

POPULAR ELECTRONICS

NOVEMBER
1957

35
CENTS

Complete Short-Wave List



Also in this issue

- Hi-Fi Extension Sp
- Transistor Short-Wa

OHIO CLEVELAND OHIO
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reception
ntercom

NC-188 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

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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NC-188

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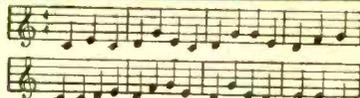
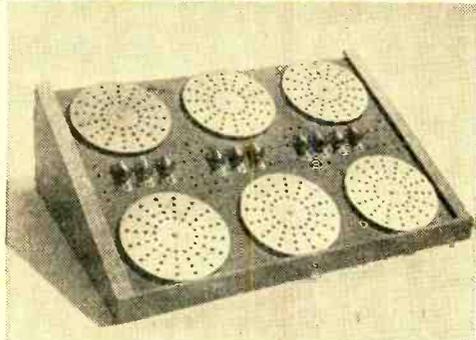
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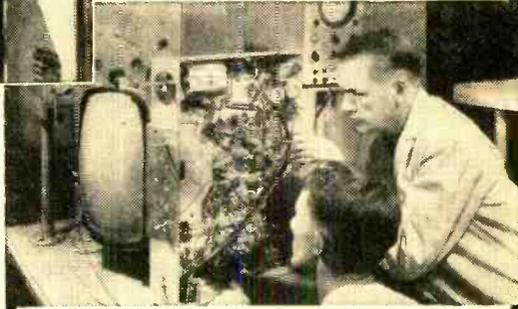
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**COMING NEXT MONTH
(DECEMBER)**



(ON SALE NOVEMBER 19)

December will be our month for useful electronic gadget building. The technical staff has been working on a Tremolo, in response to numerous reader requests, and now has a practical unit developed. It is featured on the cover and will surprise one and all with its compactness and ease of duplication. Also scheduled for appearance in the December issue are projects on Electronic Christmas Bells, Hand-Held Wireless Broadcaster, Signal Tracer, Simple Hi-Fi Tuner, Etc.

**IN THIS MONTH'S
RADIO & TV NEWS**

(NOVEMBER)

Do It by Telephone—with a Phone-Operated Switch

How to Test Your FM Tuner

Interference-Free AM Reception

Tape Recorder Quiz

Electronic Service in Northern Mexico

A New Transistorized Voltmeter

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- 2 Practical Radio Servicing — Easy-to-follow directions, diagrams, drawings — with job sheet for every repair job. 569 pages, 473 illus. By William Marcus, Alex Levy, Electronic Training Experts.
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- 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.
- 6 Complete Home Course Outline — Getting started in television and radio servicing. How to get the most out of your Course. How to get ahead FAST. By John Markus.

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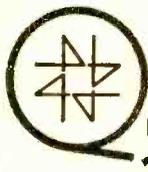
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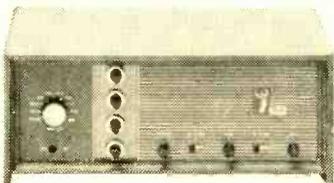
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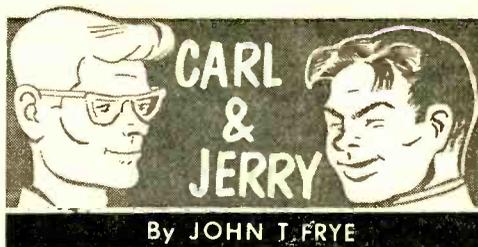
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The Demonstration

SCHOOL was out for the day, but Carl and Jerry were still in the physics laboratory putting away equipment they had been using in an experiment. Mr. Paisley, the instructor, was setting up apparatus to be used in a demonstration of static electricity the following day. Outside it was pouring rain.

Mr. Paisley vigorously turned the hand crank of the static electricity generator and then hopefully brought one of the charged electrodes closer and closer to the other. Only when the metal balls were nearly touching could a feeble spark be seen to cross the tiny gap.

"I'm afraid we're not going to have a very good demonstration tomorrow," the teacher said with a rueful sigh, as he put on his hat and coat and took an umbrella from the wall closet. "The insulators in this machine are pretty leaky, and with the high humidity we're having the static charge runs off as fast as it's generated."

