

For the Hobbyist, Experimenter, SWL and Hi-Fi'er

POPULAR ELECTRONICS

SEPTEMBER
1957

35
CENTS

*Multiple Speakers
for Very Best
in Hi-Fi*

(pp. 59 & 67)



16
*More Pages
In This Issue*

THE ACCENT IS ON VALUE... A LOW PRICED GENERAL COVERAGE RECEIVER

A new low-priced general coverage receiver featuring smart, modern styling.

Receiver is directly calibrated for the four general coverage ranges and five bandspread ranges for the amateur bands (80-10 meters).

Covers 540 KC to 40 MCS. Voice or CW.



NATIONAL RADIO CORPORATION, U.S.A.

FEATURES:

- ★ Calibrated bandspread for 10, 11, 15, 20, 40 and 80 meter amateur bands. Separate tuning capacitors, knobs, and scales for general coverage and bandspread.
- ★ Large easy-to-read 12 inch slide-rule dial with combination edge and backlighting. Has large tuning knobs with two pointers for two scales; general coverage and bandspread.
- ★ Adequate over-all selectivity with nine miniature tubes including rectifier.
- ★ Has gang-tuned RF amplifier stage for increased sensitivity and image rejection.
- ★ Covers 540 KC to 40 MC in four bands.
- ★ Two IF amplifier stages and two audio stages with tone control.
- ★ Separate antenna trimmer on front panel.
- ★ Separate High Frequency oscillator tube for increased stability. Oscillator is temperature compensated and ventilated for increased stability.
- ★ Separate RF and AF gain controls.
- ★ Series type automatic noise limiter.
- ★ Receives AM, CW and SSB signals. BFO provided for CW and SSB.
- ★ Has "S" meter on front panel for signal strength indication and more accurate tuning.
- ★ Provision for balanced or unbalanced antenna input at 50 to 300 ohms.
- ★ Handsome two-tone gray cabinet.

COVERAGE:

BAND	GENERAL COVERAGE	BANDSPREAD
A	.54-1.6 MC	
B	1.6-4.7 MC	3.5-4.0 MC (80 meters)
C	4.7-15 MC	6.9-7.30 MC (40 meters)
D	14.0-40 MC	14.0-14.35 MC (20 meters) 20.4-21.5 MC (15 meters) 27.0-30 MC (10/11 meters)

TUNING SYSTEM: Separate general coverage and bandspread tuning capacitors connected in parallel on all bands. Bandspread, used primarily for tuning the amateur bands, can be used as vernier for general coverage use. Separate antenna trimmer control.

AUDIO SYSTEM: Two-stage audio amplifier with single 6AQ5 output tube provides 1.5 watts at less than 10% distortion. A handsomely styled accessory speaker is available. Phone jack.

SENSITIVITY: Under 2.5 microvolts (10 DB signal/noise ratio).

SELECTIVITY

	NORMAL
6 DB	5.2 kc
60 DB	22 kc

CONTROLS: Main tuning; bandspread tuning; antenna trimmer; band selector switch; RF gain control; AC ON/OFF and AF gain control; stand-by-receive switch; noise limiter switch; tone control switch; BFO pitch control; AM/CW switch.

TUBE COMPLEMENT:

RF Amp.	6BA6	2nd IF Amp.	6BA6
Freq. Conv.	6BE6	Det, AVC and ANL	6AL5
HF Osc.	6C4	1st AF and BFO	12AT7
1st IF Amp.	6BA6	AF Output	6AQ5
		Rectifier	5Y3GT

OTHER SPECIFICATIONS:

Antenna Input: 50-300 Ohms, Balanced or unbalanced.

Size: 16-13/16" Wide x 10" High x 10-7/8" Deep.

Finish: Handsome two-tone gray wrinkle finish.

Shipping Weight: Approx. 35 lbs.

Optional Accessories: Matching Speaker.

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NUMBER 3

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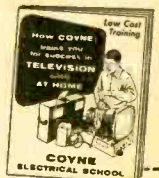
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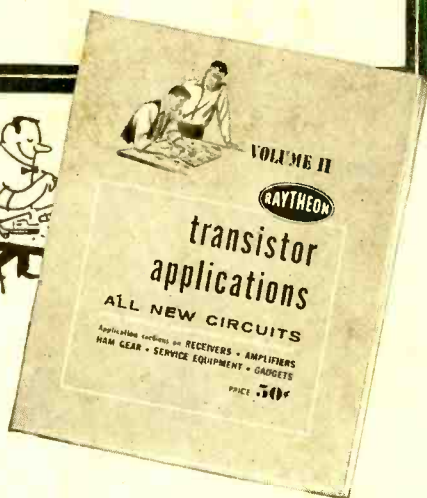
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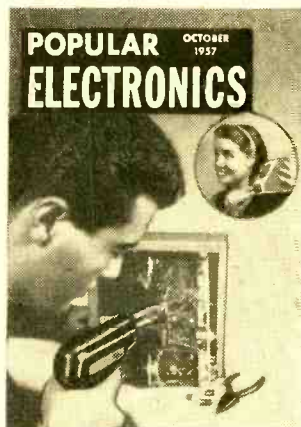
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COMING NEXT MONTH
(OCTOBER)



(ON SALE SEPTEMBER 19)

Would you like to know the actual tape code by which an electronic brain is told to do a certain piece of work? See our October issue. A few tricks on your tape recorder and you can become a barbershop quartet all by yourself. See our October issue! We'll also have a story for you on "Pay TV"—how it works, and arguments pro and con.

Adding a few parts to your AM radio will enable it to do double duty as an intercom—we'll tell you how. The Heathkit CR-1 is a basic crystal set for beginners; by putting a transistor amplifier and loudspeaker in the same case, you can get improved results. And don't miss the third article in the series on oscilloscope traces—it's all about "parasitics."

IN THIS MONTH'S
RADIO & TV NEWS

(SEPTEMBER)

- Career Opportunities in Electronics
- Precision Steering at 18,000 M.P.H.
- Electronics at the L.A. County Fair
- FM Tuner Alignment Problems
- An Electronic Turntable Drive
- A Transistorized 10-Meter Receiver

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- 2 Practical Radio Servicing** — Easy-to-follow directions, diagrams, drawings — with job sheet for every repair job. 509 pages. 473 illus. By William Marcus, Alex Levy, Electronic Training Experts.
- 3 Profitable Radio Troubleshooting** — WHERE to look and WHAT to do for every trouble. How to avoid costly mistakes, handle customers profitably. 330 pages. 153 "how-to" illus. By William Marcus, Alex Levy.
- 4 Profitable TV Troubleshooting** — Short-cuts to SPOT and FIX every trouble — fast, for big profits. By Eugene A. Anthony, Service Consultant, General Elec. Co.
- 5 Repairing Record Changers** — Step-by-step pictures and directions — how to set up service bench, etc. 278 pages. 202 A-B-C pictures. By Eugene Ecklund, Eng. DuMont Lab., Inc.
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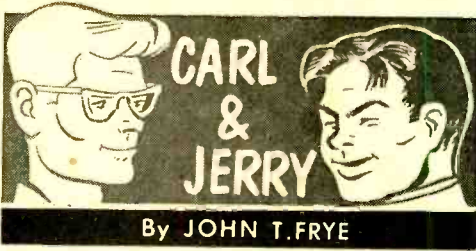
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Electronic Shadow

MRS. BISHOP had told Chief of Police Morton that Carl and Jerry were out in the back yard; and that is where he found them, busily engaged in fastening a weird-looking object to the luggage carrier of Carl's bicycle. The Chief stood for a moment unnoticed and then walked over to where the two were working.

"Hi, boys," he greeted them. "What are you up to?"

The boys glanced up with the startled, retrospective look the unexpected sight of brass buttons and blue serge usually evokes from boys their age, but their faces broke into welcoming grins as they recognized Mr. Morton.

"Hi, Chief; we're just getting ready to

try out a new gadget we've been working on," Carl explained. "We call it 'the electronic shadow.'"

"'Electronic shadow,' huh? Sounds as though you two might be trying to muscle in on my job. But let's have the details—how does it work?"

"Basically," Jerry explained, "the thing is a small working model of a gyro-compass. It consists of this gimbal-mounted gyroscope that has its heavy but carefully counterbalanced and easily turning rotor driven at high speed by this battery-operated electric motor here on the end of the rotor shaft. The mounting and weighting are such that the axle of the rotor is always maintained in a horizontal plane in spite of any tilting of the surface on which the compass rests. Under these conditions, the spinning axis of the rotor will align itself with the axis of the earth in such fashion that both the rotor and the earth are turning in the same direction. One end of the rotor shaft will continually point north no matter how the object on which the compass is sitting is turned about.

"Next, note this small variable resistor mounted here on the frame supporting the gyroscope mounting. It looks like an ordinary radio volume control, but there are important differences. For one thing, the shaft of this variable resistor can be turned

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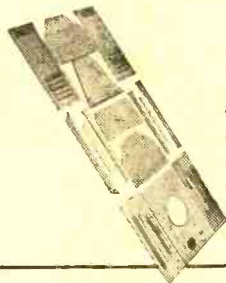
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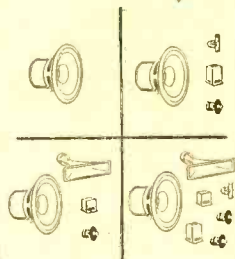
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Carl & Jerry (Continued from page 8)

around and around without meeting a stop. You can see that it only has two terminals. One terminal is connected to one end of the resistance element; the other goes to the slider that contacts this element. As the shaft is turned, the resistance appearing between the two terminals rises gradually from zero to a maximum value and then falls abruptly back to zero with each complete rotation.

"You can see here that the shaft of the variable resistor is fastened to the gimbal holding the spinning rotor. Watch what happens as Carl turns the bicycle around. See: the shaft is maintained in the same position by the gyroscope, but the resistor case itself turns with the bicycle. That means that a different value of resistance appears between the terminals for every point of the compass at which the bicycle is pointed.

"The variable resistor is connected in the circuit of a transistorized resistor-capacity type audio oscillator. The frequency of this oscillator varies as the resistance of the compass-controlled resistor varies. That means that as the bicycle is pointed in different directions, different tones are produced by the audio oscillator. This oscillator

modulates a small transistorized transmitter whose signal can be picked up on a receiver down in the laboratory.

"Down there, too, is an identical audio oscillator containing a matching variable resistor. The shaft of that resistor is locked in the same position as that of the one up here which is controlled by the gyroscope. An arrow is fastened to the resistor case. When that arrow points in the same direction in which the bicycle up here is pointing, the tone coming from the receiver and the one coming from the oscillator down there are at exactly the same pitch. If I want to know which way the bicycle is pointing at a given instant, all I have to do is swing the arrow around until the tone of my audio oscillator matches that coming from the receiver and note the direction in which the arrow is pointing."

"**WHEW!**" Chief Morton exclaimed, mopping his brow. "I think I follow you, but it isn't easy for a duffer whose knowledge of electronics is confined to how a flashlight works. What does that little wheel riding on the rear tire have to do with it?"

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Carl & Jerry (Continued from page 10)

cam on a shaft of this gear train closes a pair of contacts momentarily every tenth of a mile and modulates the little transmitter with a high-pitched 'beep' produced by another transistorized audio oscillator. This allows the fellow down in the lab to keep track of the direction and distance the bicycle has traveled at all times."

"Come on down to the lab and let's see if we can keep track of where Carl is riding," Jerry invited.

"Fine," Chief Morton agreed with an eagerness that seemed a little strange in one who had no knowledge of or interest in electronics.

Jerry had a map of the city spread out on the workbench of the basement laboratory. He flipped on the receiver and the audio oscillator, then pecked on the basement window and motioned for Carl to take off.

"He's heading south," Jerry announced, as he turned the arrow so that the two tones were alike. There was a loud beep from the receiver. Jerry picked up a plastic map-measuring instrument and put the little roller wheel on the map at a point just south of where they were.

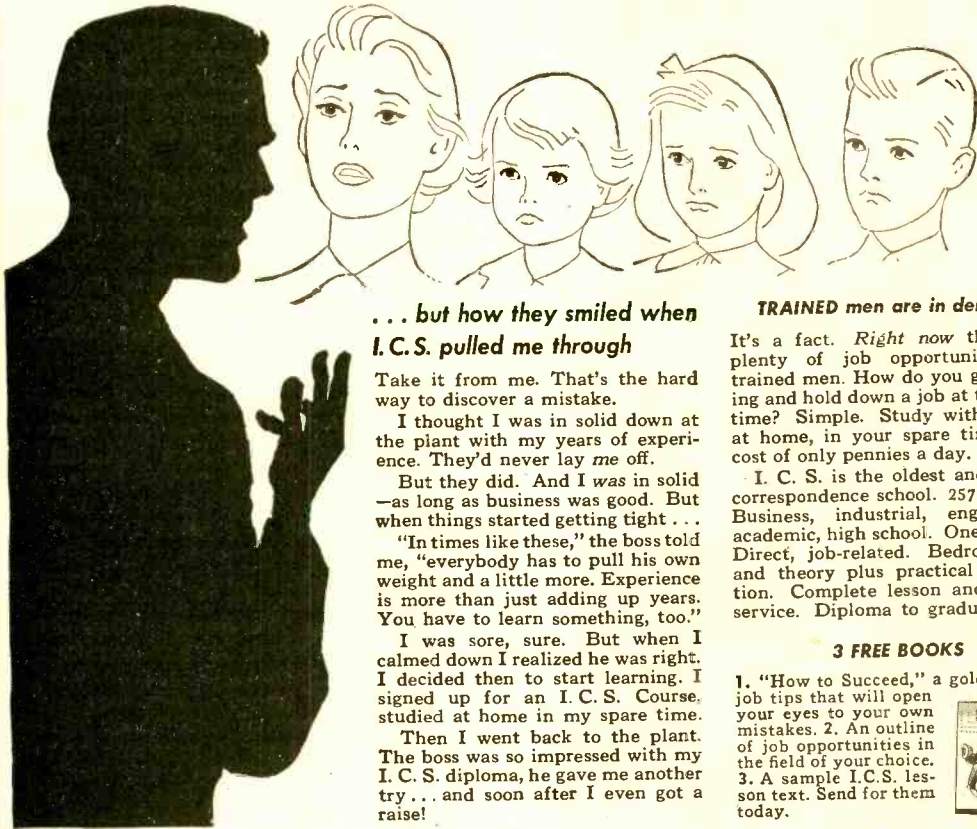
"This map is drawn to a scale of ten-inches-to-the-mile, and I have this map-measuring gadget set to that scale," he explained. "Every time we hear a beep, I'll roll it along the direction we know Carl is traveling until it shows a tenth of a mile. That way we should be able to keep track of where Carl is at all times."

DOING THIS turned out to be easy, because Carl rode along streets that were laid out in a rectangular pattern. When he turned, it was usually at right angles, producing an abrupt change in the tone coming from the receiver. When this happened, Jerry simply swung the arrow until the tones were again in step and changed the direction in which he was moving the map-measurer to agree. All at once, though, the sound coming from the speaker began to sound like: "Baweek, baweek, baweek."

For a moment a worried frown crossed Jerry's round face, then he broke into a grin. "The smart aleck is riding around in a circle at this street intersection," he said, pointing at the map. A little later the indication showed that Carl was riding straight for home. When the map-measurer had crawled back to the starting point, Chief Morton opened the basement door just in time to hear the squeak of Carl's brakes outside.

"That was a wonderful performance, boys," the chief said as Carl came down the steps into the laboratory. "Now, as you

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Carl & Jerry (Continued from page 12)

may have guessed, I had a problem on my mind when I came over here; but I'm almost convinced you two have come up with the solution before even hearing the problem. To be sure, though, I have one question: do you think that 'electronic shadow' will work as well in a car as it does on the bicycle?"

Jerry wrinkled his brow a minute and then answered slowly, "I can't see why not. The distance-traveled roller could be driven from one of the car wheels. The diameter of the roller would probably have to be changed so that the distance indication would be accurate. But what do you have in mind?"

"**H**ERE'S the story," the chief began. "Remember about a month back when a bank bandit held up the First National Bank and got away with forty-seven thousand dollars? If you do, you'll recall that we nabbed him with a roadblock about thirty minutes after the robbery was committed; but he didn't have any of the actual cash with him. Only some bonds were found on him. Somewhere here in town he had hidden the cash. He's a pretty tough cookie, and nothing we can do will make him tell us where the money is hidden. We had just about given up on this guy but something came up recently that makes us think we may have a chance of uncovering the loot after all.

"A couple of days ago, a guard at the jail came to us with the story that this bandit—his name is Palmer—had promised him half of that forty-seven thousand if he would arrange a jail break. All the guard has to do is to allow Palmer to overpower him and have a car waiting in the alley behind the jail.

"We're of half-a-mind to go along with this jail break in the hope of making Palmer lead us to the missing money. The guard is willing to cooperate with us for a share of the reward offered by the bank for the recovery of the money. The hitch is that we're afraid of losing Palmer and the money, too! We're pretty sure he hid it somewhere around those refining plants at the south edge of town. As you know, there are acres of ground out there covered with huge steel tanks, steel towers, etc., all of which reflect radio waves like mad. These reflections make the kind of direction-indicating equipment we used on those car thieves useless. A trial run proved that to us, for we lost the test car completely when it got near the refineries. But I've got a hunch that this electronic tattle-tale of yours would keep the finger right on Pal-

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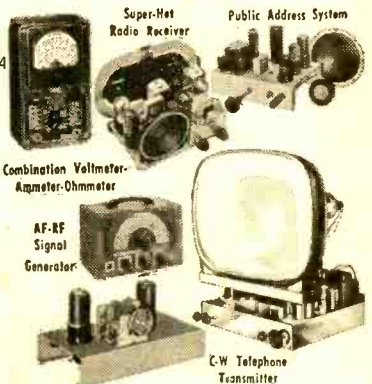
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Carl & Jerry (Continued from page 14)

mer. With it, all we have to do is *hear* the signal without worrying about whether the signal heard is a reflection or not."

"Sure it will work!" Carl exclaimed, eager for the excitement to come.

"Let's make a test and see," Jerry suggested more cautiously.

So they did. They installed the compass in the car that Palmer would be driving if the scheme were carried out, and this car was driven all over town while the two boys and Chief Morton kept track of it at police headquarters. When the record the driver kept of his course was compared with that plotted on the map at the police station, the two records were found to agree in every minute detail.

"I'M SOLD!" Chief Morton announced.

"We'll arrange the jail break for tonight around midnight. You two boys be sure and be here around eleven. I'm going to have every man I can on duty. Men on foot equipped with hand transceivers will be scattered all around the refinery district. We'll have to depend on one of them being close when Palmer gets out of the car to pick up the money. We can't crowd him too closely with the squad cars or he'll get suspicious; but we can keep them in a circle

around him to make sure he doesn't slip through our fingers. If that happens, this town will have a new police chief in short order."

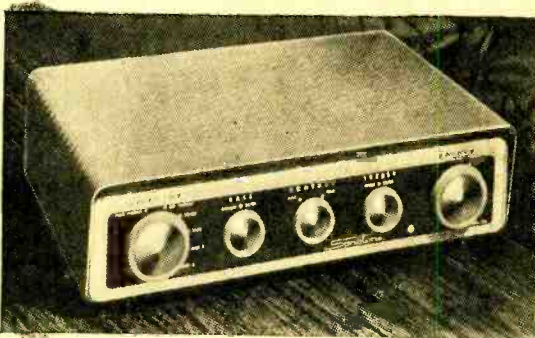
Carl and Jerry, of course, were at the station by ten o'clock. The chief explained that the guard had arranged with Palmer for the break to occur at exactly midnight. A relay had been connected to the ignition switch to turn on the "electronic shadow" when the motor was started and to cut the transmitter off when the motor stopped.

As the clock hands scissored together at the top of the clock face, tension mounted around the large map of the city spread out on a table near the radio dispatching position in the police station. Carl was to operate the receiver and the direction-indicating arrow of the audio oscillator. Jerry was to keep track of the car on the map. A policeman with a stop watch was to keep a record of the time intervals elapsing between the tenth-of-a-mile beeps. Chief Morton would move between the map and the dispatcher so as to keep all forces coordinated for fast, smooth operation.

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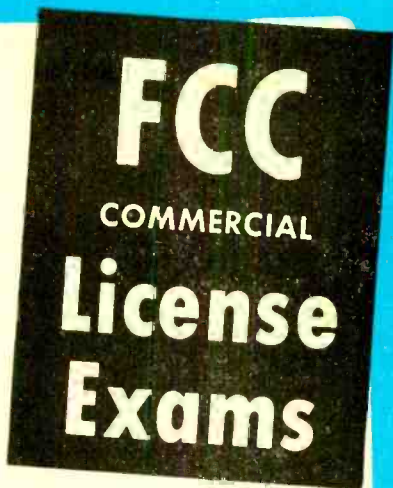
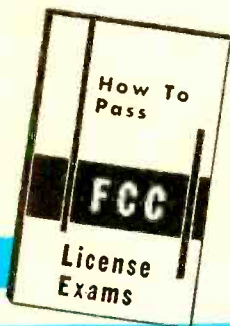


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Prentice Harrison, Lewes, Delaware	1st	27 weeks
W. E. Evey, Ottawa, Kansas	2nd	24 weeks
Raymond L. Gersig, Pittsburgh, Pa.	2nd	24 weeks
Francis W. Bartley, Danbury, Conn.	2nd	15 weeks

(Names and addresses of trainees in your area sent on request)

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"I am now employed by the Collins Radio Company as a Lab Technician. (This job was listed in your bulletin.) I have used the information gathered from your course in so many ways and I know that my training with Cleveland Institute helped me a great deal to obtain the job."

Charles D. Sindelar, Cedar Rapids, Iowa

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September, 1957



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|---|---|
| <input type="checkbox"/> Military | <input type="checkbox"/> Broadcasting |
| <input type="checkbox"/> Radio-TV Servicing | <input type="checkbox"/> Home Experimenting |
| <input type="checkbox"/> Manufacturing | <input type="checkbox"/> Telephone Company |
| <input type="checkbox"/> Amateur Radio | <input type="checkbox"/> Other _____ |

In what kind of work are you now engaged?

In what branch of Electronics are you interested?

Name _____ Age _____

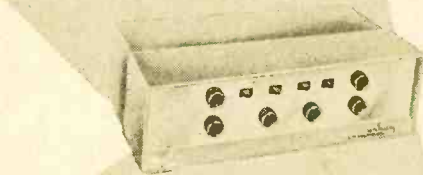
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City _____ Zone _____ State _____

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MODEL SA-25—dual channel pre-amp drives a monaural 25 watt Linear Williamson amp. with your present amplifier for unsurpassable realism of Binaural sound.

Channel 1—25 watt amp: freq. resp. ± 2 db. @ 20 watts, 20 to 20,000 cycles: sens. tape phono—4 mv. for 20 watts: tuner aux.—.3V for 25 watts: Loud. Control: Volume Control—controls dual channels: Bass Control and Treble Control 2 pos. "Lo-Cut" and "Hi-Cut" filters: Equal. switch for all labels plus NARTB tape head.

Channel 2—.5V output—same sens. as channel 1: same pre-amp. features. Just add your present Hi-Fi amp. to channel 2 and prepare yourself to enjoy the sound reproduction only ARKAY stereo can offer.

Kit \$59.95
Wired \$89.95



ST-11—a binaural tuner designed to provide the listener with stereo Hi-Fi of exceptional quality. Because each section contains own tuning condenser I.F. strip, detector and cathode follower outputs, monaural tuning of AM or FM is possible. Arkay "Miracle Ear" sensitivity on FM gives 4 mv. for 20 db. quieting: Bandwidth 200 KC, 6 db. down: freq. resp. ± 5 db. 20 to 20,000 cycles: Hum level—65 db.: AFC: adj. cathode follower output: 75 microsecond de-emphasis network.

Arkay "Miracle Ear" sensitivity on AM gives 3mv. for 20 db. quieting: Bandwidth — 8 KC: freq. resp. 20-8,000 cycles: adj. cathode follower output.

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SP-6—Dual channel, preamp with cathode follower outputs. Can be used with tape deck, mag. phono, tuner, or aus. equipment. The construction of the SP-6 allows for use as a conventional pre-amp. Features include 6 position func. switch: Simultaneous volume control: Loudness control: Bass control ± 16 db. @ 60 cps: Treble control ± 16 db. @ 10,000 cycles: 3 position Hi-filter and Lo-filter: Freq. response ± 5 db. 20 to 40,000 cps. Sensitivity—tape, 4 mv. for .5 volt output—phono, 6 mv. for .5 volt output—tuner and aux. .3 volt for .5 volt output: DC fil.: Built-in power supply:

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arkay 120 CEDAR STREET N. Y.

Carl & Jerry (Continued from page 16)

the boys were easily keeping track of the car. Chief Morton, bent over Jerry, could see that Palmer was driving an aimless course about town, apparently trying to throw any possible pursuit off his trail. Before long, though, he started driving straight for the south edge of the city. The chief kept a wide circle of squad cars around the position indicated on the map by the crawling map-measurer in Jerry's hand.

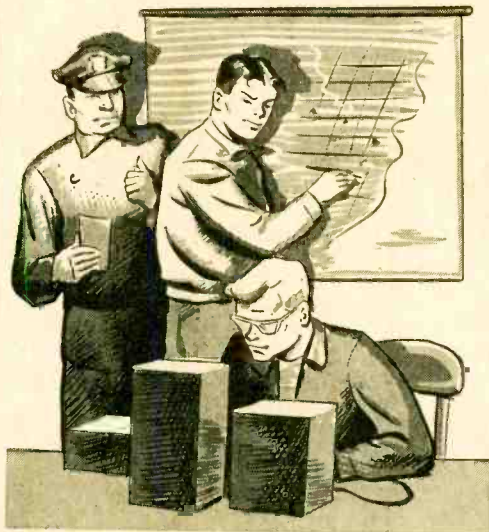
As Palmer reached the vicinity of the refineries, the car seemed to have slowed down, for there was an exceptionally long interval between two of the beeps. Then he apparently turned down a side street, drove for about a block, and cut off the motor. At any rate, the signal from the receiver disappeared.

Chief Morton sprang into action with a volley of commands intended to focus all his forces at the spot where the car had stopped, but to keep them out of sight.

Suddenly there came from the speaker of the police radio the chilling report, "There's no car here, Chief."

For a long, long minute, Jerry and Chief Morton stared at each other in dismay. Then Jerry suddenly reached over and grabbed up the sheet of paper on which the policeman had been keeping a record of the time intervals between beeps.

"That long interval!" Jerry exclaimed, and looked again at the map. "We thought he was just driving slowly, but I'll bet he accidentally went past this alley, then stopped and backed up. That means that



... The practice sessions paid off; soon the boys were easily keeping track of the car. Chief Morton could see that Palmer was driving aimlessly ...

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INEXPERIENCED MEN ONLY —
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Transistorized portable and home radios, amateur equipment, and FM converters.

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Carl & Jerry (Continued from page 18)

instead of being parked on this street here, he is really parked in the alley . . ."

BEFORE the boy finished speaking, the chief of police had instructions crackling through the air. It was only seconds until the reassuring word came back, "The car is here all right. Palmer is just getting out of it and walking over to the side of a warehouse. He's digging around in the sand with the toe of his shoe. Now he's lifting out a tin box. Stand by. We're going to grab him!"

And grab him they did. The box contained the entire amount of cash taken from the bank. As a squad car was bringing Palmer back to the jail, the chief explained to the boys that they would undoubtedly receive a part of the reward.

"That's dandy," Carl remarked; "but our folks will just sock it away in the bank for our college education. What gives us our kicks right now is the satisfaction of knowing that for once we dreamed up a gadget that really worked."

"You mean some of your inventions don't work?" Chief Morton asked in wide-eyed wonder. "That's hard to believe. You're batting 1000 with me. I've called on you twice, and both times you came through."

"Come on, Blabbermouth; let's go home," Jerry said, taking Carl firmly by the elbow and steering him toward the door. "You're so tired and sleepy you don't know what you're saying. Good night, all," he called cheerfully back over his shoulder as he hustled Carl out the door.

-30-

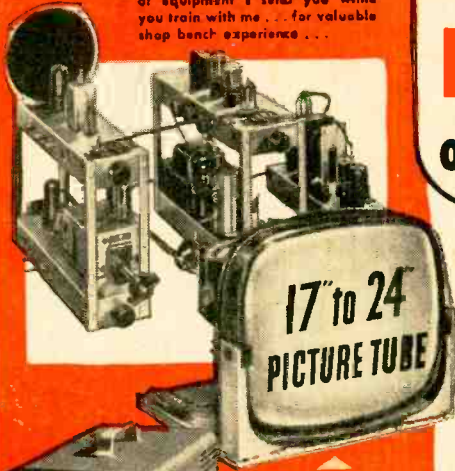


. . . "He's lifting out a tin box. Stand by. We're going to grab him." And grab him they did. The box contained all the cash taken from the bank . . .

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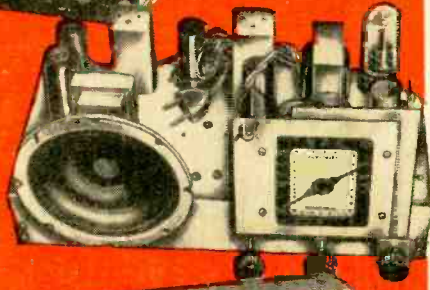


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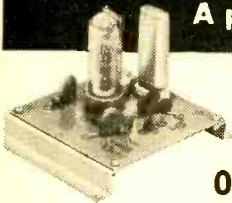
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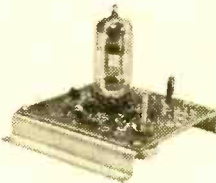
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LETTERS FROM OUR READERS

Mystery?

■ I have run into a mystery. While tuning the 38-39 mc. band, I picked up a broadcast transmitting simultaneously on 38.3 and 39.5 mc. It consisted of a series of numbers which was repeated 10 to 15 times. A woman was calling the numbers, and at the end of each series the call letters were given. The broadcast was apparently on tape. I would be very grateful if you could tell me the purpose of this transmission.

SKIP CLARK
Bakersfield, Calif.

Skip, we are pleased to report that the answer to your question can be found in our article on radio paging, page 41 of this issue.

Our Halo

■ In reference to the unusual antenna pictured on page 42 of your May 1957 issue, you are right—it is a halo. The halo antenna is designed for horizontal rather than verticle polarization. This particular one was probably for 6-meter mobile work.

AL BABB
East Lansing, Mich.

■ Your "halo" is probably a variation of the halo-type non-directional dipoles used by many hams. The one shown is probably intended for 2-meter operation.

JOEL LOOK
Milton, Mass.

■ I believe that your mystery antenna is a homemade job to cover the 6-meter band.

WILLIAM H. MOOS
Moorestown, N. J.

Projects—Past and Planned

■ I built your "Worm Turner No. 1" (May 1957, p. 71), and put in a polarity reversing d.p.d.t. switch which eliminated turning the plug around to change "hot" probes. Also, by replacing the 10-watt bulbs with 60-watt bulbs, I got improved results. As a whole, I must say that the gadget is a sure back-saver for anglers.

J. HACKETT
Rochester, N. Y.

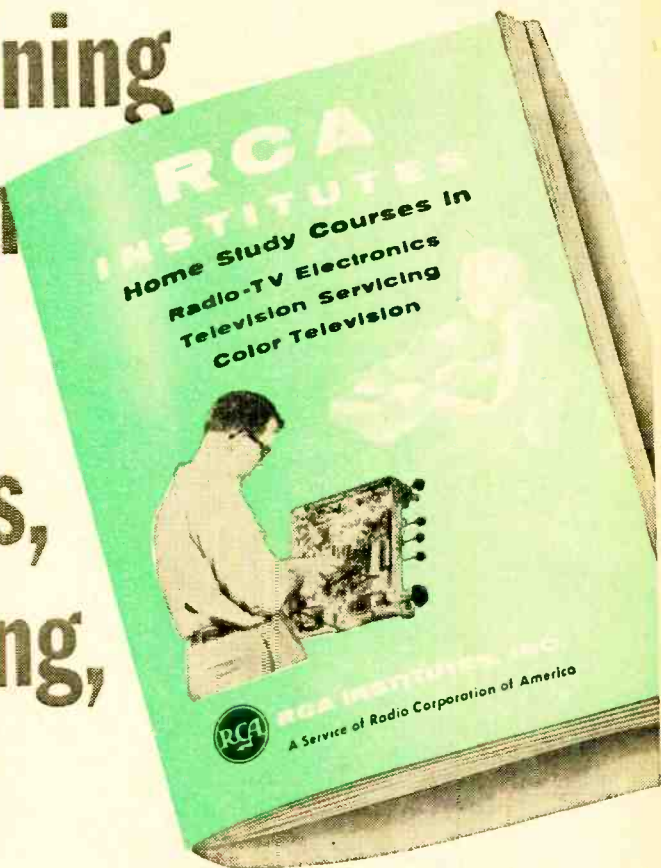
■ I built the "Simplest Code Practice Set" (July 1957, p. 48) and found its operation satisfactory. However, a stronger signal may be obtained by grounding to a fluorescent lamp. If the buzz is too loud, the volume may be changed by placing a 420- μ fd. variable capacitor in series with the ground wire.

BOB SISK
Berwyn, Ill.

■ I would like to see something in the way of a two- or three-tube simple receiver with plenty

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Export Dept. Rocke International, N. Y. C.

Letters

(Continued from page 22)

of explaining and specific directions for a complete beginner like me.

MARY ZETTELMAN
 Evanston, Ill.

■ In the June 1957 issue, you mention an ultra-miniature enclosure coming up. Could it be that it was so miniature I couldn't find it?

MALCOLM P. McLELLAN
 S. Weymouth, Mass.

We promise, Mary and Malcolm, that both the receiver and enclosure articles are scheduled to appear in the very near future.

Acclaim from Abroad

■ I want to let you know how much I appreciate POPULAR ELECTRONICS, which I consider the finest magazine for experimenters. Special congratulations to you on the articles entitled "How to Fix Up Old Radios" and "Get New Sound from Old Radios" (Feb. 1957).

JOSE REYES GONZALEZ
 Habana, Cuba

■ I'm writing to tell you what a swell magazine I think POPULAR ELECTRONICS is. There are many pages of fine reading, and being an SWL, I find "Tuning the Short-Wave Bands" particularly interesting.

N. TRUEMAN
 Nottingham, England

Oops—We Goofed!

■ In your June 1957 issue, p. 42, under "Writing Faster Than Light," you state that an electron beam moves across the face of a tube at a speed faster than light. Is this really possible?

JERRY HASKINS
 Alamogordo, N. M.

It may be, Jerry, that our statement in this instance was badly worded. It is true that the electron beam is propagated at the speed of light, but because of the angle between the point of deflection and some areas on the face of the tube, the scanning of the pattern (not the motion of the actual particles) exceeds the speed of light.

■ A Mobius strip (see July 1957 issue, p. 96) has only one surface bounded by a single curve.

DICK VON BRIESEN
 Milwaukee 11, Wisc.

Right, Dick. Thanks for bringing this to our attention.

More Transistor Projects

■ The more transistor projects you publish, the better I like it.

LOWELL EVERETT
 Greggton, Texas

■ I missed "Transtopic Experiment #18" in the May issue. Where is it hiding?

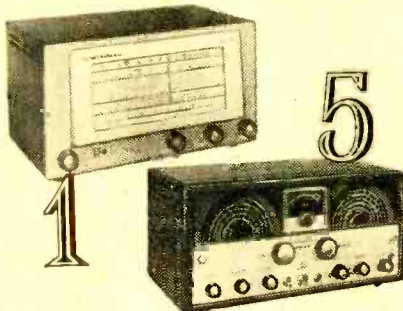
GENE MITCHELL
 Merion, Pa.

See "Transistor Topics" in each issue. More projects coming up—we promise.

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model S-38D \$49.95

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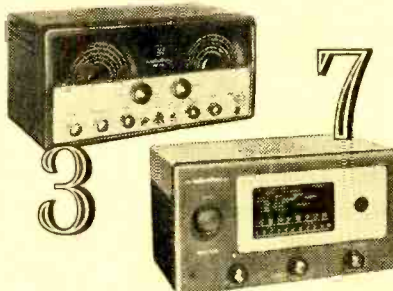
model S-53A \$89.95

Has easy-read overseas dial with international stations indicated. Electrical bandspread and logging scale. Complete with 5 in. speaker, head-phone jacks plus phono-jack. Two stages of i.f. Coverage: standard broadcast from 540-1630 kc. plus four SW bands over 2.5-31 and 48-54.5 Mc.



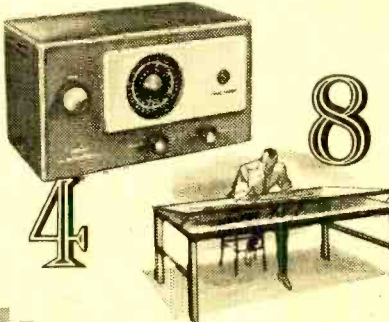
model S-85, S-86 \$119.95

A superb receiver that pulls them in on 10, 11, 15, 20, 40 and 80 meter amateur bands. Over 1000° calibrated bandspread gives better selectivity on large easy-to-read dial. Features separate tuning condenser and built-in PM 5" speaker. Coverage: Broadcast band 540-1680 kc. plus three S/W bands 1680 kc-34 Mc. S-85 AC, S-86 AC-DC.



model S-94, S-95 \$59.95

Advanced models that bring in emergency radio, police and fire calls. Newly engineered FM chassis provides low frequency drift and low noise figure. Modern styling with simplified control gives easy operating. Coverage: S-94-30 to 50 Mc; S-95-152 to 173 Mc.



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The best at its price with all features demanded by DX enthusiast. Has "S" meter, separate bandspread tuning condenser, crystal filter and antenna trimmer. Easy-read dial has over 1000° calibrated bandspread through 10, 11, 15, 20, 40, and 80 meter amateur bands. Coverage: standard broadcast 540-1680 kc. plus three Short-Wave bands 1680 kc-34 Mc.

model S-102, S-106 \$59.95

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model SX-104, SX-105 \$89.95

Two new high frequency crystal controlled/tunable receivers at low cost. First time available on single band receiver. Ideal for monitoring government marine, fire, police and other emergency frequencies. Coverage: SX-104-30 to 50 Mc.; SX-105-152 to 173 Mc.

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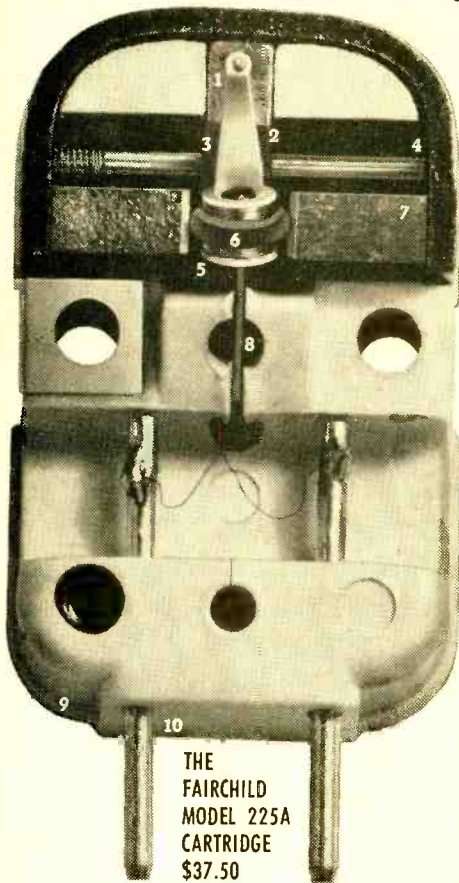
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TOOLS and GADGETS

BATTERY ELIMINATOR FILTER

The Model 1055 battery eliminator accessory filter provides additional filtering of the output of EICO's Model 1050 battery eliminator and charger or a similar unit when it is used for powering transistor and "hybrid" automobile radios and other transistorized equipment. This LC-type filter functions on either the 6- or 12-volt ranges of the battery eliminator up to 10 amp. maximum current. It is adequately rated to remain in use for all functions of the battery eliminator. Price: \$11.95 in kit form; \$15.95 factory-wired; 5% higher on the west coast. (*Electronic Instrument Co., Inc.*, 33-00 Northern Blvd., L. I. C. 1, N. Y.)



"HANDI-TESTER"

Claimed to be the only appliance and auto battery tester in its price class which uses a D'Arsnonval type meter instead of an iron vane type, the EMC Model 108 features maximum accuracy, maximum scale length and minimum battery replacement cost. The 0-800 micro-amp. meter is accurate $\pm 2\%$.

Ranges include: a.c./d.c. volts—0-15, 0-150, 0-300; a.c./d.c. amperes—0-15; a.c./d.c. watts—0-1500. Resistance is 0-2000 ohms.

Weighing only 1¼ pounds, the "Handi-Tester" is housed in a rugged, polished case. It comes complete with test leads and instruction manual. Price: \$15.95

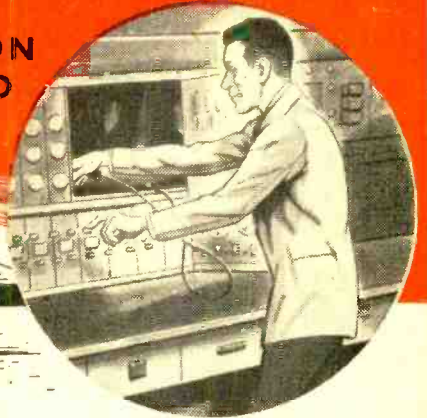
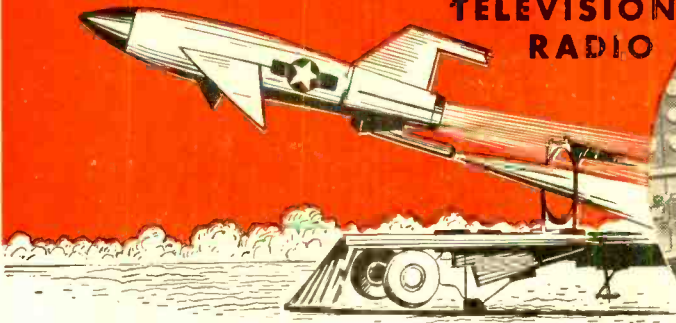


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1. HOME STUDY COURSE (with 9 kits of equipment)—Qualifies you for diploma, FCC license exam, and a variety of electronics jobs (or transfer into advanced resident training).

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Central's complete, accredited training is designed to get you the technical job you want . . . in the shortest possible time! Through Central's "Progressive Plan" of study, as you complete each phase of training your earning capacity goes higher! How far "up the ladder" you want to go is entirely up to you. A few short weeks of training prepares you for certain basic jobs. Then, with every additional phase of training you complete, you qualify for more advanced types of positions that command higher salaries. You can settle for any of a wide variety of well-paid, worthwhile jobs along the line . . . or you can use Central's complete training to advance right up to the top-level, top-pay positions! *Don't limit yourself!* Get the facts on Central's complete training. Mail the coupon today!

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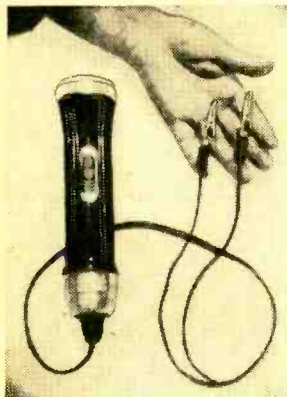
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wired and tested; \$12.95 in kit form. (*Electronic Measurements Corporation*, 625 Broadway, New York 12, N. Y.)

