes for quality). • Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakage, etc. • Will measure current consumption while the appliance under test is in operation • Incorporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, motors, etc. • Leakage detecting circuit will indicate continuity from zero ohms to 5 megohms (5,000,000 ohms).

AS AN AUTOMOTIVE TESTER

• Tests both 6 Volt and 12 Volt Storage Batteries • Generators • Starters • Distributors • Ignition Coils • Regulators • Relays • Circuit Breakers • Cigarette Lighters • Stop Lights • Condensers • Directional Signal Systems • All Lamps and Bulbs • Fuses • Heating Systems • Horns • Also will locate poor grounds, breaks in wiring, poor connections, etc.



Model 70
Utility Tester $15.85
Terms: $3.85 after 10 day trial then $4.00 per month for 3 months.

Model 70 comes complete with 64 page book written in plain easy-to-understand language. Explains laws of electricity, how to proceed with repairs of appliances and automobile circuits, how to test TV tubes, etc. Only **$15.85 Net**

USE APPROVAL FORM ON NEXT PAGE ➡

We invite you to try before you buy any of the models described on this 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.

TRY FOR 10 DAYS

before you buy! **then** if satisfactory pay in easy, interest free, monthly payments. See coupon below.

Superior's New MODEL 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER

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

- Model 77 completely wired and calibrated with all accessories (including even portable carrying case) sells for only $42.50.
- Model 77 employs a sensitive six inch meter. Extra large meter scale enables us to print all calibrations in large easy-to-read type.
- Model 77 uses new improved SICO printed circuitry.
- Model 77 employs a 12AU7 as D.C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability.
- Model 77 uses a selenium-rectified power supply resulting in less heat and thus reducing possibility of damage or value changes of delicate components.
- Model 77 meter is virtually burn-out proof. The sensitive 400 microampere meter is isolated from the measuring circuit by a balanced push-pull amplifier.
- Model 77 uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

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

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

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

SPECIFICATIONS

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

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

Model 77 — VACUUM TUBE VOLTMETER . . . $42.50—Terms: $12.50 after 10 day trial then $6.00 per month for 5 months.

Superior's New Model TV-40

PICTURE TUBE TESTER

NOT A GADGET—NOT A MAKE-SHIFT ADAPTER, BUT A WIRED PICTURE TUBE TESTER WITH A METER FOR MEASURING DEGREE OF EMISSION—AT ONLY $15.85

Tests ALL magnetically deflected tubes . . . in the set . . . out of the set . . . in the carton!!

- Tests all magnetically deflected picture tubes from 7 inch to 30 inch types.
- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Test for open elements.

EASY TO USE: Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube case (Ion trap need not be on tube). Throw switch up for quality test . . . read direct on Good-Bad scale. Throw switch down for all leakage tests.

Only **$15.85 Net**

Model TV-40 — PICTURE TUBE TESTER . . . $15.85—Terms: $3.85 after 10 day trial then $4.00 per month for 3 months.

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 DISTRIBUTING CO., INC.
Dept. D-454, 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.

☐ Model TW-11....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ Model TD-55......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.

☐ Model TV-40......Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.

☐ Model 70..........Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.

☐ Model 76..........Total Price $26.95 $6.95 within 10 days. Balance $5.00 monthly for 4 months.

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Model TD-55—TUBE TESTER . . . $26.95—Terms: $6.95 after 10 day trial then $5.00 per month for 4 months.

Superior's New Model TD-55

EMISSION TYPE **TUBE TESTER**

FOR
- The Experimenter or Part-time Serviceman, who has delayed purchasing a higher priced Tube Tester.
- The Professional Serviceman, who needs an extra Tube Tester for outside calls.
- The busy TV Service Organization, which needs extra Testers for its field men.

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**

Superior's New Model TW-11

STANDARD PROFESSIONAL TUBE TESTER

Model TW-11—TUBE TESTER . . . $47.50—Terms: $11.50 after 10 day trial then $6.00 per month for 6 months.

- Tests all tubes, including 4, 5, 6, 7, Octal, Lockin, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity Fuse Types, etc.
- Uses the new self-cleaning Lever Action Switches for individual element testing. **All elements are numbered according to pin-number in the RMA base numbering system.** Model TW-11 does not use combination type sockets. Instead individual sockets are used for each type of tube. **Thus it is impossible to damage a tube by inserting it in the wrong socket.**
- Free-moving built-in roll chart provides complete data for all tubes. Printed in large easy-to-read type.

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

EXTRAORDINARY FEATURE

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

Housed in hand-rubbed oak cabinet **$47.50 Net**

TRY FOR 10 DAYS

BEFORE you buy! ***THEN*** if satisfactory 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!

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