"Aw, maybe it'll turn out all right," Carl said encouragingly. Both he and Jerry were fond of the gentle, easily embarrassed physics instructor.

"I hope so," Mr. Paisley said wistfully. "Mr. Stagg, the principal, war—told me he expects to visit our class tomorrow."

Neither boy could think of anything to say to this. They understood perfectly why Mr. Paisley had almost said "warned." Mr. Stagg was a positive, dynamic, aggressive person; and he respected only these qualities in others. He considered Mr. Paisley's gentle kindness to be weakness, and was constantly trying to "put some backbone" in the physics teacher—as he expressed it. Quite often "putting in some backbone" came dangerously close to bulldozing.

"I have a dental appointment in ten minutes," Mr. Paisley finally said. "I wonder if you boys would mind locking up the lab when you're through. You can give me back this key tomorrow. I have another one I can use to open up in the morning."

"Sure!" the boys chorused.

"Golly," Carl remarked, after they

Always say you saw it in—POPULAR ELECTRONICS

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RECEIVER

DETECTOPHONE

WIRELESS TRANSMITTER

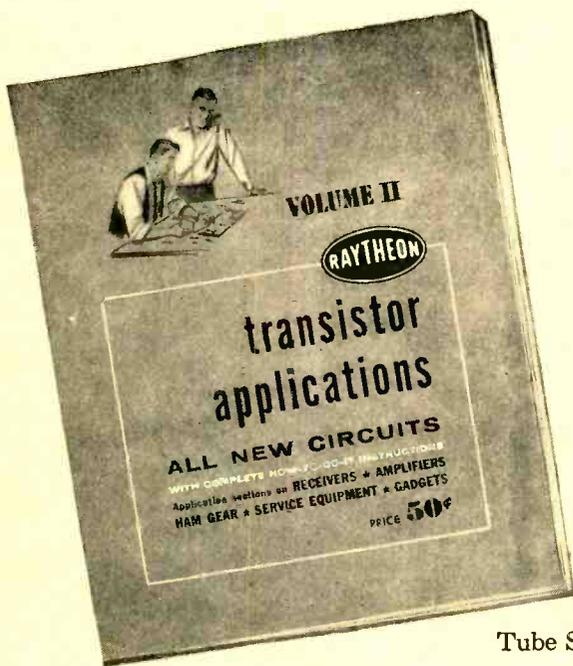
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SIGNAL TRACER

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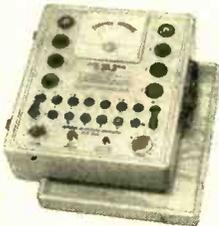


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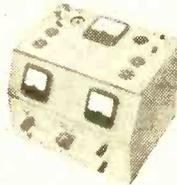
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heard the outside door close behind Mr. Paisley, "I feel sorry for him. He's such a nice guy, and he gets so flustered when an experiment doesn't turn out perfectly. He always seems to think it's his fault, even though it's not. With Stagg here tomorrow, he's bound to be rattled."

"Yeah, I know," Jerry said slowly; "and I've been wondering if maybe we couldn't do something about it."

"Such as what?" Carl demanded, pacing restlessly up and down the room. "That stupid static machine should have been sent back for reconditioning long ago, but Stagg won't okay it. He expects Mr. Paisley to make like Thor with a practically worn-out generator. How can we do anything about that?"

"You still got that little Tesla coil we built up a few months back?"

"Sure, but what's that got to do with the price of hay in Lower Slobbovia?"

"We got a four- or five-inch arc out of that thing, didn't we?"

"Y-e-s-s-s, we did! And you're starting to come through to me!"

"Suppose we come back here tonight and fasten the Tesla coil up underneath the desk where it can't be seen. We can connect its electrodes to those of the static machine with very fine wires. It'll be easy to alter the remote-control receiver we use in our miniature motorboat so that it will operate a relay to cut the power on and off the Tesla coil. One of us can operate it by means of our little transistorized R/C transmitter that fits into a coat pocket."

"What a cool, cool idea!" Carl applauded. "If Principal Stagg wants a good demonstration of static electricity, that's what he'll get. What time do you think we ought to come back and hook the stuff up?"