FLASHLIGHT CIRCUIT TESTER

This regular-size flashlight using two standard batteries is also a circuit tester.



A 30" paired cord plugs into its tail end. If the light flashes on when its alligator or needle clips (you have a choice of one or the other) are connected into a circuit, it means that the circuit is all right. If the light does not come on, the circuit is broken or deficient.

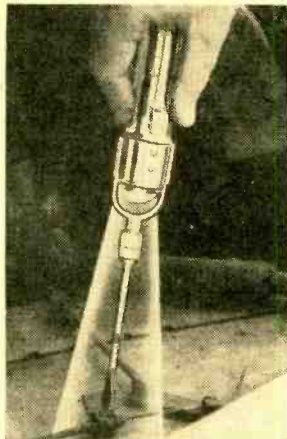
With the flashlight circuit tester, you can test radio or TV circuits and practically all of the circuits in an automobile's electrical system. You can also use it around the house and workshop for checking fuses, low voltage lamps, appliances,

small motors, loose connections, etc. Retail price, \$3.75, postpaid, less batteries. (*A. V. Olson Mfg. Co.*, 1608 Hollywood Way, Burbank, Calif.)

"TOOLITE" KIT

Convenient for those hard-to-look-into and work-in areas, the "Toolite" enables

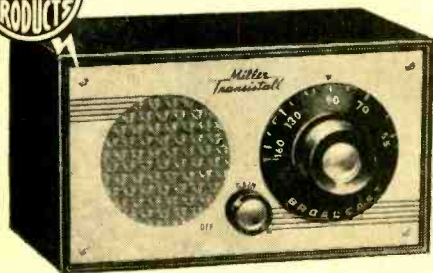
you to handle two essential instruments with one hand. It is essentially a flashlight built into a screwdriver. Made of polished steel chrome, it includes a removable grip-chuck (so that the flashlight can be used by itself), four interchangeable screwdriver bits, and a handy Leatherette case. Less batteries, the complete kit retails for \$1.98. (*Suburban Products Co.*, Box 6531, Philadelphia 38, Pa.)



-50-



THE All-New MILLER NO. 555 TRANSISTALL*



From its smart modern exterior to the advanced circuitry beneath, the "Transistall" represents a truly outstanding achievement.

Painstaking research, leading to the development of many circuit innovations gives the #555 a degree of performance usually associated with much higher priced units. Skillfully engineered, using the latest design techniques including printed circuit construction, the #555 is completely free from wiring and assembly difficulties.

A beautiful bakelite cabinet with a gold-colored front panel gives the unit an appearance rivaling even its outstanding performance.

- Printed circuit construction
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- All American components
- Battery required: NEDA 1602 (Commercially available)

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J. W. MILLER COMPANY
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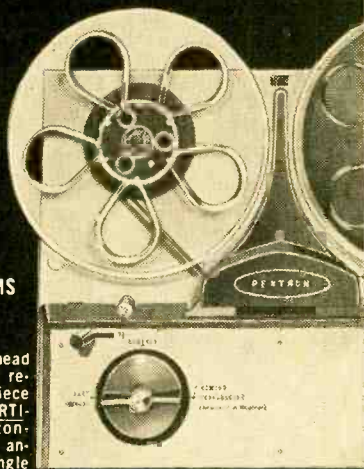
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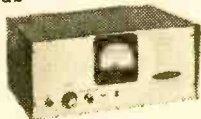
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All CA units have same physical dimensions and require same cutout.



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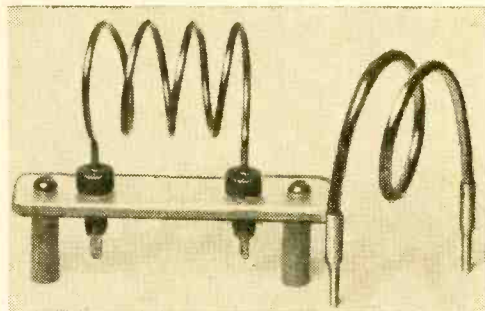
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Canada: Atlas Radio, Ltd., Toronto

TIPS and TECHNIQUES

HIGH-FREQUENCY PLUG-IN COILS

Low-loss, simplicity, and economy are features of these high-frequency plug-in coils. Use a polystyrene strip measuring $3\frac{1}{4}$ " x $\frac{3}{4}$ " x $\frac{1}{8}$ ". A $\frac{5}{32}$ " hole is drilled about $\frac{3}{8}$ " from each end for the round-head wood screws and $\frac{3}{4}$ "-long fiber sleeves used for



mounting the strip to a baseboard. Then mount two standard phone-tip-jacks in $\frac{3}{8}$ " holes about $1\frac{1}{2}$ " apart.

The coil is simply four turns of bare #12 solid copper wire wound around a broomstick handle and spread so that it will fit the tip-jacks perfectly. If you want to use #10 or #8 wire, simply solder the ends of the coil into phone tips. —A. T.

PROTECTING FILES AND HACKSAWS

Manufacturers caution against storing sharp-edged tools where they might rub against one another. Here's a trick you



can use to protect your files, hacksaws, and similar tools. Simply fasten a piece of
(Continued on page 36)

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Today thousands of electronics hobbyists have an opportunity to turn their hobbies into profits. It's the "Age of Electronics"! Trained men are in crucial demand! You may be "outside" the electronics industries now, working on a job you enjoy far less than experimenting, building, transmitting, receiving; working for less money than is being paid to electronics engineering technicians. But your "true love" is electronics. Why not awaken to your opportunities—now?

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Sure you have some experience. But the fellows with only partial technical knowledge move slowly, or stand still while you—the man with advanced technical training—plunge ahead in the golden world of electronics opportunities.

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Use spare-time hobby hours for CREI Home Study as thousands of successful technicians have done since 1927. Get concentrated training in minimum time, then step into a good job and enjoy good pay in the mushrooming electronics industry.

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How to gain career success in the tremendous electronics industries. It pinpoints opportunities which exist. By 1960, the electronics industries will do no less than \$15 billion worth of business per year, not counting military orders. Take TV for example: there are about 36,000,000 TV sets and over 425 TV stations on the air. Color TV is pushing ahead furiously. Electronics is the ONE field of maximum opportunity in this electronic age.

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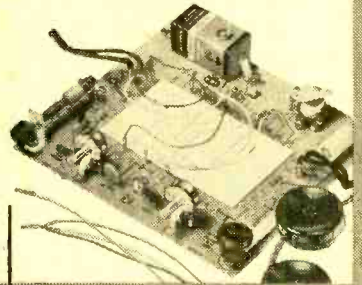
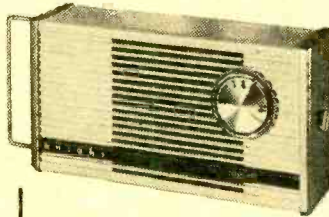
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Model Y-767
\$245
Tiny, cigarette-pack-size 1-transistor radio kit—fascinating to build. Covers the local AM broadcast band with exceptional sensitivity and selectivity. Features: ferrite core tuned coil; low-drain transistor operating for months from single penlight cell; handsome plastic case. Complete with all parts, transistor, battery and easy-to-follow instructions. (External antenna required.) A wonderful value. Shpg. wt., 8 oz.

Model Y-767. Net only.....\$245
J-149. Headphones. 1 1/4 lbs....\$2.15
C-100. Antenna Kit. 1 1/2 lbs....\$1.03

knight-kit 5-Transistor Superhot Portable Radio Kit

Model Y-766
\$2995
Handsome, easy-to-build personal portable with every ultra-modern design feature: 5 transistors (up to 200 hours playing time from 9v. battery supplied); printed circuit for easy building; big 3 1/2" speaker; push-pull audio output; built-in ferrite loopstick antenna. Sensitive reception of AM broadcast band with exceptional tone. In ultra-smart high-impact ivory plastic case with handsome gold trim; size only 7 1/2 x 3 3/4 x 1 3/4". With all parts, transistors, battery and instructions. Shpg. wt., 2 lbs.

Model Y-766. Net only.....\$2995

knight-kit 10-Circuit Transistor Lab Kit

Model Y-299
\$1575
Sensational transistor hobby kit! Assemble the basic parts once, then complete project after project (10 in all), just by plugging leads into proper jacks on printed-circuit board—no wiring changes needed. Make the following: AM radio; amplifier; wireless oscillator; code practice oscillator; electronic timer, switch or flasher; voice-operated, capacity-operated or photoelectric relays. Includes all parts, 2 transistors, battery, headphones, instructions for each project. Shpg. wt., 3 lbs.

Model Y-299. Net only.....\$1575



Model Y-262
\$1465

knight-kit 2-Transistor Pocket Radio Receiver Kit

It's fun to build this pocket-size two-transistor radio—enjoy loud, clear local broadcast-band reception wherever you go! Completely self-contained with built-in ferrite loopstick antenna—no external antenna needed. Extremely efficient reflex type 2-transistor circuit actually does the work of 3 transistors! Printed circuit board reduces building time to about one hour. Has air-dielectric variable capacitor for easy, accurate station tuning. Operates for months and months on long-life alkaline battery supplied. Sensitive miniature earpiece provides remarkably fine tone. Complete with all parts, including plastic-impregnated case, earpiece, battery and transistors. 4 x 3 3/4 x 1 3/4". Shpg. wt., 1 1/2 lbs.

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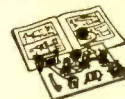
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LATEST DESIGN—each ALLIED KNIGHT-KIT incorporates the very latest circuitry for top-quality performance!



Interruption of light beam triggers relay, to sound chime or bell, turn on lights, etc.

knight-kit Transistorized Code Practice Oscillator Kit

Model Y-239
\$395

Advanced-design code practice oscillator—ideal for beginners learning the code. Uses transistor circuit—operates for months from a single penlight battery. Has clear, crisp tone of approximately 500 cycles. Includes jacks for headphone tips; screw terminals for key. Compact black bakelite case with aluminum panel, only 2 3/4 x 3 3/4 x 1 1/2". Complete with all parts, transistor, battery and step-by-step instructions for quick, easy assembly. (Less earphones and key.) A fine code practice kit at very low price. Shpg. wt., 1 lb.

Model Y-239. Net only.....**\$395**

knight-kit Photo-Electronic Relay Kit

Model Y-702
\$1350

Advanced-design, ultra-sensitive photo-electronic relay—build it yourself and save! Covers 250-ft. with white light; 125-ft. with "unseen" (red filter) light (made available in Light Source Kit listed below). Ideal as announcer, counter, burglar alarm (can be set to ring bell continuously when beam is broken). Hundreds of uses. SPST relay contacts. 6.3v. terminals provide power for accessories. 105-120 v. 50-60 cy. AC use. 6 lbs.

Model Y-702. Relay Kit. Net..**\$1350**

Model Y-703. Light Source Kit. With long-life sealed beam bulb and red filter. Shpg. wt., 3 1/2 lbs. Net..**\$6.75**

knight-kit 2-Way Intercom System Kit

Model Y-295
\$1475

Easy to build—ideal for home or office. Consists of Master and Remote unit, each with press-to-talk switch. Remote can be left "open" for switchless answering and baby-sitting. In "closed" position, Remote is private", but can be called and can originate calls. High-gain 2-stage amplifier and 4" PM speakers. Delivers full volume from only a whisper. With tubes and 50-ft. cable (up to 200-ft. may be added). Antique white finish. Size each unit, 4 3/4 x 6 1/2 x 4 3/8". For 110-120 v. AC or DC. Shpg. wt., 8 lbs.

Model Y-295. Net only.....**\$1475**

knight-kit "Space-Spanner" Bandswitching Receiver Kit

Model Y-243
\$1595

Thrilling 2-band receiver, easy to build, fun to operate—a terrific value. Bandswitch selects exciting short wave, including foreign broadcast, amateur, aircraft, police and marine radio (6.5 to 17 mc), and standard broadcast. Features highly sensitive regenerative circuit. Includes built-in 4" PM speaker and beam-power output for strong volume. Headphone connectors are available for private listening; switch cuts out speaker. Kit includes calibrated panel, punched chassis, all parts and tubes (less cabinet). Easy to build from step-by-step instruction manual. 7 x 10 x 6". For 110-120 volt, 50-60 cycle AC or DC. Shpg. wt., 5 lbs.

Model Y-243. Net only.....**\$1595**

Y-247. Matching cabinet for above.....**\$2.90**



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**"6-IN-ONE"
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Y-770 **\$8.45**

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Y-790 **\$9.45**

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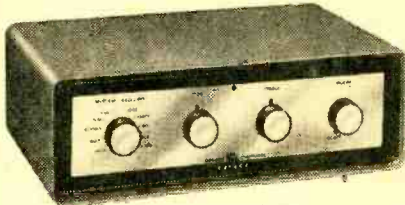
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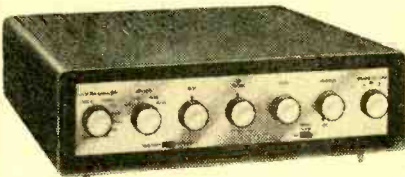
Model Y-786

\$39⁹⁵

Only \$3.99 down

Here is a custom-styled, easy-to-build complete Hi-Fi amplifier at unbeatable low cost. Features 8 inputs for every possible signal source, including NARTB equalized tape head input. Delivers full 18 watts output at only .5% distortion; uses new RCA 6973 hi-fi output tubes; frequency response, ± 1 db, 20-30,000 cps; tape head and magnetic cartridge sensitivity, 5 mv for 18 watts output; hum and noise level better than 60 db below 18 watts; output taps for 4, 8 or 16 ohm speakers. Separate bass and treble controls; full record equalization. Simplest assembly is made possible through use of exclusive printed circuit switch and two printed circuit boards—no critical wiring to do. With beautifully styled custom cabinet; 4 x 13 x 8". Complete with cabinet, tubes, step-by-step instructions. Shpg. wt., 15 lbs.

Model Y-786. 18-Watt Hi-Fi Amplifier Kit. Net only..... \$39⁹⁵



- New Printed Circuit Switches
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- 8 Inputs • Full Equalization
- Full 30 Watts • Custom Cabinet

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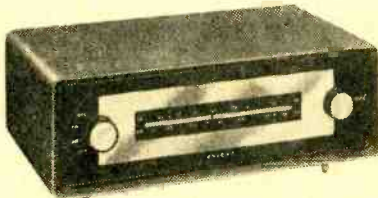
Model Y-762

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Comparable to the best—and you SAVE MONEY! Advanced features include: Linear-deluxe, Williamson-type circuit; equalization for all records within $\frac{1}{2}$ db of recommended accuracy; 2 exclusive new printed-circuit switches; 3 printed-circuit boards for time-saving, error-free assembly; separate continuously variable Level and Loudness controls; 8 inputs for every signal source; DC on all filaments of preamp tubes; exclusive 3-way speaker selector switch (use speakers of mixed impedances without mismatch!); Power Amplifier response, $\pm \frac{1}{2}$ db, 15-100,000 cps at full 30 watt level; distortion—harmonic, 0.55% at 30 watts—IM, 0.74% at 20 watts; rumble filter switch; variable damping. Output 8 and 16 ohms. With cabinet, $4\frac{1}{4}$ x 15 x 15". Ready for easy, money-saving assembly. Shpg. wt., 32 lbs.

Model Y-762. 30-Watt Hi-Fi Amplifier Kit. Net only..... \$76⁹⁵



- Latest Printed Circuit Design
- Flywheel Tuning • Built-in AFC
- High Sensitivity • Hi-Fi Response
- Advanced Custom Styling

knight-kit FM-AM Hi-Fi Tuner Kit

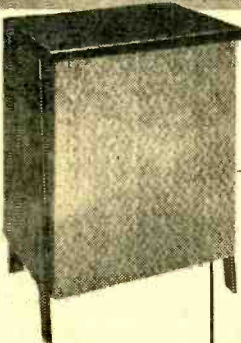
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\$49⁹⁵

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The best-looking, best-performing FM-AM tuner your money can buy! Covers full AM broadcast and 88 to 108 mc FM. Sensitivity is 2.5 microvolts for 20 db of quieting on FM; 3 microvolts for 10 db signal-to-noise ratio on AM. Features include: Inertia Flywheel Tuning for easy, accurate tuning; Automatic Frequency Control (plus AFC disabling) to "lock-in" FM stations; printed circuit board for time-saving, error-proof assembly; pre-aligned RF and IF coils; tuned RF stage on FM; drift-compensated oscillator; neon glow tuning pointer; cathode follower output; two output jacks—one for recorder, one for amplifier; built-in AM ferrite antenna. Ideal for use with KNIGHT-KIT amplifiers above. Includes handsome, custom-styled case, 4 x 13 x 8". Ready for easy assembly. Shpg. wt., 12 lbs.

Model Y-787. FM-AM Hi-Fi Tuner Kit. Net only..... \$49⁹⁵



knight-kit 2-Way "Ducted Port" Complete Speaker System Kit

Model Y-789

\$49⁹⁵

Only \$4.99 down

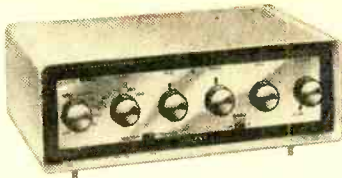


BIG SAVINGS—assemble your own quality KNIGHT-KIT 2-Way Speaker System—it's easy! Cabinet is pre-finished—you just assemble 7 pieces, mount the speaker components and enjoy rich Hi-Fi sound. Special Jensen-engineered baffle features "ducted port" construction to enhance bass response. Kit includes Jensen 12" woofer and compression-type tweeter; genuine L-pad control permits adjustment of tweeter for best tonal balance. Impedance, 16 ohms. Assembled unit delivers frequency response of 45-14,000 cps. Enclosure measures 26 x 19 x 14". Kit includes everything required for easy assembly. Specify blonde or mahogany finish when ordering. Shpg. wt., 33 lbs.

Model Y-789. 2-Way Speaker System Kit.

Net only..... \$49⁹⁵

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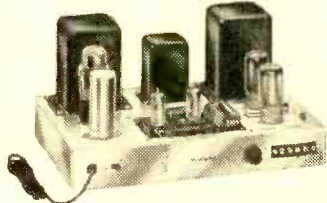


Model
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\$39⁹⁵
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Model Y-754. Preamplifier Kit. Net only..... **\$39⁹⁵**



Model
Y-755
\$44⁵⁰
Only
\$4.45
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knight-kit 25-Watt Basic Hi-Fi Amplifier Kit

Here's superb Hi-Fi performance at less than half the cost of a commercially assembled unit. Williamson-type linear-deluxe circuit delivers full 25 watts of virtually undistorted reproduction; use with KNIGHT-KIT preamp above. Printed circuit board. Response: ± 0.5 db, 10-120,000 cps at 20 watts. Distortion: 0.15% at 30 watts. Output Impedance: 4, 8 and 16 ohms. Includes balance control, variable damping control. Chrome-plated chassis; 6 1/4 x 14 x 9". Ready for easy assembly. Shpg. wt., 25 lbs.

Model Y-755. 25-Watt Amplifier Kit. Net only... **\$44⁵⁰**
Y-759. Metal cover for above. Wt., 3 lbs..... **\$4.25**



Model
Y-751
\$38⁹⁵
Only
\$3.89
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knight-kit Hi-Fi FM Tuner Kit

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Model Y-751. Hi-Fi FM Tuner Kit. Net only... **\$38⁹⁵**

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Model Y-128. Net..... **\$16⁹⁵**



Model
Y-125
\$24⁹⁵

**knight-kit VACUUM TUBE
VOLTMETER KIT**

Printed circuit board for easy wiring. Easy-to-read 4 1/2" meter; 200 ua movement. Zero-center scale, direct-reading db scale. Polarity reversing switch. Response, 30 cycles to 3 mc. Input resistance, 11 megs. Ranges: AC peak-to-peak v., 0-4-14-40-140-400, 1400, 4000; AC rms v. and DC v., 0-1.5-5-15-50-150-500-1500; ohms, 0-1000-10K-100K; 1-10-100-1000 megs; db scale, -10 to +5. 7 3/4 x 5 1/4 x 4 3/4". Shpg. wt., 7 lbs.

Model Y-125. Net..... **\$24⁹⁵**

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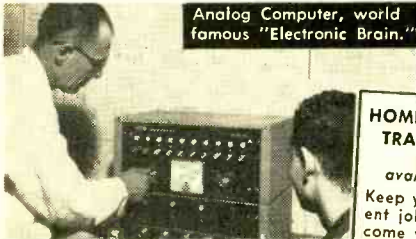
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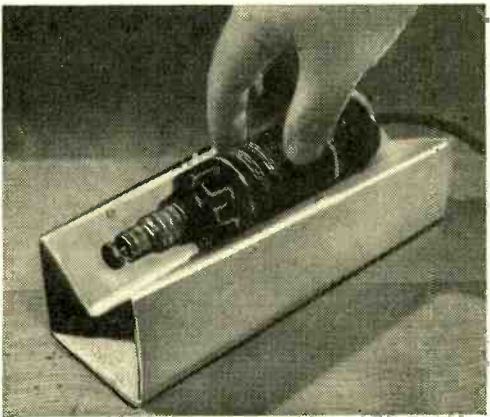
Tips

(Continued from page 30)

masking tape to the cutting surfaces of the tools. The tape will cushion and protect the tools. What's more, when you remove the tape later, you'll find that stray shreds of metal filings and other dirt will adhere to the tape—and you'll have a clean tool for your next job. —L. E. G.

CARDBOARD HOLDS HAND POWER TOOL

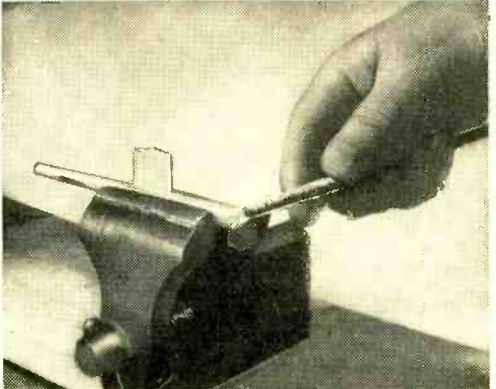
You can keep your hand power tools from rolling around the workbench or dropping to the floor by placing them in this simple



cardboard cradle when not in use. Bend a small sheet of stiff cardboard into the shape of a trough and staple the overlapped edges at the bottom. If you like, you may just hold it together with paper clips instead of staples so that it can be flattened out in order to save storage space. —K. M.

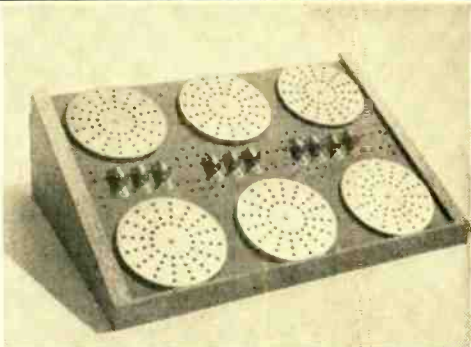
HOMEMADE ALIGNMENT TOOL

For alignment and trimmer capacitor adjustment of radio sets, a five-cent plastic



penholder is easily made into a practical tool. Cut off the hollow end intended for the pen nib, then work it into the shape of a screwdriver with a round file. The

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OVER 400 COMPONENTS AND PARTS. Circuits operate on one flashlight battery, and the use of ingeniously designed parts makes building circuits one of the most fascinating things you've ever done! You set up problems in a variety of fields—and get your answers quicker than you can set them up! Play games with the machine—nim, tic-tac-toe, etc.—and pit your brain against its logic! Solves puzzles in a few seconds that would take you hours without the aid of the machine. You actually see how computing and problem-solving is analyzed with algebraic solutions transferred directly into circuit diagrams.

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Tips

(Continued from page 36)

other end of the penholder can be similarly treated to make a tool with a smaller blade. —K. M.

TOOLS STORED IN TRAVEL BAG

To keep small tools—such as interchangeable screwdriver and socket sets—from getting lost, store them in a small



plastic travel bag. The moisture-proof bag will also keep them from rusting. —J. A. C.

RUBBER BAND PROTECTS PHONO NEEDLE

A phonograph needle or pickup cartridge can be damaged, while moving the player about, if the pickup arm should slide from its rest. It's a good idea to bind the pickup



arm to the rest with a heavy rubber band when the player is not in use. The band can be easily slipped from the rest and may remain on the arm while records are being played. —K. M.

EMERGENCY BATTERY RENEWAL

When flashlight batteries go dead during an emergency and replacements are not available, connect them in series between the spark plug of a running engine and the high voltage lead. This will rejuvenate them in short order. —S. C.

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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.

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 \$19.95. The Signal Tracer alone is worth more than the price of the entire Kit.

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

Here is an excerpt from a letter that we received from Loren DePrest, 1495 4th St., Mansfield, Ohio: "I have spent many pleasant hours in constructing the radios from the schematics in your book, and have learned a great deal from them. Being as I am interested in Radio, I consider the money spent for your course as wise investment. I have learned more from your course by actually doing than I did from an expensive course."

Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 75 countries of the world. The "Edu-Kit" has been care-

fully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

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tools, a professional electric soldering iron, and a self-powered Dynamic Radio & 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 all parts, tools, instructions, etc. Everything is yours to keep.

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J. Stakatis, 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."

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One of the most important aspects of the "Edu-Kit" is the Free Consultation Service which we provide. Our staff of experts carries on an extensive correspondence with students in all parts of the world, concerning all phases of electronics. We welcome and encourage students to send us their problems, whether related to any of the material covered in the "Edu-Kit" course, or encountered in other experiences in the field of electronics.

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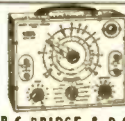
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NEW!
60-WATT
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HIGH
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#HF60 with ACRO 10-330 OUTPUT XFMR
KIT \$72.95 WIRED \$99.95

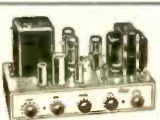


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POWER
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- proven trouble-free designs
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NEW! 12-WATT Williamson-type
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NEW!
COMPLETE with
FACTORY-BUILT
CABINET-2-WAY
HI-FI SPEAKER
SYSTEM #HF51
\$39.95





RADIO

Keeps You in Touch

Photo Courtesy DeMont Labs., Inc.

By **LEO G. SANDS**
and
MIKE BIENSTOCK

**Paging and telephone systems
use radio waves to keep pace
with today's business world**

You're a doctor. You're out on a call this evening, and it's a half-hour drive to your patient. When you get there and call in, your nurse tells you one of your patients has had a serious accident. He's in the hospital now, and they're operating.

* * *

You're a doctor. You're out on a call this evening, and it's a half-hour drive to your patient. Suddenly the phone under the dash rings once. You pull over, pick up the handset, press the button, and you are in instant contact with your office. Your nurse tells you one of your patients has had a serious accident. You speed to the hospital where you are in time to supervise the operation. . .

September, 1957





The little lady above is shown demonstrating one-way radio paging. Subscriber presses button and hears the taped message.

these receivers are pocket-size jobs which weigh a few ounces. They can be rented or bought at a cost of about \$50. The subscriber to this private service takes the tiny radio out of his pocket, holds it to his ear, presses a button and listens. The names or call numbers for those with messages waiting are transmitted from a base station. Generally the information is taped and rebroadcast until the subscriber calls in, then the signal is erased.

To extend this service over a greater range, a mobile receiver with a built-in speaker can be mounted under the dash. Since a superheterodyne circuit is used, the range is stepped up. The car battery



Mobile telephone transmitter and receiver control panels (right) at Pacific Telephone & Telegraph Co.

DID THAT sound nice, but a bit futuristic? You're partly right. It is nice, but communication with a moving car is here *today*, a bustling youngster growing lustily and with practically an unlimited future. The prospects are tremendous, not only for the doctor who receives emergency calls, but for anyone whose business requires him to keep in constant touch with home base . . . salesmen, who may get tips on customers . . . executives whose advice may be needed to make a critical decision . . . newspapermen, who may be routed to cover a top story while it's happening . . . radio and television servicemen who may be sent on an emergency. The list is nearly endless.

There are a wide variety of services available. Let's examine them in order of cost and complexity.

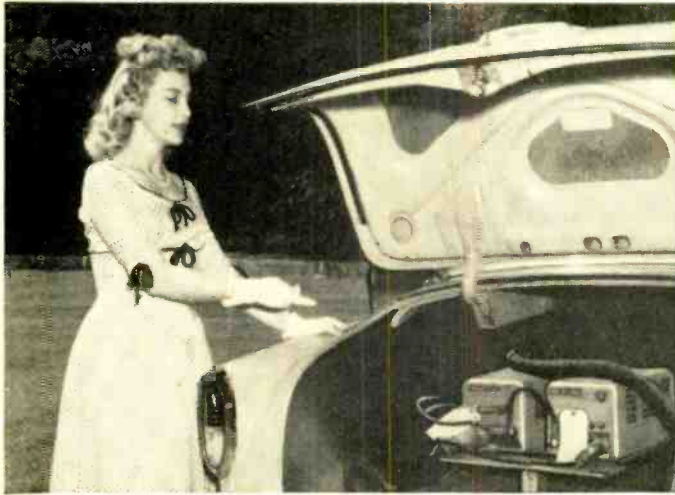
One-Way Radio Paging. Not quite the same as the Dick Tracy wrist radios,

furnishes the power to operate the set.

Telephone companies provide a similar auto signaling service. The signal is a buzzer and light. Installation for such service is half of the regular auto radio-to-telephone service—\$25 for most areas, plus \$12.50 for rental and maintenance, plus a minimum calling charge of \$5 which would pay for 30 to 40 calls.

Message Service. This is handled by private communications firms. The installation includes equipment similar to that used in regular mobile radiotelephone, which will be described under that category. The service differs in this way: instead of direct voice contact between both parties, the message is shortstopped by a third person, the company operator.

Suppose the doctor's nurse wants to call him. She rings up the private operator and gives her the message she wants delivered. Then the operator calls the doctor



Mobile telephone equipment installed in the trunk of the car (left) takes up relatively little space, is out of the way.

Message service control center (below) is operated by two persons, one taking telephone messages, the other on radio.



on the road. He gets the signal, picks up his mike or handset, and answers her. She gives him the nurse's message. Direct communication, of course, would be in violation of the common carrier tariff filed by the telephone company.

Typical charges in the New York area are as follows: a monthly fee of \$36.30 allows 100 air-minute messages, after which you are charged 10 cents per call. Incoming messages are billed at a straight

KIND OF SERVICE	SERVICE CATEGORY	APPROX. RANGE (miles)	FREQUENCY BAND (mc.)	TYPE OF MODULATION	OPERATOR'S LICENSE	APPROXIMATE COST		
						Mobile Unit	Base Station	Monthly Service
Radio Paging	Misc. one-way signaling	5 to 25	38.58 and 43.58 v.h.f.	AM	No	\$50	*	\$12.50
Radio Message	Misc. common carrier	5 to 25	152 to 162 v.h.f.	FM	No	\$475 up	*	\$36**
Private Walkie-Talkie	Citizens Radio Class B	1½ to 6	465 (only) u.h.f.	AM	No	\$139.50 and up		None
Private Mobile	Citizens Radio Class A	5 to 25	460 to 470 u.h.f.	FM	No	\$600 up	\$1000 up	None
Extended Telephone	Urban Mobile Radiotelephone	5 to 25	35 to 44 152 to 162 v.h.f.	FM	No	—	*	\$32
Private Mobile	Amateur	Unlimited	All licensed radio ham bands	FM, AM, on SSB	Yes	Depends on installation		None

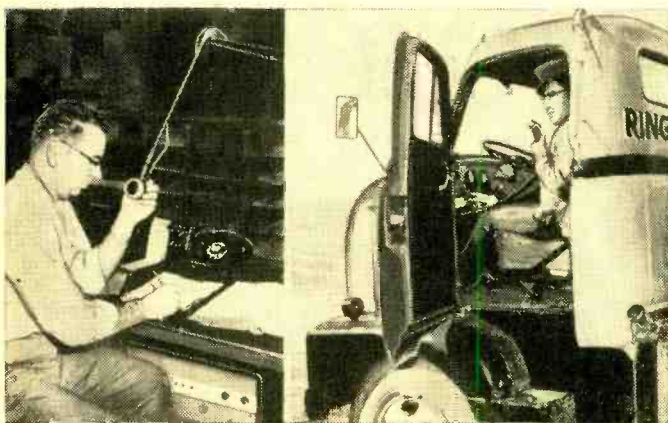
* Operated by common carrier

— Furnished by phone company (some permit subscriber to furnish own equipment)

** Includes equipment, maintenance, limited number of calls or messages

The car at right is equipped with a two-way Bendix mobile unit provided by message service common carrier.

A typical mobile telephone is installed in the car below. Note handset holder and control unit under dash.



RCA installation of a two-way mobile radio system at a large trucking firm. Dispatcher is shown at far left in communication with one of the local pickup and delivery trucks.

10 cents each. The fee is broken down to \$17.50 monthly for service, \$10.50 for rental and \$5 for maintenance. There is a 10% Federal tax. Installation charge is \$25 per unit, and removal charge is \$10 payable in advance.

Citizens Radio Service. There are three types in this category: Class A, B and C stations. We are concerned with only the first two, since Class C is strictly for remote control transmission.

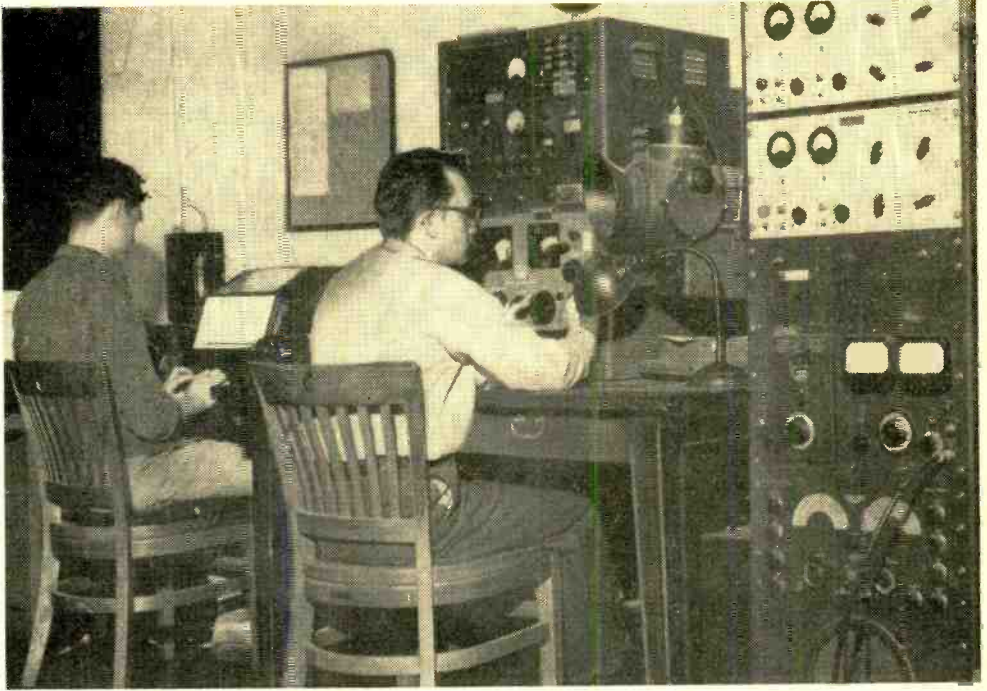
Class B stations may only be operated on 465 mc., with a maximum input power of 10 watts. Class A may be operated on any frequency in the 460 to 470 mc. band, with power limited to 10 watts between 462 and 468 mc. and 50 watts on the other frequencies.

The further distinction between the two is that equipment cost for Class A transmission pretty well limits its use to commercial firms interested in getting distance,

which is usually eight to ten miles, depending on terrain and conditions. Class B, therefore, is generally used by private citizens who get a range of one-and-a-half to six miles, depending on conditions. Vocaline makes transceivers for this band which sell for \$139.50 a pair. They require no installation.

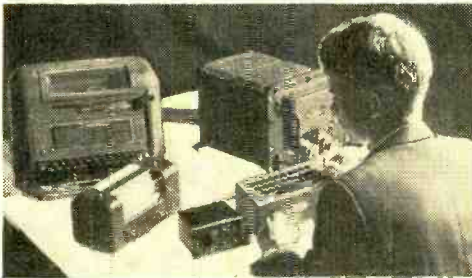
For a Class A installation, initial cost may run to about \$700 for the car equipment and \$1200 for the base station, which can be at home or in the office. It may cost more if a tall antenna support is needed at the base and if a heavy-duty generator is necessary in the car. The equipment will give a range of eight to ten miles in most areas even without elaborate antenna systems at the base. The higher the base antenna, of course, the greater the range. Reflection characteristics of u.h.f. make it possible to enjoy good com-

(Continued on page 118)



NBS Sets Up Radio Warning Network

From the control room above, teletype messages come and go to and from all corners of the world. Phrased in an unusual coding system, the messages deal with radio receiving and transmitting conditions between IGY observatories. Operators of the equipment installed at Ft. Belvoir, Va., by the National Bureau of Standards predict radio conditions so that communications during this vital period will not be interrupted.



Teletype Takes to the Air

Bulk and weight of ordinary teletype-writers used to present a problem in sending and receiving printed messages in flight. Wright Air Development Command, at Dayton, Ohio, has now licked this problem with a small, lightweight model. The photo above shows the separate keyboard and printing unit of the new design in front, contrasted against the bulk of the older equipment. The new machine is also capable of transmitting messages from a memory storage and will work regardless of the aircraft's heaving and yawing while in flight in any type of weather.

The Loudest Yell

The frightening "bomb" pictured here won't tear anyone to bits. Actually, it isn't a bomb at all, but an instrument of peace. It tries to talk the enemy out of shooting. This "bomb" houses a 500-watt battery-powered amplifier and a horn-type loudspeaker which delivers tape-recorded messages to the enemy as it drifts down under a parachute. Its tremendous sound output is intelligible from as high as 4000 feet and will cover a wide area on the ground. The "talking bomb" was developed for the U. S. Air Force by Cook Research Laboratories of Skokie, Ill. It if does its job, the "bomb" can save more lives than real bombs of the same size could destroy.



PUSH-BUTTON WEATHERMAN

By H. H. FANTEL
Associate Editor

MARK TWAIN, who complained that "everybody's talking about the weather but nobody is doing anything about it," evidently reckoned without Dr. Irving P. Krick, who uses electronic trickery to outsmart the weather. When his methods are perfected, weather can no longer come unexpected. "Soon we'll be able to tell you," promises Dr. Krick, "when and where it will rain next year, and about how much."

Charting the Air Ocean. The trick consists in charting all the churnings of the vast air ocean which makes our weather. If you know the pressure fronts, and wind patterns at various altitudes, it is possible to predict just how the weather-bearing air masses will push themselves around. But since so many factors are involved in the formation of weather, and every factor influences every other factor, the weatherman needs complex mathematics to take all that into account.

That's where electronics comes in. Dr. Krick employs a UNIVAC computer to do his figuring. More important, he relies on the UNIVAC's electronic memory to "keep in mind" a vast background of past weather history. The current weather situation is interpreted against this background to arrive at the future prediction.

Long Memories. The accuracy of the prediction naturally depends on the



amount of such previous data available. This is inherent in the logic of the method. For this reason, Dr. Krick and other meteorologists spent over two million dollars to compile 15,000 maps, showing the weather in the northern half of the world for every day back to 1899. Since there was no official weather reporting in many places until recently, much of this information had to be dug out of the logs of old ships, from town journals, and other rare sources.

To rifle through this mass of data and pick out what is pertinent would ordinarily take so long that the weather would have passed by the time the forecast was ready. To speed it up, about 100,000 men would be needed to complete the figuring before the forecast turned to history—and they all would have to look over each other's shoulders to copy their partial results.

Fast Figuring. But now UNIVAC comes to the rescue of the weatherman who missed the climatic bus. Doing the work of 1000 man-hours in 38 seconds, it sifts the mountains of information and relates them in a jiffy to the present weather



Air Traffic Aid

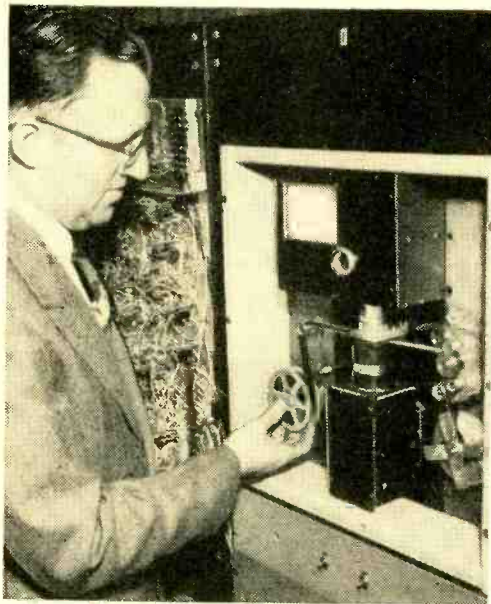
This new cathode-ray tube (above) was designed by Stromberg-Carlson to meet some of the complex problems of airport traffic control. The "Indicoder," with a 1½" square screen, will have a 1" number projected on it. A group of the tubes in combination will form an electronic display board which can keep current, detailed information on scores of aircraft near the field. This job is getting more and more difficult to do by hand. The Indicoder will be plugged directly into the computer. Electrons deflected through a stencil inside form the numbers.

Free Courses

Queens Evening Trade School, 37-02 47th Ave., Long Island City, N. Y., is offering free radio and television service courses. Registration for all classes will take place at the school from 7 to 9 p.m. on September 9 and 10.

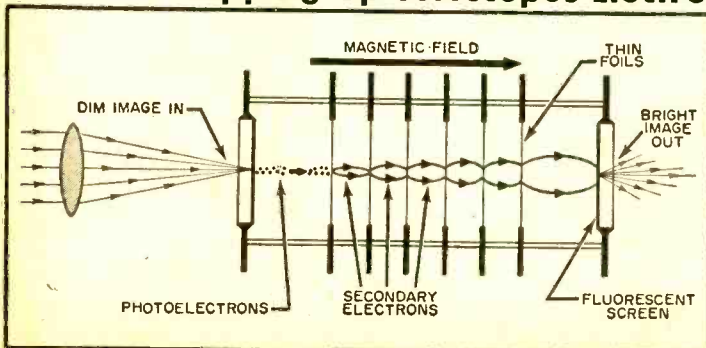
Matchless FOSDIC

The Bureau of Standards' new FOSDIC II (Film Optical Scanning Device for Input to Computers) is a great movie-goer. It reads microfilmed copies of punched cards. Since there are 300 million of these cards at the Weather Records Center in Asheville, N. C., the electronic scanner (below) was designed to cut down the labor of search by reading as many as 4000 cards a minute. In addition, the film gives the operator a chance to study any card visually, cuts down on storage space and allows easy duplication of cards. Also, records can be kept indefinitely. The film is read while in motion. As it passes the scanning head, the columns are read and



results stored. At the end of the scan, the memory contents are compared to the pattern. When agreement is found, the film stops, leaving the image in the field of view to be examined.