"Well, we don't want anyone to catch us here. I've noticed that the janitor cleans this floor first and then moves down to the next floor; if we wait until after dark, we shouldn't have any trouble keeping out of his way. We can come in through the side alley and walk in the shadow of the building around to that side door next to the band room. Let's go home now and get the stuff together and check it out."

SHORTLY after eight o'clock two furtive shadows, one short and plump and the other tall and athletic, slipped in the side door of the quiet high school.

"Can't you walk without sounding like
 (Continued on page 14)

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Case finished in gray hammertone if desired	\$.75
Adjustable shoulder strap (not shown) if desired	\$.50

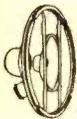
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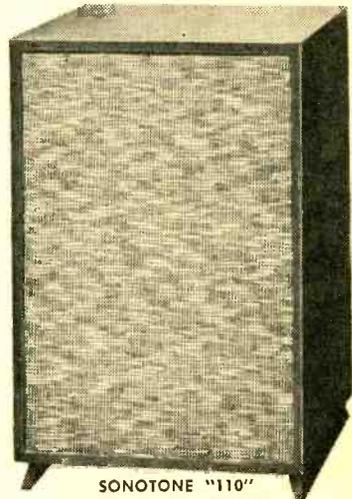


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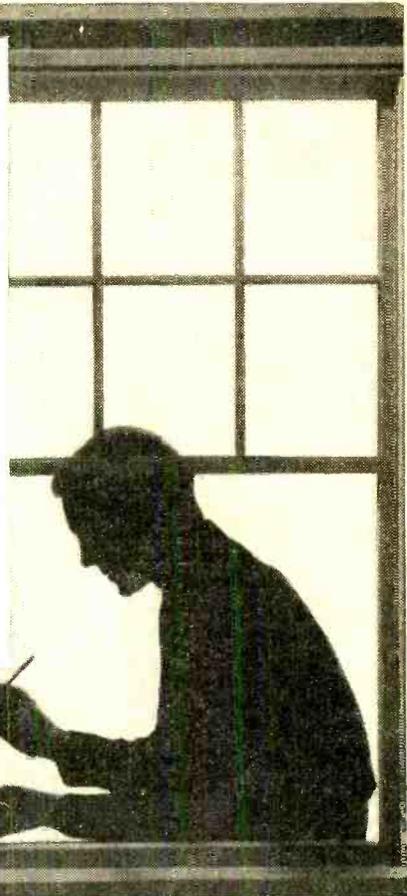
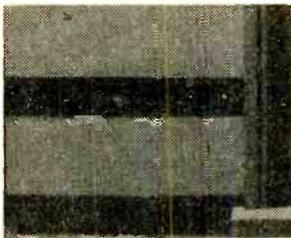
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Carl & Jerry (Continued from page 10)

a cavalry charge?" Jerry whispered hoarsely as they tiptoed up the stairs.

"You don't sound as though your shoes were half-soled with marshmallows yourself," Carl retorted. "Give me the key and let's get inside the lab."

They didn't dare turn on the room lights, but the flashlights that they had brought along enabled them to see what they were doing. The Tesla coil, which is a high-frequency air coil transformer that achieves very high potentials by means of transformer action and resonated windings, was already mounted on a shelf along with its power supply and the controlling R/C receiver. The shelf had been equipped with brackets that permitted it to be fastened quickly in place beneath the instructor's table.

They ran hair-thin wires from the coil to the two electrodes of the static machine. Then they looped up the chains that made connection with the inside foils of the Leyden jars so that the capacitors would not load the secondary of the Tesla coil or be damaged by the high potential.

When all was ready, they checked the operation of their installation. It worked beautifully! The boys locked the labo-

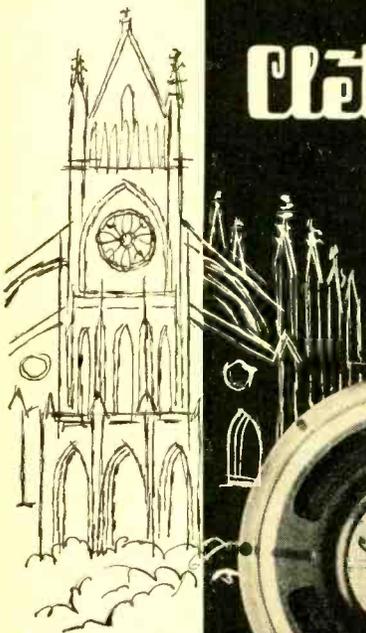
ratory and slipped out of the building without being detected.