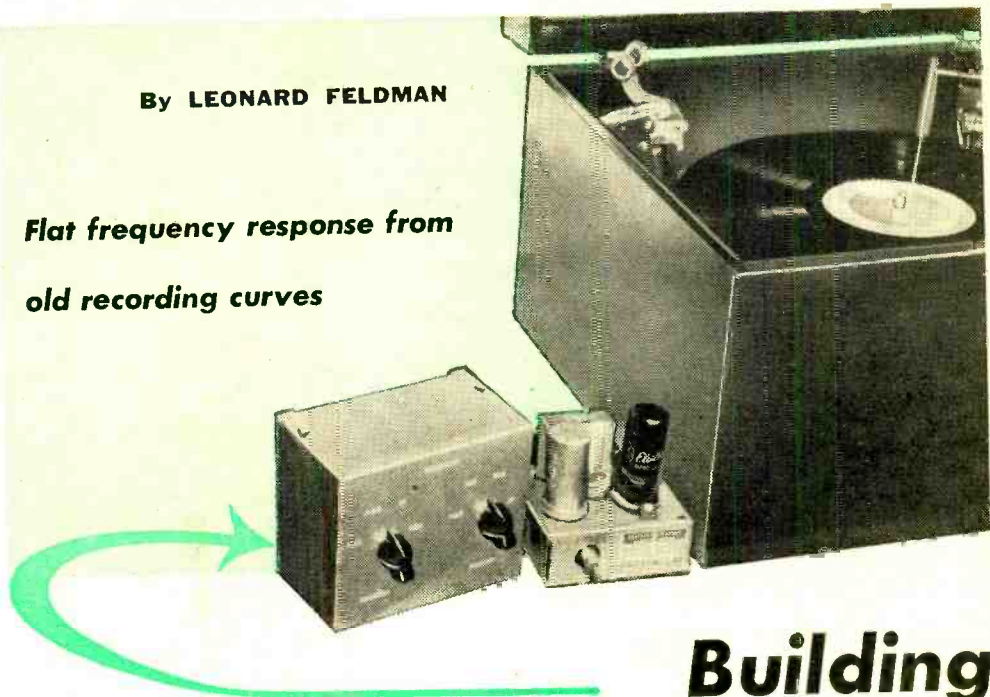
Hopping Up Telescopes Electronically



Astronomers expect to hop up the power of telescopes tenfold by using the "image multiplier" tube (left) which multiplies photoelectrons released when photons of light strike. As electrons hit successive foil "screens," they release correspondingly larger numbers, aided by the magnetic field.

By LEONARD FELDMAN

**Flat frequency response from
old recording curves**



Building a **Hum-Free** Hi-Fi Equalizer

FOR THE PAST several years *all* recordings have been standardized so that you need no longer vary equalization settings. Any good preamplifier with accurate RIAA (Record Industry Association of America) playback characteristics will reproduce records correctly—*provided that* they don't happen to be made before 1953, the year the record manufacturers got together and agreed on a standard equalization curve.

Before that time, virtually every important disc maker had his own way of "gimmicking up" his recording equipment during a session, so that your hi-fi equipment had to provide different record equalization settings. Since the end of 1953, however, life has become much simpler. Purchasers of new recordings merely set their equalization switches to RIAA (sometimes called Orthophonic, by RCA) and leave them there.

Some equipment manufacturers, taking their cue from this simplification, abandoned the extra levers, knobs and switches in favor of this single standard setting. The small "outboard" preamplifiers for magnetic cartridges (such as the single-tube jobs made by G.E. and Fisher) settled comfortably into RIAA equalization, after

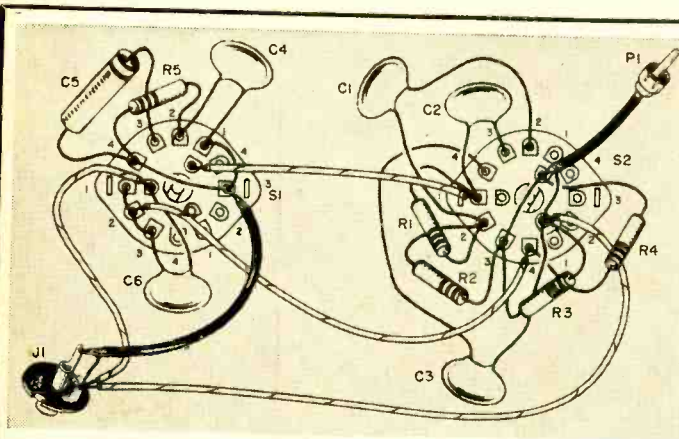
abandoning all the others. Thousands of these small, "fixed equalization" preamps are successfully in use today and do a splendid job for people who improved their older phonographs by adding a magnetic pickup.

What About Older Records? With so many "fixed equalization" preamplifiers in use, both old and new, what does the penurious hi-fi fan do about reproducing records made before RIAA?

The equalizer shown here has two very important aspects. First, the parts required to build it cost less than \$4.25 and are all available from standard jobbers. Second, the unit is an outboard affair which is plugged in between your preamp—any preamp—and your amplifier.

The latter feature makes this equalizer compatible with almost any setup for which it provides a choice of equalization settings. What's more, because it is "patched into the circuit" after preamplification, there's no danger of hum and noise because the signal has already been amplified at the point of insertion to a level where these problems no longer exist.

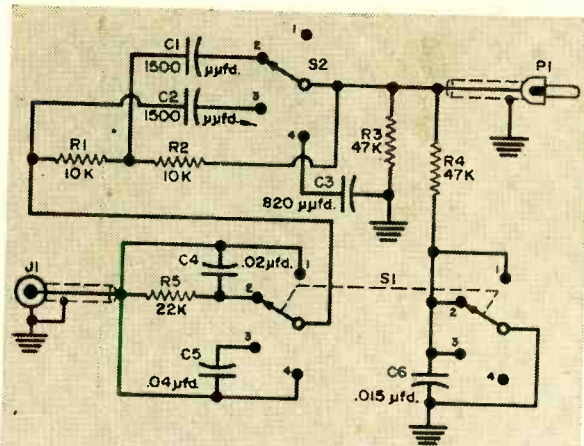
What the Equalizer Does. There are four selectable positions of low-frequency equalization (sometimes called "turn-



Wiring layout for the equalizer should closely follow the pictorial diagram at left. Switches S1 and S2 are viewed from rear. The schematic diagram below shows how S1 controls the bass turnover frequency while S2 regulates treble roll-off.

PARTS LIST

- C1, C2—1500- μ fd. disc capacitor
- C3—820- μ fd. disc capacitor
- C4—0.02- μ fd. disc capacitor
- C5—0.04- μ fd., 200-volt paper tubular capacitor
- C6—0.015- μ fd. disc or tubular capacitor
- J1—Standard phono-tip jack
- P1—Standard phono-tip plug
- R1, R2—10,000-ohm, 1/2-watt carbon resistor
- R3, R4—47,000-ohm, 1/2-watt carbon resistor
- R5—22,000-ohm, 1/2-watt carbon resistor
- S1, S2—3-pole, 4-position rotary switch (Mallory 3134J)
- 1—Cabinet (ICA No. 29440)
- Misc. shielded cable, hookup wire, etc.



SWITCH POSITIONS

	1	2	3	4
S1	RIAA	AES	LP	NAB
S2	RIAA	AES	RCA	LP

over”) and four positions of high-frequency equalization (sometimes called de-emphasis or roll-off). Since the two selector switches operate independently, the unit can actually produce sixteen distinct equalization settings to accommodate virtually any record ever made.

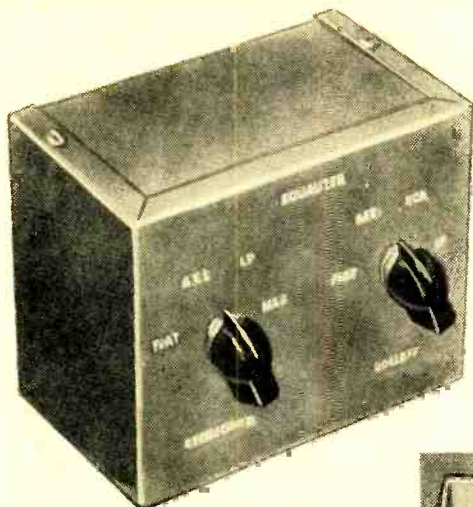
Suppose an RIAA type of record were to be played through a preamp having only RIAA equalization. No additional equalization would be needed to get a response as flat as it should be. Since the bass on the record is attenuated and the treble is peaked, the action of the preamp is just the reverse, resulting in perfectly flat response.

But if, for instance, an old LP recording made in 1950 is played through the same preamp, the record's frequency response is *not* the reverse of the preamp's playback response. Consequently, the net

result is *not* flat frequency response, but rather a departure from flat by as much as 4 db at 50 cycles and nearly 2 db at 10,000 cycles. To a discerning listener, and through a first-rate loudspeaker, these differences are quite apparent.

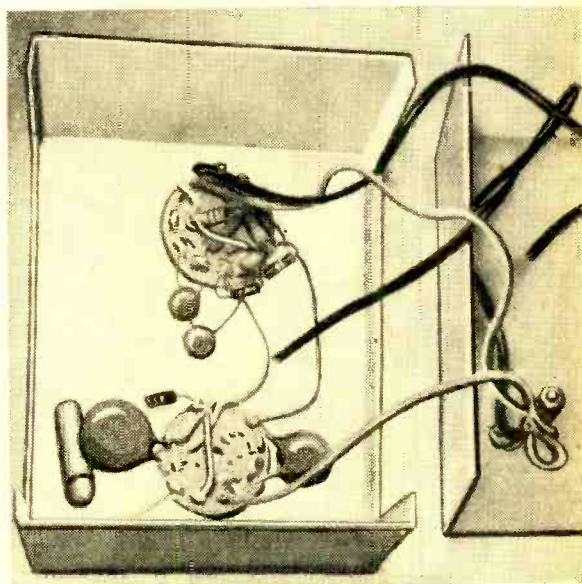
Since your preamp already has RIAA equalization built in, the equalizer discussed here merely adds or subtracts the *difference* between RIAA and the old playback curve to restore flat response. As the maximum deviation of any of the curves compared to RIAA is only about 5 db, it was possible to construct this unit without any tubes. The total volume loss introduced by the equalizer is just slightly less than 6 db, which simply means that your volume control on the amplifier will have to be set *slightly* higher.

Building the Unit. Wiring should follow exactly the layout shown in the schematic



Finished equalizer appears above with its two rotary switches, one for adjusting the bass turnover and the other for adjusting the treble roll-off of various recording curves to the RIAA standard.

You can see the basically simple wiring of this instrument at the right, where the unit is pictured with its cover removed.



and pictorial diagrams. The two switches, *S1* and *S2*, form the heart of the system. For standardization, two 3-pole, 4-position switches were chosen even though not all the lugs of both switches are actually utilized. Some of the extra lugs are used as tie points.

The front of the chassis requires two symmetrically spaced $\frac{3}{8}$ " holes for mounting the switches. At the rear of the chassis, there should be a $\frac{1}{4}$ " hole for the output cable and a $\frac{1}{32}$ " hole centered between two clearance holes for #6 machine screws, $\frac{1}{16}$ " apart, in which the input phono jack *J1* is mounted. The pointer knobs are supplied with the switches.

In finishing our unit, we used decals, which provide an assortment of words and phrases commonly used in electronics.

Wiring Hints. Most of the switch wiring can be done before mounting the
September, 1957

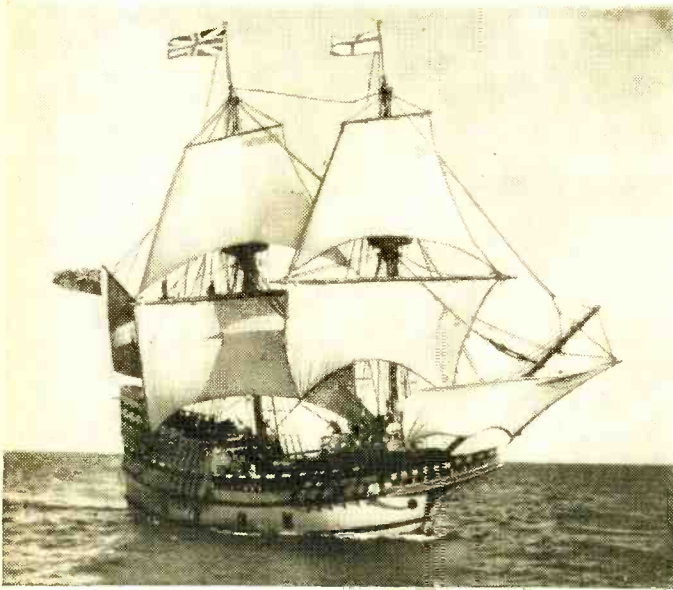
switches to the chassis. It is not necessary to use shielded wire, except where indicated in the diagram. The only physical return to chassis ground is made at the input jack, a practice highly recommended.

Connect the shielded cable now going from your preamplifier to your main amplifier to the input of the equalizer instead. The output cable from the equalizer (which should not be longer than 8 feet) is then connected to the input jack of your main amplifier. With the two equalizer switches set in the flat position, you will get RIAA equalization just as before and this setting is correct for all of the newer recordings.

If your preamp also has provisions for

microphone or tuner inputs, set the equalizer for "flat" when using these signal sources. *It is not necessary to disconnect the equalizer even when listening to high level signals such as tape or tuner.* However, if in doubt, what better advice can we offer than to set the switch positions to yield sound most closely resembling live music as you know it. An ear accustomed to hearing live music is still the ultimate test of "fidelity."

Remember, this equalizer does not take the place of regular tone controls. These should still be used—with discretion, however—as you find them necessary to compensate for acoustic conditions in your listening room, speaker deficiencies, and—most important of all—your own personal taste and tonal preference. After all, your listening pleasure is the real purpose of any high-fidelity installation.



Mayflower II sails gallantly across the Atlantic, her only link with civilization a compact transmitter/receiver (below, left) operated by Jim Horrocks, marine radio operator. In order to keep the barque as authentic as possible, the antenna (see arrow in photo below, right) was designed to blend in with the rigging. Even the insulators were shaped to look like pulley blocks, to add to the realism. The vessel is on display in New York until Nov. 15, at which time it will be moved to Plymouth.

A "Voice" for Mayflower II

WHEN the Mayflower put to sea in 1620, the gallant little barque disappeared from the face of the earth, as far as England was concerned. When her descendant, the Mayflower II, made the 53-day voyage in 1957, maritime rules forced on her one of the few concessions to modernity—a Marconi Transarctic II transmitter/receiver, manned by Jim Horrocks, a Lancashire marine operator. Through POPULAR ELECTRONICS, Jim sends his apologies to all hams who tried to work the Mayflower. He didn't have the fuel capacity to run his rig more than 4 hours a day, during which time he was

kept busy with position reports, weather messages and official contacts. He worked the 6-mc. band, speaking to Portishead Radio in England and then switching to South Chatham Radio on Cape Cod. The rig, which was donated for the history-making voyage, has a 70-watt output and is standard equipment on deep sea trawlers operating in the Arctic, considered the toughest assignment afloat. The top problem was the antenna. It was run from foremast to mainmast, with insulators designed to blend with the antique rigging. "Ground" was a copper plate attached to the hull.

-30-



Frost Sentinel

By HARVEY POLLACK

**Thermistorized alarm system
stands guard and gives warning
when temperature drops**

FREEZING TEMPERATURES have a habit of descending upon us without warning. Many a home owner, farmer, orchard raiser, and greenhouse operator have suffered damage from sudden frost—damage that might have been avoided if that frost could have been forecast. The "Frost Sentinel" described in this article can trigger either a warning light or a high-frequency buzzer when the temperature drops to near-freezing.

This alarm system has several advantages over commercially available devices of the same nature: there is no bimetallic strip to be protected from the weather, there are no moving parts, and the sensing element does not have to be specially oriented. Being immune to the elements, the sensing element—a virtually indestructible thermistor—may be left out in the rain and snow, or be buried underground. It can be placed up to 500 feet away without affecting the alarm circuit. Through economical buying, initial cost of the sentinel can be limited to about \$12.00.

The Control Box. Any type of cabinet may be used. Should you want to build the unit in a neat metal case, you can't do much better than the little hammertone aluminum box illustrated here.

Chassis-type construction is recommended. The Bud chassis is about $\frac{1}{4}$ " too wide and must be filed down to fit the cabinet. A flange should be added as shown in the photo on page 56.

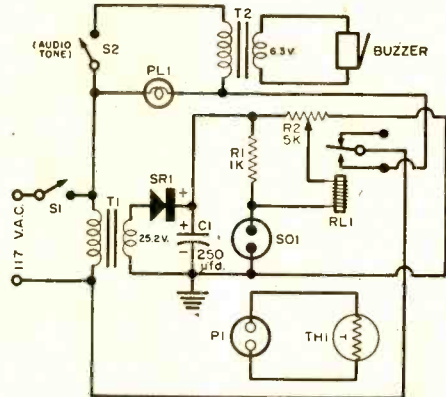
Mount the Sigma relay on a small shelf formed from another piece of scrap aluminum. The circuit is isolated from the a.c. power lines for safety, but the relay contacts do carry line voltage. Since this particular relay grounds out when fastened directly to the metal support, it must be insulated. Drill the mounting holes in the shelf large enough to take small rubber



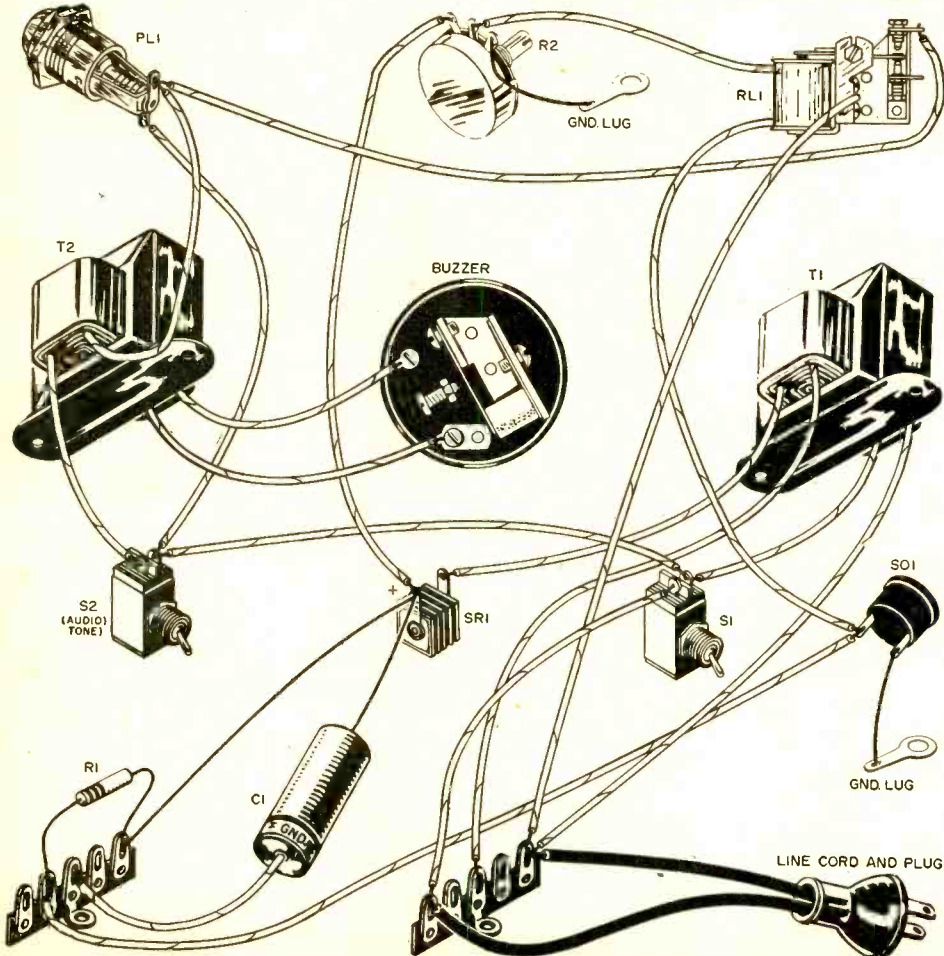
Photo by Janet Konkle
Courtesy of Popular Photography

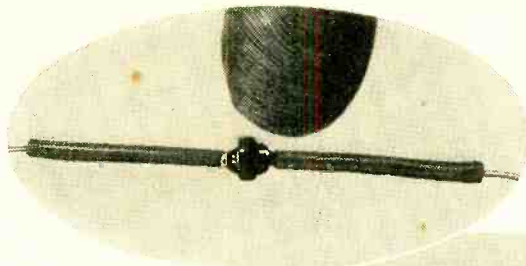
Follow the schematic and pictorial diagrams shown on this page when you construct the Frost Sentinel. Parts list is given below.

- CI—250- μ fd., 50 w.v. tubular electrolytic capacitor
- PI—1-cable terminal two-prong male connector to match SO1
- PL1—Alarm lamp assembly (117-volt candleabra base "bull's eye" with standard 117-volt pilot lamp)
- R1—1000-ohm, 3-watt carbon composition resistor
- R2—5000-ohm, 4-watt wire-wound potentiometer (IRC WPK 5000)
- RL1—8000-ohm coil relay (Sigma Type 4F)
- S1, S2—S.p.s.t. switch
- SO1—Small chassis-type two-prong female connector
- SR1—117-volt, 65-ma. selenium rectifier
- T1—Power transformer; primary 117 volts, secondary 25.2 volts @ 1 amp. (Stancor P-6469)
- T2—Filament transformer; primary 117 volts, secondary 6.3 volts @ 0.6 amp.
- TH1—Type 31D7 thermistor (Victory Engineering Corp.—available from Lafayette Radio Corp., 100 Sixth Ave., New York, N. Y., for \$3.00)
- BUZZER—High-frequency buzzer (E. F. Johnson Co., Catalog #114-400)



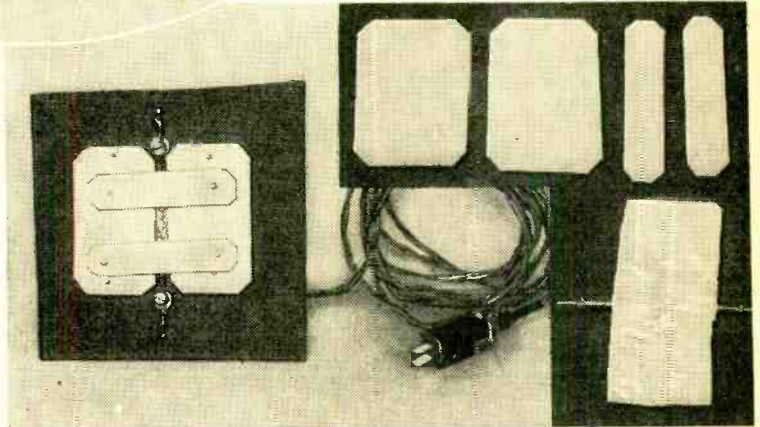
- 1—4" x 5" x 6" grey hammertone aluminum cabinet (ICA #29812)
- 1—3½"-diameter x 4½" wide x 2" high natural finish aluminum chassis (Bud CB-1625)
- Misc. terminal strips, 18-gauge and 24-gauge scrap aluminum in small pieces, length of twisted waterproof line for remote thermistor sensing element, small square of plywood (about 5" x 5" x ¼") for thermistor mounting.





Start assembling the thermistor mount by slipping spaghetti tubing over the leads right up to the ceramic body of the temperature-sensing element (left), leaving $\frac{1}{2}$ " bare leads exposed. Wrap thermistor in aluminum foil (below), leaving heat-dissipating wings exposed. Cut out four pieces of scrap aluminum as shown.

Complete thermistor assembly and connecting cable (right). The larger pieces of scrap aluminum are nailed over the foil wings; the smaller pieces are nailed over the spaghetti-covered thermistor leads.



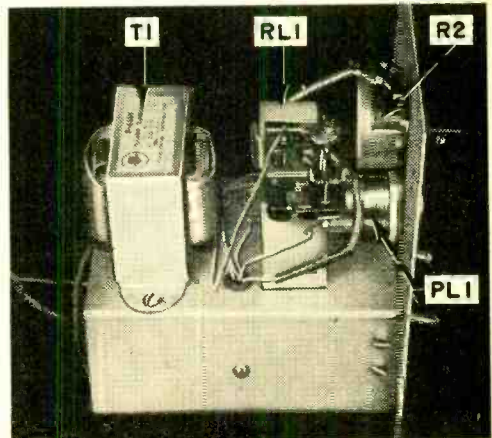
grommets. The relay mounting screws then pass through the center holes of the grommets while the relay itself rests on the rubber insulation. The grommets also prevent the vibration of the buzzer from fluttering the armature.

There is nothing tricky about the wiring. But here are two things worthy of note: although the chassis and case are used as common grounds for the B- end of the low-voltage power supply, neither wire of the incoming a.c. is grounded, and all small parts are mounted on terminal strips for mechanical support.

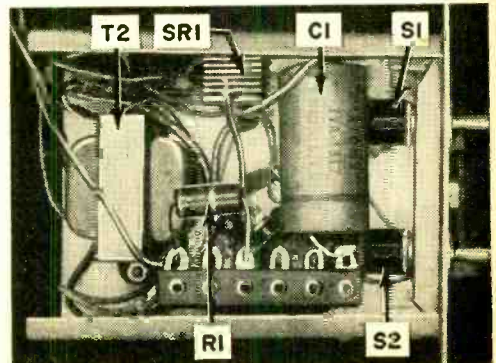
Thermistor Mount. The small surface area of the thermistor must be enlarged. This is managed with the help of a strip of aluminum foil and a few small pieces of thin roof-gutter aluminum.

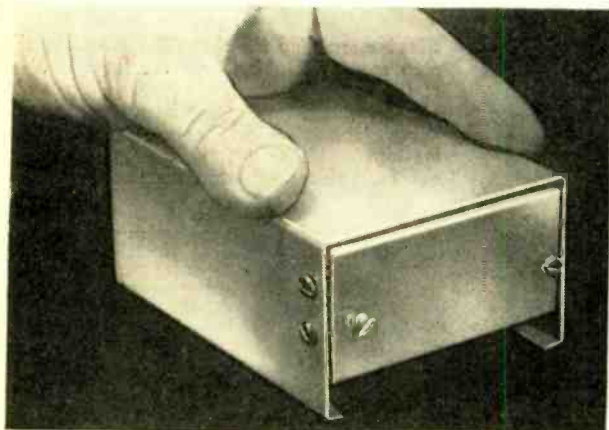
First thread a short piece of insulated spaghetti tubing over each thermistor lead right up tight against the ceramic body, leaving about $\frac{1}{2}$ " of lead wire exposed. Wrap the body of the thermistor in the center of a section of aluminum foil about 4" long and $1\frac{1}{2}$ " wide, leaving foil fins about $1\frac{1}{2}$ " long projecting from each side. Clamp the fins down to a small plywood base with two aluminum pieces secured by short wire brads. Finally, brad down two narrow strips of aluminum crosswise over the insulated thermistor leads to hold the thermistor firmly in place.

Check across the leads with your VOM when the mounting is finished to be sure that you have not short-circuited the thermistor. The resistance should be about



Top and bottom views of the chassis, showing how the parts are mounted. Note the aluminum shelf with rubber grommets used to support the relay.





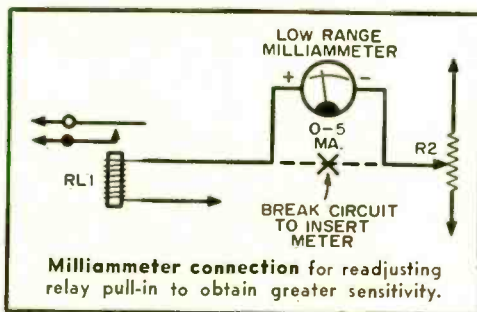
Bend a strip of aluminum to fit the open end of the chassis (left) so that the chassis may be fastened to the cabinet's front panel. Below is a front view of the finished Frost Sentinel.



1000 ohms. Two solder lugs to take the transmission line on the thermistor leads complete the assembly.

Relay Adjustment. The Sigma 4F relay is factory-adjusted for a certain armature pull-in current. For greater frost detection range, you will want to reset the relay for more sensitivity. To do this, disconnect one end of the relay coil and cut into the circuit with a low-range milliammeter (such as a 0-5 ma. type) as shown in diagram at right. Set $R2$ at about half-scale. With the power turned on, the milliammeter should read less than 1 ma. If it tends to read backward, first turn the knob fully clockwise to determine whether this is the cause of the reverse current. If the condition is not corrected, remove the power and reverse the connections to the milliammeter. Repeat the trial with $R2$ set at half-scale again.

Slowly adjust the potentiometer until the current is exactly 1.0 ma., and then adjust the spiral spring tension screw at the top of the relay until the armature just pulls down. Now rotate $R2$ counterclockwise; the current should decrease and the relay



should drop out when the current reaches about 0.5 ma. Bring the knob around clockwise again—but very, very slowly—and make sure that the tension of the spring is right for a 1.0-ma. pull-in.

Each time the relay pulls in, $PL1$ should light brightly. With switch $S2$ in the "on" position, the high-frequency buzzer will sound at the same time.

Calibration. The precision of this instrument depends on the care taken in calibration. For most applications, only three calibration points are required.

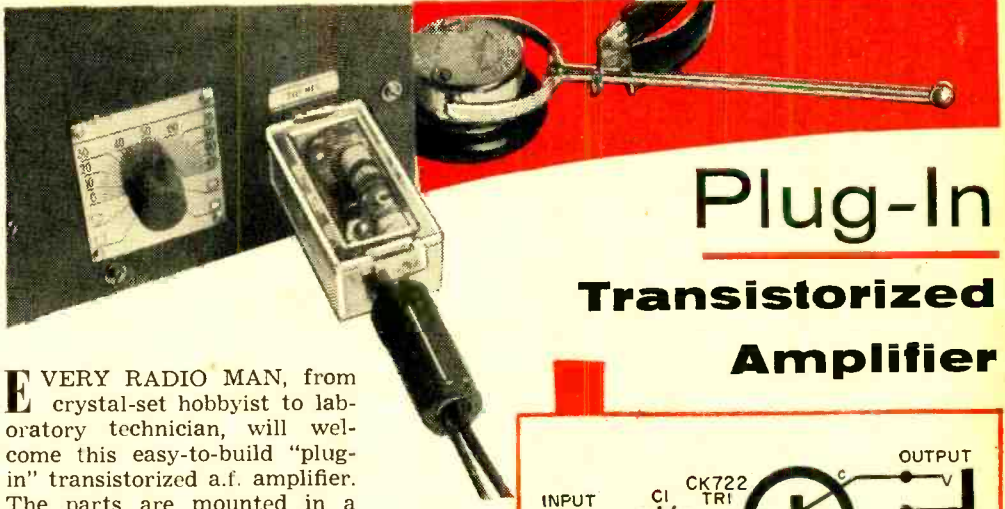
Your refrigerator is your calibration chamber. The temperature in the freezing compartment is well below 32° F, while the temperature in the highest food section is above freezing. Ice cubes allowed to stand in still air outside the refrigerator will

(Continued on page 126)

HOW IT WORKS

A thermistor is a heated resistor having a high negative temperature coefficient; as its temperature rises, its resistance decreases by relatively large amounts. The thermistor in the Frost Sentinel forms one arm of a Wheatstone bridge which is maintained in a slightly unbalanced condition by the setting of the calibration control, $R2$. As the thermistor cools due to the radiation of its heat into air, its resistance increases, throwing the bridge still further out of balance. This results in increased relay current, sufficient to pull the armature down and sound the alarm.

Once the relay pulls in, the circuit "latches in" so that the alarm signal continues to sound. Latching-in is automatically accomplished because relay $RL1$ will not drop out until the current decreases to about half its pull-in value. Relay release is thus possible only by restoring the bridge to balance with potentiometer $R2$ (counterclockwise rotation) or by turning off the power.



Plug-In Transistorized Amplifier

EVERY RADIO MAN, from crystal-set hobbyist to laboratory technician, will welcome this easy-to-build "plug-in" transistorized a.f. amplifier. The parts are mounted in a plastic hinged-cover box. An inexpensive, general-purpose *p-n-p* junction transistor is powered by a single 1½-volt penlite battery. And total construction cost comes to about \$3.00.

The 1¼" x 2½" x ⅞" plastic box is a General Cement Mfg. Co. radio hardware container which you can purchase empty. At the same time, obtain an ICA No. 30 phone plug and an ICA No. 325 phone jack, or close equivalent.

Bore or shape a ⅜" hole through one end of the plastic box. Twist the threaded part of the phone plug (with the barrel removed) into the hole. Then cut another ⅜"-diameter hole in the opposite end of the box for the phone jack, leaving ample clearance for the cover hinge.

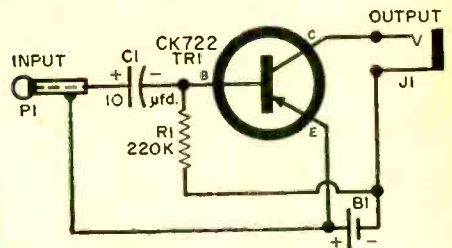
Cover the transistor leads with small spaghetti tubing, and solder the "collector" lead to the outside of the longest prong on the phone jack. Now mount the jack into the hole prepared using a washer and a hexagon nut on the outside of the box.

Place the battery holder in the box. Bend the long outside lug of the phone plug so that it contacts the battery holder lug, then solder the transistor "emitter" lead to both lugs.

The "minus" lead of *C1* is cut off to a length of ½". Ditto for one lead of *R1*. Hook the ends of the capacitor and resistor leads together and solder the "base" lead of the transistor to the junction. Solder the remaining lead of *R1* to the outside of the short prong on the jack, and to the "minus" lug of the battery holder.

When using a Raytheon CK722 transistor, the amplifier gain will be about 20 db. This enables the plug-in amplifier to be used for phono-record earphone listening. Simply plug the amplifier directly into the output of a crystal or a ceramic phono pickup.

—Art Trauffer



B1—1½-volt penlite cell (Eveready No. 912, Ray-O-Vac No. 400)

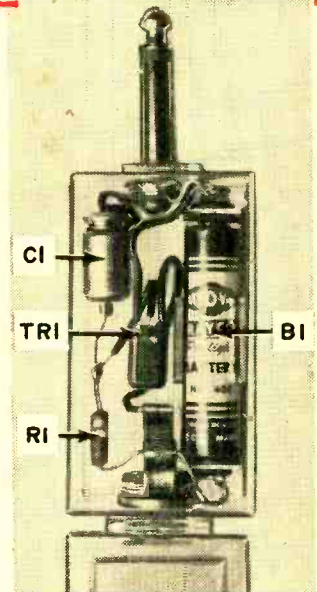
C1—10-μfd., 6-volt midget electrolytic capacitor

J1—Single open-circuit phone jack (ICA No. 325)

PI—Phone plug (ICA No. 30, midget shielded)

R1—220,000-ohm, ½- or ¼-watt fixed resistor

TR1—General-purpose *p-n-p* junction transistor (Raytheon CK722, General Electric 2N107, or equivalent)



Major components are identified in this interior view of the amplifier with hinged-cover open. Wire the parts according to schematic diagram above.



Short-Wave Report

By HANK BENNETT

ONE OF THE MORE ACTIVE Listening Posts around the New York area is that of Charles Maxant, 642 Stowe Ave., Baldwin, Long Island, N. Y. "Chuck" is 21 and a student at the C. W. Post College of Long Island University, where he is currently majoring in business management.

Although he has been interested in DX'ing for about eight years now, Chuck didn't really get going on his short-wave hobby until 1952. Since that time he has amassed a log of 130 countries heard, 80 verified.

The Maxant monitoring station features a Hallicrafters SX-96 receiver and three antennas: a 40' doublet beamed east-west, and two single long-wires, one pointing east-west, the other north-south. A switching system near his receiver enables him to choose the best antenna for a particular band.

Of his veries, Chuck prizes most one from *Radio Peking*, China. His "best DX heard" is the 5000-watt outlet in Taipei, Formosa, in the 25-meter band, which also happens to be his favorite s.w. band. He especially likes the interesting programs presented by

Radio Nacional, Portugal, and the Swiss SW Service.

Chuck's DX'ing hobby extends into various phases of radio, including hi-fi. He is a member of the International Shortwave Club and plans to join the Newark News



Chuck Maxant, POP'tronics reporter, uses a Hallicrafters SX-96. His antenna switching system is on the table beneath the receiver.

Radio Club in the near future. And, incidentally, he's engaged to be married to a Miss Florence Clark, of Ayer, Mass.

(Continued on page 127)

WANT TO JOIN A RADIO CLUB?

There are quite a few radio clubs and organizations to which you might like to belong. Here is a brief resume of the larger ones.

Newark News Radio Club (NNRC)—The \$4.00 yearly dues covers membership plus a monthly bulletin. This bulletin includes articles on the broadcast, ham, FM, TV, short-wave broadcast and short-wave commercial bands. For complete information, write to: Walter Townley, Treasurer, NNRC, 215 Market St., Newark 1, N. J.

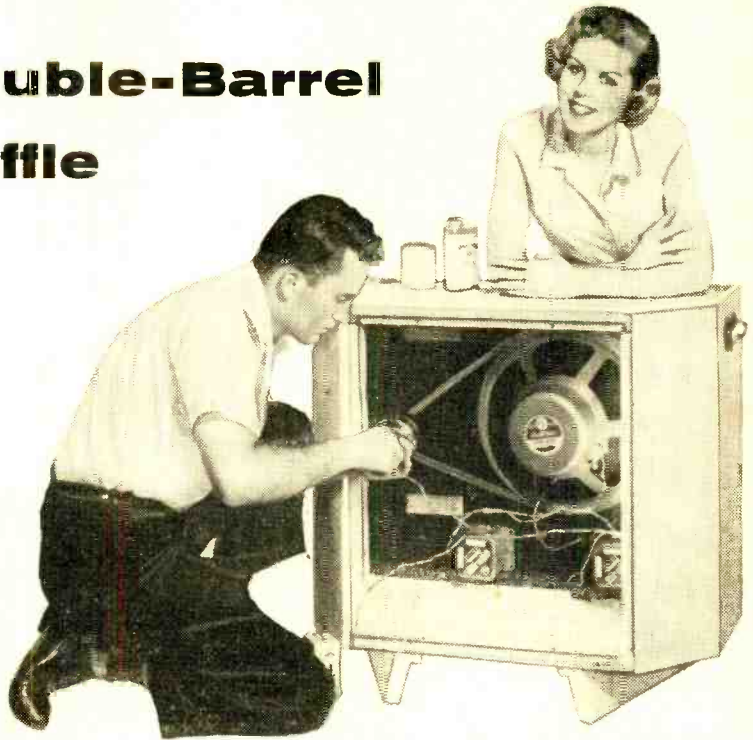
Universal Radio DX Club (URDXC)—The dues of \$3.00 covers membership and a total of 19 bulletins a year on the short-wave broadcast and ham bands. For complete information,

write to: URDXC, 21446 Birch St., Hayward, Calif.

International Shortwave Club (ISWC)—This club issues a monthly bulletin covering the short-wave broadcast and ham bands. For complete details on membership requirements and dues, write to: ISWC, 100, Adams Gardens Estates, London, SE 16, England.

A new club for SWL's is being formed for those who tune the ham bands and who have: (1) 100 countries logged; or (2) 50 countries verified; or (3) all states verified. For complete information, send a stamped, self-addressed envelope to: Allen Kelly, Route 3, Box 354-A, DeRidder, La.

Double-Barrel Baffle



*Speaker system "grows up" gradually,
is adaptable in cost and performance*

IT'S HUMAN NATURE never to be satisfied with what you've got and always to want something better or different. Audio fans are particularly susceptible to this trait, but constriction of the pocket-book often thwarts their headlong rush for the highest fi.

Electro-Voice has devised a "grow-up" speaker system that lets you choose seven different compromises between ambition and economy as you gradually work your way towards higher fi. Each rung along this ladder of hi-fi investment is in itself a balanced system. And every step of improvement gives good value for the money.

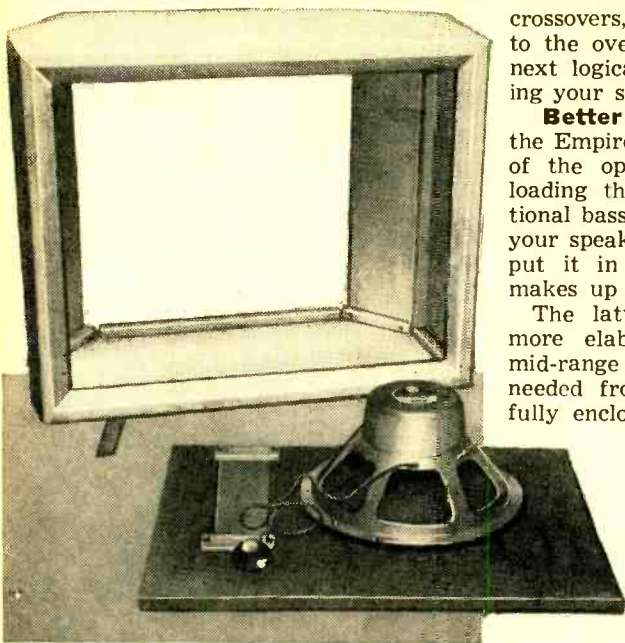
Your starting point is the "Empire" enclosure, available either as a kit or fully assembled.

Two-Way Design. This is one of the most versatile enclosures ever developed. It can be stood flat against a wall or, for added bass response, you can push it into a corner. It takes either a single 15" speaker, or separate elements for two-way or three-way systems.

Best of all, a simple insert allows you a choice of two enclosure principles: (1)

the Electro-Voice "BLS" (Bi-linear Lenticular Slot) principle, which employs two vertical parallel slots to support the loudspeaker in the bass range by adequate air loading; or (2) phase loading, in which the woofer is fully enclosed, facing into a horn. If the BLS principle is employed, the woofer front faces into the room, which permits the use of coaxial speakers. Phase loading requires entirely separate woofer and tweeter elements, but provides smoother bass response with resonant peaks at a minimum. It also helps the woofer to pelt out the bass transients more cleanly and without cone breakup.

Add-a-Part Method. Getting down to particulars, let's say you are short on cash and want to start with the simplest system, provided that it gives you balanced sound and is pleasant to listen to. You might just put in a 15" coax, such as the E-V SP15B. Since this sells for less than \$40.00, it won't take you too long to recover from the financial shock, and you can add a 3500-cps crossover network and a tweeter to extend your treble range for more brilliance. Then you wind up with



crossovers, which give a more solid feeling to the over-all sound. This would be the next logical step if you feel like expanding your speaker system still further.

Better the Bass. Another way to use the Empire enclosure is to take advantage of the optional arrangement for phase-loading the woofer. This provides exceptional bass quality. If you want to set up your speaker alongside a wall rather than put it in a corner, such phase loading makes up for the bass loss.

The latter plan requires a somewhat more elaborate start. Separate woofer, mid-range and tweeter elements are needed from the beginning, because the fully enclosed woofer only reaches up to

Start off your "Empire" kit with a single 15" coax speaker. Holes for later expansion are precut in panel and temporarily covered up.

the equivalent of a 15" three-way speaker, such as the E-V Model 15TRXB.

E-V has recently developed a method of augmenting the mid-range of its 12" or 15" three-way speakers. It is done by adding a mid-range driver and horn with suitable

about 300 cps. But the added smoothness of the bass might make this approach worth the higher cost.

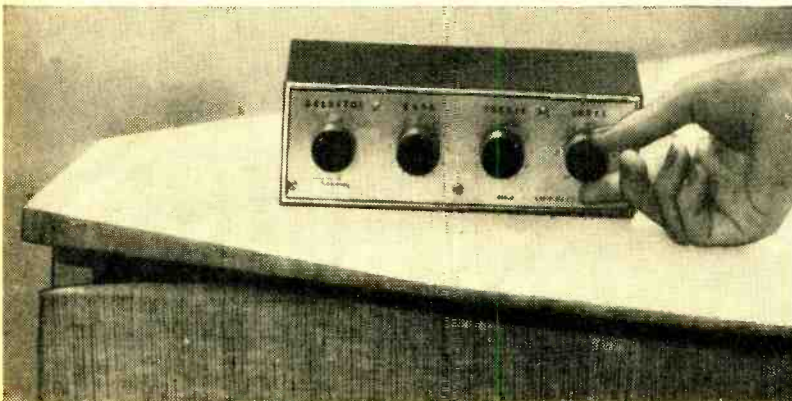
In any case, you enjoy good listening at every stage of your gradual progress, and each change in itself is a source of new pleasure and excitement. —30—

Transistor Preamp Takes the Bumps

Phono preamps have such high gain that they are usually sensitive to vibrations from the outside. This is called "microphonics" because the preamp then acts like a microphone, uttering a burp for every bump. One of the advantages of the new transistor preamps is demonstrated in the photo below. Here the Regency HFT-1 (now available either as kit or ready-wired for \$34.95 or \$47.50, respectively) sits right on top of a Lansing "Harlan" loudspeaker, riding on the vibrations

in velvet silence. All you hear is the music.

Besides being impervious to vibrations, transistor preamps can be made very small and compact. Battery requirements are minor and probably will only need changing every 500 hours. The Regency HFT-1 has full control over bass and treble response. Provisions are built into the circuit to match a G.E. cartridge, but others may be used by altering tone control settings.



Powered by flashlight batteries and fully self-contained, this Regency transistor preamp makes the critical high-gain input for magnetic pickups impervious to hum and microphonics.

K I T

BUILDER'S KORNER

ALTHOUGH the sweep generator may not be used as often in the average shop as, say, the VTVM, there is no other instrument that will serve as an adequate substitute for it when aligning and servicing broadband receivers. Actually, the sweep generator is simply a special type

and it is sold by leading local and mail-order electronics parts distributors.

Putting It Together. The Model 368 is actually three instruments in one—an r.f. sweep generator, a variable-frequency marker generator, and a crystal-controlled fixed-frequency marker generator. The



EICO 368 Kit
TV-FM Sweep Generator
and Marker

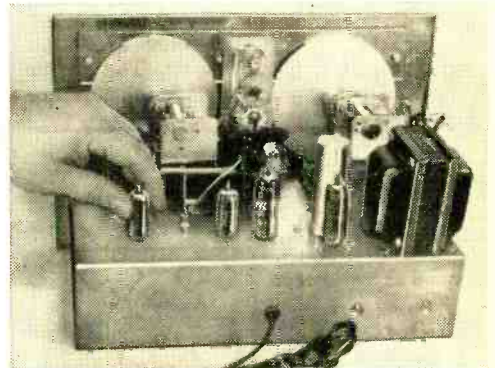
of r.f. signal generator. Instead of supplying a single fixed frequency for a given setting of its tuning dial, it automatically varies its output frequency back and forth over a range of frequencies—it *sweeps* across a band.

When used in conjunction with an oscilloscope, the sweep generator makes possible an instantaneous display of the actual frequency response curve of a tuned amplifier, r.f. or i.f. stage, or a single resonant circuit. Thus, changes in the circuit's response characteristics can be observed as tuning, coupling, or loading is adjusted. Oscillation, regeneration, unusual peaks or dips in response, or other defects can be spotted immediately.

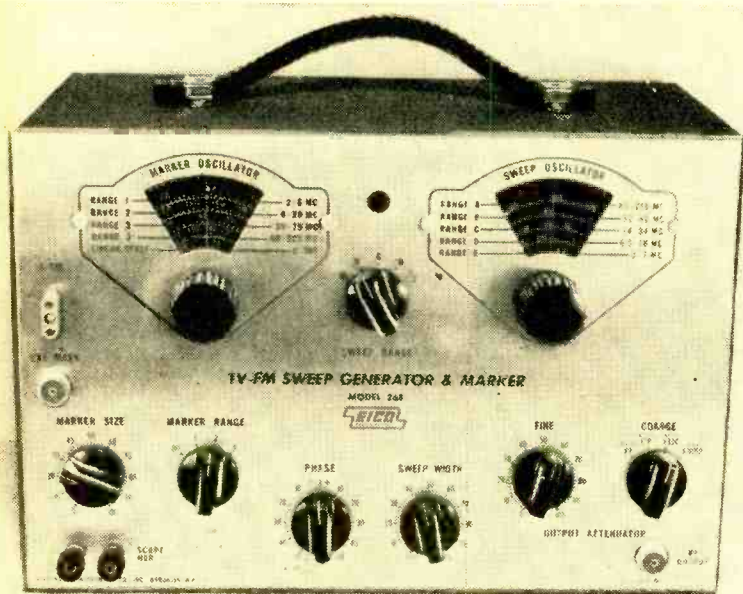
Of the many excellent sweep generators available, the EICO Model 368 TV-FM Sweep Generator and Marker is typical of those instruments designed especially for servicing TV and FM receivers and tuners. Manufactured by the Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City 1, N. Y., it is available both as a kit and as a factory-wired unit,

two marker generators are used to insert single-frequency "pips" on a response curve for identifying exact bandwidth and i.f. values.

Three accessory cables are provided—an r.f. output cable, a 'scope horizontal input cable, and a compensated 'scope ver-



Here is the completed instrument. Tubes are inserted after both the sweep oscillator subchassis and the marker oscillator subchassis are mounted.



Front view of the EICO Model 368. When it is used in conjunction with an oscilloscope, it enables an instantaneous display of the actual frequency response curve of a tuned amplifier, r.f. or i.f. stage, or a single resonant circuit. Although the project is intended for the fairly advanced constructor, the instructions in the manual are clear and easy to follow.

tical input cable. Physically, the unit measures $8\frac{3}{4}$ " x $13\frac{1}{2}$ " x $7\frac{1}{4}$ " and weighs approximately 11 pounds. It requires 50 watts at 105-125 volts, a.c., for operation.

Although the instructions furnished by the manufacturer are quite clear and easy to follow, the assembly of any r.f. sweep generator is not a project suitable for the rank beginner. If you've assembled other kits, have built a project or two from "scratch," and are reasonably handy with standard tools, you'll probably find this project fun to assemble. It is challenging enough to be interesting, but not so difficult as to become tedious. If you work at reasonable speed, you should be able to assemble the Model 368 in about a week in your spare time—or on a weekend if you like your work in larger doses.

Actual assembly and wiring is carried out in five major phases. The marker oscillator and sweep oscillator are each wired on individual subchassis. The power supply and other parts of the circuit are

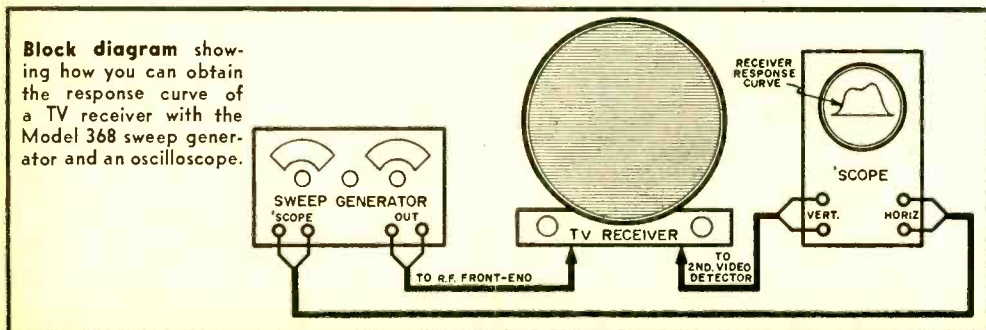
wired on the main chassis. As the final instrument assembly step, the subchassis are mounted on the main chassis and the connections made.

Follow the instructions scrupulously, especially when wiring the r.f. circuits. Layout and lead dress are critical in such circuits at the frequencies involved. Take special pains when handling and wiring the *increductor* sweep coil assembly.

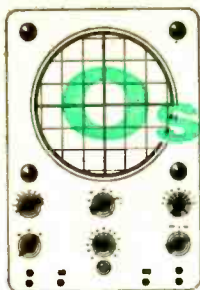
Special Features. The frequency coverage is from 3 to 216 mc. in five ranges. All sweep frequencies are fundamental. The nominal maximum output voltage is 0.1 volt on the 80-216 mc. range, higher on the lower frequency ranges. Sweep width is continuously variable from 0-3 mc. (lowest maximum deviation) to 0-30 mc. (highest maximum deviation).

The variable frequency marker generator covers from 2 to 225 mc. in four scales. All are accurately calibrated on the easy-to-read tuning dial. A 4.5-mc.

(Continued on page 141)



Block diagram showing how you can obtain the response curve of a TV receiver with the Model 368 sweep generator and an oscilloscope.



Oscilloscope Traces

Hum Hunting

Your 'scope tracks down that nasty old buzz—in the second part of this series **By HOWARD BURGESS**

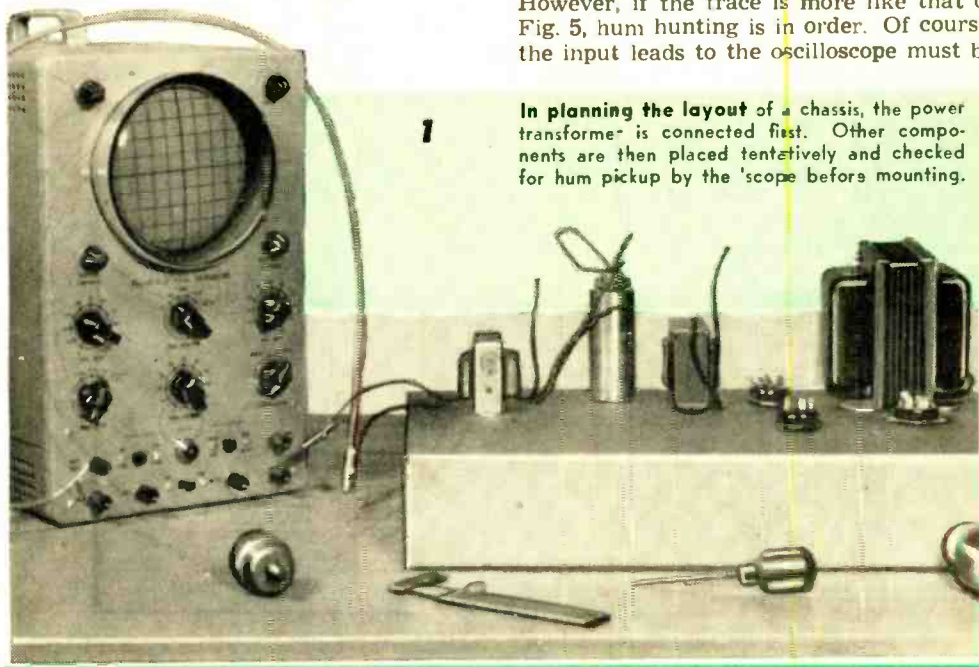
HUM in an amplifier is like an ambitious mosquito on a dark night. It keeps right on buzzing; you can't put your finger on it, and a reckless attempt to kill it can attract other—and even worse—members of the same clan. An oscilloscope cannot do much about mosquitoes but it will help in locating the source of a hum. When its cause has been located, "killing" it is usually simple.

In nearly all cases hum is at the power line frequency of 60 cps or some multiple of this value. Too much stray coupling to the a.c. supply is to blame. This can be caused by direct coupling through the power supply, inductive coupling into audio transformers or chokes, or capacitive cou-

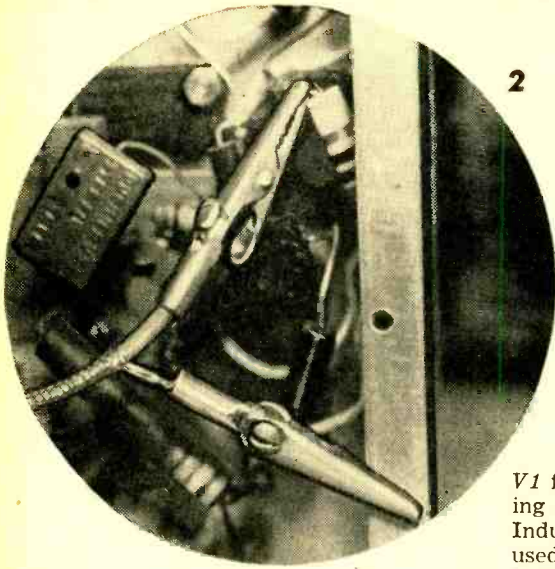
pling between improperly placed wires or component parts.

Test Hookup. The amplifier circuit of Fig. 8 will seldom be used as shown here. It has been drawn in this form to illustrate a number of possible hum sources. If an audio signal of several hundred cycles is applied to terminals *A* and *B* of transformer *T1*, and the vertical input to the 'scope is also connected to the same terminals, the 'scope gain and sweep can be adjusted to give a pattern such as is shown in Fig. 4.

The 'scope leads are now moved to the output of the amplifier. If the same pattern is obtained simply by reducing the vertical gain of the 'scope, little hum is present. However, if the trace is more like that of Fig. 5, hum hunting is in order. Of course, the input leads to the oscilloscope must be



In planning the layout of a chassis, the power transformer is connected first. Other components are then placed tentatively and checked for hum pickup by the 'scope before mounting.



When checking hum, the test leads should be shielded to prevent stray hum pickup from points other than the signal take-off. Note that the clip connected to the braided shield of the test lead is attached to the chassis for grounding as close as possible to the take-off point of the test signal.

well shielded to avoid erratic traces due to stray hum pickup.

Another very sensitive method of hum detection is to remove the signal from input terminals *A* and *B* and connect the resistor *R1* across the terminals as shown. The value of this resistor should be somewhat near the input impedance of transformer *T1*. With the 'scope across terminals *C* and *D*, advance the gain controls on both the amplifier being tested and/or the 'scope itself. Assuming that there is no parasitic oscillation in the amplifier, any trace will be caused by hum.

Check Points. If hum is present, the power supply should always be suspected. To check this possibility, connect the test leads to test point *TP1* and the chassis, and open up the vertical gain. The trace should be a straight line and *not* like that of Fig. 6. If hum is found here, the filtering of the power supply must be corrected before proceeding further.

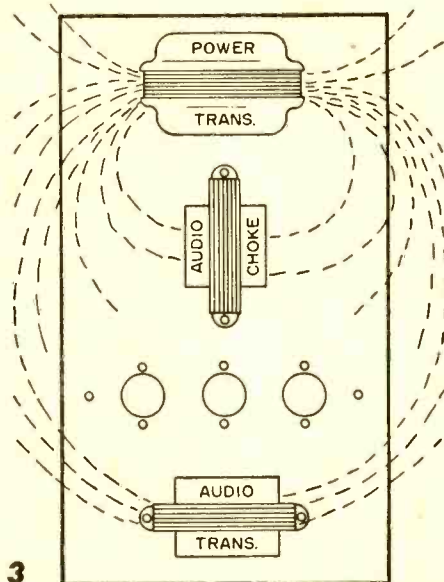
If no hum is found in the power supply, move the 'scope to *TP3*. Should there be no hum here, we have localized the source in tube *V2*. However, if hum is found at *TP3*, there are several possible trouble spots. If the trace disappears when the amplifier gain control (*R2*) is turned to minimum, we have front-end trouble. This can result from unshielded leads, a poor ground, or *T1* being too close to a power or filament transformer. A check at *TP6* will show up any induced pickup. In actual practice, *T1* may be a microphone transformer, a line matching transformer, or even a magnetic phono pickup.

Should hum persist with *R2* at minimum, connect test leads to *TP5*, and remove tube

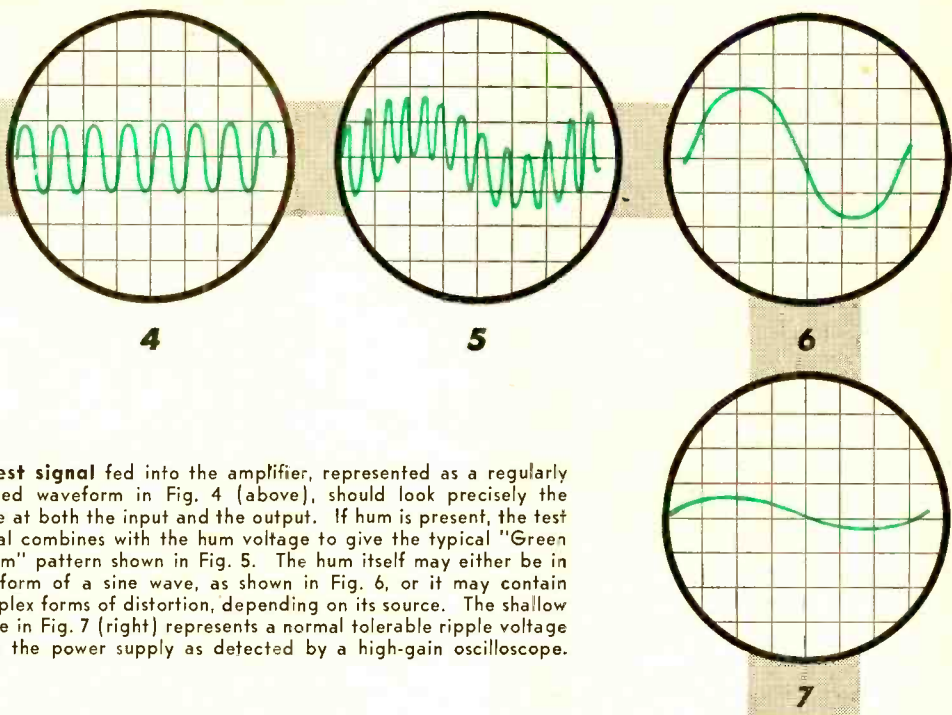
V1 from the socket. Any hum now remaining is probably induced in either *L1* or *L2*. Inductors *L1* and *L2* are typical of the kind used for impedance coupling and bass or treble boost. Many of these inductors are capable of picking up hum voltage even when they are several feet from a power transformer—unless positioned correctly. This type of pickup can usually be eliminated by rotation of the inductor at fault.

If the hum disappeared when *V1* was removed, it can indicate either a poor tube at *V1* or cathode-to-filament leakage. This latter type of hum often cannot be corrected by a change of tubes.

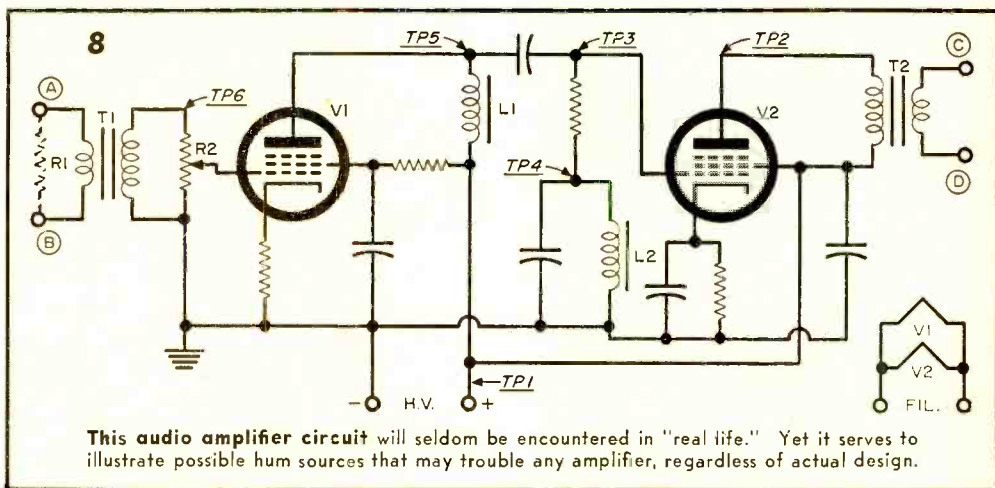
Planned Layout. For those who build their own equipment, half of the hum battle



Magnetic lines of force from a power transformer can induce hum in other components.



A test signal fed into the amplifier, represented as a regularly shaped waveform in Fig. 4 (above), should look precisely the same at both the input and the output. If hum is present, the test signal combines with the hum voltage to give the typical "Green Worm" pattern shown in Fig. 5. The hum itself may either be in the form of a sine wave, as shown in Fig. 6, or it may contain complex forms of distortion, depending on its source. The shallow curve in Fig. 7 (right) represents a normal tolerable ripple voltage from the power supply as detected by a high-gain oscilloscope.



can be won even before the unit is turned on. When the chassis layout has been decided, mount the power transformer first. Tape up the loose secondary leads to prevent shorting and apply power to the primary. Connect the 'scope across a winding of each audio transformer and choke one at a time, and check for induced hum voltage in the planned position. In making this test, the vertical gain of the 'scope should be kept quite high. Turning the audio transformer or choke by just a few degrees often will mean success.

When planning a chassis layout, the audio

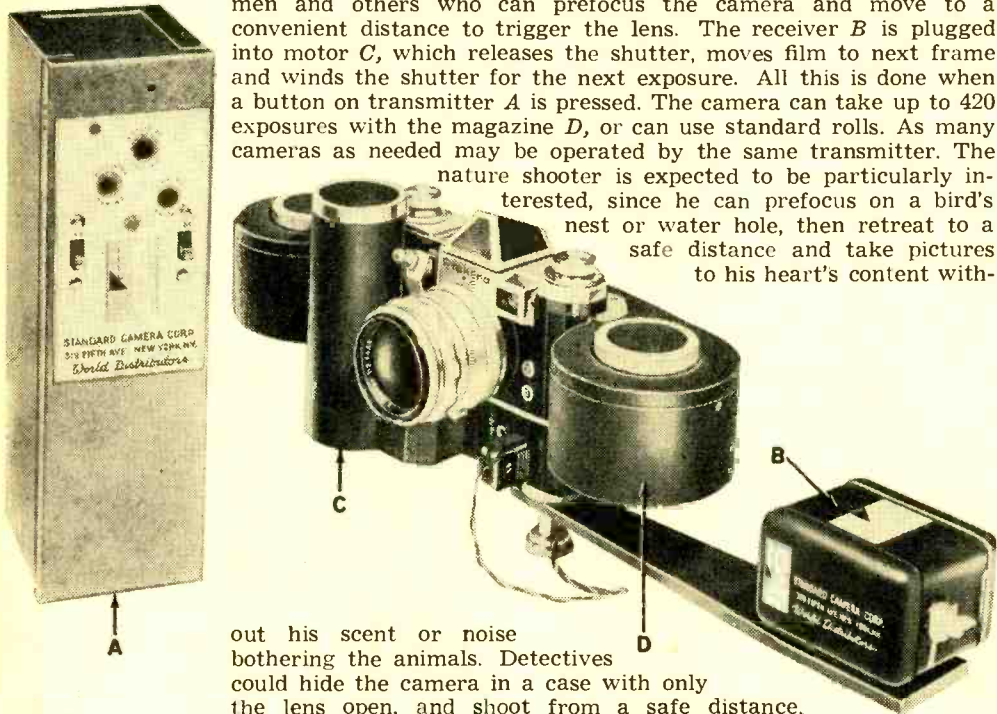
components with inductance should be located in such a manner that lines of force from the power transformer or a filter choke do not pass lengthwise through the windings. In Fig. 3, the audio transformer will pick up more hum than the choke, even though it is farther away from the power transformer, because the lines of force pass through the windings at the correct angle.

There are many methods of hum hunting with an oscilloscope. These few suggestions are intended to be just a start. Any procedure which forms a logical process of elimination should be successful.

Electronics Adds a Long Arm to Camera

A field day for the photographer looms into focus with the new radio control unit which allows automatic operation of a camera up to a mile or more. Developed by Standard Camera Corp. for the Praktina FX 35-mm. camera, the device should prove invaluable for nature photographers, radiation workers, detectives, sports lensmen and others who can prefocus the camera and move to a convenient distance to trigger the lens. The receiver *B* is plugged into motor *C*, which releases the shutter, moves film to next frame and winds the shutter for the next exposure. All this is done when a button on transmitter *A* is pressed. The camera can take up to 420 exposures with the magazine *D*, or can use standard rolls. As many cameras as needed may be operated by the same transmitter. The

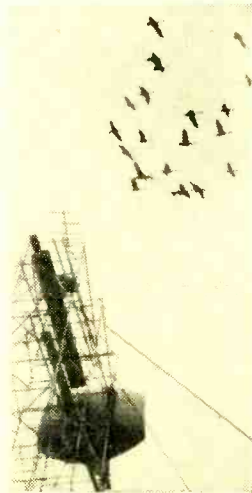
nature shooter is expected to be particularly interested, since he can prefocus on a bird's nest or water hole, then retreat to a safe distance and take pictures to his heart's content with-



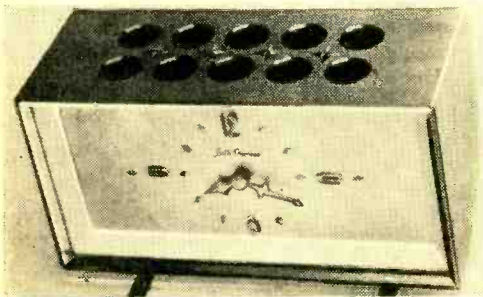
out his scent or noise bothering the animals. Detectives could hide the camera in a case with only the lens open, and shoot from a safe distance. Stores could use it to take photos of shoplifters, military shots could be taken from a safe distance and sports photos from many points at once. Cost of the radio control unit is about \$100. Cost of the camera plus the control unit is about \$500, which is said to be far less than any similar system now on the American market. The equipment is West German.

Sanctuary

The huge Canadian bird sanctuary of Jack Miner, the famous naturalist, is being used by the Radio Research Board to study the effect of bird flocks on radar reception. They are trying to determine whether a large flock of geese might look like a flight of bombers to the radar operator. The sanctuary, fitted with radar, is in Kingsville, Ontario.



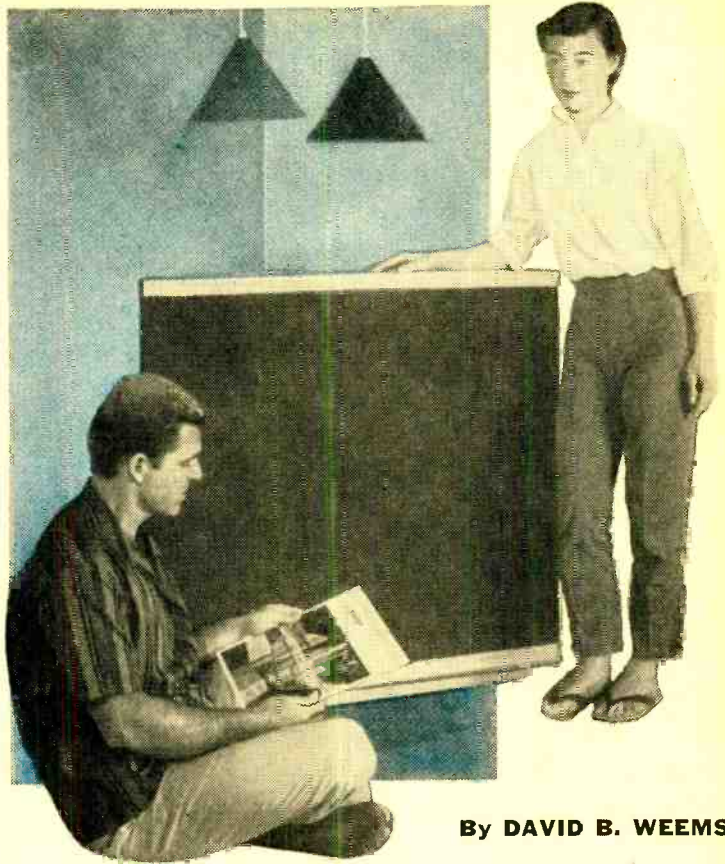
POPULAR ELECTRONICS



Solar Clock

General Time's "solar clock" runs on light—a short exposure lasts for days. It contains a series of silicon cells which charge a special battery to operate the electric clock mechanism. There is enough storage capacity to keep it going for a year without additional light.

B U I L D I N G



By DAVID B. WEEMS

the "Hi-Five"

***Broaden the sound source and widen your range
with this versatile three-way speaker system***

HERE'S AN ENCLOSURE and speaker system that will solve a multitude of problems for the hi-fi enthusiast who wants the utmost in flexibility. Once built, it won't go obsolete at the next change in your speaker line-up, nor do you have to mortgage your home to get started on it.

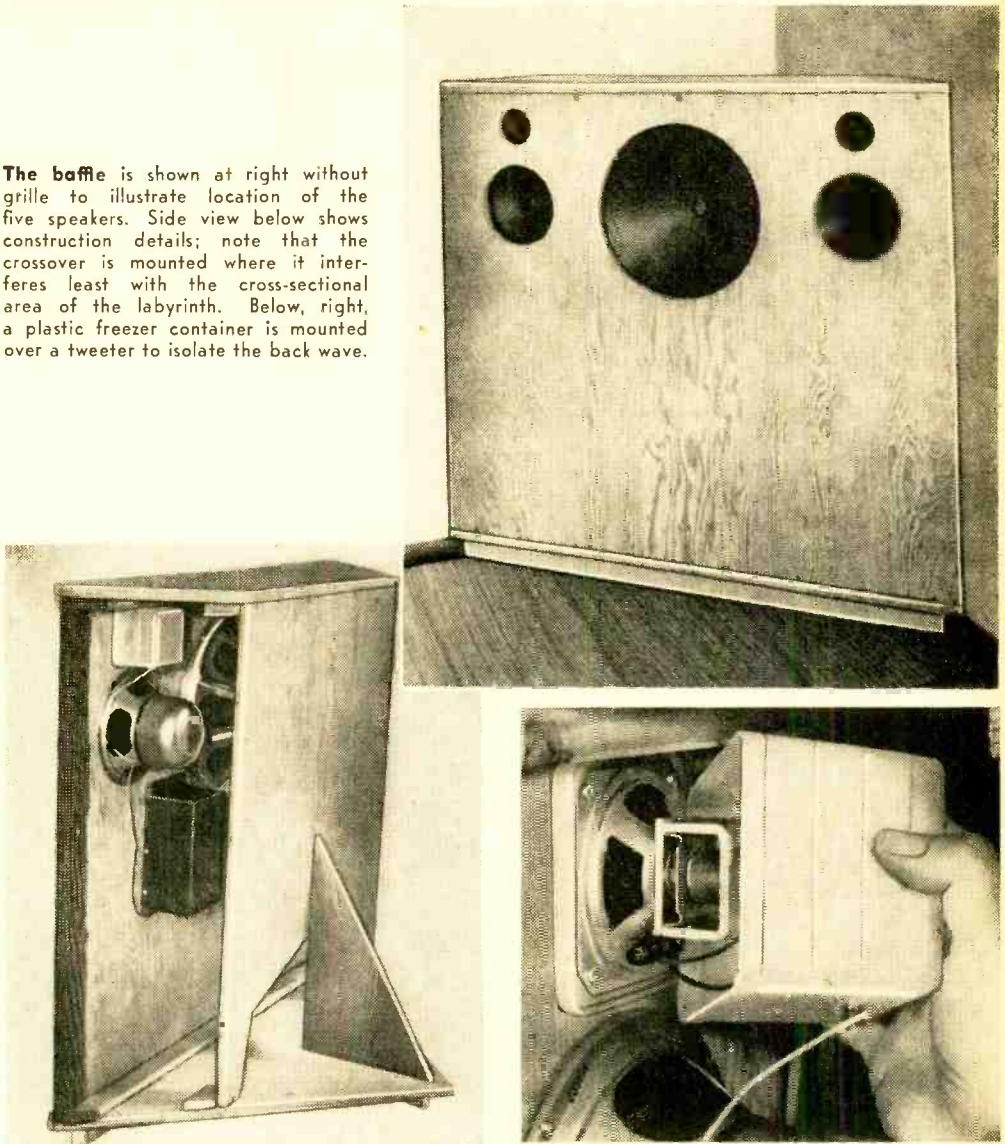
You can begin with a single speaker, if you wish, and add the crossover network and the other speakers later. When you get all five speakers working, the spread of sound, as compared with a single coax or ordinary woofer-tweeter combination, will amaze you. It does for sound what the wide screen has done for movies.

The secret of the system's versatility lies in the special advantage of the folded labyrinth design. Other types of enclosures are particular about the speakers you mount

in them. A large infinite baffle will sound wonderful when you use an expensive low resonance woofer in it, but with an ordinary speaker you'll wonder where the bass went. A reflex is even more critical. Change speakers on one of those, and you've got a woodworking job ahead of you. But our friend, the labyrinth, will tolerate just about any speaker that will pass for high fidelity. Of course, the labyrinth doesn't alter the facts of life. Good speakers still sound better than cheap ones.

Three-Channel System. Distortion is kept low by splitting the sound three ways with a Sherwood crossover network. It provides rather sharp crossover points at 300 and 5000 cycles. In the final version, a single 15" woofer handles the bass, two 8" squawkers fill in the mid-range, and two

The baffle is shown at right without grille to illustrate location of the five speakers. Side view below shows construction details; note that the crossover is mounted where it interferes least with the cross-sectional area of the labyrinth. Below, right, a plastic freezer container is mounted over a tweeter to isolate the back wave.



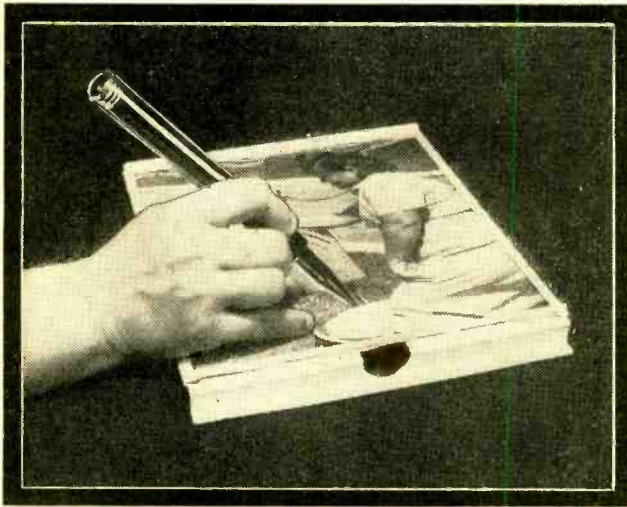
you need is an ordinary hand saw, a key-hole saw for the speaker holes, a screwdriver, a hand drill, and a hammer. If you have a power saw and want to bevel the edges of the front panel (A), fine, but don't forget that will change the dimensions. To maintain the same inside measurements, you should add $1\frac{1}{2}$ " to the long width of all parts beveled, such as panels A and D, and bring out B and C to points instead of chopping off the corners as shown. Actually, beveling is unnecessary and mainly a matter of taste.

After you have marked and cut out the parts, begin assembly by mounting the glue blocks, glued and screwed, to the bottom

(B) and the top (C). This is also a convenient time to mount the feet, which may be made any height to clear the room moulding. Next, glue and screw the front panel to the top and bottom. Then mount the speakers and crossover network, using either bolts or screws.

It is necessary to isolate the tweeters acoustically as well as electrically. A convenient method is shown in the photo above. Remove the top of the soft plastic freezer cartons and cut a central hole to match the tweeter diameter. A sharp knife will cut the material very easily. Then, using the tweeter as a guide, drill the mount-

(Continued on page 114)



Photographer's Electric Pencil



**Why not sign your "masterpieces" with
this easily built darkroom accessory?**

IF ONE OF YOUR HOBBIES is photography, chances are you've turned out a number of photographic "masterpieces" that you would be proud to sign. Just like the great artists of the past who invariably signed their paintings, you want to identify your work.

With an inexpensive "electric pencil," you can not only sign your name when processing photographic prints but you can make your signature an integral part of the photo. What's more, you can use the instrument for simple retouching jobs—from outlining objects to blacking out background areas, or from adding identification letters and numbers to dividing a photo into sections.

You can put together your own electric pencil in a single evening from parts which shouldn't cost much over a dollar.

Forming the "Pencil." Approximate assembly details are shown in the cross-sectional sketch. The model in the photographs was made up from a "radiator inspection light" picked up at a local auto supply store; this is essentially a standard penlight equipped with a curved Lucite rod to conduct light "around corners."

To make up the electric pencil, cut off the curved portion of the plastic rod with

a small hacksaw. The remaining straight portion, attached to the penlight, is then reformed to a pencil-like shape, using a small file, a pencil-sharpener, and a moderate amount of elbow grease.

For good results, it is extremely important that the tip of the "pencil" be properly shaped . . . *it must end in a flat surface*, though the area covered can be very small. This surface may be formed at right angles to the axis of the pencil or at an oblique angle, depending on how you intend to use the completed instrument.

If the flat working tip is at right angles to the axis of the instrument, then the electric pencil must be held vertically when in use. If the tip is at an oblique angle, the instrument must be held at an oblique angle. In any case, it is essential that the tip be formed so that it can be held flat against a smooth surface. The actual size of the tip will determine the size of the "line" which can be

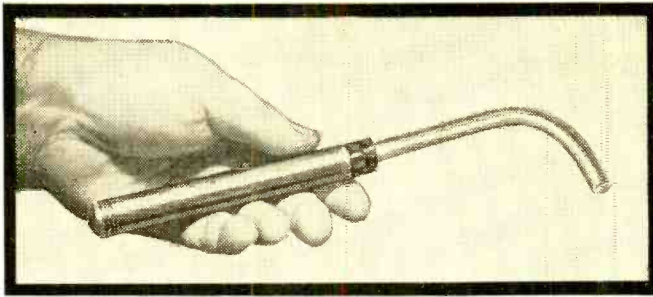
drawn. A small, flat, fine file is useful for shaping the tip . . . you'll find that a flat ignition file is almost ideal for this job.

With the Lucite rod filed to a pencil-like shape and the flat working tip properly formed, coat all of the rod except the extreme working tip with an opaque or deep red lacquer. Deep red fingernail polish is good for this operation. Use at least three heavy coats, allowing the lacquer to dry between each coat.

Check the operation of the completed electric pencil in a darkened room. Install the batteries, turn off room lights, and wait a few minutes for your eyes to become accustomed to darkness. Then look for light leaks—the only white light visible should be the pinpoint of light radiating from the small flat working tip. If there are any light leaks, you may have to apply additional lacquer.

If you are unable to obtain a "radiator inspection light" as described above, you can assemble your electric pencil from a standard penlight and a short (3") length of Lucite rod.

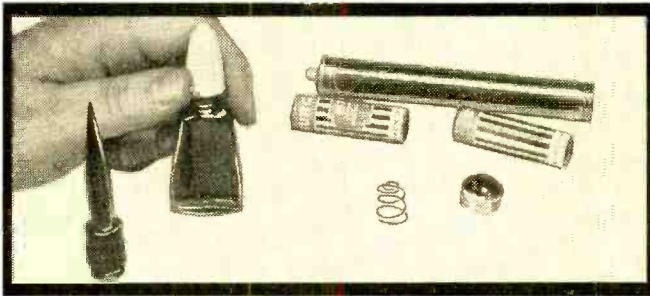
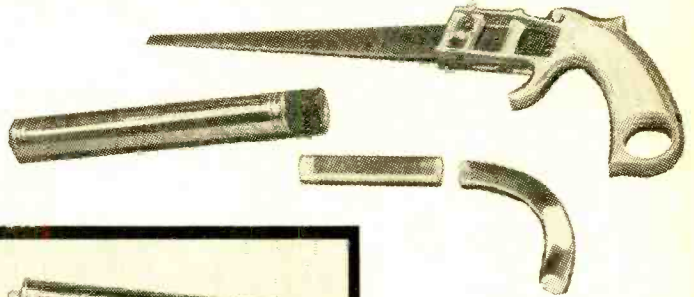
"Writing" with Light. Using the pencil, you can write with light, exposing undeveloped photographic paper to the pinpoint



Start with a low-cost "inspection light" having a curved Lucite rod like the one at left (or a standard penlight and a short length of Lucite rod).

Cut off the curved portion of the Lucite rod with a hacksaw as shown below. The remainder of the rod is reformed to a pencil-like shape using a small file and a pencil-sharpener.

After you shape the tip so that the point has a flat surface, coat the rod—except for the flat tip—with lacquer. Three or more coats of deep red fingernail polish will do the trick nicely. Allow the lacquer to dry between coats.



Cross section of the electric pencil. Your penlight may differ slightly in details. Photo on page 70 shows completed pencil being used for retouching.

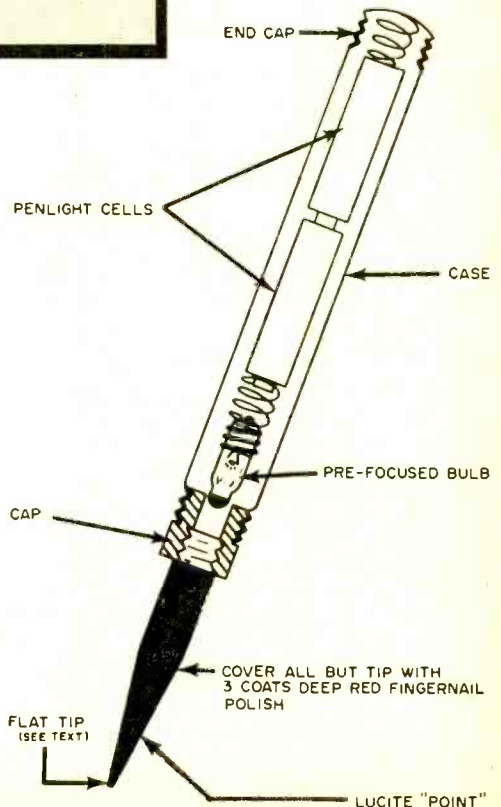
of light radiating from the flat working tip of the instrument. Thus, the "pencil" line becomes black when the paper is developed.

For proper results, it is important that only the paper directly beneath the working tip be exposed—hence the need for a flat tip surface that can be held tightly against the photographic paper. Since all "writing" is on unexposed photographic paper, the pencil must be used in a darkroom.