THE NEXT DAY was a real nerve-twanger for Carl and Jerry. The physics class was the last period of the day; so they had plenty of time to wonder if anyone would detect the tiny wires connected to the static electricity generator, if the machine might be moved and the wires broken, or if something else would go wrong at the last minute. Finally the last period bell rang, and the boys hurried into the laboratory. A quick, surreptitious inspection showed them that the wires were just as they had left them.

The students had just taken their places when the door opened and the principal, Mr. Stagg, entered. With elaborate care he tiptoed to an empty seat at the rear of the class, while all the students watched his elephantine progress.

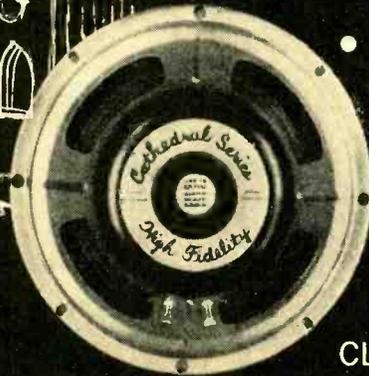
Mr. Paisley cleared his throat nervously and said: "Today, students, we are going to attempt an experiment in the generation of static electricity. We are honored to have our principal with us to observe what he tells me has always been his favorite physics demonstration."

Carl and Jerry could see that Mr. Pais-



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I have a shop at home and have been working on radio and TV after working hours of my regular job. I average \$50 a week for this part time work. RTTA training helped me in making extra money and giving me experience in the electronic field.

Richard Hennis, Little Rock, Ark. 6/30/54

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William Phillips, Fort Lauderdale, Fla.

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RTTA training helped me to understand TV more thoroughly. I have repaired every set that I was called on to repair. 6/21/54

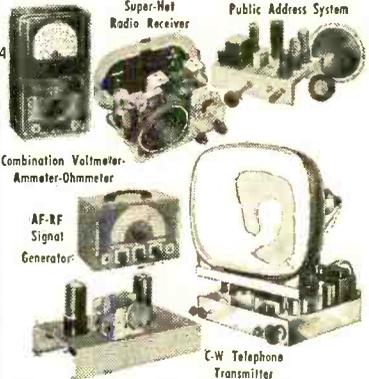
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John Hernandez, Fresno, Calif. 6/7/54

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Larry H. Stafford, Kibstgen, Ont., Canada 7/8/54

"... very good reception..."

I have really enjoyed the course and have come a long way in TV servicing. I am getting very good reception on my TV station considering that the nearest VHF station is 120 miles.

J. W. Hanlon, Jr., Henderan, Texas 7/1/354

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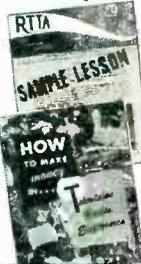
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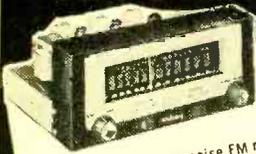
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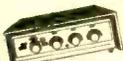
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Carl & Jerry (Continued from page 14)

ley's hands were shaking slightly as they nervously played with a pencil. Jerry made sure his thumb was firmly on the switch of the R/C transmitter in his coat pocket.

"Perhaps I had better explain that you should not expect a very great charge to be generated," Mr. Paisley went on. "The insulators in this machine are not as non-conductive as they once were, and the humid atmosphere that accompanies these autumn rains is not conducive to the generation of a static charge. In fact, Carl, it might be well if you would draw the blinds across the windows to be sure that we all may see the faint spark I hope will pass between the electrodes."

"Oh, come now, Mr. Paisley!" Mr. Stagg boomed from the rear of the room. "I remember sitting right here as a student and seeing that machine produce an arc a full half-inch long. We expect you to do as well. A spark like that can be seen easily without pulling the shades."