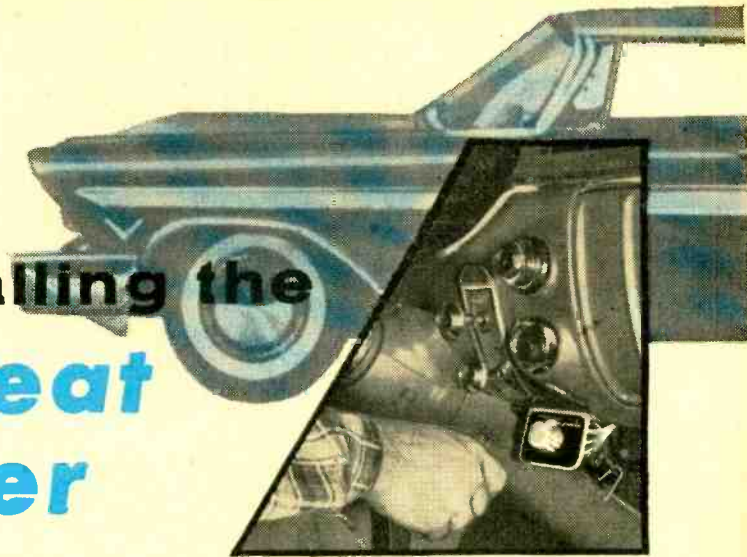
Hold the flat working tip against the paper at the point where you want to start writing. Switch the "pencil" on, taking care not to tilt the point. Trace out what you want to write on the paper, then switch the instrument off *before* lifting the tip. The speed at which you move the tip across the paper will determine exposure.

You'll have to experiment to determine the best writing speed for the type of photographic paper you use. As you acquire skill in writing, through practice, you will want to tackle more difficult jobs.

For retouching, you can work with the image projected by your enlarger. First expose the paper in the usual manner. Then move the red safety filter on the enlarger into position and use the pencil to retouch the faint image. —Louis E. Garner, Jr.

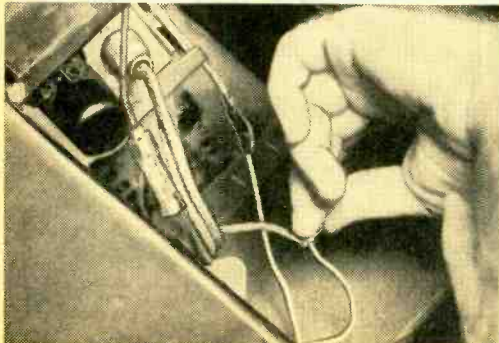


Installing the Back Seat Speaker



WIRE SWITCH. The switch, with 1 triple, 2 double contacts, taps line from transformer to front speaker, with extension line and ground for rear. Solder long "blue" line to triple "both" contact. Hook 2' "white" line to 2-contact "rear" position, "red" to 2-contact "front" post. Mount under dash.

SPLICE TO OUTPUT. Cut line from transformer. Splice "red" to transformer lead, "white" to speaker lead. Run "blue" to trunk under mats and seats.



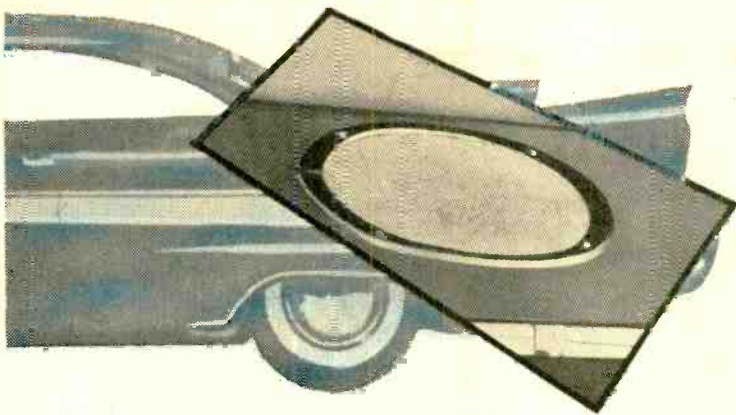
THE CAR'S INTERIOR is an almost-perfect listening booth. The upholstery, carpeting and roof lining add up to a tailor-made baffle. But they also account for the usual inaudibility of radios from the rear seat. To overcome this, add a rear-seat speaker—it shouldn't cost you more than \$5 or thereabouts.

All you need are a 5"x7" or a 6"x9" PM speaker, a three-position switch (Centralab), 25 feet of #18 or #22 wire, a speaker baffle, a moulding, four mounting bolts and an escutcheon plate and sheet metal screws for mounting the switch below the dashboard.

Follow the pictures on these pages for the easy, step-by-step instructions. You'll be amazed at the added listening pleasure you and your passengers will get. -30-

MOUNT SPEAKER. If there's no cutout, trace template on rear shelf. (Use stiff paper to make your own.) Drill holes, hold with bolts, trace speaker.

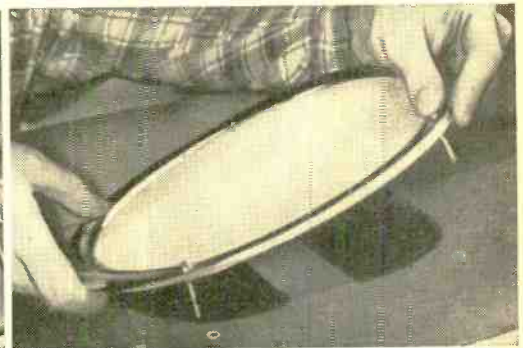
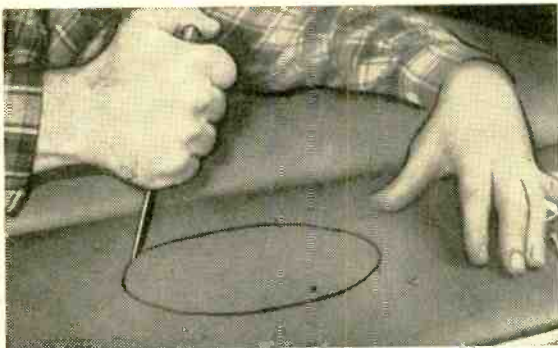




By
JOE PETROVEC
and
LEN PROKINE

A professional-looking installation of switch and speaker will be the end result for just \$5 or so.

...It's easy and inexpensive

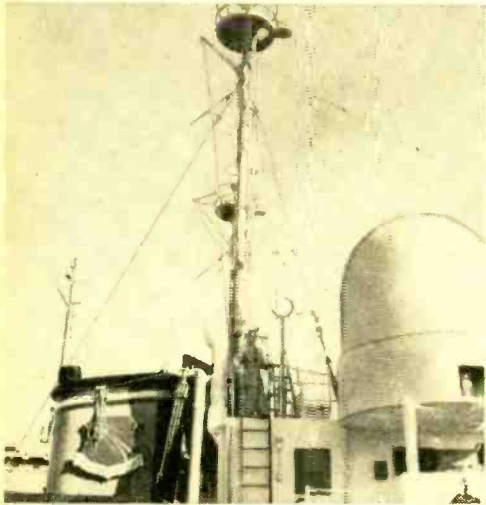


CUT SHELF. Using a sharp knife, carefully follow outline (above). Then lay moulding and baffle in place and drop mounting bolts through holes (above, right). Mount speaker from the trunk, using a weight to hold bolts in place (as shown below).

SOLDER TERMINALS. Hook "blue" line to one terminal. Ground the other with a short line to the body (below). Then turn on radio and check operation of speakers. If one or both don't work, or they are transposed in position, recheck your wiring.



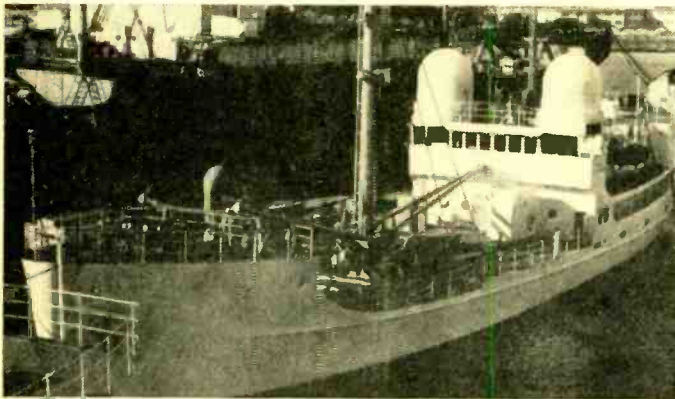
Air Force at Sea—Tracking Missiles



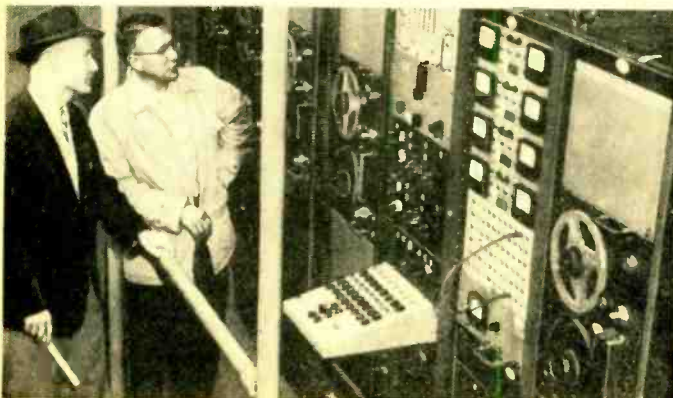
Radar antenna on mast of one of the six "floating" bases being prepared for the Air Force will track missiles in the South Atlantic testing range.

THE U. S. AIR FORCE is all at sea these days—literally. The "fly boys" are setting up a chain of "floating" bases to fill in the gap in tracking the three services' long-range missiles. Links in this 3000-mile chain in the South Atlantic will be six "telemetry" ships. They are old Army freighters modified with special electronic equipment to record and send data on missiles to Cape Canaveral, Fla., the Air Force missile test center. Holds of the ships serve as the telemetry centers—the electronic brains of the craft. They have been de-humidified, air-conditioned, soundproofed and insulated to insure accuracy of data recorded by the helical telemetry antennas housed in the twin plastic "radomes" above the bridges. Operation of the fleet is under the direction of Pan American Airways, and the electronic equipment will be operated by RCA. The ships will be capable of remaining at their bases for as long as three weeks, if necessary, and will return to ports in South America to pick up supplies.

—30—

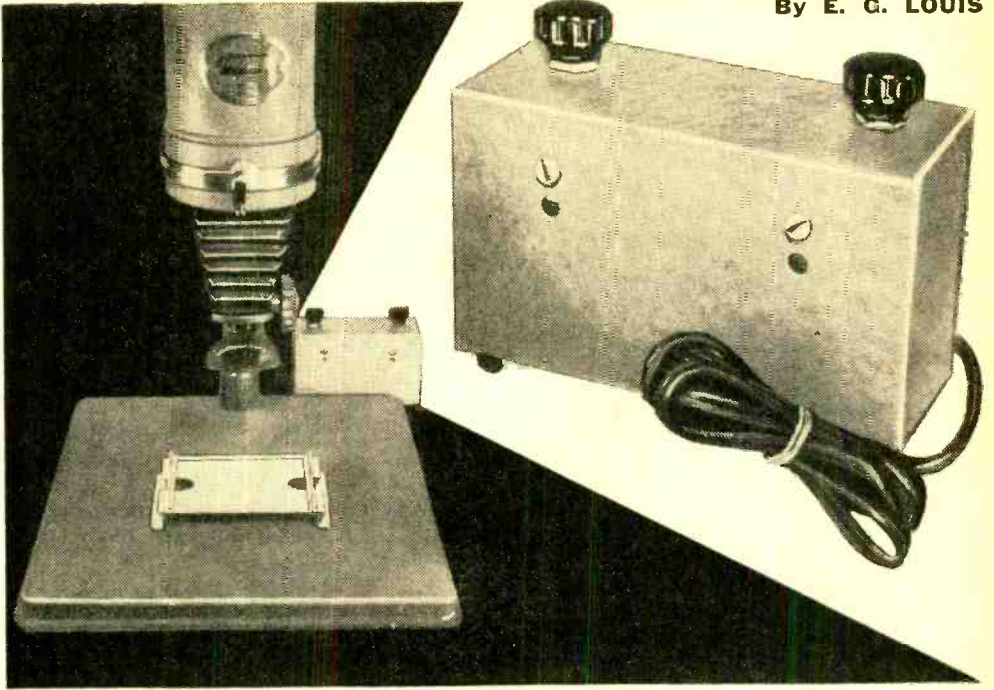


Missile-tracking "Ocean Range Vessel" of the Air Force is 178' long and 30' in beam. The large white structures at each end of the bridge are plastic "radomes" which, together with the radar antenna on the mast, "keep their eyes" on the South Atlantic missile tests.



"Telemetry Room" in each ship houses equipment to record data sent automatically from missiles launched from Cape Canaveral. The operation of the equipment is under the direction of RCA. It is located in de-humidified, air-conditioned and insulated holds.

By E. G. LOUIS



Low Cost

DARKROOM TIMER

The "blinks" of the neon bulbs will tell

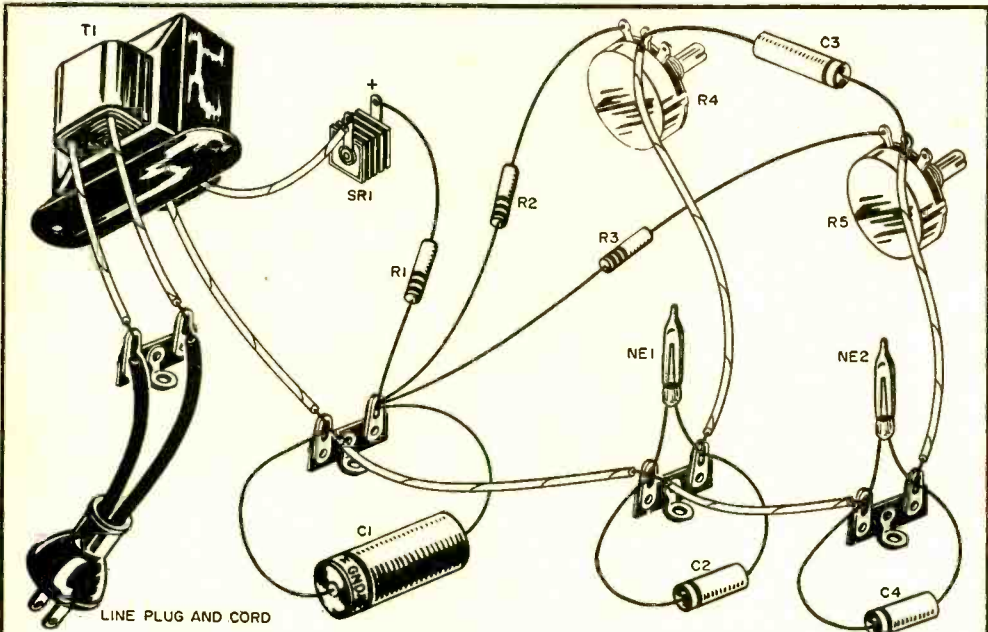
you when your print is properly exposed

AFTER YOU'VE DONE some photographic work, you will realize that the success of each operation depends on proper timing. The exposure of the film must be accurately timed and, when making prints, the paper exposure depends on such factors as paper "speed" (sensitivity), intensity of the light used for exposure, and the density of the negative. The exposing interval may be several seconds—or perhaps approach a full minute or more in some cases. Thus, the photographer must rely on special mechanical, electrical or electronic timing devices which are accurate to a second.

Most commercially manufactured photographic timers are rather expensive; some cost as much as small cameras. So the photographer with a thin pocketbook either has to do without or to build his own. Here's

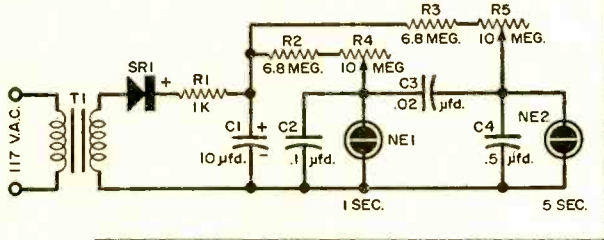
a reliable timer you can build for only a few dollars—one that doesn't require a single tube, transistor or relay, yet will provide accurate timing for all your printing and enlarging needs. With no tubes to burn out, no batteries to become exhausted, and no relay contacts to become dirty, burnt or pitted, your first cost will be your last.

This timer consists simply of a small aluminum box in which two lights are visible. Both glow with a pale orange color that is safe in the typical darkroom. Each light flashes at a periodic rate—one at a rate of one "blink" per second, the other at a rate of one "blink" every five seconds. To time an exposure requiring, say, 19 seconds, it is only necessary to watch for three blinks of the 5-second light and four blinks of the 1-second light. A 27-second exposure would



Pictorial and schematic diagrams for the darkroom timer. Since the circuit is not critical, other parts may be substituted for those given below in certain cases (see text).

- C1—10- μ fd., 150-volt elec. capacitor
- C2—0.1- μ fd., 200-volt paper capacitor
- C3—0.02- μ fd., 200-volt paper or ceramic capacitor
- C4—0.5- μ fd., 200-volt paper capacitor
- NE1, NE2—Type NE-2 neon bulb
- R1—1000-ohm, 1/2-watt resistor
- R2, R3—6.8-megohm, 1/2-watt resistor
- R4, R5—10-megohm carbon potentiometer
- SR1—20-ma. selenium rectifier
- T1—117-volt isolation transformer
- 1—5 1/4" x 3" x 2 1/8" "Channel-lock" aluminum case (ICA No. 29410)



HOW IT WORKS

The timer is basically two interlocked neon relaxation oscillators operating with different repetition rates. Transformer T1, rectifier SR1, resistor R1 and capacitor C1 form a simple half-wave rectifier, delivering an output of approximately 150 volts, d.c. Alternating-current ripple is filtered by the L-type filter made up by R1 and C1.

One oscillator circuit comprises series resistor R2 and R4, capacitor C2 and neon bulb NE1. The other oscillator consists of R3 and R5, capacitor C4 and neon bulb NE2. The two oscillators are "locked" together electrically by capacitor C3.

In operation, C2 is charged gradually through R2 and R4. The voltage on C2 builds up until NE1 fires (at about 60 to 70 volts). When the bulb fires, it acts more or less like a short circuit, discharging C2. When the voltage across C2 is too low to maintain NE1 in a "conducting" state, the bulb is extinguished, and C2 starts to charge again. The entire action is repeated at an interval determined by the time constant of C2, R2 and R4.

Each time NE1 fires, it flashes or "blinks," and at the same time a pulse is delivered to the second oscillator circuit (R3, R5 and C4) through coupling capacitor C3. Adjusting R4 permits the rate to be changed until NE1 blinks at exactly 1-second intervals. The time constant of the second circuit is made five times longer than that of the first—note that C4 is five times larger than C2—so that NE2 blinks at exactly 5-second intervals.

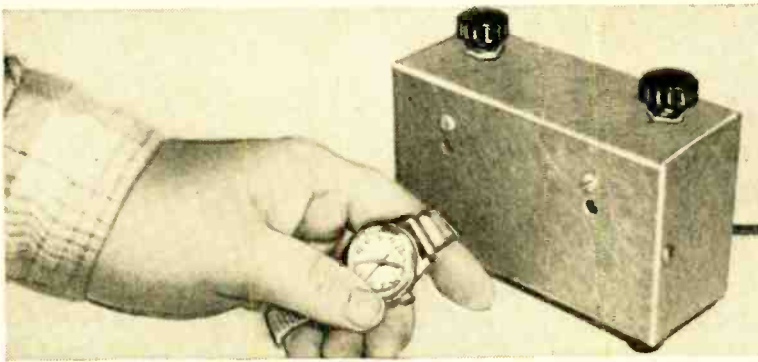
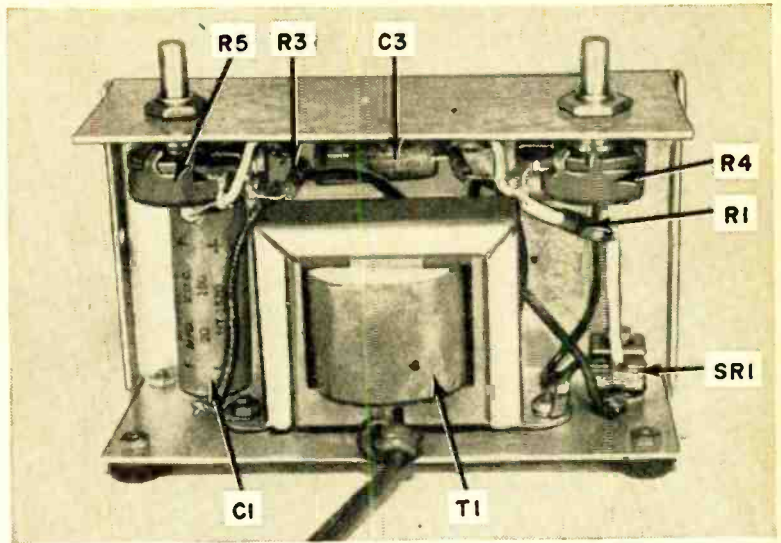
require five blinks of the 5-second light and 2 blinks of the 1-second light.

Construction. All the components are inexpensive and readily available at radio parts stores. A commercially available aluminum case was used to house the timer shown. However, any similar-size box will serve as well. The unit could be assembled in a plastic, wooden, or even a strong cardboard box.

Neither the circuit layout nor wiring arrangement is at all critical. Just be sure to observe correct circuit polarity when installing the selenium rectifier (SR1) and the electrolytic capacitor (C1). Use small cable clamps to mount the neon bulbs (NE1 and NE2) behind holes in the case, arranging them so that both electrodes (the wires inside each bulb) are visible from the front.

Since the timer circuit is completely non-critical, quite a number of changes may be made in parts values without affecting operation. Often, a suitable component from the junk box can be used in place of a specified part. Almost any 117-volt selenium

Interior view of the wired timer with major components identified. Note that the unit provides accurate timing without the use of tubes, transistors or relays.

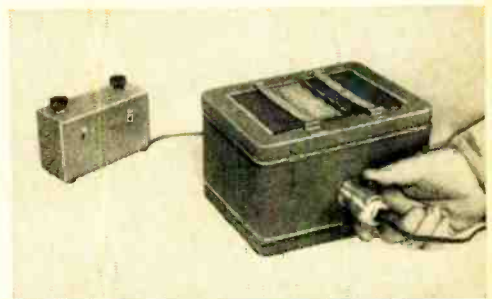


Adjusting the timer's calibration (left) with a wrist watch.

rectifier will serve as *SR1*. You can substitute a larger or smaller resistor for *R1*—values of from 560 to 2200 ohms are satisfactory—and a 1-watt or 2-watt unit will do instead of the ½-watt unit listed. Capacitor *C1* may range from 8 μ fd. to 30 or 40 μ fd., with ratings from 150 to 450 volts d.c. Type NE-51 neon bulbs can be employed in place of the NE-2 bulbs, if desired.

Adjustment. Using a watch or clock with a sweep-second hand, and operating the timer in a partially darkened room, gradually adjust *R4* until *NE1* is blinking at exactly 1-second intervals. Then adjust *R5* until *NE2* blinks at exactly 5-second intervals. Finally, readjust both *R4* and *R5* until the two bulbs are blinking in perfect synchronism.

Ideally, the first bulb should blink four times—on the fifth blink, both bulbs should flash together. However, depending on the tolerances of the neon bulbs, it is sometimes possible for one bulb to blink four times, then for the second bulb to supply



A print box exposure is being timed in the photograph below.

the fifth—or 5-second—blink. Recheck the timer's calibration adjustment at periodic intervals, especially if you do not use it for extended periods.

Proper timing intervals are determined simply by counting the number of blinks on the 1-second and 5-second bulbs. For example, an 11-second interval calls for two blinks of the 5-second bulb, one of the 1-second bulb, and a 23-second interval calls for four blinks of the 5-second bulb, three of the 1-second bulb.

AFTER CLASS

Special Information on Radio, TV,



Radar and Nucleonics

WORKING WITH SELENIUM RECTIFIERS

SELENIUM RECTIFIERS have long been accepted as an efficient means of converting a.c. to d.c. in industrial applications with relatively large power requirements. Their use has recently been ex-

panded to include radio and TV receivers as well as all types of electronic control gear and mobile equipment. But although many millions of these units are now being employed, most experimenters are dangerously ignorant of their characteristics and limitations. "To know it well is to use it wisely" may be a highly questionable aphorism in many ways but it fits the selenium rectifier like the proverbial glove.

Figure 1 is a cross section of a finished selenium cell. The etched-aluminum baseplate serves as the negative electrode and the low-temperature alloy as the positive electrode. In operation, electrons flow readily from the alloy to the baseplate but encounter high resistance in the opposite direction. The alloy plating behaves like the cathode of a vacuum tube and the alumi-

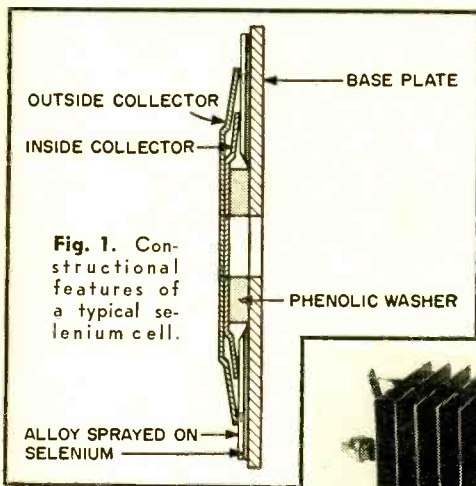


Fig. 1. Constructional features of a typical selenium cell.

This photo shows a large 5-amp. selenium rectifier compared in size with a 500-ma. unit (left), a 50-ma. unit (center), and a common matchbox cover (right).

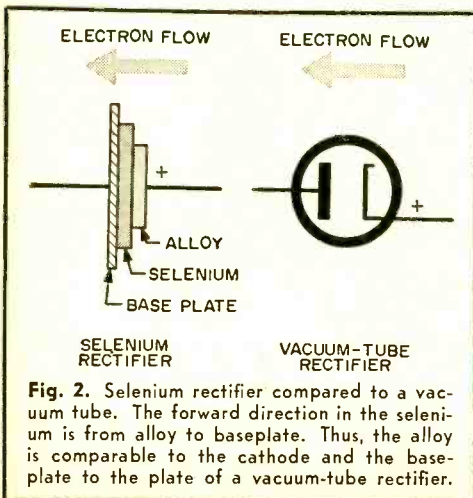
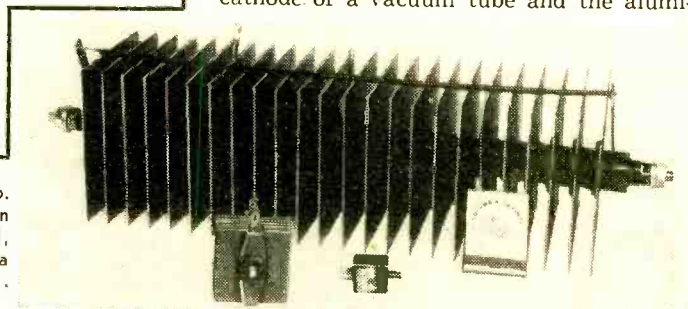


Fig. 2. Selenium rectifier compared to a vacuum tube. The forward direction in the selenium is from alloy to baseplate. Thus, the alloy is comparable to the cathode and the baseplate to the plate of a vacuum-tube rectifier.

num baseplate serves as the anode or plate, with the selenium crystal layer actually performing the rectifying action (Fig. 2).

Rectifying Action. During the manufacturing process, much care must be taken in the deposition of the metallic selenium on the baseplate, because performance of the finished rectifier depends upon the orientation of the individual crystals in the "barrier layer," as the selenium coating is called. Although the rectifying action is still imperfectly understood, the need for correct orientation suggests the following explanation.

Consider a single crystal having a shape like that of a pyramid (Fig. 3). All metals contain many free electrons or *carriers* which distribute themselves according to certain well-known laws of electrostatics. One of these laws states that electric

Resting on top of a modern selenium of the power variety is an old-type copper oxide rectifier. Although almost three times the size of the copper oxide unit, the selenium weighs less. Both can handle 5 amperes, but the selenium is rated at a five-times higher voltage, hence the extra length.

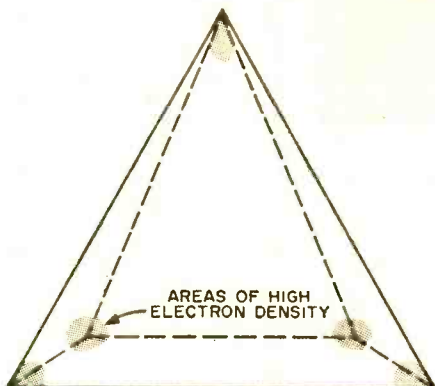
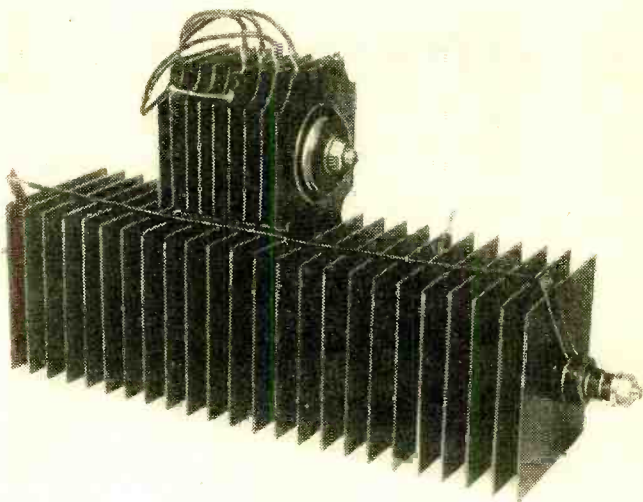


Fig. 3. Electron charge density is always greatest at the points of greatest curvature. Here, density is highest at corners of pyramid.

charges will concentrate on surfaces with the sharpest curvature; this is called the *effect of points*. As the sharpest curvatures on the surface of a pyramid are found at the corners, we should expect to find free electron density highest at these points.

A potential applied to a line of crystals of this shape oriented end-to-end may or may not cause a current to flow, depending upon the polarity of the voltage. When the direction of the e.m.f. is such as to move the electrons from a corner to a face (Fig. 4A), the carriers readily cross the interfacial boundary at B, moving into face AC, and thence distributing themselves at the corners. This is the *forward* or *conduction* direction. When the polarity of the voltage is reversed (Fig. 4B), the deficiency of electrons on the flat faces limits the number of carriers, conduction does not occur readily, and the resistance is substantially higher. If we now replace the batteries with an a.c. source, the conduction is essentially unidirectional and rectification takes place.

Voltage and Current Ratings. Seleniums are available in an almost unlimited range of voltages and currents. Those

popular for radio and TV applications may be roughly limited to a maximum r.m.s. voltage input of 130 volts and a current range from 50 ma. to 600 ma. d.c. Such seleniums are designed to operate at a.c. line voltage, i.e., about 120 volts r.m.s. Note, however, that even a 500-ma. rectifier is capable of carrying more than twice the current of the largest receiving type rectifier, the 5U4G. In the real power sizes—5 ampere capacity and more—selenium rectifiers are no less bulky than other types but they weigh considerably less.

The selenium ratings given above carry
(Continued on page 104)

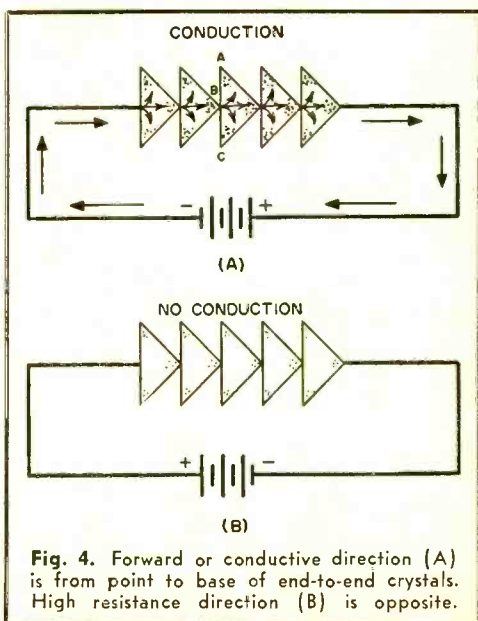
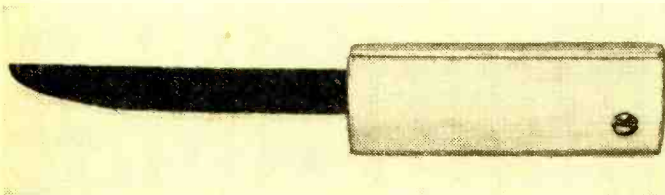


Fig. 4. Forward or conductive direction (A) is from point to base of end-to-end crystals. High resistance direction (B) is opposite.

How to Make and Use a Chassis Saw

There are several ways of cutting a large, rectangular, transformer-mounting hole in a chassis. You can use a hammer and chisel, or you can drill a number of small, close-spaced holes around the area to be cut away, but the neatest and easiest method is the one employed in small model shops—do the job with a chassis saw.

A typical chassis saw consists of a length



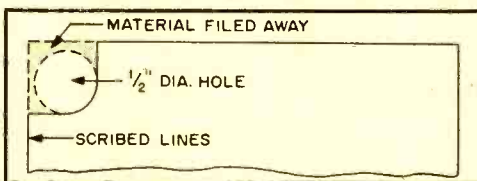
of ordinary hacksaw blade fitted into a handle and held in place with a single 6-32 machine screw. A blade with 32 teeth per inch is best for cutting the relatively thin sheet metal of a chassis. Coarser blades, i.e., those having fewer than 32 t.p.i., will tend to catch or hang during the cutting process. If you choose a 12" blade, you can break it exactly in two, and thereby provide yourself with enough material for the saw and a spare blade. Taper the end of the blade on a grinding wheel. This will make it easier to use when you start a cut. Remember to dip the blade frequently in cold water during the grinding to prevent it from heating up and losing its temper.

The handle is a 3" length of 1"-diameter dowel (broomstick will do), with a narrow slot cut in it to accept the blade. This slot should be no wider than the blade.

The best way to make it is to use a conventional hacksaw and a very coarse blade. Make the slot about $1\frac{1}{16}$ " deep and keep the bottom of it parallel to the length of the dowel. When the slot is finished, locate and drill a hole for a 6-32 screw near one end of the dowel. This hole should go entirely through the dowel so that the screw can pass through it and through the hole in the end of the hacksaw blade. If you counter-bore each end of the hole slightly, the head of the screw on one side and the nut on the other will be flush with the handle, making the saw much more comfortable to use. The cutting edge of the

blade should extend about 3" from the handle of the chassis saw.

To use the saw, first lay out the dimensions of the rectangular hole on the chassis deck with a straight-edge and a sharply



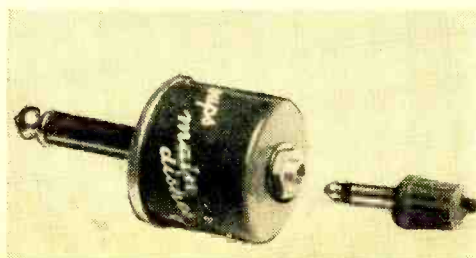
pointed scriber. Then drill a $\frac{1}{2}$ "-diameter hole in the diagonally opposite corners, and file away two sides of each hole to the scribed line, as shown by the dashed lines in the drawing above. You can now insert the chassis saw and cut just inside the scribed lines extending away from each hole.

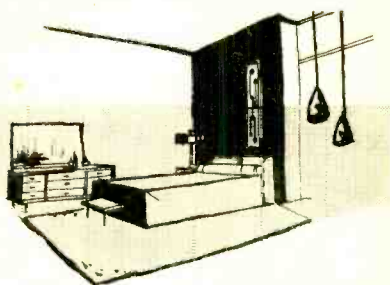
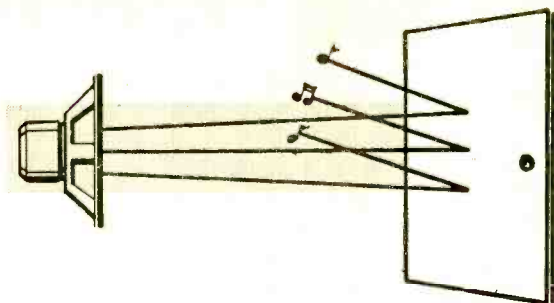
—Frank H. Tooker

Fitting a Miniature Phone Plug into a Standard Jack

Making this adapter will enable you to fit miniature phone plugs to standard-size phone jacks. Cut off a 1"-diameter metal can with a friction lid to a length of about $\frac{7}{8}$ ". Then cut a $\frac{5}{8}$ "-diameter hole in the bottom of the can to take an Amphenol 75-MC1P phone plug. Twist the phone plug into the hole and hold it securely with a few drops of solder applied around the knurled edge. Now cut a $\frac{1}{2}$ "-diameter hole in the lid of the can to take a Lafayette Radio MS-282 miniature phone jack (or Telex #9240 miniature jack). Scrape off the paint around the hole before mounting the miniature jack in the lid. Solder a short length of flexible insulated wire to the center contact on the Amphenol plug, and solder the other end of this wire to the "floating" or insulated lug on the

miniature jack. Finally, scrape off the paint at the place where the lid contacts the can, and solder the lid to the can with a few drops of solder. This procedure automatically connects the frame of the jack to the frame of the plug, thus eliminating one wire in the hookup, and providing shielding at the same time. —Art Trauffer





Keep It Where It Belongs

Hi-fi addict soundproofs door of room so family can sleep

WHEN the representatives of the 13 colonies foregathered in Philadelphia in 1776 to write themselves a Constitution, they whipped up a Preamble which every hi-fi aficionado should take close to heart: "We, the People of the United States, in order to form a more perfect union . . . to insure domestic tranquility . . ." It isn't every family, you see, which is as enthusiastic as the head of the household when it comes to hi-fi, particularly in the wee smaller hours.

What can you do about domestic tranquility? Well, there's one very important project you can undertake to cut down on the room-to-room transmission of sound that will cost only a nominal amount. At the same time, it should give your family almost complete peace while you fiddle with the base and dabble with the treble.

The Big Problem. In most rooms, sound leaks through the doors. Generally the walls are of fairly solid construction, but the door panels may be as thin as $\frac{3}{16}$ ths of an inch—hardly enough to stop 74 decibels. Here's how you can fix that.

Your local lumber supply dealer has various thicknesses of plywood in stock. This material is the best you can use for the job. However, it is somewhat more expensive than other composition materials such as Masonite. At any rate, buy a piece cut to size to cover your door completely. If it is plywood, have the man bevel the edges; if it is the thinner Masonite, beveling shouldn't be necessary.

The same dealer can then sell you Fiberglas insulation material at about a nickel a board-foot, cut from a 24" roll. If he doesn't have it, your electronics distributor can sell it to you, or if necessary you can get a kit from an auto supply store which includes the cement. Rubber cement will

Remove knobs, other hardware.



Apply cement in random patches. It'll hold fast.

After trimming, put Fiberglas on very carefully.





With Fiberglas in place, attach the panel.

serve as a substitute if you can't get Fiberglas cement.

After you've assembled your materials, remove the door from its hinges. Remove the latch hardware and trim the Fiberglas to fit the panel cavity. Then dab on the cement in random patches—enough so that the center and all edges are held fast. Place the Fiberglas in the cavity.

Attach the Sheathing. Drill holes in the plywood or Masonite board about 10" apart and 2" from the edge and countersink. The holes should be large enough for No. 6 1½" flathead wood screws. Lay the

board over the door, beveled edge out if it's plywood. You might want to use a good wood glue first, before you screw it on, but the screws should be ample to hold properly. Screw the panel to the door, and use Plastic Wood or putty to fill the holes.

Flop the door and drill through for the door handle. You are then ready for finishing, which can be done to your taste—you may want to use a natural finish or stain and coat the plywood with clear varnish, or perhaps paint it to match or contrast with the room.

Rehang the door, replace the knob and plate, and test the door. You will find that it now has the heavy feel of a good refrigerator or automobile door—it closes with a heavy thud. Have someone stand on the other side and shout. Notice how much less sound carries through.

One important note. It is best to place the soundproofing on the inner side of the door—that is, the side on which the sound originates. However, for some reason you may not be able to do that, so it will be acceptable to use the other side. Of course, if you want to go all out, you may do both sides of the door, to cut down the sound to a minimum. That is entirely up to your pocketbook and your desire to work. At any rate, you should have happy listening now, while the family has happy dreams.

—Tracy Diers

CROSSWORD PUZZLE

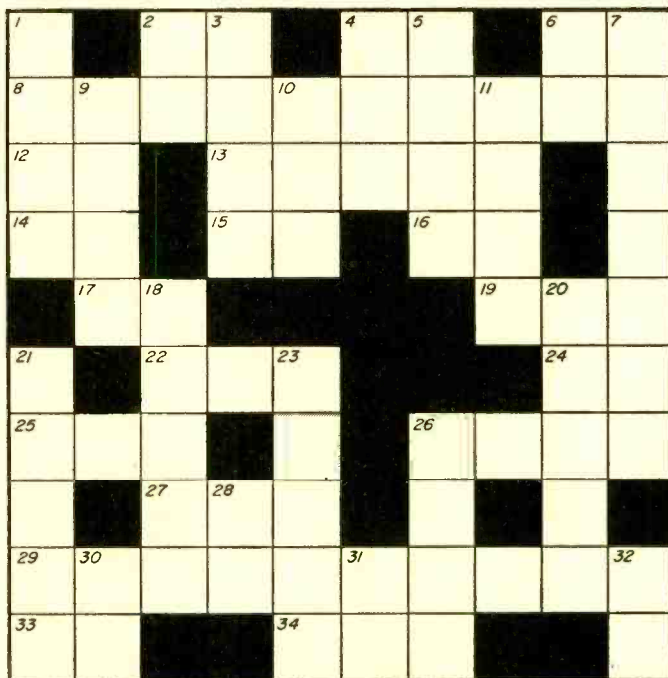
By Arthur L. Branch

ACROSS

- 2 Type of voice broadcasting: Abbr.
- 4 Exclamation.
- 6 Rectified current.
- 8 Special type of a.c. generator.
- 12 Chemical symbol for lithium.
- 13 Electromagnetic wave used for communication.
- 14 In: Span.
- 15 Egypt: Abbr.
- 16 Registered nurse: Abbr.
- 17 Suffix denoting one who does.
- 19 Devour.
- 22 Sound detecting device.
- 24 Southern state: Abbr.
- 25 Liquid insulator.
- 26 Part of a transformer.
- 27 Assistance.
- 29 Tubes that operate at firing voltages.
- 33 Compass point: Abbr.
- 34 Five-and-a-half yards.

DOWN

- 1 Emitter of magnetic lines of force.
- 2 Input current to rectifier.
- 3 Deep mud.
- 4 Ancient.
- 5 Parts of the head.
- 6 To commit.
- 7 Piezoelectric material.
- 9 Wave propagated by one cycle of a.c. voltage.
- 10 Relation of current to voltage in an inductive circuit.
- 11 Quality of sound.
- 18 Electromagnetic switch.
- 20 To adjust circuit for specific frequency.



- 21 Units of electromotive force.
- 23 Microwaves.
- 26 Line from power source.
- 28 Formula for voltage drop.

- 30 That man.
 - 31 Toward.
 - 32 Type of broadcasting: Abbr.
- (See page 122 for solution)

The "Challenger"



Building Your First Electronic Game/Computer

THIS IS THE PROJECT you've been waiting for!!

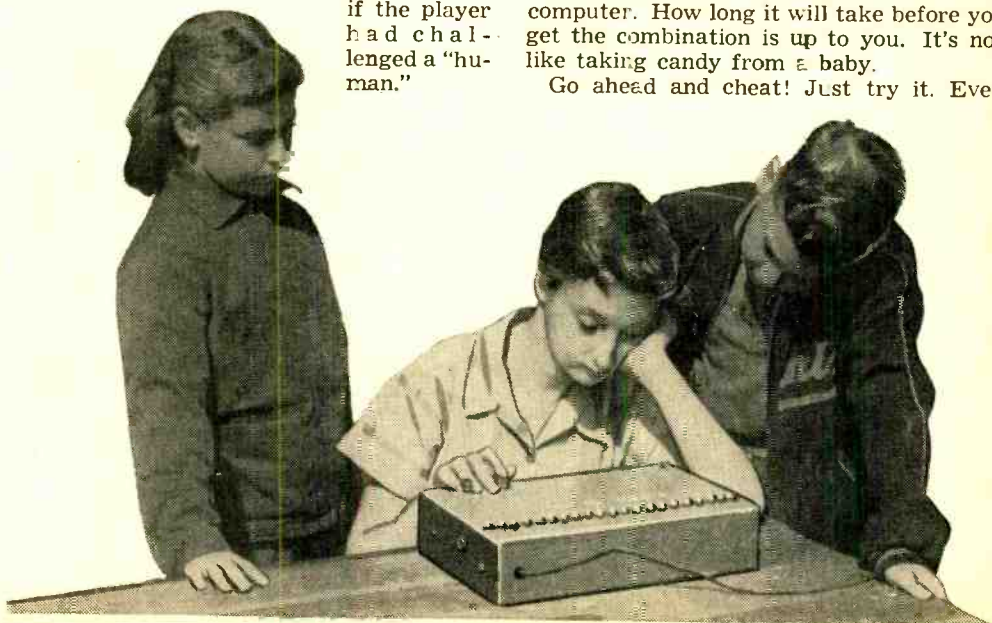
This machine is a rudimentary computer—complete with a built-in program (see "Can You Run a Computer?", June, 1957, p. 37). It challenges all comers to a battle of wits in a game of numbers. Regardless of whether the player or the machine starts first, the object is not to be trapped into lighting the last—or the 21st lamp. The machine and the player are permitted to light one, two or three bulbs during each turn. The machine and player alternate turns, just as if the player had challenged a "human."

By HARVEY POLLACK

**Stump your friends with an
electronic battle of numbers**

It's fun to play and puzzling in a delightful sort of way the first few times the machine beats you, but then you begin to realize you've got to *think* to outwit the computer. How long it will take before you get the combination is up to you. It's not like taking candy from a baby.

Go ahead and cheat! Just try it. Even



if you do, the machine will beat you—unless, of course, you solve the “program.”

Two Versions. There are two versions of this game. The simpler one should be assembled first. You can then add the remaining parts for the de luxe model if you wish.

In the basic unit, the player must “advise” the machine that its turn has come by pressing the *Machine* button after he has made his move. Either the player or the computer may go first. In the de luxe model, an automatic response circuit makes it unnecessary to use the *Machine* button. It is operated only when the player decides that the machine is to make the first play. After the player has pressed and released his push button, he waits three or four seconds while the machine “thinks” over its strategy, makes its decision, and then waits in turn while the player cudgels his brains to select the next move.

In either model, the game may be interrupted in mid-play to allow the player to start afresh. Operating the *Start* button causes the computer relay to “home” automatically for a re-play.

Basic Construction. The model was built on a 10"x14"x3" aluminum chassis. A bottom cover makes it tamperproof. The pilot light bulbs are friction-fitted in rubber grommets. Mount the relay and switches as shown in the photos.

Now hold the relay (*RL1*) so that the coil and spiral spring are on the right side facing you. The terminals will then lie along a semi-circle pointing upward. In this position, the first terminal at the extreme right is the wiper for each deck. The next one up is terminal number 1, then 2, 3, etc. The last terminal on the extreme left is 22.

Of the five relay decks, you use only three. The top one is the pilot light deck and is wired after all other parts are in place. The third deck is for “locking” and should be wired so as to prevent contact of the wire with other terminals. The fifth deck is the “homing” section; terminals 1 through 21 are joined together by a single piece of uninsulated tinned wire spot-soldered to each lug, one after the other. Terminal 22 is left unconnected.

The wipers of the “locking” and “homing” decks are joined by a short jumper and a lead brought out from the common connection for later soldering to a ground (chassis). Solder the wiper of the top (“pilot”) deck to a long insulated lead for connection to the center-tap of *T1*.

Cut 21 holes for the pilot lamps with a $\frac{1}{2}$ " twist drill. Grommets ($\frac{1}{2}$ " O.D., $\frac{3}{8}$ " I.D.) are then forced into the holes. Later on, the pilot lamps will be pushed into place

The basic computer assembly (photo on page 85) is shown with baseplate removed. At right is the schematic of the basic game, and complete parts list is given below. Table at bottom of page 85 indicates sequence of lights.

C1—1000- μ f.d., 15-volt tubular electrolytic capacitor (*C-D* Type BR-10001)

RL1—Self-pulsing-type stepping relay, 22 positions, 5 decks, 6-12 volt coil (Type SS-6, available from Lafayette Radio)

S1—D.p.d.t. push-button switch, spring return (Switchcraft #1006 or equivalent)

S2, S3—Push-button switch, spring return, used as s.p.s.t. normally open (Lafayette Type 127-76 or equivalent)

SR1—120-volt, 500-ma. selenium rectifier

T1—Filament transformer, 117 volts to 12.6 volts @ 2 amperes (Stancor Type P-8130)

1—10" x 14" x 3" aluminum chassis

1—10" x 14" aluminum bottom plate for chassis

21—6.3-volt pilot lamps (Type #47)

21— $\frac{3}{8}$ " I.D., $\frac{1}{2}$ " O.D. soft rubber grommets

HOW IT WORKS

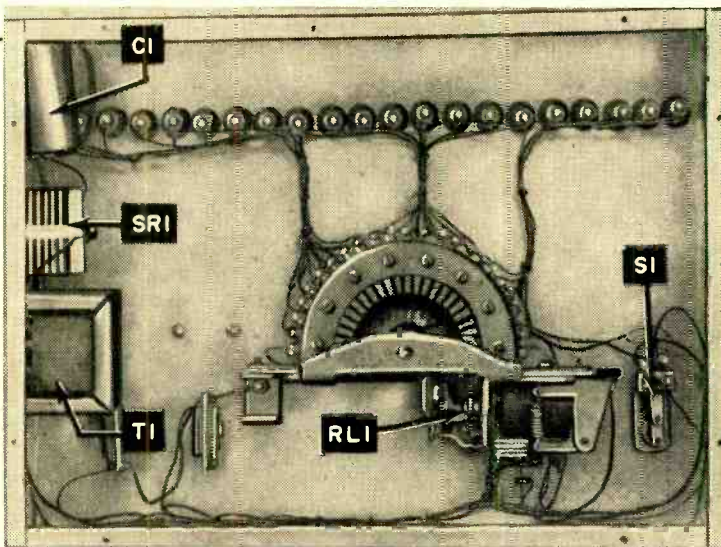
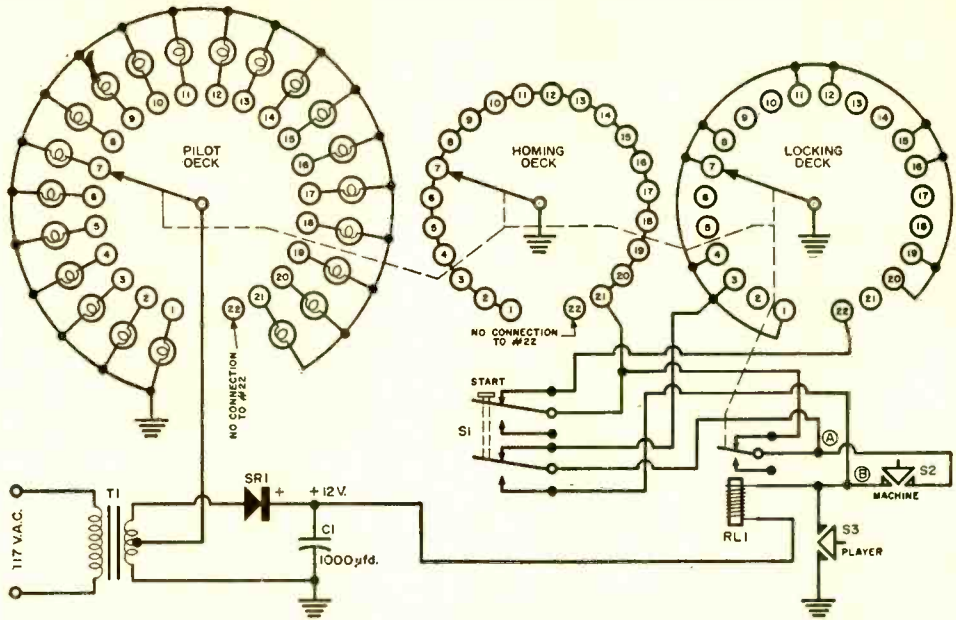
This may mean war, but your Editor is convinced that giving away the secret of the machine's built-in strategy would spoil the game for the readers. So, from behind a bulletproof steel plate designed to protect us from frustrated readers, we say: figure it out for yourselves!

in these grommets. No sockets are used since all connections are made directly to the lamp bases by spot-soldering. Group the 12.6-volt transformer, 500-ma. selenium rectifier, and 1000- μ f.d. capacitor near each other. The push buttons labeled *Player* and *Machine* should be placed so that they will be easy to operate while the *Start* button is best positioned out of the way where it will not be pressed inadvertently.

Before you begin final wiring, identify the normally closed armature contacts on the stepping relay; also find the coil terminals and remember their location. Operate the relay manually by squeezing down on the armature while you observe the stepping action. Watch how the armature contacts break on each step because this will help you identify the correct terminals.

Testing the Machine. First check the *Player* button action. With power applied, the light should advance to the right one lamp at a time for each operation of the *Player* button. Check the entire string to be sure that all the lamps are working. If the light does not advance at all, test for B+ at the output terminal of the power supply; the reading here should be between 9 and 12 volts. Check to see that the same voltage appears across the relay coil when the *Player* button is held down.

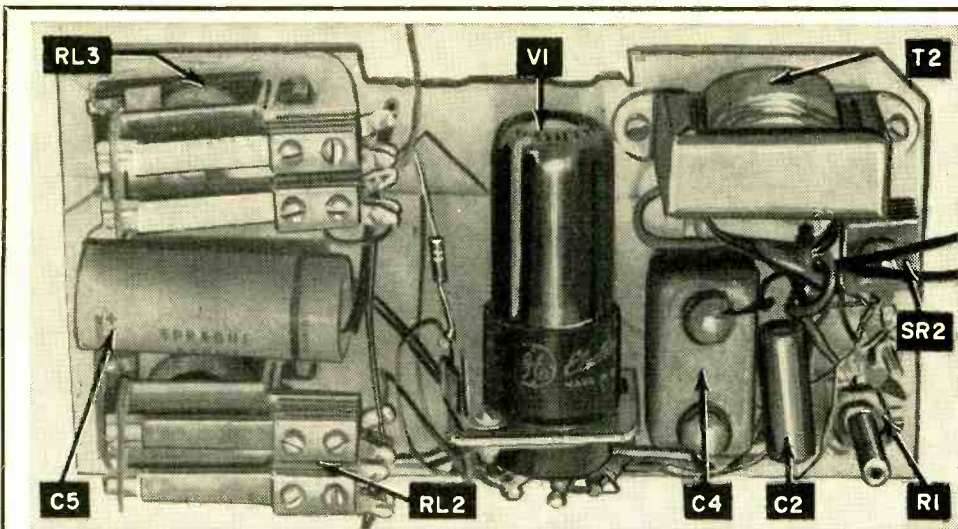
Then test the *Machine* button action. Each time this button is depressed, the machine should advance the lamps in the sequence shown in the table. Start with all lamps off. Should you find that this se-



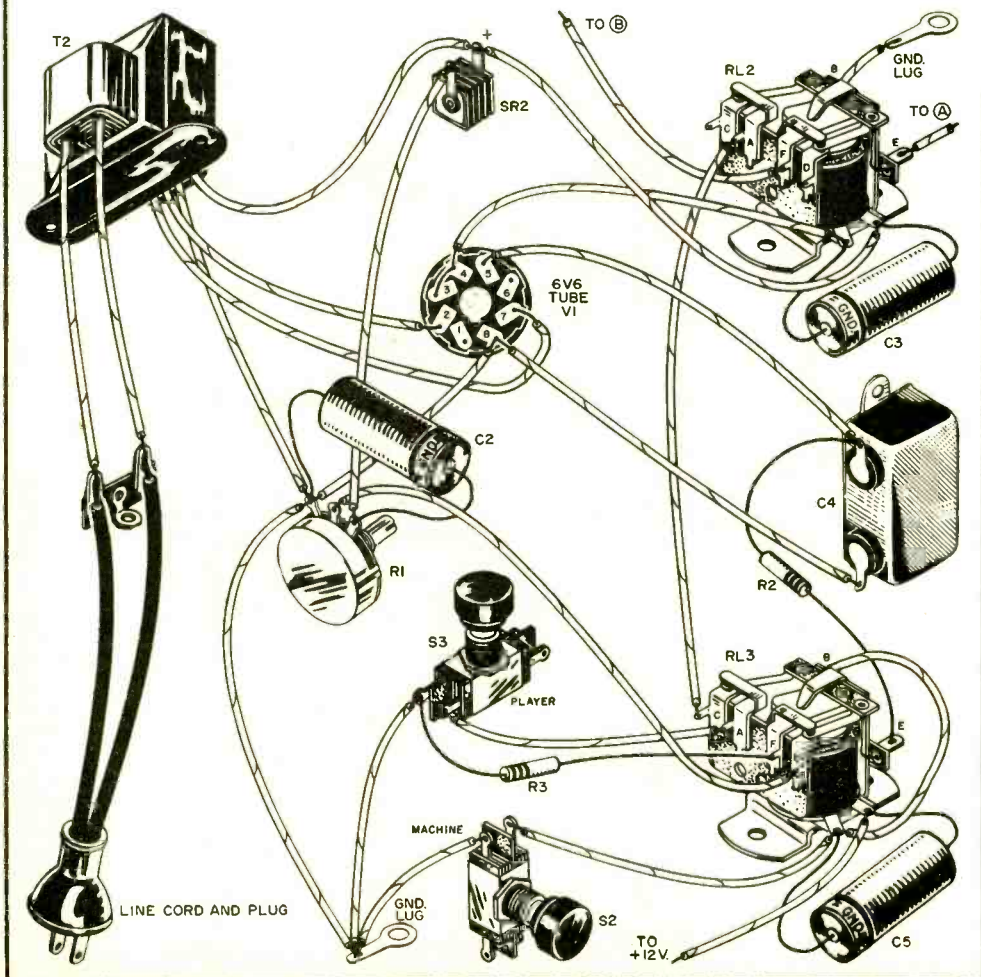
quence is not followed, you may be sure that some part of the wiring of the "locking" bank is incorrect. You may have joined terminals which should not be connected or you may have omitted one or more joints.

Finally, test the *Start* button action. Advance the light to the first lamp using the *Player* button. Now press the *Start* button. You should hear a whirring sound accompanied by a sequential flashing of the lamps from 1 through 21, each lamp lighting briefly as the pulse is automatically transferred from one relay contact to the next. The light should proceed all across

Operation Number	Light Stops on Lamp Number:	Light Skips by Lamp Number:
1	2	1
2	4	3
3	5	None
4	8	6, 7
5	9	None
6	12	10, 11
7	13	None
8	16	14, 15
9	17	None
10	20	18, 19
11	21	None

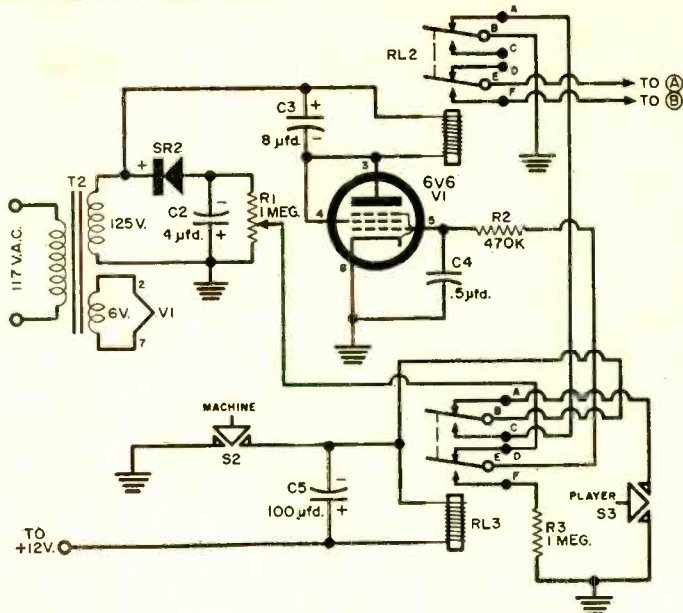


Relative positions of components on the auto-response panel are shown above before inclusion in the chassis. Referring to the pictorial diagram below will simplify construction.



PARTS LIST

- C2—4- μ fd., 150-volt tubular electrolytic capacitor
 C3—8- μ fd., 150-volt tubular electrolytic capacitor
 C4—0.5- μ fd., 400-volt paper capacitor, bathub type
 C5—100- μ fd., 150-volt tubular electrolytic capacitor
 R1—1-megohm linear taper potentiometer (Mallory U-59)
 R2—470,000-ohm, 1/2-watt carbon resistor
 R3—1-megohm, 1/2-watt carbon resistor
 RL2—D.p.d.t. relay, 12-volt d.c. coil (Guardian Series 200 or equivalent)
 RL3—D.p.d.t. relay, 5000-ohm plate circuit type (Guardian Series 200 or equivalent)
 SR2—117-volt, 65-ma. selenium rectifier
 T2—Power transformer, 125-volt secondary at 30 ma., 6.3 volts at 0.6 ampere (Olsen Radio Warehouse Type T-173; Stancor Type PA-8421 is also suitable)
 V1—6V6 tube
 1—Octal socket
 1—4" x 6" panel, 1/8" thick (polystyrene, Bakelite, wood, or Masonite)



Schematic diagram of auto-response assembly. See page 126 for an explanation of how the auto-response circuit works.

the panel but should stop after lamp 21 has lit and extinguished. If this action is not obtained, check the wiring of the "homing" deck and make sure that all terminals except 22 are joined together. Trace the lead from the wiper of the "homing" deck to be sure it goes to the back or normally closed contact of the armature. In addition, check the connections to the *Start* button since these must be right if proper homing action is to be obtained.

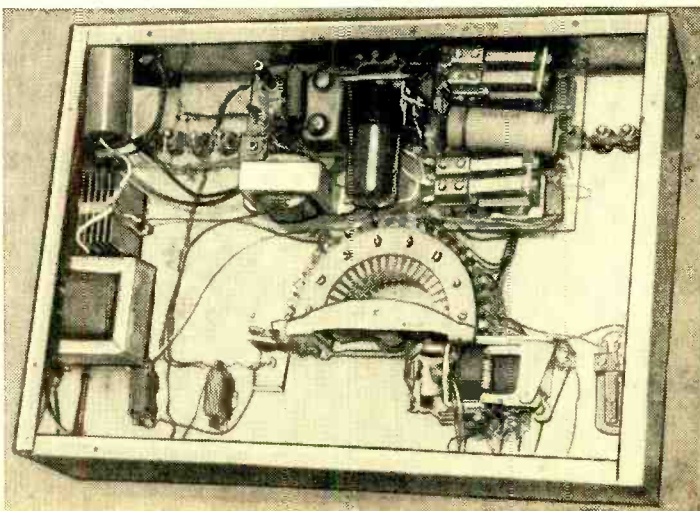
Automatic Response Panel. Although your family and friends can have loads of fun with the machine set up in this simple form, the action becomes bewildering and uncanny when the computer reacts automatically after each player moves. The auto-response section is simply an ingenious timing circuit.

Layout of the timing parts is not critical. All the wiring is completed before the

panel (see photo) is mounted in the machine base. Wire leads (color-coded) of sufficient length are brought out during wiring for later connection to the main circuit.

Only two minor changes in the computer wiring are necessary when you install the auto-response panel: (1) disconnect the wires from points A and B on the *Machine* button and reconnect these wires to points A and B on the auto-response panel, leaving the *Machine* button free of wires at this point; and (2) connect either

(Continued on page 124)

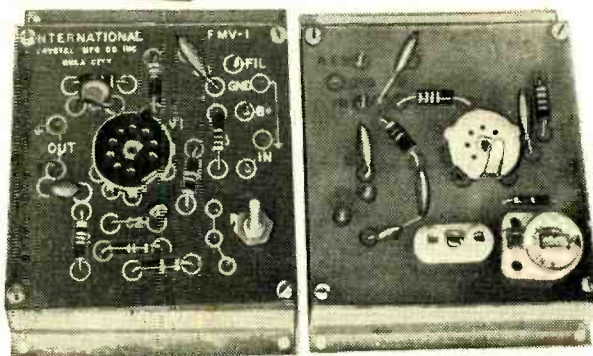


Underside of the game with the auto-response circuit in place. You are now ready to play. Good luck!



Front panel view of the spot frequency injector (left) which is designed around two printed-circuit kits. Below are the printed-circuit boards shown with all small parts mounted.

By PAUL HARVEY



Spot Frequency Injector

Kits simplify crystal calibration

for hams and SWL's

THE UTILITY of any short-wave receiver can be enhanced by pairing it off with a reliable frequency standard. If you take advantage of commercially available printed-circuit kits and the economy of a homemade power supply, you can build an accurate crystal calibrator that performs right up to 30 mc.

The unit pictured here is designed around two kits manufactured by the International Crystal Manufacturing Co., Inc., 18 N. Lee St., Oklahoma City, Okla. The first of these is a 100-kc. crystal oscillator and the other is a 10-kc. multivibrator. With the proper power supply and housing, 100-kc. and 10-kc. markers may be obtained right up to the limit of the

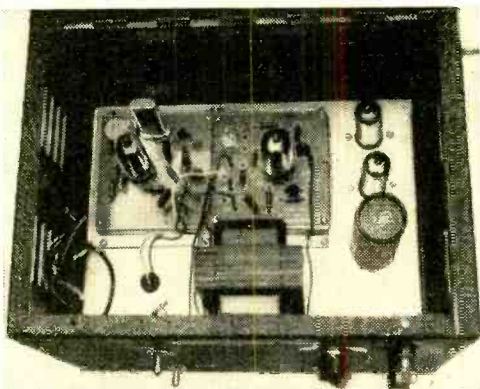
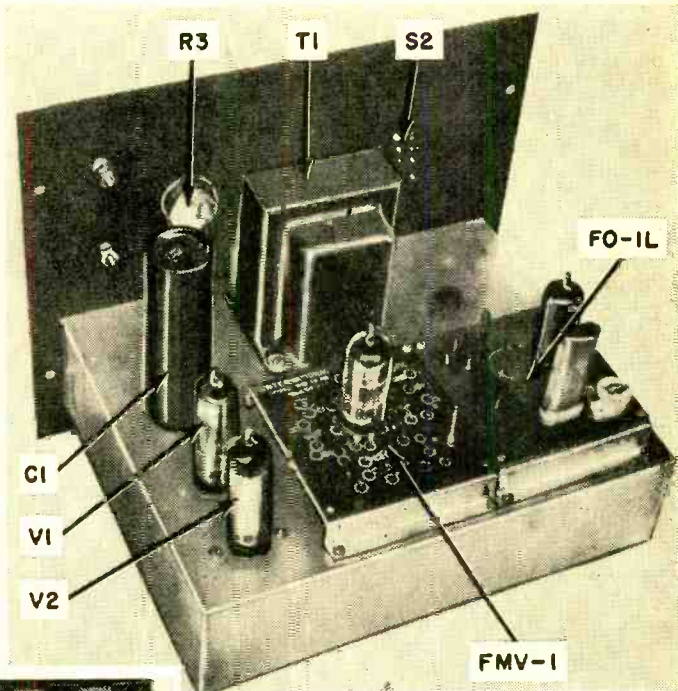
high-frequency end of most short-wave receivers.

Construction. After obtaining the kits and accessory parts given in the "Bill of Materials," you will find it easy to follow the construction steps below.

Step 1: Locate all the components in the positions indicated in the manufacturer's assembly instructions except for one modification: connect both the 100- μ fd. capacitor that comes with the FO-1L 100-kc. oscillator and the 0.01- μ fd. capacitor accompanying the FMV-1 multivibrator to the common r.f. terminal on the FO-1L board. This leaves two free wire ends, one on each of the capacitors. The free end of the 0.01- μ fd. capacitor will later join the input terminal on the FMV-1 board while the 100- μ fd. capacitor will be connected to the switch that selects *either* the 100-kc. or 10-kc. output. Solder the components according to instructions.

Step 2: Lay out and mark the positions

Layout of components above the chassis is shown at right; the OA2 regulator tube is in the left-hand corner, while the 6X4 rectifier is located between the filter capacitor and the OA2. In the photograph below, you can see the interconnecting wires and how the chassis looks installed in the cabinet, viewed from the top.

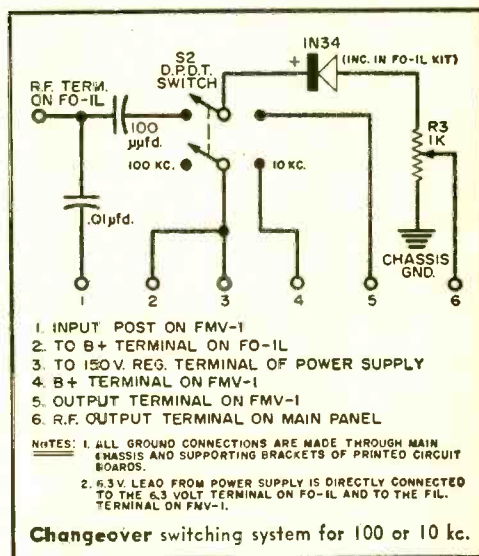


of the printed-circuit boards on the aluminum chassis. Group the power transformer (*T1*), filter capacitor (*C1*), OA2 regulator tube (*V2*), and 6X4 rectifier tube (*V1*) around the boards and mark their positions. Drill the cabinet panel for the two output terminals, the level control (*R3*), pilot light assembly, and the two switches (*S1* and *S2*). One additional grommeted hole should be drilled in the chassis between the panel and the FO-1L board to permit passage of connecting wires from the parts beneath the chassis to those aboveboard.

Step 3: Wire the power supply. The filter resistor (*R1*) and series resistor (*R2*) for the regulator are supported by solder lugs on the tube sockets and filter capacitor.

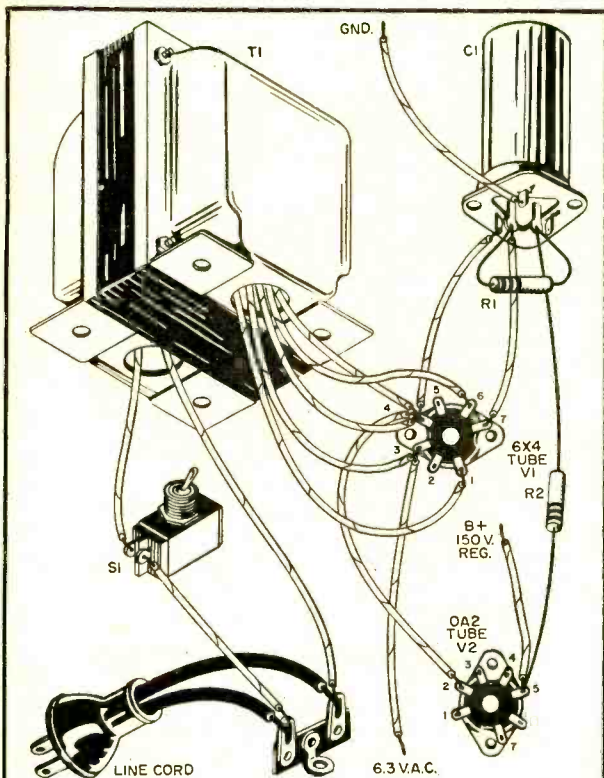
Step 4: Secure the printed-circuit boards to the chassis with the small screws and

September, 1957

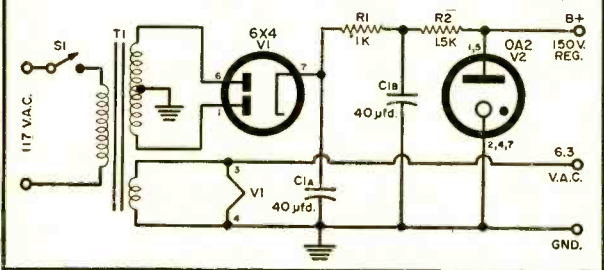


brackets that accompany the kit. Complete all the aboveboard wiring at this time. Insert the crystal in the FO-1L board socket, the 6BH6, and the 12AT7; be certain that the 6X4 rectifier and the OA2 regulator are in the correct sockets.

Testing and Adjustment. With the power off, couple the output terminal of the frequency standard to the antenna post of your short-wave receiver and join the ground terminal of your receiver to the ground post on the calibrator. Tune your



Pictorial and schematic diagrams for the power supply.



Bill of Materials

- 1—100-kc. crystal oscillator kit supplied with 6BH6 tube (Int. Crystal Co. Model FO-1L)
- 1—10-kc. multivibrator kit supplied with 12AT7 tube (Int. Crystal Co. Model FMV-1)
- C1—40-40 μ d., 250-w.v., dual filter capacitor
- R1—1000-ohm, 5-watt resistor
- R2—1500-ohm, 5-watt resistor
- R3—1000-ohm linear taper potentiometer
- S1—S.p.s.t. toggle switch
- S2—D.p.d.t. toggle switch
- T1—Power transformer, primary 117 volts, 60 cps, secondaries 250 volts @ 25 ma., 6.3 volts @ 1.0 amp. (Stancor PS-8416 or equivalent)
- V1—6X4 tube
- V2—OA2 tube
- 1—7" x 9" x 2" aluminum chassis
- 1—Black crackle steel cabinet, hinged top
- 2—5-way type binding posts, one black and one red
- 2—7-pin miniature Bakelite sockets for subchassis mounting
- Misc.—Bakelite pointer knob, Dialco 81410 pilot assembly, #47 bayonet-base, 6-volt pilot lamp, two-lug terminal strip, a.c. line cord, decals for trim.

receiver to the National Bureau of Standards transmitter at Station WWV; this station can be heard at any time of the day on 2.5, 5.0, 10, 15, 20, and 25 mc., and may be recognized by ticks that resemble those of a clock.

Set the changeover switch on the calibrator to "100 kc.," and turn the level control up to maximum. With proper operation, an audio beat note will be heard indicating that the 100-kc. oscillator is emitting a harmonic close to WWV's frequency. Adjust the trimmer capacitor on the FO-1L board for zero beat.

Now your BFO may be turned on while you check for the presence of 100-kc. marker signals throughout the band. After the initial test, you will want to reduce the output level of the crystal calibrator using potentiometer R3; it may also be advisable to loosen the coupling between the calibrator and the receiver.

To test the 10-kc. multivibrator section, set the changeover switch on "10 kc." and adjust the tiny potentiometer on the FMV-1 board for a locked-in condition. This is accomplished by rotating the shaft while listening to the beat note of the harmonic of the FMV-1 with either WWV or any standard broadcast station. The potentiometer is adjusted until the multivibrator locks at 10 kc. and produces a beat signal with the broadcast station of a few cycles per second. An S-meter is useful here because its slow visible oscillation tells you when zero beat is being approached.

Precise frequency measurements and receiver calibration procedures are outlined in the literature which forms a part of each of the kits. The success and satisfaction you have with this instrument depends in part on the way you handle it. The setting of R3 is important to avoid overloading your receiver and "swamping" the incoming signal. More output is required for the higher order harmonics, of course.



Transistor Topics

By LOU GARNER

WITH the hottest part of summer past and autumn just around the corner, chances are many POP'tronics readers have found that their fingers are starting to itch . . . that the old urge is returning . . . and that they get chills up and down their spines whenever they look in a radio parts catalog.

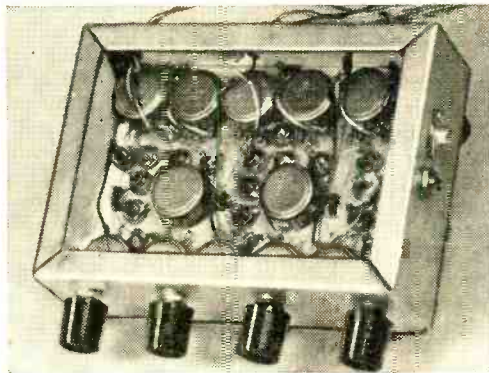
All of these sensations are symptoms of that old and rather pleasant ailment—"electronic builditis." A sure remedy is to choose a good project from your favorite magazine, gather together the necessary parts, heat up the old soldering iron—and start assembling. So why not start with a transistorized project?

Transistor Circuit Designer. Few thrills match that of creating and developing a completely new circuit. Unfortunately, transistor circuit design is not easy. There are so many variables to consider

that even a highly trained design engineer may have difficulty designing a circuit "on paper" that will work without changes when it is assembled.

But Dick Keller, of the Semiconductor Products Department of *General Electric*, has developed an instrument that should prove valuable in every electronics workshop. Dubbed a *Transistor Circuit Designer*, it will enable a fledgling to devise new transistor circuits with an ease approaching that of an "old hand." And you don't have to know . . . or to use . . . mathematics to operate the device! !

Basically, the circuit designer consists of a partially wired three-stage transistor circuit assembled on a 5" x 7" aluminum chassis (see Fig. 1 and the photos). Sockets are provided for each transistor, with small potentiometers used for all resistive elements. Six potentiometers are available



Below-chassis view of Dick Keller's transistor circuit designer. See Fig. 1, on following page, for the schematic diagram of the gadget.

Using the circuit designer, even a beginner can create new transistor circuits.

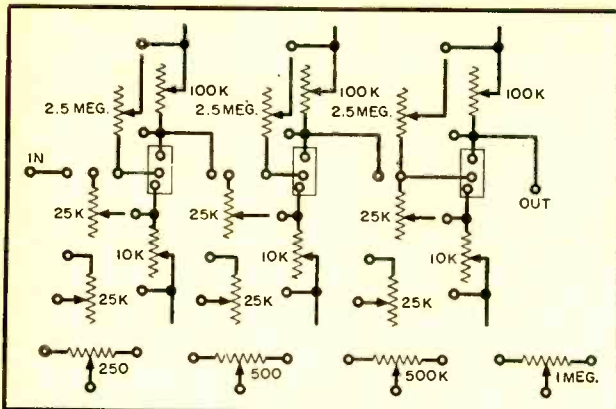


Fig. 1. Schematic diagram of the circuit designer. Small potentiometers are used for all resistive elements.

Fig. 2. Two-transistor receiver circuit, submitted by reader Roy Frank. It utilizes complementary properties of n-p-n and p-n-p transistors.

for each stage. Instead of trying individual resistors one at a time, the best value can be determined simply by adjusting the appropriate pot.

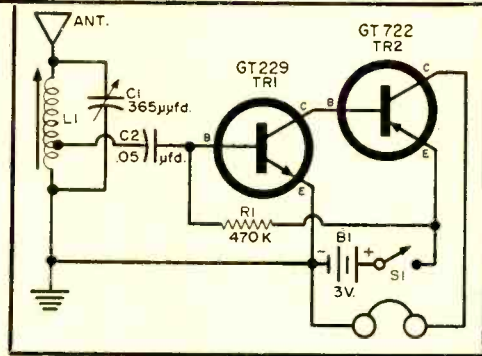
The transistor electrodes may be returned to either polarity of the external battery power supply and even reversed from one stage to the next for *n-p-n/p-n-p* configurations. Pin jacks are used for each terminal connection, making it a simple matter to insert capacitors, transformers, coils, diodes, or other special components into the circuit being designed.

In operation, a tentative circuit is assembled by interconnecting appropriate pin jacks with short wire leads. Afterwards, the emitter, base, and collector resistor values may be adjusted experimentally simply by rotating the proper potentiometer. Once the desired circuit operation is achieved, the resistance values may be measured and fixed resistors specified in the final design.

If there is any question concerning circuit stability or transistor interchangeability, the necessary tests may be made while the circuit is still in the experimental stage. Parts changes, if required, can be made before the circuit design is "frozen."

Reader's Circuit. An interesting two-transistor receiver circuit utilizing the complementary properties of *n-p-n* and *p-n-p* transistors is given in Fig. 2. The basic circuit design was submitted by reader Roy Frank, of 4783 Fair Ave., Oakland 19, Calif., and the transistor types specified are manufactured by *General Transistor*.

L1 is a ferrite transistor antenna coil (*Lafayette* No. MS-299). *C1* is a standard 365- μ fd. variable capacitor and *C2* a 0.05- μ fd. paper or ceramic capacitor. *R1* is a 470,000-ohm, 1/2-watt carbon resistor, *S1* a s.p.s.t. toggle or slide switch and *B1* two penlite cells connected in series to supply three volts. Standard moderate-to-high-impedance (2000 to 4000 ohm) magnetic headphones are used with the receiver. A medium-length external antenna is



needed in most localities, but a ground is not necessary for the reception of nearby stations.

You can assemble this simple receiver on a small metal chassis or in a wooden or plastic box. Parts layout and lead dress are not critical. For optimum operation, you may want to experiment with the values of *C2* and *R1*. Try values from 100 μ fd. to 0.05 μ fd. for *C2*, values from 250,000 ohms to 1 megohm for *R1*. Choose the final values which give the best results with your individual transistors.

In operation, r.f. signals picked up by the antenna (*Ant.*) are selected by tuned circuit *L1-C1*. *C1* may be adjusted to tune the desired station. A tap on *L1* permits a match to the comparatively low input impedance of the first stage and prevents excessive loading of the tuned circuit. *C2* serves as a d.c. blocking capacitor for the base bias current supplied through *R1*. Amplification and detection occur in the two-stage direct-coupled transistor amplifier.

In Other Lands. We've received a note from Mr. R. V. Parrett of Ellison Queale Radio Supply, Ltd. (1205 Quadra St., Victoria, B. C., Canada), who would like us to "pass on the word" that Canadian readers can obtain transistor components and sup-

(Continued on page 142)



Among the Novice Hams

By HERB S. BRIER, W9EGQ



ALL AMATEUR RECEIVERS and transmitters require power supplies, which are normally operated from the commercial power lines. In addition, a knowledge of how power supplies operate is required to pass the General Class, Conditional, and Technician license examinations.

The following discussion refers to Fig. 1, which is a basic diagram of a typical a.c.-operated power supply.

The Power Transformer. One-hundred-seventeen-volt, 60-cycle current is fed into the primary winding of power transformer *T1*, which consists of several windings on a laminated iron core insulated from each other. A typical receiver or low-power transmitter transformer has a core with a cross-sectional area of around two square inches and a primary winding of about 350 turns, or three turns per volt. More powerful transformers have larger cores and fewer turns per volt.

Of course, 350 turns of wire on an iron core have quite a bit of inductance. Thus, when 60-cycle a.c. is fed into it, a strong alternating magnetic field is generated around it. This field, in turn, induces a counter voltage in the primary winding which is just a quarter cycle behind the original voltage. Consequently, the two voltages cancel each other almost com-

pletely, and only a small current is forced through the primary winding.

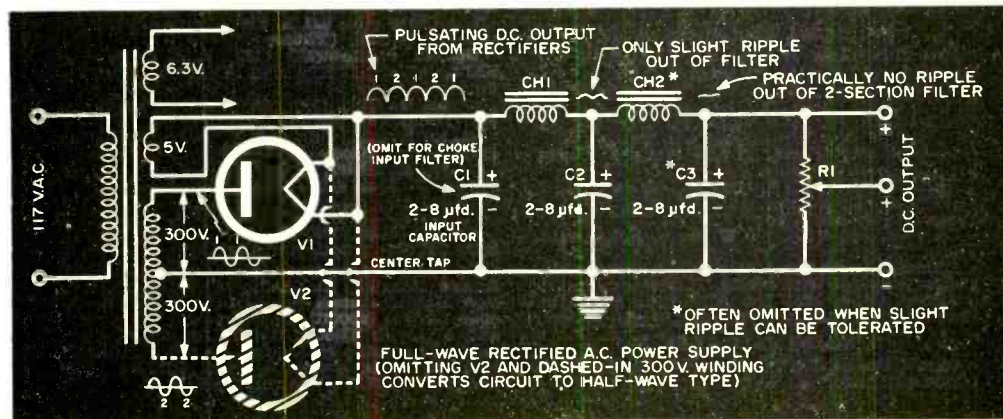
As the other windings on the transformer are within the magnetic field also, it induces a voltage in each of them proportional to the number of turns they contain. Three secondary windings, delivering 5, 6.3, and 300 volts, are shown on *T1* (considering half of the longest secondary). At three turns per volt, they must have 15, 19, and 900 turns respectively.

As soon as power is drawn from any of these secondary windings, it is subtracted from the surrounding magnetic field and reduces its strength slightly. As a result, the counter voltage in the primary winding decreases just enough to allow sufficient current to flow into the transformer to replace the power drawn out of it.

Remember that you cannot take more power out of a transformer than is fed into it. Do not confuse *voltage* with *power*. While adding turns to a secondary winding will increase its output voltage, the current that can be drawn from that winding will be reduced in exactly the same proportion, unless additional power is fed into the primary winding.

Rectification. *V1* is a diode tube, consisting of a plate and a filament/cathode inside a glass envelope from which the air

Fig. 1. Basic diagram of a typical a.c.-operated power supply as discussed in the text.



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, 366 Madison Ave., New York 17, N. Y. Please print your name and address clearly. Names are grouped geographically by amateur call areas.

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To help prospective amateurs obtain their Novice licenses, the Radio-Electronics-Television Manufacturers Association offers a set of code records (recorded at a speed of 33½ rpm) and a Novice Theory Course for \$10.00, post-paid. The complete course or more information on it is available from RETMA, 1721 DeSales St., N.W., Washington 6, D. C.

is pumped to create a high vacuum. Normally, a vacuum is an excellent insulator, because it contains few electrons to be set in motion by an applied voltage. But, when an electric current is passed through the filament/cathode from a winding on the transformer, it becomes so hot that a copious quantity of electrons is boiled out of it.

Under these conditions, when a positive voltage is applied to the diode plate, it attracts the electrons toward it, allowing the tube to pass current. But, if a negative voltage is applied to the plate, the electrons from the cathode are repelled; so no current passes in that direction.

As the transformer is feeding 60-cycle a.c. to the diode plate, driving it alternately negative and positive, 60 pulses of current a second pass through *V1*, thereby converting the a.c. into pulsating d.c. This process is called rectification and the diode a half-wave rectifier.

Half-wave rectification is seldom used, except in inexpensive a.c./d.c. receivers, because it is difficult to smooth out its stop-and-go output pulses. However, by extending the high-voltage secondary winding on *T1* past the center tap indicated and connecting its open end to the plate of a second half-wave rectifier *V2* (the filament/cathode terminals of which are connected to those of *V1* as shown in dashed lines on the diagram), a full-wave rectifier is formed.

Through this back-to-back connection, each half of the alternating current cycles produces an output pulse from the rectifier system, resulting in 120 output pulses a second instead of 60.

Filters. The next step in converting a.c. into pure d.c. to power a receiver or a transmitter is to steam-roller it smooth by passing it through a filter system.

The simplest filter is a large capacitor (*C1*) connected across the power supply output terminals. Each pulse from the rectifiers charges up *C1* to almost the peak voltage of the pulse as well as feeding current into the load circuit. In between pulses, current flows out of *C1* into the load to fill in the valleys between pulses.

For additional smoothing, a high-inductance filter choke (*CH1*) and another ca-

pacitor (*C2*) may be added. The choke skims the peaks off the incoming pulses, converts the energy they contain into a magnetic field around itself, and then converts this energy back into electrical current that flows into the load between pulses. *C2* provides additional filtering action and also acts as a reservoir to supply heavy instantaneous current demands of the load circuit. Additional filter sections may be added to the supply for still more filtering if necessary.

A capacitor input filter delivers an out-



Neil, KOELS, operates at Lexington, Nebraska. Not shown here are his 15-meter directional antenna and doublets for 40 and 20 meters.

put voltage almost equal to the peak value of the input pulses at light current loads. But its output voltage drops off rapidly as current drain increases. In addition to poor voltage regulation, several times as much current flows into the input capacitor on each pulse from the rectifier as flows into the load. Consequently, such a filter makes the rectifier tube work quite hard.

Omitting the input capacitor (*C1*) converts the filter into a choke input type. This drops the output voltage to about two-thirds of the capacitor input value; however, the voltage will remain quite constant for any current drain within the ratings of the supply. Also, the peak current demand on the rectifier system is reduced to little more than the current actually drawn out of the supply by the load circuit.

Capacitor input filters are mostly used in power supplies delivering up to about 500 volts at 200 ma. in applications where poor voltage regulation under varying current loads is not too important. A choke input filter is almost always used in higher volt-

(Continued on page 136)

Sound Impressions

THE SNOWBALLING of hi-fi into a national sport has proved Americans to be one of the world's most musical people. That vast numbers of people, through hi-fi, have taken to music like the proverbial duck to water, is only part of the story. Music, after all, is always an individual experience that can't be expressed in numbers.

What really counts is the high percentage of hi-fi'ers to whom music has become something deeply important, personal, and profound. It's a safe bet that there is a greater proportion of more really appreciative listeners among hi-fi fans than among the run-of-the-mill concert-goers.

Getting "Inside." The hi-fi'ers' quest for tonal detail and fine orchestral color forces him to pay attention to what's going on in the music. For what's the use of the best hi-fi system and the most splendid recording unless you really listen closely?

It is through the habit of such careful and intense listening that hi-fi fans not only admit the mere sound of music into their ears, but—perhaps unwittingly—also the deeper meaning of the works they hear. Hi-fi helps them to get *inside* the music emotionally as well as acoustically. One thing is certain: hi-fi has awakened the musicality of the American people on a nation-wide scale.

This evidence of America's musical appetite should make American composers

very happy, for they have been hungry a long time. Nobody wanted to take a chance on their work. But record companies now realize that hi-fi'ers are a generally open-minded bunch who like to get off the track to explore the unknown.

Columbia Records has done pioneer work in bringing to the American record buyer the music of his own country. Other companies are also waking up to the fact that there is plenty of first-rate music now composed in America—serious, solid works of art that speak the language of our time. Several such works are making their disc debut this month.

Native Masterworks. From California comes a new *Piano Concerto* by Leon Kirchner. It is a powerful work, proportioned with dignity and grandeur; earnest, yet basically lyric. Emotionally vital and expressive, it stands in contrast to the arid withering that afflicts so much of modern music.

There are no empty show-off solos in this concerto. Orchestra and piano interplay as equals in the score, sounded with skill and conviction by the composer at the piano and the New York Philharmonic under Mitropoulos backing him up with their very best. The sound quality of this Columbia disc (ML-5185)—sharp and clear, yet full-bodied—does full justice to the score and the performers.

Another new American work, Walter
(Continued on page 108)



Goddard Lieberman, President of Columbia Records, believing that living American composers should get a hearing on discs, has pioneered recordings of contemporary works. Here he is testing a special sound-effects setup.

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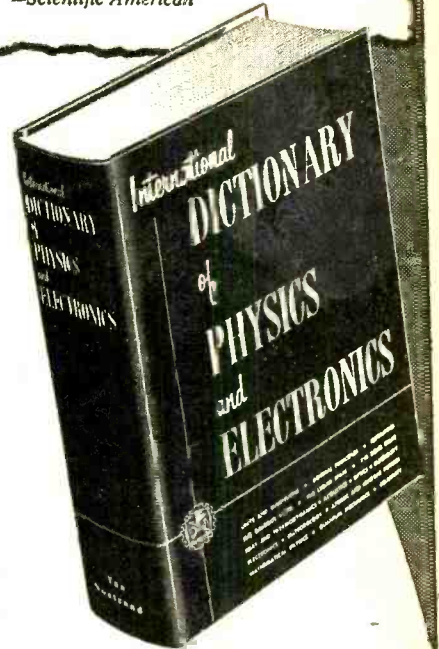
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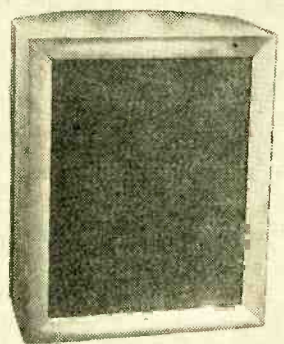


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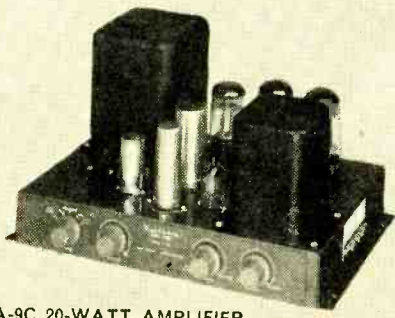
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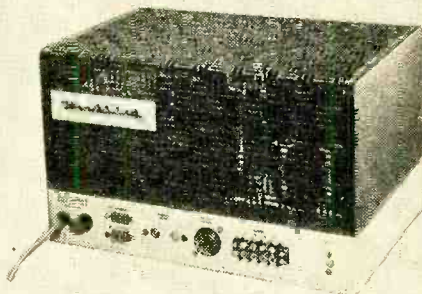
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A new concept in radio reception! Now you can forget about external electrical connections and have fine radio performance anywhere! Low-drain circuit using regular flashlight cells makes battery operation cheaper than power-line operation of table model sets. Tunes 550 to 1600 kc and features a 4" x 6" speaker for "big-set" tone, six Texas Instrument transistors for fine sensitivity and selectivity, built-in rod-type antenna, and unbreakable molded plastic cabinet in "Holiday" gray. Measures 9" L x 8" H x 3 3/4" D. Appearance and performance are unmatched at this price level. Easy to build! Shpg. **\$34⁹⁵** Wt. 4 lbs.

Model XR-1

(with cabinet less batteries)

HEATHKIT BROADCAST BAND RADIO KIT

Covers 550 to 1600 kc with good sensitivity and selectivity. Has 5 1/2" PM speaker for good tone quality. Features transformer power supply and built-in antenna. Signal generator recommended for alignment. Cabinet, as shown, available separately. Shpg. Wt. 10 lbs.

Model BR-2

\$18⁹⁵

(less cabinet)

HEATHKIT CRYSTAL RADIO KIT

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

Model CR-1

\$7⁹⁵

HEATHKIT ENLARGER TIMER KIT

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

Model ET-1

\$11⁵⁰



TABLE-MODEL RADIO

CRYSTAL RADIO

ENLARGER TIMER

HEATHKIT FUEL VAPOR DETECTOR KIT

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

6-volt FD-1-6,
12-vt. FD-1-12
\$35⁹⁵
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
\$14⁹⁵

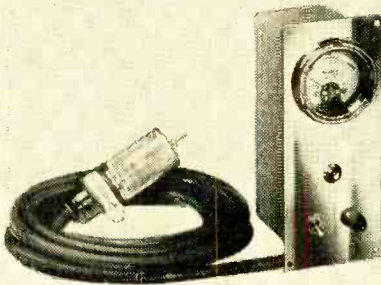
HEATHKIT TRANSISTOR RADIO DIRECTION-FINDER KIT

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 5⅞" D. Supplied with slip-in-place mounting brackets, which allow easy removal from ship bulkheads or other similar places. Shpg. Wt. 4 lbs.

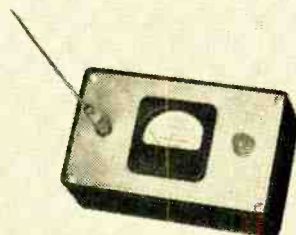
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HEATHKIT



DX-20 TRANSMITTER



RF SIGNAL GENERATOR



GRID DIP METER



HANDITESTER

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

Model DX-20
Shpg. Wt. 18 lbs. **\$35⁹⁵**

HEATHKIT GRID DIP METER KIT

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

Model GD-18
Shpg. Wt. 4 lbs. **\$19⁹⁵**

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. Preamigned coils eliminate the need for calibration after completion.

Model SG-8
Shpg. Wt. 8 lbs. **\$19⁵⁰**

HEATHKIT HANDITESTER KIT

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

Model M-1
Shpg. Wt. 3 lbs. **\$14⁵⁰**

HEATHKIT ETCHED-CIRCUIT VTVM KIT

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

Model V-7A
Shpg. Wt. 7 lbs. **\$24⁵⁰**

HEATHKIT ALL-BAND RADIO KIT

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

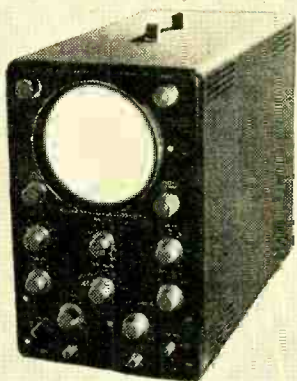
Model AR-3
Shpg. Wt. 12 lbs. **\$29⁹⁵**

(less cabinet)

HEATHKIT "GENERAL PURPOSE" 5" OSCILLOSCOPE KIT

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

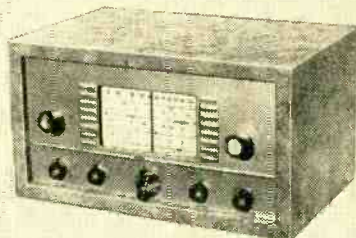
Model OM-2
Shpg. Wt. 21 lbs. **\$42⁵⁰**



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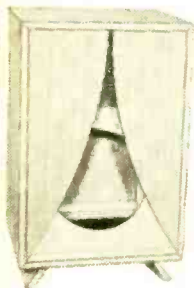
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After Class

(Continued from page 79)

two distinct warnings: do not exceed the rated current for any extended period of time and *do not use a radio-type selenium rectifier with step-up power transformers*, unless you take steps to extend the working-range.

Series or Parallel Systems. Units may be connected either in series to increase their voltage range (Fig. 5A) or in parallel to improve their current handling ability (Fig. 5B). Polarity must be observed at all times.

An additional point worth keeping in mind is that there is approximately 5 volts of drop across each selenium unit in the series connection; these add up and may play havoc with the voltage regulation of such a power supply if too many elements are included in the series circuit. In our example of the parallel connection, two 500-ma. seleniums provide a total load current up to one ampere. The author has used ten of these 500-ma. units in a circuit where the current demand was a continuous 5-amp. drain—with no ill effects.

Surge Resistor. A resistor of low value—5 to 22 ohms, depending upon the particular rectifier—is always encountered in series with a selenium stack (Fig. 6). *This resistor must never be omitted.*

When the equipment is first turned on, the uncharged filter capacitor *C* behaves like a hungry rhinoceros with its maw wide open to gobble up its fodder—coulombs in this case. If this large surge current were allowed to flow into the capacitor with only the resistance of the selenium rectifier in the way, it would reach enormous values instantaneously. The heat generated might be more than

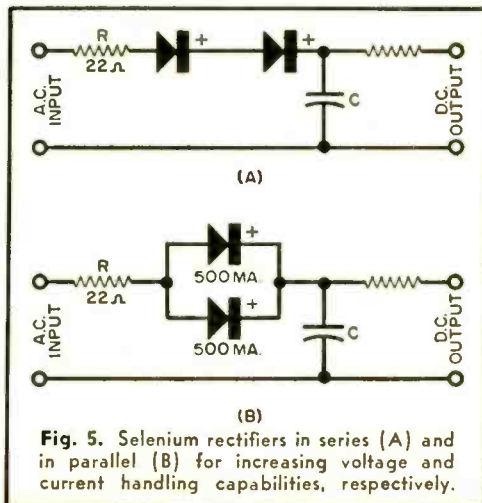
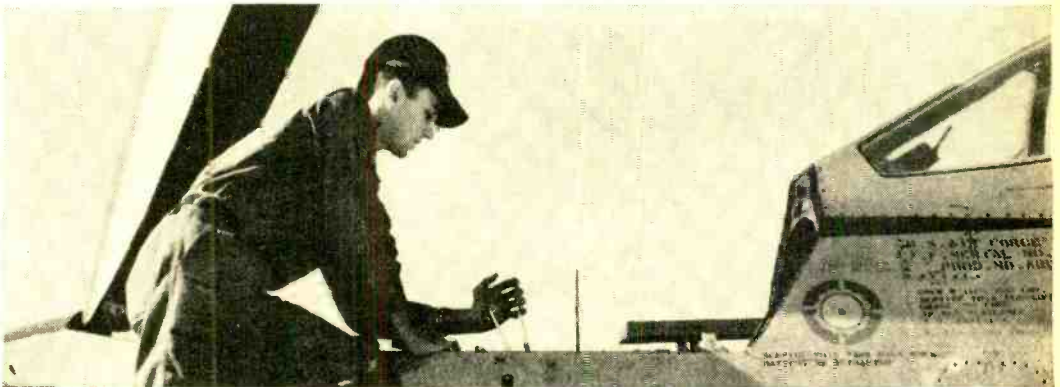


Fig. 5. Selenium rectifiers in series (A) and in parallel (B) for increasing voltage and current handling capabilities, respectively.

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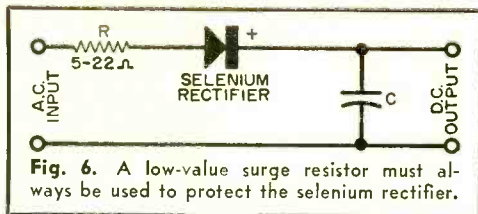


Fig. 6. A low-value surge resistor must always be used to protect the selenium rectifier.

enough to destroy the barrier layer. Resistor *R* limits the surge current to a safe figure. After the first few cycles, the capacitor takes on full charge and the current through the selenium then becomes a steady value equal to the load current of the device being operated by the rectifier.

The surge resistor is also an inexpensive fuse that protects the costlier selenium rectifier if a short circuit develops.

Duplex Power Supply. In Fig. 7, a low voltage isolation transformer (Stancor PA-8421) provides protection against the ever-present shock hazard and at the same time makes available a 6.3-volt secondary for heaters of tubes. Two selenium rectifiers are so connected that they supply either +135 volts or -135 volts with respect to the zero level terminal.

These voltages are ideal for circuits in which positive plate and screen voltages are needed in addition to negative bias voltages. Two wire-wound potentiometers provide control of voltage level for testing many types of small devices, such as photo-relays, timers, bridge circuits, transistorized apparatus, etc. And the output voltage may be doubled by taking it from the -135 and +135 volt terminals, with the former acting as the zero level point.

Threshold Voltage. A minimum voltage is required to make a selenium rectifier conduct in the forward direction. Most authorities agree that a good average is one volt. Under most temperature conditions, a selenium rectifier will pass no current at all until the applied e.m.f. exceeds this value.

-30-

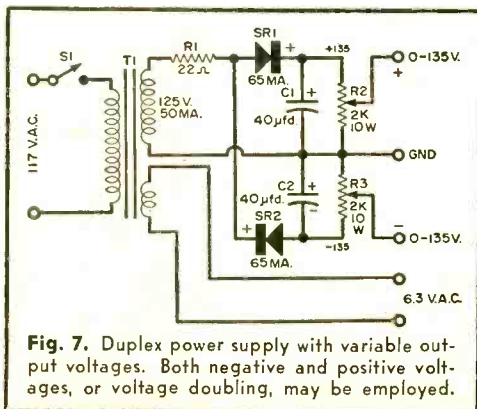
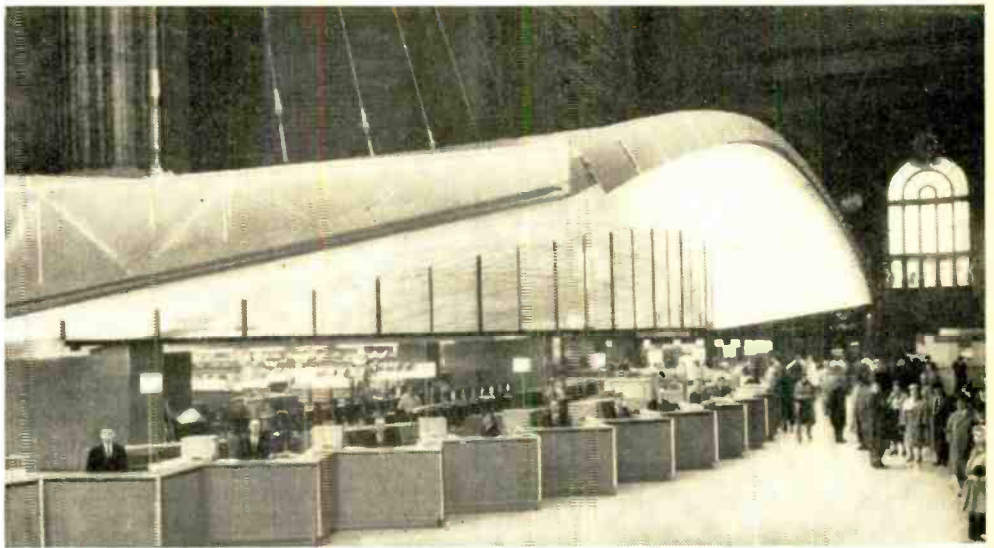


Fig. 7. Duplex power supply with variable output voltages. Both negative and positive voltages, or voltage doubling, may be employed.



TV Speeds Up Ticket Sales

THE WORLD'S LARGEST closed-circuit television installation at Pennsylvania Station, New York City, has cut down ticket selling time to two minutes. Where once customers waited for reservations an average of eight minutes, and the clerk made two phone calls, this Dage system of 105 cameras and 100 receivers has not only cut down on time, and phoning, but has also pared errors to a bare minimum. Here's how it works:

Say that a customer at any one of the ticket counters (above) wants a bedroom to Chicago. The seller (lower left) switches to the "space availability chart" for Chicago trains, which shows by symbol all space on Chicago trains for 14 days. After the traveler makes her choice, the agent tunes to a space distribution clerk and asks for the specific reservation over the microphone. The latter picks the ticket from a rack (lower right) and puts it into a facsimile

transmitter. In seven seconds the facsimile is at the ticket counter. The agent attaches the fare coupon and rail ticket, collects, and in two minutes the sale is completed.

There are variations of the system for telephone, branch office sales and firms who subscribe to "direct wire" ticket service, but essentially it works in the same way—direct view of the "availability chart" via TV camera and receiver. In building the office, which is the largest such sales room in the world and a block long, more than 400,000 electrical connections were made to bring the whole assemblage of TV units, lights, intercoms, telephones, facsimile machines and electronic longhand writing instruments into a coordinated and smoothly functioning system. It uses 170 miles of wire and cable in the net. The bureau is tied in electronically with other offices as well as local offices of connecting railroads, and by facsimile to Philadelphia. —30—



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Sound Impressions

(Continued from page 96)

Piston's *Symphony No. 6*, makes its disc debut on Victor LM-2083. The symphony, though big in scope, is lighthearted in spirit. A basically serious, yet lighthearted symphony is something rare. Here is humor, but no comedy; feeling, but no pathos; order, but no pedantry. These are marks of a truly civilized man speaking his mind in music. Walter Piston thus eloquently bespeaks America's musical maturity.

The performance by the Boston Symphony Orchestra under Charles Munch is evidently a labor of love. The engineers also earned themselves special praise for magnificently natural sound—balanced and yet detailed—foregoing the easy temptations to "sensationalize" the sound of the colorful orchestration. More of this kind of recording will add to the musical integrity of hi-fi.

American Sidelights. As its title suggests, *Adventures in a Perambulator*, a tone poem by John Alden Carpenter, is conceived on a less exalted plane of artistic endeavor. Yet the baby buggy rolls along very melodiously, encountering the musical pictures of playful dogs, policemen flirting with the baby's nurse, and other impressions of a stroll in the park. This quaint and nostalgic picture of a more leisurely America of bygone years is drawn with affection by Howard Hanson, conducting the Rochester Symphony Orchestra, and cleanly engraved on Mercury MG-50136.

The back side of this record features another piece about American childhood: Burrill Phillip's *Selections from McGuffey's Reader*. Yet there is nothing childish about this music. Its composer attempts to portray what he considers to be "universal characteristics of us as a nation: a certain naive strength of moral fiber, some sentiment verging on the sentimental, love of movement, and grand gestures and attitudes." On reading his notes and hearing the music, one almost wishes Mr. Phillips were a writer instead of a composer.

In the light vein, one of America's most popular composers is Leroy Anderson, an attractive hybrid of juke-box and concert hall. His unpretentious but appealing little pieces, such as *Penny-Whistle Song*, *Sleigh-Ride*, *Bugler's Holiday*, etc., are paired with his charming *Irish Suite* on Mercury MG-50130 (*The Music of Leroy Anderson*). Frederick Fennel conducts the Eastman-Rochester "Pops" on this sprightly disc. The sound has Mercury's wanted


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Men from Missouri. Not only American composers but American performers are featured prominently in recent record releases. As orchestras throughout America are developing the professional polish demanded by hi-fi-conditioned audiences, the large cities of the eastern coast no longer have a monopoly on first-rate music. For instance, Columbia set up mikes for the St. Louis Symphony, turned tables on the men from Missouri (turntables, of course) and said "show me."

The result is a new recording of the *First Symphony* by Shostakovich, (ML-5152) a youthful work which the composer handed in as a sort of "term paper" to the Leningrad Conservatory when he was 17 years old. Thanks to its durable freshness and the undisguised intensity of its feeling, this symphony has become one of the most popular pieces of music written in our own time. The sweep of its soaring lines is punctuated by witty impertinence and hard-biting satire. The latter element stands out in conductor Golschmann's performance. Columbia's recording underlines his acerbic clarity of sound.

Another performance proving that St. Louis is musically pitching in the major leagues is on Columbia ML-5155. It features Ravel's sweet-and-sour "*Valses Nobles et Sentimentales*," which might perhaps be translated as "Straight and Swooshy Waltzes." These small gems sparkle in their polished orchestration, which lends itself willingly to Columbia's rather brittle tonal treatment. On the other side, Debussy's *La Mer* paints impressions of the sea in pellucid pastel.

F.O.B. Detroit. More evidence that Midwesterners are musically becoming citizens of the world comes from Detroit, whose Symphony Orchestra gives finely wrought and excitingly paced performances of Bizet's typically French music on Mercury MG-50135. Of course, the fact that they have a French conductor in the person of Paul Paray helps the Michiganders to capture the fervor of *Carmen* in the orchestral suite from the opera, and add convincing accents to the starkly beautiful folk themes of the *Arlesienne Suites 1 & 2* (both on a single side).

This simple, immediately appealing music has been a top hit for about 80 years, and this fine recording is bound to win it new friends still. It is highly recommended to hi-fiers of every taste.

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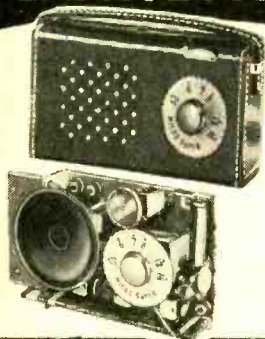
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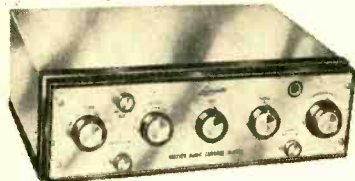
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Building the "Hi-Five"

(Continued from page 69)

ing holes and screw the assembly to the baffle. The connecting wires from the tweeter may be brought out through the box by means of small bolts and lugs. Each hole drilled through the plastic should be of the same diameter as the bolt or screw put through that hole in order to prevent air leaks. Carefully seat the box edges in the grooves, and you'll have an airtight compartment that provides ready access to the tweeters at any time.

Accessibility to the other speakers may be accomplished by not using glue on panel *D* or on the rear brace *J*. The brace may be cut from any convenient leftover, specifically from the excess of *C* if you cut *C* from a triangular section. Screw the brace to *D* from the inside before *D* is in position. Then, after screwing *D* to the top and bottom glue blocks, put the final screws up through the bottom to fasten *J* in place. If you haven't planned the location of *J* and the rear foot so that they are offset from one another, you may have trouble getting screws to go in both directions.

This completes assembly of the cabinet except for the grille, moulding, and internal padding. The labyrinth should be padded, but the amount of padding depends on several factors—mainly on how you like it. Keep the padding symmetrical with regard to the mid-range speakers.

Selecting Speakers. The Sherwood crossover network was designed to be used with 16-ohm speakers, but a slight mismatch will not be noticeable with most modern amplifiers (especially if they have damping controls). Actually, the use of an 8-ohm woofer will result in a few db of boost in the range below 300 cycles, producing an effect that many people will like. The 8" speakers should be 8-ohm units—to make 16 ohms when wired in series—but again perfect matching isn't essential.

This network has a rather sharp cutoff of 12 db per octave beyond the crossover points, but the manufacturer recommends that the speakers selected should have undistorted response at least one octave beyond the crossover frequencies. Thus, the requirements for the 8" speakers include undistorted response from 150 to 10,000 cycles, which shouldn't be hard to meet. Use of two speakers for the mid-range and treble reduces the distortion still further.

Substitutions. For best results, a 15" woofer is recommended for this enclosure, but there is no reason why you can't substitute a 12" speaker if you have one on hand. Or two ten's or twelve's might be

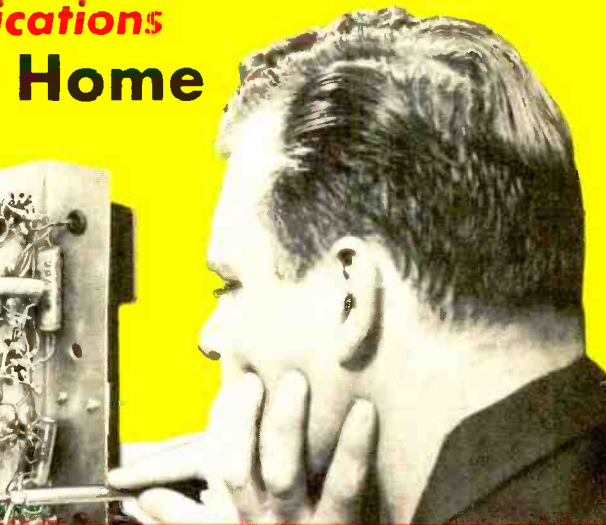
(Continued on page 118)

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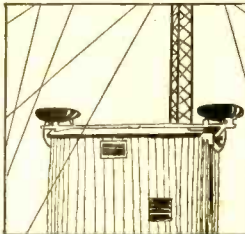
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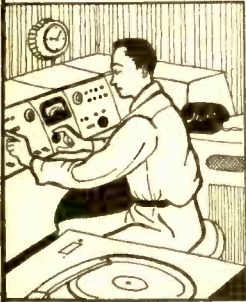
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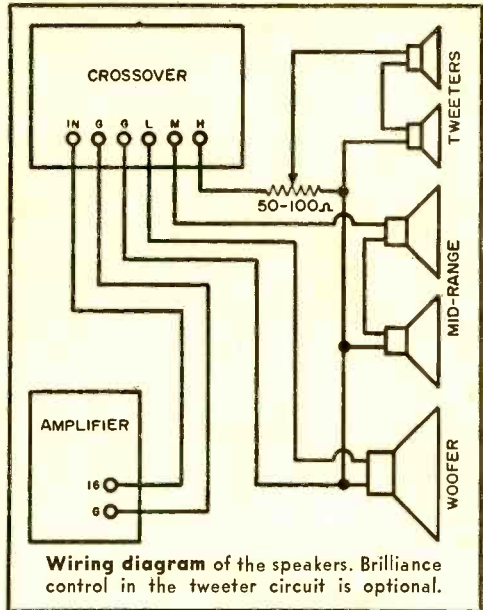
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—30—

Radio Keeps You in Touch

(Continued from page 44)

munication in shielded areas such as streets lined with tall buildings.

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(Continued on page 122)

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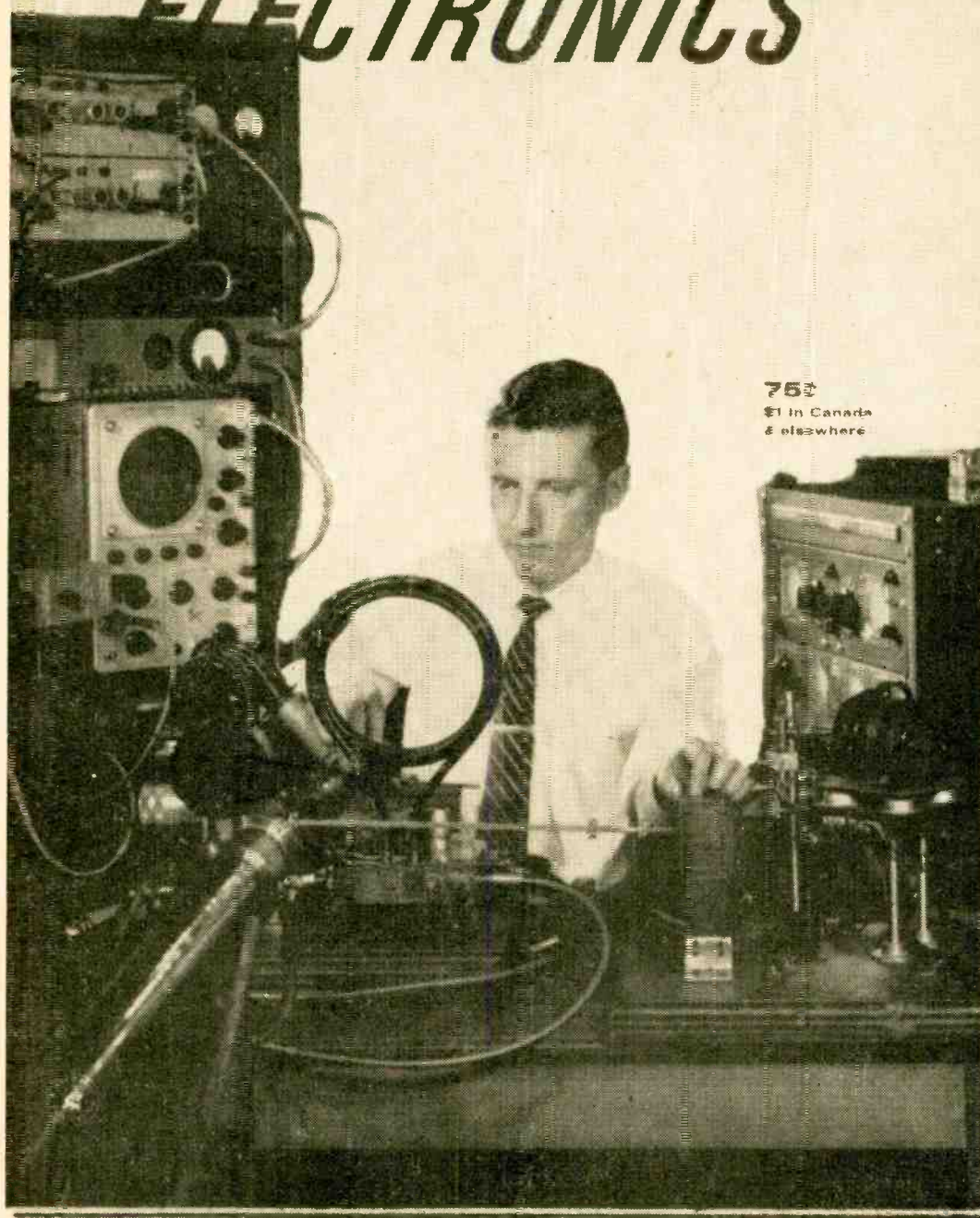
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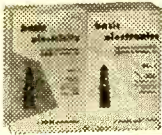
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Radio Keeps You in Touch

(Continued from page 118)

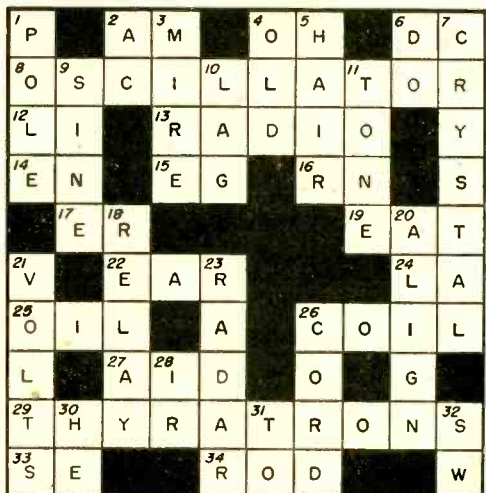
When you hear your office call, you pick up the microphone, press the button on it and talk. When you are through, you release the button to hear the incoming message. The base station operation is similar, except that a desk-type microphone is generally used. Telephone handsets may be used in place of microphones.

Specific frequencies are not assigned in Citizens Radio. You can order your equipment for any frequency in the band. If you find that someone else's system interferes with yours, you may have your frequency changed.

No operator's license is required. To get your station license, fill out and mail FCC Form 555 to the nearest FCC field office or to the FCC in Washington. Your equipment must meet FCC approval.

Mobile Telephone Service. Just as the name implies, this means a telephone in your car. Similar to ship-to-shore radiotelephone, the system is operated by the local telephone company and makes a phone booth of your car. Under the dash there is a control unit with signals to light when power is on, a bell and a hand phone which fits into a hanger on the unit. When you are called, the bell rings, a "call" light goes on and you pick up the handset, press the button in it and talk—just as simply as if you picked up your home phone. The latest addition is a "dial-direct" system by Du Mont, which allows direct dialing in the local phone network.

In the trunk of the car, there is a v.h.f. transmitter, receiver, power supply and dialing decoder. A short antenna is mounted on the car roof, and sometimes an



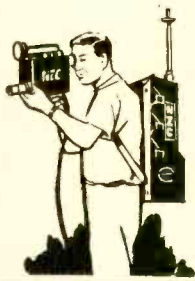
Solution to crossword puzzle appearing on page 82.

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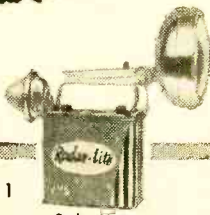
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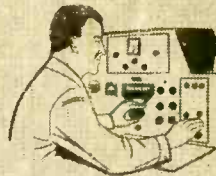


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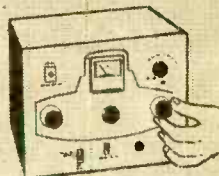


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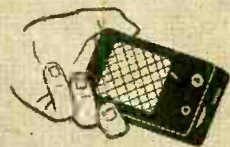
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ELECTRONIC DEVICES



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Prices of Basic Electricity and Basic Electronics, 5 volume training courses, published by John F. Rider, 116 West 14th Street, New York, were incorrectly listed in an ad appearing in the July issue of POPULAR ELECTRONICS. The correct prices are: Basic Electricity, \$10.00 per 5 vol. set; Basic Electronics, \$10.00 per 5 vol. set. Soft cover.

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oversize generator is furnished to take the added load from the battery.

By picking up the handset and pressing the push-to-talk button, the driver can signal the phone exchange. When the operator answers, he gives the number of the phone he wants to reach, identifies his own unit by number, and the call is placed. Calls to mobile units can be placed from any telephone or from similar mobile installations.

To sum up, this system is essentially the same as an ordinary phone installation, with radio being used in place of phone wires. Generally the phone company has one transmitter in the headquarters building, with several receiving stations at strategic locations. Transmitting and receiving stations are connected by telephone lines to the central office.

The range of the system is generally confined to the 15 to 25 mile radius of the transmitter. The service is on a "party line" basis, with several subscribers using the same channel. Charges for such service in a large area of the country (including such cities as New York, Cleveland, Chicago, Philadelphia, Los Angeles and Dallas) are \$50 for initial equipment installation and \$32 monthly. The monthly cost includes maintenance as well as a minimum charge which pays for 15 to 20 calls. Additional calls cost 30 cents or more, depending on distance and length of conversation.

Other Services. There are, of course, other services. These, however, will only be mentioned, since they ordinarily are not available to the private individual. *Private Two-Way Radio, Licensed* includes police, taxis, railroads, bus lines, utilities and pipeline companies who have for years used their own mobile sets. *Amateur Radio Mobile Service* is ordinary amateur radio moved into the air. An operator's license is needed, which limits the latter service to relatively few people. Note that while Citizens Radio is open to any citizen for private or commercial use, Amateur Radio Mobile Service is strictly limited to personal use with no profit motive.



The "Challenger" (Continued from page 87)

side of the *Machine* button to chassis ground and the other side to the negative end of the 12-volt relay coil (*RL1*).

Adjustment of Timing. Timing of the machine's response is controlled by the setting of potentiometer *R1*. Allow the unit to warm up and then rotate *R1* until you see relay *RL2* pull in. Back off *R1*

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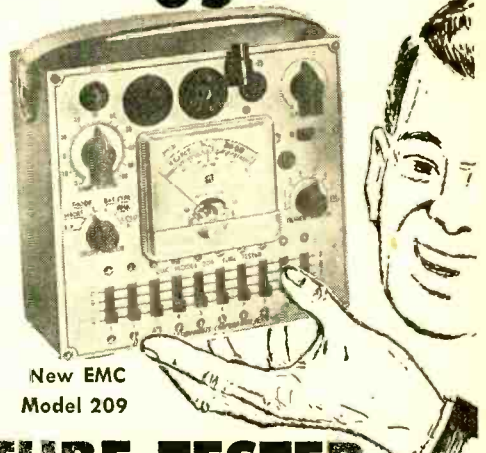
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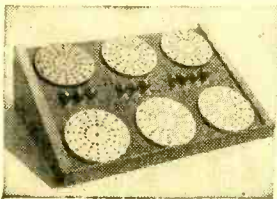
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Palley's

AUTO-RESPONSE CIRCUIT

With the *Player* button up in its normal position, *C4* in the grid circuit of *V1* charges negatively on the grid side via the wiper of *R1*, contacts *D* and *E* of *RL3*, and through *R2*. This keeps the plate current of the tube at cutoff so that *RL2* is not energized. *RL3* is also de-energized because current cannot flow through its coil while the *Player* button is released.

When the *Player* button is depressed, current flows through the coil of *RL3* to contacts *A* and *B*, thence to ground. As *RL3* pulls in, it latches closed due to the continued current through the holding contacts *B* and *C* of *RL3* and *A* and *B* of *RL2*. When *RL3* pulls in, however, contacts *E* and *F* connect the top of *C4* to ground through *R2* and *R3*, causing it to discharge slowly. When the grid potential of *V1* loses enough of its "negativeness," plate current flows through the coil of *RL2* and energizes it.

Contacts *E* and *F* of *RL2* now operate the machine just as though the *Machine* button had been depressed. At the same time, contacts *A* and *B* on *RL2* open up and release *RL3*. A fraction of a second after this release, *C4* again charges to cutoff through contacts *D* and *E* of *RL3*, causing *RL2* to open and stop the machine's play. The charging rate of *C4* which restores the cutoff condition is intentionally slowed down slightly by including *R2* in the charging path; this gives *RL2* enough "down time" to complete the machine's move. With the release of both *RL2* and *RL3*, the timing cycle is complete.

until the armature releases in a positive manner, and leave it this way.

To check the operation of the auto-response section, advance the light to any position by pressing the *Player* button three times. On the very first operation of the *Player* button, *RL3* should instantly pull in and latch for about four seconds. At the end of this interval, *RL2* should pull in, advance the lights according to the machine's choice, then quickly drop out. In addition, as *RL2* is activated, *RL3* should instantly drop out, completing the cycle.

If the machine tends to react too soon after the *Player*'s move, the timing interval may be lengthened by adjusting the setting of *R1*.

—50—

Frost Sentinel

(Continued from page 56)

reach 32° F about five minutes after they begin to melt.

Start calibrating by allowing a half dozen ice cubes to melt down to about half their normal volume. Fire up the Frost Sentinel with the extra meter still in the circuit, and place an ice cube on top of the thermistor while you adjust *R2* for a current of about 0.5 ma. Slowly rotate *R2* clockwise, pausing each time the meter needle climbs one or two divisions. This precaution is necessary to allow the thermistor to stabilize its resistance under the new conditions. When the current reaches 1.0 ma., the relay

should pull in and sound the buzzer. This is the freezing point, or 32° F calibration point, and the scale should be so marked.

The temperature of your freezing compartment should be determined as accurately as possible with a thermometer. Place the thermistor assembly in the freezing compartment and repeat the procedure described above, using the same slow motion-and-pause method. Mark the triggering point on the scale with the freezing compartment temperature. Lastly, do the same thing for an upper food section to obtain an above-freezing calibration point. The intervening spaces between calibration points may now be divided equally into single-degree intervals.

-30-

Short-Wave Report

(Continued from page 58)

The following is a compilation of the latest reports received. All times shown are EST and the 24-hour system is employed. Please remember that, at time of compilation, all listings are correct. Stations reserve the right to make last minute changes in frequencies and/or programs.

Argentina—One of the lesser known stations in this country is LOL, a time station located near Buenos Aires. It has been noted on 15,000 kc. around 1915 with language announcement. (26)

Belgium/Belgian Congo—Brussels is operating on a new frequency of 21,715 kc. at 0500-0700, 0715-0800, 0830-1145 (Sundays) and 1300-1600 beamed to Africa. (100)

Further schedules of *World Fair Radio* are: Sundays, Tuesdays, Thursdays, and Fridays at 1730-1800 on 15,335 kc. and at 1930-2000 on 15,335 and 9655 kc.; Mondays at 1930-2000 on 15,335 kc., and Saturdays at 1815-2000 on 9655 kc. The 9655-kc. outlet is the 50-kw. relay xmtr in Leopoldville. Address for all reports is: *World Fair Radio*, P. O. Box 26, Brussels, Belgium. (RK, 11, many others)

Brazil—ZVK3, 9565 kc., Recife, has moved back to this frequency from 9785 kc. and is scheduled at 0500-2120. (100)

R. Bandeirantes, Sao Paulo, was reported on 15,045A kc. at 0000-0015 with orchestral music and native language. The IS was a

DX Programs

DX programs are broadcast to N.A. in English as follows:

Australia—Every Sunday at 0830-0845 over V1C11, 11,810 kc.

Denmark—Every Wednesday at 2130 and 2300 over OZF, 9520 kc.

New Zealand—On the first Wednesday of each month at 0430 on ZL2, 9540 kc.

Sweden—Every fourth Monday at 2030 on 11,810 kc.

Switzerland—On the first Thursday of each month at 2100 on 15,305, 11,865, 9535, and 6165 kc. This is repeated at 2340.

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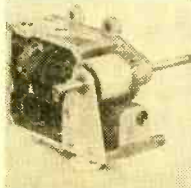
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TRI-STATE COLLEGE

3697 College Avenue Angola, Indiana

rooster crow and gong. This may have QRM from Mozambique. (MA)

Burma—The new high-powered xmtr of *Radio Burma* at Rangoon is being noted in the western states on 11,764 kc. at 0635-1015. The IS is drums, gongs and an oboe. Western music was noted until 0700, programs in Burmese to 0915, English from 0915 with news at 1000. This station is reported as also using 9543 kc. but not as having been heard on this channel. (61, 246)

Costa Rica—TIFC, *Faro Del Caribe*, San Jose, 9647 kc., has an Eng. pgm to N.A. at 2300-0000. This religious pgm is also noted on parallel 6037 kc. (RK, 104)

Cuba—COBL, *R. Aeropuerto*, 9833 kc., Havana, reports by letter that it is now operating 24 hours daily. This one has dance music after 0000 with ID between each selection. (25, 54)

Reloj de Cuba, Havana, was again noted on 11,750 kc. around 1700 but no call was announced for this frequency. (54)

Czechoslovakia—*Radio Prague* is scheduled to N.A. as follows: 1930-2000 on 9550 and 11,835 kc., 2200-2300 on 11,935 and 15,145 kc., and 0000-0030 on 15,285 kc. Letters are answered Mondays at 0000, Saturdays at 2200, Sundays at 1930 and 0000. The address is: North American Service, *Radio Prague*, Prague 12. (RK, WK, 211, 240)

El Salvador—YSUA, *R. Mil Cinquenta*, San Salvador, is noted on 6188 kc. (dual to 1050 kc.) at 0030 with concert music. Anmts are all in Spanish. ID is *Transmite Radio YSU*. Listeners in the southern states may be able to tune in the 1050-kc. outlet. (152)

Federation of Rhodesia and Nigeria—Salisbury, on 7290 kc., rarely heard, has been noted on the east coast at 1015 with a musical pgm in language. (26)

France—Paris now operates on 21,720 kc. at 1100-1300 in Arabic. (100)

Germany—The German Democratic Republic station in Leipzig broadcasts on 9730 kc. in Eng. to Europe daily at 1530-1600 and is being well heard in N.A. (61, 104)

Honduras—HRD2, *La Voz de Atlantida*, La Ceiba, 6235 kc. (listed for 6195 kc.) is being noted from 2140 s/on with ID as *Muy Buenas noches, transmite HRD2*. Latin-American and



Ronald Whistler, shown at his listening post in Wichita, Kansas, uses a Hallicrafters SX-99 receiver.

SELL TO UNCLE SAM!

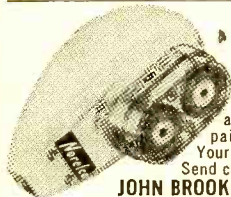


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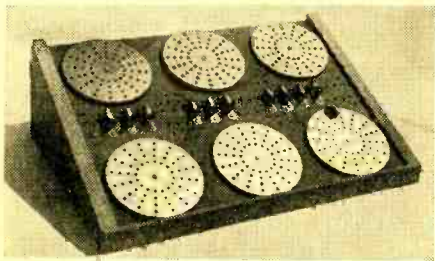
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I enclose \$..... in full payment.
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N.A. music is heard, with anmts in Spanish. This is hard to pull through QRM. (152)

Hong Kong—R. Hong Kong, 3940 kc., carries an English lesson on Mondays, Tuesdays, Thursdays, and Fridays at 0530-0545 with notes in English, Kuoyu, and Cantonese. This 2500-watt station is listed as ZBW. (ST)

Iceland—TFJ, Reykjavik, 12,175 kc., was noted for five minutes with news in Icelandic at 1120. It is very difficult to hear on the west coast. (246) (Editor's Note: This is difficult to hear on the east coast, too, Don!)

Indonesia—The Voice of Indonesia, YDF6, Djakarta, 9710 kc., has an Eng. session at 0600-0700 daily, dual to YDB2, 4910 kc. It is beamed to New Zealand and the Pacific Islands. (104, 226)

Radio Australia reports that **Radio Republik** is operating over YDG on 4880 kc. from 0630. (MA, 61)

Iran—**Radio Teheran** operates as follows on 15,100 (best) and 9680 kc.: Arabic at 1400-1415 daily; Russian at 1415-1430 daily; Turkish at 1430-1445 daily; German at 1445-1500 on Sundays, Tuesdays, and Thursdays; French at 1445-1500 on Saturdays, Mondays,

SHORT-WAVE ABBREVIATIONS

A—Approximate frequency
anmt—Announcement
BBC—British Broadcasting Corporation
BBCFES—BBC Far East Station
Eng.—English
ID—Identity, identification
IS—Interval signal
kc.—Kilocycles
kw.—Kilowatts
L.A.—Latin America
N.A.—North America
pgm—Program
QRM—Interference
QSL—Verification
R.—Radio
s/off—Sign-off
s/on—Sign-on
V—Frequency varies
xmsn—Transmission from station
xmtr—Transmitter used by station

and Wednesdays; English at 1500-1530 daily. News comes first, followed by recorded music. The beam is omni-directional. Address is: External Service, **Radio Teheran**, Teheran, Iran. (RK)

Italy—Rome has moved from 9575 kc. to 15,400 kc. for the 1730-1955 xmsn to N.A. (100)

Jamaica—In answer to several requests, **Radio Jamaica**, 4950 kc., does verify but at last report was temporarily out of QSL cards. Wait a couple of months and if there is still no reply, send a new report.

Kenya—ZHW6, Kisumu, 4943 kc., has a BBC news relay at 0100. The signal is not usually strong and QRM can be anticipated from aero stations. (MA)

Malaya—BBCFES, Singapore, is noted on 15,310 kc. at 1000-1150 with programs relayed from the BBC. The schedule for this Far East xmsn is 0900-1150V and runs in dual with 17,890 and 21,720 kc. (39, 61)

A new channel in use by BBCFES is 21,655 kc., scheduled at 0800-1145. (100)

Mauritius—V3USE, Forest Side, reported previously on 15,027V kc., is currently operating nearer to 15,060 kc. with programs scheduled at 2200-2315 and 0300-0515 weekdays.

English is noted just prior to 2315 s/off. (16)

Mexico—XEXE, *Radiodifusora Mexico*, Leon, is noted on 11,900 kc. at 1200-1300 with all-Spanish anmts, commercials, and Mexican and L.A. music. World news in Spanish at 1300-1308 is followed by Ravel's *Bolero* and s/off at 1310. At times this station has ball games, relayed from XEQ on 940 kc. (61)

XELZZ, Mexico City, is heard all day on 11,870 kc. except for some periods of QRM from a jamming xmtr. This station is anxious for reports from outlying areas of Mexico. (54)

Netherlands—Hilversum has moved from 15,445 kc. to 15,220 kc. for the 1530-2115 xmsn. The higher channel is still used at 2130 to North America. (100)

New Zealand—A report from *Radio New Zealand* telling of a new antenna system also mentions that the station has intermittent operation to the West Indies area, accomplished by reversing the Australian antenna and adjusting frequency. Some Malayan service is also provided by using the Australian antenna straight through and adjusting frequency. In addition, intermittent broadcasting to the N.Z. Antarctic Expedition is accomplished by using a 7500-watt xmtr into a tilted V antenna on a bearing of 183°. (11)

Norway—*Radio Norway*, LLN, Oslo, 17,826 kc., is heard at 1750-1830 with news in language and music. *Radio Japan* causes QRM on this xmsn. An English-Norwegian pgm of music is noted at 1830-1900 daily except Sundays. (226)

"Norway This Week" is presented Sundays

at 2100-2120 on LLN, 17,826 kc., LLM, 15,175 kc., and LKQ, 11,735 kc. (11, 26)

Poland—*Radio Warsaw* is scheduled to N.A. at 0600-0630, 0715-0745, 0745-0815, 2000-2030, 2130-2200, and 0030-0100 on 15,120 and 11,740 kc. The "Mailbag" is heard Mondays at 0730. (82, 211)

Portuguese Guinea—This country is planning three new stations, one of which will be a 50-kw. outlet for short-wave—the frequency is not known as yet. The remaining two xmtrs will be 25-kw. power units for medium-wave service. (MA)

Portuguese India (Goa)—This country is noted on 9610 kc. with poor signals during the newscast at 0240-0245 and at 1010. You'll really have to dig it out from beneath the heavy QRM. Verification is by letter. (ST)

Reunion—St. Denis, 7170 kc., is rarely heard but has been noted in Virginia at 2315 in French. This transmitter is listed as having only 100 watts output. (26)

Roumania—*R. Bucharest* is scheduled to N.A. as follows: English at 2200-2230 and 2330-0000 on 11,937 and 9570 kc; Roumanian at 1815-1856 on 15,250 kc. and 2230-2300 on 11,937 and 9570 kc; Yiddish at 2100-2130 on 9570 kc. A concert is aired daily at 1100-1200 and an English "Letterbox" program is broadcast Fridays at 2200, both on 11,937 and 9570 kc. The address is: North American Service, *Radio Bucharest*, Bucharest. (RK, BR)

Sierra Leone—The Sierra Leone B/C Service sent the following information. Their xmtr is a Redifon G41 with 5000 watts power and

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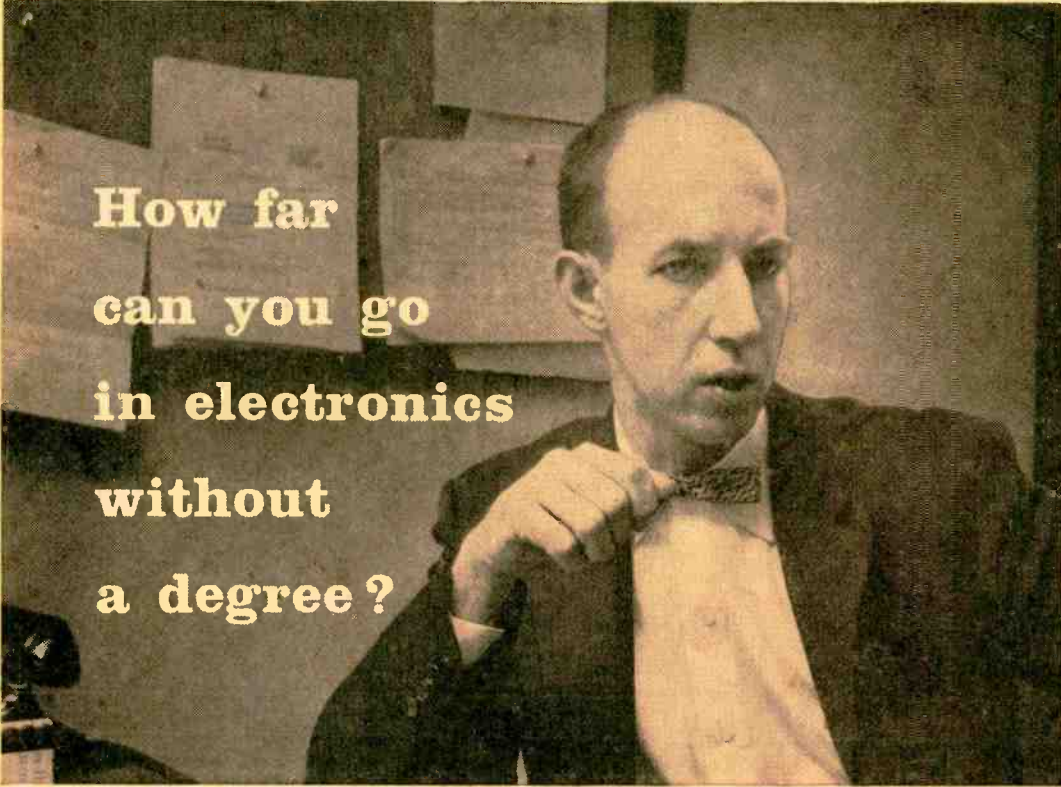
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in electronics
without
a degree?

Bill Miles talks frankly about the technician's biggest problem

2 years ago, degreeless Bill Miles had reached a blind alley in his career. Yet today, with IBM, he's actually supervising engineers in America's biggest electronics project. Here's how this technician broke through the "education barrier."

"Training and local assignments," recalls Bill Miles, "were what caught my eye when I saw an IBM ad in 1955. So I investigated. Now here I am with an advanced electronics education under my belt — and responsibility as a Group Supervisor in Project SAGE. I work on the world's largest and most advanced computer. I live in my home town. And my future in the company is what I make it. Yet only 2 years ago, I thought I'd gone as far as a technician ever could!"

Becomes radar technician. Bill's background is typical of thousands of capable, ambitious technicians who never acquired a formal engineering degree. His interest in electronics, aroused in Camden, New Jersey, high school, was nourished by a 3-year stint as Aviation Radar Technician in the Navy's "Black Cat" air-sea rescue squadron.

Discharged in 1946, Bill married a girl he'd known in high school. During the next 9 years, Bill

was teacher in a radio-TV institute, TV service man, TV company technician, and chief supervisory TV technician. All the while he pursued an engineering education at night. But growing family responsibilities made it more and more difficult.

Finds doors barred. However, feeling he was equipped for greater responsibility, Bill, now 30, investigated several companies but found that, while they liked his abilities, his lack of degree barred the door to significant advancement.

Enters IBM school. In May 1955, when he moved his family to Kingston, New York, and started at IBM, Bill wasn't quite sure what to expect. The 8-month training course—valued at many thousands of dollars per man—had been the big magnet for him.

"Sixty of us started school at IBM, attending class 8 hours a day. The course consisted of about 20 subjects, mostly dealing with computer circuits and units, and maintenance techniques. The teaching was adult, superb. During training, we received a living expense allowance, over and above salary. We kept our own grades, and every 6 weeks when we reviewed them with the instructors, they asked us for ways to improve the course.

I expected a casual 'hello' when I met the Division Manager of Education, but he talked to me for an hour about myself and my interests. IBM has real concern for you as an individual, both before and after they hire you."

Joins home-town computer site. Bill had joined IBM as a Field Systems Engineer. After graduation, Bill was assigned to a computer site near his home



Bill gets electronic computer education at IBM Kingston

in Mt. Holly, New Jersey, with IBM paying his moving expenses. For the first two months he helped install the SAGE computer, an important link in America's air defense. Ultimately, such computers will

ring America's entire air defense perimeter.

World's largest computer. "The computer is probably the largest one in the world, with over a million components. Flattened out, it would probably fill a ball field. The computer analyzes radar data on every object in the sky. Then it checks each object against available traffic information and identifies it as either friendly or hostile. It can make suggestions, but it can't send a Nike missile against what it thinks is a 'baddie.' Only airmen can make that decision."



Miles does diagnostic programming on the Operating Console of the SAGE Computer

Supervises fifteen. Recently promoted to Group Supervisor, Bill now directs an entire shift of 15 men, reporting to a Group Manager. His job: to maintain the computer in combat readiness. "I have to be familiar with the entire system. I rely on two types

of specialists to help me: computer units men who are specialists in certain areas; systems engineers for the over-all computer."

But the question remains: Is Bill really an engineer?

September, 1957

"No, I certainly don't consider myself a 'professional' engineer, qualified to design machines, for instance. But the point is, I'm doing work ordinarily done by engineers . . . work usually denied to men without a degree."

IBM upgrades technicians.

Could he do this elsewhere? "Of all the companies I know, IBM appears to be one of the few upgrading the technician to the level of engineering responsibility. Fortunately for me, IBM had the imagination



Miles nails down problem with Site Manager R. Schimmel

to get men without degrees and encourage them to rise in responsibility and income to the level of their native talents . . . not what their formal education dictates."

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"Student" Bill Miles diagrams computer circuit

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Patent Attorney & Advisor
 U. S. NAVY DEPT. 1930-1947
PATENT LAWYER

their antenna a delta matched 1/2-wave. The frequency used is 3316 kc.; they also are licensed to operate on 9630 kc. Current schedule is 0215-0240, 1600-1700, and at times 1330-1500. Most programs are BBC relays. (25)

Sudan—The Sudan B/C Service, Omdurman, is noted daily at 1100-1130 on 5005 kc. with an English session. Signals are usually poor. A report was promptly acknowledged by letter. (ST)

Sweden—Radio Sweden operates to N.A. at 0400-0430 on 17,840 kc. and at 2030-2100 on 11,810 kc. The latter program varies from DX news to lessons in Swedish, with a "Smorgasbord" program noted on Wednesdays. (AA, DD, CF, RK, 39)

Switzerland—The Swiss SW Service is anxious to receive reports from midwestern USA for HER4, 9535 kc. The director of the station is especially interested in knowing of any interference being caused to or from Radio Sweden. Reports should go to: Swiss B/C Corp., Neuengasse 23, Berne. (DD)

Tanganyika—Dar-es-Salaam is reported as being on 4770A and 4582A at 2100-2300 with

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- Edes Matsukado (81), Honolulu, T.H.
- John Mann (82), St. Laurent, P.Q.
- Roger Legge (100), McLean, Va.
- EJ Kowalski (104), Philadelphia, Pa.
- Ray Bugden (152), Fort Lauderdale, Fla.
- Jacob Schanker (211), Brooklyn, N.Y.
- William Bing (226), New Orleans, La.
- Bill Roemer (240), Bowling Green, Ky.
- Orval Oppertshauer (242), London, Ont.
- Don Kenney (246), Pacific Palisades, Calif.

native music and amnts, followed by English amnts. Further details are requested by Your Editor. (JT, 242)

Tangier—The new address for WTAN is: The Voice of Tangier, WTAN, P. O. Box 2219, Tangier, Morocco, North Africa. (27)

Thailand—HSK9, Bangkok, 11,670 kc., has an Eng. session with news and talks at 0600-0620 and music to 0630. After 0630, they go into Malayan. This is heard daily except Sundays with little or no QRM. (81, 226)

Turkey—Radio Ankara is heard well in its xmsn to Western Europe over TAU, 15,160 kc., at 1600-1645 with Eng. news, talks, and music. TAT, 9515 kc., is noted at 1915-2000 with another English newscast and music. (RK, RS)

Yugoslavia—Radio Belgrade now has Eng. at 0730-0800 and 1330-1400 on 6150, 7200, and 9505 kc. The latter outlet may be QRM'ed by Voice of America-Tangier on the same frequency. (25)

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Peter H. of River Edge, N. J., created an averaging machine.

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Among the Novice Hams

(Continued from page 95)

age supplies—especially when mercury-vapor type rectifiers, which are easily damaged by excess peak currents, are employed.

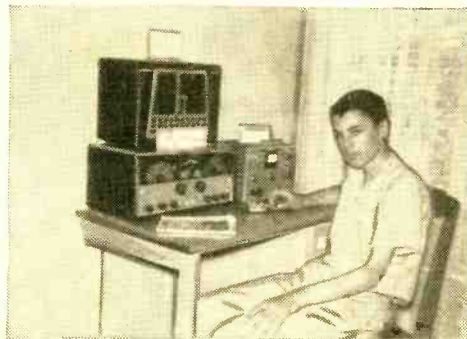
Resistor *R1* puts a minimum load on the power supply at all times and bleeds off (discharges) the filter capacitors within a few seconds after the supply is shut off. Otherwise, they would stay dangerously charged for hours afterwards. A tapped bleeder resistor may also be used to deliver an output voltage of less than the maximum output voltage of the power supply.

This discussion does not cover everything there is to know about power supplies, but studying it carefully should make the questions about power supplies in the License Manual much easier to understand and to answer.

News and Views

Pete, KN5JCC, (15), agitates a 40-meter dipole antenna with a WRL Globe Scout 65B transmitter and receives with a Hallicrafters S-85 receiver. Doing both, not continuously, for four and a half months has netted him 40 states, Canada, Puerto Rico, Newfoundland, England, New Zealand, and the Panama Canal Zone, mostly on 15 meters. Pete wishes more hams would QSL 100% as he does, and offers to schedule anyone needing a Texas card or contact. . . . Who said a 20-meter "folded dipole" antenna wouldn't work on 15 meters? **Frank, KNØJPJ**, has worked 10 states and Puerto Rico in a week on the air using one on "15." His transmitter is a Johnson Viking Adventurer, and his receiver is an S-85 with a Q-Multiplier added to it. . . . **Mike, KN6VCI**, (15), sticks to 40 meters exclusively. And why not? He has 32 states and two continents confirmed on that band. A WRL Globe Chief transmitter and a Heath AR-3 receiver work in push-pull—to push out his signals and to pull in the other fellow's. Contact Mike if you want a California QSL—on 40, of course.

Since moving to Maine, **Alan, KIAKO**, ex-KN2QLS, is not cramped for antenna room. He has an 80-meter dipole, a 40-meter dipole,



Lloyd, KN6RLQ, at his station in Oakland, Calif.

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a Hallicrafters S-40B receiver, K1AKO has worked 32 states without making any special effort to add new ones. . . . Phil, KN2ZAU, has spent his eight weeks on the air on 40 and 15 meters. Besides working 30 states (25 confirmed), Canada, England, and Puerto Rico, Phil has acquired a 15-wpm code-proficiency certificate and a Rag Chewers Club certificate from ARRL, and has passed his General Class examination. Equipment at KN2ZAU is a Johnson Adventurer transmitter, a Hallicrafters SX-99 receiver, and a 40-meter doublet antenna.

Orville, KØIHK, has had his "General" for two weeks after waiting eight anxious weeks for it to come. In the three months he was a Novice, he worked 27 states—with Washington and California being his best DX—all on 80 meters. An AR-3 with a Q-Multiplier does the receiving and a Globe Chief does the transmitting at KØIHK. In the dream stage is a pair of 50' poles to raise his doublet antenna above its present 20' of height and a National NC-98 receiver. . . . Gil, VE2YF, and Mary, VE2YZ, operate on 40-meter c.w. and find that about every other U.S. station they work tells them that they are the first VE2 for the U.S. station. They will make skeds with anyone needing a VE2 contact, and encourage anyone in getting over the "hump" on the way to a ticket. In addition, Mary would like to hear from other nurses interested in radio. . . . Art, VE3CGD, (17), uses an AT-1 transmitter on 40 and 15 meters and offers to sked anyone who would like to have a VE3 contact.

Ray, KN4JUE, uses a home-built 6146 transmitter running 75 watts input and feeding a 40-meter dipole about 35' high. He receives with a converted ARC-5 receiver. In a month on the air, he has worked 15 states, but is beginning to doubt that there are any "6's" or "7's" on the air. . . . While waiting for his "dream" rig, Serge, VE2AWR, built a little 10-watter for local work. In four short weeks

ends, however, he has made 53 contacts in nine states and three Canadian provinces. VE2AWR operates on 80 meters only and uses a 125' "zepp" antenna. He QSL's 100% when he has an address to which to send his card.

... **Tex, KN2VAB**, whose farthest DX is California and whose shortest DX is one block, has made 209 contacts in seven months on the air on 40 and 15 meters.

Ken, W5GIV, (16), can't understand why many Novices think 40 meters is better than 80 meters. Maybe his record of 47 states and a lot of DX—including two New Zealanders and an Australian—worked on 80 explains why he is puzzled. Ken uses a converted BC-696 transmitter to feed a 400' antenna which is 30' high. His pet peeve is hams who call "CQ" 50 times, sign their own call letters 50 times, and then repeat the whole performance half a dozen times. ... **Joe, KN5JOK**, gets a bit irate after waiting 10 minutes for a station to stop calling CQ—so that Joe can call *him* or hear someone call KN5JOK for five minutes in reply to one of his own CQ's. (Add the fellow who replies to your transmission with "R R R," which means "I copied everything you said—three times, no less," then continues, "Sorry, I missed my report and your name—please repeat your location," and you have examples of three of the most common operating faults in the amateur bands.) Because of school, getting married, and similar distractions, it took Joe about eight years to obtain his ham license; so he knows how it feels to battle for one. He of-

fers to help anyone requesting it to get a ticket.

Nathan J. Schulman, K4OYG, (19), helped several of the readers of this column obtain their licenses earlier this year when he was K2LDN in Brooklyn. He again offers help to those living near his new address of 790 Highland Ave., Eau Gallie, Florida.

Contributors to News and Views: **Peter Roussel, KN5JCC**, 6515 Brampton, Houston 5, Texas; **Frank Gilmore, KN0JPJ**, Route 2, Box 286A, Springfield, Mo.; **Mike Kaufman, KN6YCI**, 11615 Canton Place, Studio City, Calif.; **Alan Savery, K1AKO**, Box 24, Vanceboro, Maine; **Phil, KN2ZA**, 25 Shore Road, Pelham, N. Y.; **Orville D. Taylor, K0IHK**, RFD 4, Eldorado Springs, Mo.; **Gil, VE2YF**, and **Mary, VE2YZ**, Groome, 1225 Ouimet St., Montreal 9, P.Q., Canada; **Arthur Childerhose, VE3CGD**, Box 152, Cobden, Ontario, Canada; **Ray Edwards, KN4JUE**, 422 Burns Ave., Charlotte, N. C.; **Serge Langlois, VE2AWR**, R.R. 3, Rawdon, P. Q., Canada; **Tex Birnholz, KN2VAB**, 634 High St., Newark 2, N. J.; **Ken, W5GIV**, Rt. 1, Box 228, Victoria, Texas; **Joe A. Rolf, KN5JOK**, Box 613, Harrison, Ark.

Remember that this is your column; so how about telling the rest of us about your experiences and offering some suggestions. A recent suggestion was made to include a Novice DX section as part of the column. What do you think? We can always use good pictures of you and your station. Until next month. 73,

Herb, W9EGQ

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Kit Builder's Korner

(Continued from page 62)

signal is provided by the crystal-controlled fixed-frequency marker. The crystal socket is mounted on the front panel of the instrument, permitting other crystals to be used if special frequencies are needed.

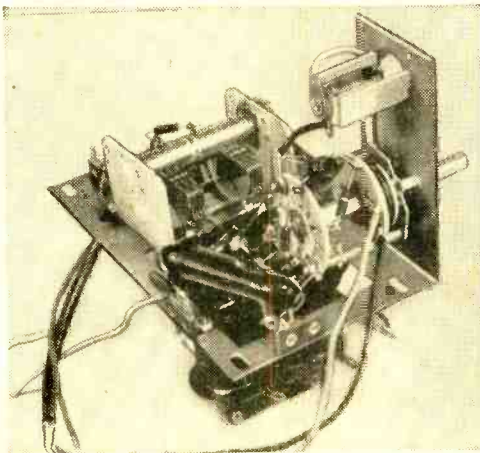
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Comment. There are no unusual difficulties either in assembling or using the Model 368 sweep generator. All controls and their operation are described in the instruction manual, and the general operation of the instrument is discussed carefully. Instructions are included covering all standard alignment procedures.

The assembly of the tuning dials required a moderate amount of "juggling," but wasn't especially difficult. The only other difficulty encountered concerned connections to the *increductor*. Part of the color-coding used to identify the



The completed sweep oscillator subchassis.

September, 1957

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QUALITY ELECTRONICS Dept. P-9

New York 13, N. Y.

leads had flaked off and we weren't too sure of connections. However, once this component was mounted, we found that the leads almost "fell in place."

In use, the sweep generator is connected to the "input" of the r.f. or i.f. amplifier to be tested or aligned. A standard oscilloscope is connected to observe the signal across the amplifier's second detector. If an individual stage is to be studied or checked, a separate broadband detector probe is employed with the 'scope. Finally, a connection is made between the *Scope Hor.* terminals of the sweep generator and the *Horizontal Input* terminals of the oscilloscope—the internal linear sweep of the 'scope is not used. With the 'scope and sweep generator controls adjusted, the frequency response curve of the amplifier under test is displayed on the screen of the cathode-ray tube.

All factors considered, the Model 368 represents a good buy for the experimenter who works with FM tuners, TV receivers, or similar types of equipment. And the assembly of the instrument is an especially good project for the advanced student.

-30-

Transistor Topics

(Continued from page 92)

plies from his firm. And he has a pamphlet of transistor projects available to anyone free for the asking. Be sure to drop him a card requesting a copy.

There are a couple of interesting developments in Germany. Elektromedizinische GmbH. is offering a battery-operated transistorized electronic stethoscope to the medical profession. And Audio-Master of New York is marketing a German-made transistorized three-speed portable phonograph which lists at \$89.50, plus tax.

Although Britain is probably about two years behind advanced U. S. firms in the transistor field, she is rapidly "catching up." Some eight major British firms are rushing transistor production. The estimated 1956 production of British transistors is about 500,000 units. Somewhere between one and ten million units is expected in 1957.

We've heard that General Electric Co., Ltd. expects 1957 sales of about 500,000 units, with a fair percentage exported. Several other Anglo-American firms are being formed, including Sylvania-Thorne and Semiconductors Limited—the latter being a joint effort of Philco (American) and Plessey Co., Ltd. (British).

Product News. The J. W. Miller Company (5917 S. Main St., Los Angeles 3,

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1J6GT	.46	5V4G	.57	6BN6	.57	6X8	.74	12S07	.39
1L4	.45	5V6GT	.49	6BQ6GT	.79	7A4	.46	12V6GT	.44
1L6	.54	5X8	.79	6BQ7	.75	7A5	.52	12W6	.59
1LA4	.55	5Y3	.38	6BY5G	.57	7A6	.44	12X4	.36
1LA6	.46	5Y4G	.42	6BZ7	.75	7A7	.44	14A4	.44
1LB4	.58	5Z3	.44	6C4	.36	7A8	.44	14B6	.44
1LC5	.48	6A7	.56	6C6	.50	7AU7	.69	14Q7	.44
1LC6	.46	6A8	.46	6CD6G	1.17	7B4	.43	15T8	.69
1LD5	.56	6A84	.44	6C6U	.79	7B5	.40	19B6GG	1.17
1LE3	.56	6AC7	.66	6D6	.47	7B6	.41	25BQ6GT	.84
1LH4	.45	6A8	.46	6E7	.43	7B7	.42	25CA5	.79
1LH5	.46	6AG5	.49	6F5	.36	7B8	.46	25CDE	1.29
1NSGT	.49	6AG7	.68	6F6	.37	7C4	.40	25CUE	.96
1R5	.50	6AH4GT	.68	6FH6	.68	7C5	.41	26L6GT	.49
1S5	.45	6AM6	.70	6J4	1.59	7C6	.42	25WAGT	.42
1T4	.50	6AK5	.53	6J5	.38	7C7	.44	25Z6	.36
1U4	.46	6AL5	.41	6J6	.48	7E5	.44	27B	.24
1U5	.45	6AN8	.79	6KGT	.38	7E6	.44	35B5	.47
1V2	.70	6AN8	.79	6K7	.38	7E7	.48	35C5	.47
1X2	.66	6A05	.45	6L6	.67	7F7	.58	35L6GT	.46
2A3	.49	6AS5	.47	6M7	.59	7F8	.65	35W4	.38
2A4	.54	6A57G	2.25	6Q7	.39	7G7	.74	35Y4	.38
2D21	.95	6AT6	.38	6S4	.39	7N7	.57	35Z3	.40
3A4	.50	6AT8	.79	6S8GT	.70	7Q7	.58	35Z5GT	.38
3A5	.50	6AUGT	.68	6S8	.49	7R4	.42	39A4	.25
3AL5	.52	6AUSGT	.60	6SB7Y	.75	7Y4	.34	50A5	.47
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3B26	.57	6AV8	.79	6S7	.40	12A05	.40	50E5	.47
3BC5	.57	6AV5GT	.64	6SH7	.42	12A6	.40	50L6GT	.44
3BN6	.57	6AV6	.38	6S7J	.42	12A85	.59	80	.39
3C86	.57	6AW8	.89	6SK7	.49	12A05	.40	84/6Z4	.45
3Q4	.55	6AX4GT	.65	6SL7GT	.56	12AT6	.40	117L7GT	1.25
3Q5GT	.56	6AX5GT	.56	6SN7GT	.56	12A77	.65	117N7GT	1.25
3S4	.46	6BA6	.46	6SQ7	.40	12AUG	.42	117P7GT	1.25
3V4	.53	6BC5	.49	6S7	.40	12A17	.58	117Q7	.36
4BQ7	.75	6BC8	.89	6T4	.65	12AV6	.41	117Z3	.36
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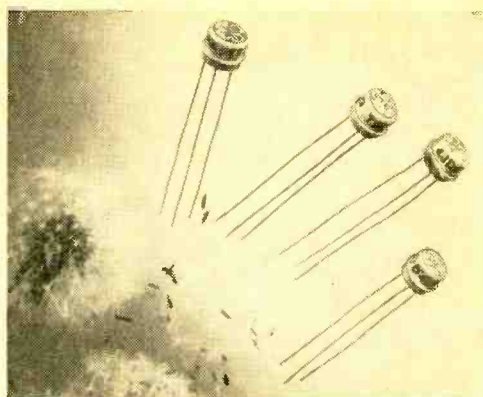
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General Electric's high-frequency silicon transistors compared in size with "seeding" dandelions.

Calif.) has introduced a new transistorized receiver kit. Catalog No. 555, the receiver is named the "Transistall." It uses a unique reflexed arrangement to achieve four-transistor performance with a three-transistor circuit.

Production of a new line of high-frequency, high-temperature silicon transistors has been stepped up by General Electric (Syracuse, N. Y.) to meet increasing industrial demands. Manufactured by the diffused-meltback process developed in G.E.'s Advanced Semiconductor Laboratory, these new units are rated at 25 mc. but can provide useful gain up to as high as 50 mc. Gain ratings vary from 12 to 30, depending on type, with a 150-mw. collector dissipation rating at room temperatures.

From the Argonne Manufacturing Company (27 Thompson St., New York 15, N. Y.), famous for its line of miniature audio transformers, comes news of three new subminiature i.f. transformers. Designed for 455-kc. i.f. stages, these units measure only $\frac{3}{8}$ " in diameter by $\frac{5}{8}$ " high, yet feature slug-tuning and a molded-in fixed capacitor. Anticipated selling price is slightly over one dollar at all Argonne distributors. Type Nos. are AR-220 (Input), AR-221 (Interstage), and AR-222 (Output).

The General Transistor Corporation (91-27 138th Place, Jamaica 35, N. Y.) is offering especially matched pairs of *p-n-p* and *n-p-n* transistors for complementary-symmetry applications.

Clevite Transistor Products (241 Crescent St., Waltham 54, Mass.) now manufactures a semiconductor diode which uses a silicon-germanium alloy. These units combine the better high-temperature performance of silicon with the higher forward conductance characteristics of germanium.

Well, fellows, that about does it for now... see you next month.

Low

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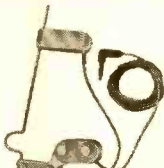
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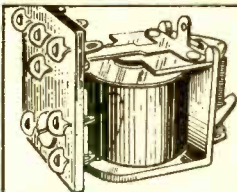
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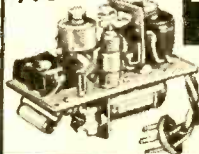
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0D3	.80	1N34A	2.51	6C96	1.49	12AV6	.59
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1B3	.78	5V4	.89	6J6	.59	12AX7	.79
1L-	.82	5L6	.59	6K6	.59	12BH7	.89
1R4	.88	6A84	.59	6K7	.79	12BY7	.89
1R5	.78	6AC7	.79	6L6	1.19	12SA7	.69
1S4	.58	6AG7	.97	6L7	.69	12SK7	.69
1S5	.68	6AM4	.89	6SA7	.79	12SN7	.69
174	.69	6AH6	.95	6SH7	.69	12SQ7	.69
1U5	.59	6AK5	.69	6S17	.69	14A7	.69
1X2	.66	6AL5	.59	6SK7	.69	198G6	1.69
2D21	.68	6A05	.66	6SL7	.69	258Q6	1.29
2K2	.48	6A55	.75	6SN7	.69	25Z6	.79
2V3	.48	6AT6	.49	6S7	.69	35C3	.59
3A5	.69	6AV4	.89	6T4	1.19	35L6	.59
3A5	10	6AU6	.59	6T8	.98	35W4	.59
3A5	.33	6AX4	.79	6U8	.98	35Z5	.58
957	.30	6BA6	.59	6V6	.59	50A5	.69
1619	4	6BC5	.59	6W6	.79	50B5	.79
1625	.29	6B6	.59	6X4	.69	60C5	.69
1626	5	6BF5	.79	7A8	.79	50L6	.69
1628	4	6B1	1.49	7C5	.79	75	1.00
807	1.15	6K5	.59	7F7	.79	75	5/11
809	.89	6BL7	.89	7F8	.79	77	5/11
5BP1	1.49	6BN6	.89	7N7	.79	117L7	1.75

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CASH Paid! Sell your surplus electronic tubes. Want unused, clean transmitting, special purpose, receiving, TV types, magnetrons, klystrons, broadcast, etc. Also want military & commercial lab test and communications gear. We swap too, for tubes or choice equipment. Send specific details in first letter. For a fair deal write, wire or telephone; Barry, 512 Broadway, New York 12, N. Y. Walker 5-7000.

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Always say you saw it in—POPULAR ELECTRONICS

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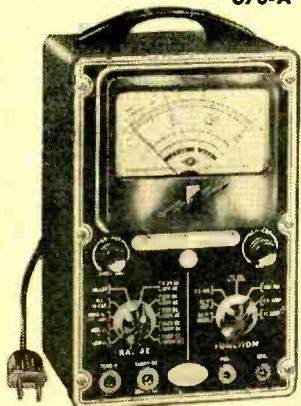
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Superior's new Model
670-A



ADDED FEATURE:
Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

SUPER-METER

A combination VOLT-OHM MILLIAMMETER PLUS Capacity Reactance, Inductance and Decibel Measurements.

SPECIFICATIONS:

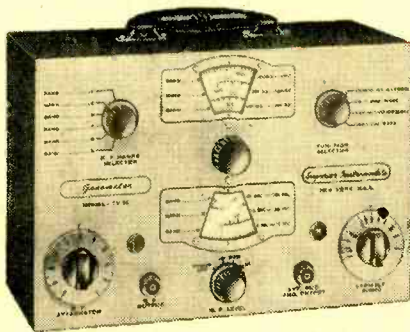
- D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
- A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
- OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
- D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
- RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
- CAPACITY: .001 to 1Mfd. 1 to 50 Mfd. (GOOD-BAD scale for checking quality of electrolytics)
- REACTANCE: 50 to 2,500 Ohms 2,500 Ohms to 2.5 Megohms
- INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
- DECIBELS: -6 to +18 +14 to +38 +34 to +58

The Model 670-A comes housed in a rugged crackle-finished steel cabinet complete with test leads and operating instructions.

\$28⁴⁰

The new Model
TV-50

GENOMETER



A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

**A.M. Radio • F.M. Radio • Amplifiers
Black and White TV • Color TV**

7 Signal Generators in One!

- ✓ R. F. Signal Generator for A.M.
- ✓ R. F. Signal Generator for F.M.
- ✓ Audio Frequency Generator
- ✓ Bar Generator
- ✓ Cross Hatch Generator
- ✓ Color Dot Pattern Generator
- ✓ Marker Generator

R. F. SIGNAL GENERATOR: The Model TV-50 Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sinewave audio, the Model TV-50 Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

CROSS HATCH GENERATOR: The Model TV-50 Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

DOT PATTERN GENERATOR (FOR COLOR TV): Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence.

MARKER GENERATOR: The Model TV-50 includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency).

BAR GENERATOR: The Model TV-50 projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

THE MODEL TV-50 comes absolutely complete with shielded leads and operating instructions.

\$47⁵⁰

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SEE FOLLOWING PAGE FOR COMPLETE DETAILS

For the first time ever: **ONE TESTER** **PROVIDES ALL THE SERVICES LISTED BELOW!**

Superior's

New Model

76



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.

Specifications

✓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. This section will also locate shorts, and leakages up to 20 megohms. And finally, this section will measure the power factor of all condensers from .1 to 1000 Microfarads. (Power factor is the ability of a condenser to retain a charge and thereby filter efficiently.)

✓RESISTANCE BRIDGE SECTION

2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 meg-ohms. Resistance can be measured without disconnecting capacitor connected across it. (Except, of course, when the R C combination is part of an R C bank.)

✓SIGNAL TRACER SECTION

A built-in high gain pentode voltage amplifier, plus a diode rectifier, plus a direct coupled triode amplifier are combined to provide this highly sensitive signal tracing service. 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, localize faulty stages, locate distortion and hum, etc. Provision has been made for use of phones and meter if desired.

✓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? The Model 76 will enable you to locate a break in any TV antenna and if a break does exist, the Model 76 will measure the location of the break in feet from the set terminals. 2 Ranges: 2' to 200' for 72 ohm coax and 2' to 250' for 300 ohm ribbon

As Design Engineers, we the undersigned would like to say that the Model 76 is in our opinion the best combination unit of its kind we have been privileged to design. Although it is comparatively a low-priced tester, it will, after you become acquainted with its multiple services, be your most frequently used instrument.

S. LITT
 L. MELENKEVITZ

Model 76 comes complete with all accessories including R.F. and A.F. Probes; Test Leads and operating instructions. Nothing else to buy Only

\$26⁹⁵

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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-369 3849 Tenth Avenue, New York 34, N. Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance or interest charges added. It is further understood that should I fail to make payments when due, the full unpaid balance shall become immediately due and payable.

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 \$11.50 within 10 days. Balance
 \$6.00 monthly for 6 months.

Model 670-A... Total Price \$28.40
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Model TV-12... Total Price \$72.50
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Model 76 . . . Total Price \$26.95
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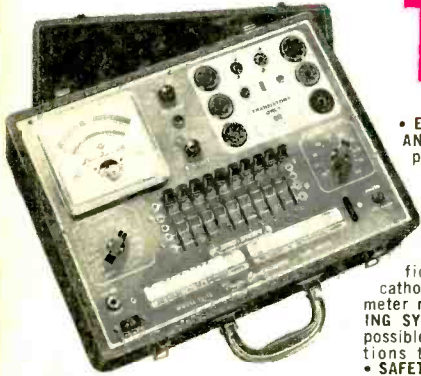
Name _____

Address _____

City _____ Zone _____ State _____

Superior's New
Model TV-12

TRANS-CONDUCTANCE TUBE TESTER



ALSO TESTS TRANSISTORS!

TESTING TUBES

• **EMPLOYS IMPROVED TRANS-CONDUCTANCE CIRCUIT.** An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading. • **NEW LINE VOLTAGE ADJUSTING SYSTEM.** A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%. • **SAFETY BUTTON** — protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching. • **NEWLY DESIGNED FIVE**

POSITION LEVER SWITCH ASSEMBLY. Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

TESTING TRANSISTORS

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale. The Model TV-12 will accommodate all transistors including NPN's, PNP's, Photo and tet-rodes, whether made of Germanium or Silicon, either point contact or junction contact types.

Model TV-12 housed in handsome rugged portable cabinet sells for only

\$72⁵⁰

Superior's new Model TW-11 STANDARD PROFESSIONAL

TUBE TESTER



- Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyatron, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.
- Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary.
- The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
- Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.

- **NOISE TEST:** Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE

- **SEPARATE SCALE FOR LOW-CURRENT TUBES** — Previously, on emission type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

\$47⁵⁰

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3849 TENTH AVENUE

NEW YORK 34, N. Y.

We invite you to try before you buy any of the models described on this and the preceding pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate. (See other side for time-payment schedule details.)

**NO INTEREST
OR FINANCE
CHARGES ADDED!**

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

**SEE OTHER
SIDE**

◀ CUT OUT AND MAIL TODAY!