The physics teacher's face first flushed a deep pink while Mr. Stagg was speaking, then it turned very white. Without making any reply, he took hold of the crank of the static electricity generator and began turning it vigorously. He kept it going at top speed for a few seconds,



... Instantly there was a noise like a ripped sheet, and a great ball of yellow flame hissed and spit between the metal spheres for a second or so ...



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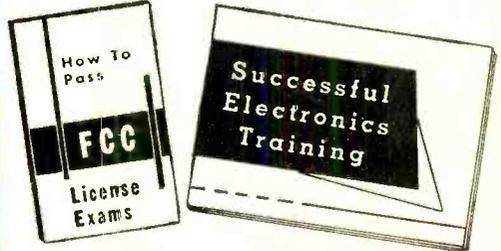
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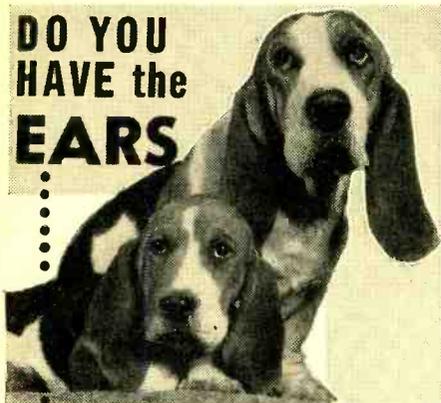
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released it, and took hold of the insulated handle of one of the electrodes and moved it toward the other.

Jerry watched the metal balls approaching each other until they were an inch apart, then stabbed his thumb down on the switch of the little transmitter in his pocket. Instantly there was a noise like a ripped sheet, and a great ball of yellow flame hissed and spit between the metal spheres for a second or so.

A WAVE OF EXCLAMATION swept through the students. Mr. Paisley's blue eyes opened wide behind his spectacles, and he stared down at the machine as if he had seen a fishworm turn into a boa constrictor.

"Wow!" was Mr. Stagg's unscholarly comment. "You certainly are hot today, Mr. Paisley. I wonder if you could do that just once more."

Mr. Paisley looked up in bewilderment for a second or so, and then he started turning the crank of the machine again, even harder than he had before. When he released the crank and took hold of the handle of the electrode, he did so gingerly, as if he did not know exactly what to expect. This time the metal spheres were a full two or three inches apart when suddenly a writhing, twisting blue arc shot between them.

Startled, Mr. Paisley jerked the electrodes apart. A blue flame played over the whole machine, leaping back and forth between the electrodes and the still coasting wheel, and filling the room with a strong odor of ozone.

"That's enough!" Mr. Stagg said hurriedly as the blue flame abruptly died out. "Man and boy, I've seen some demonstrations of the generation of static electricity, but never anything like that."

He strode to the front of the room and placed a heavy, affectionate hand on Mr. Paisley's stooped shoulder. "With your permission, Mr. Paisley, I should like to address a few remarks to the class . . . Boys and girls, you have just seen much more than an awe-inspiring demonstration of mysterious electricity here today. You have seen a performance put on by a man with a fine sense of the drama.

"Did you notice how this sly fellow led us all to believe we were going to have to look very closely to see the feeble spark this machine would produce? What a nice touch that was wanting to draw the shades! He knew all along what to expect, of course; but the impression

(Continued on page 22)

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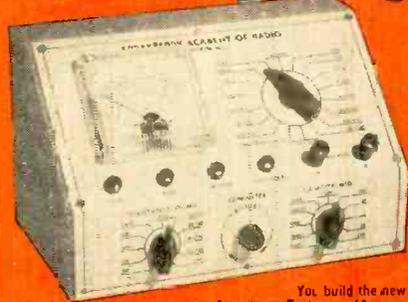
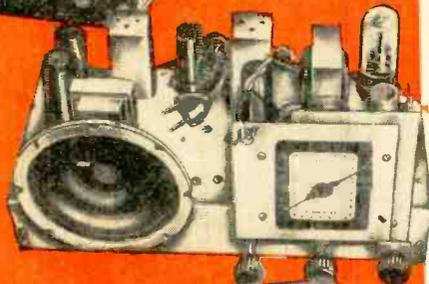
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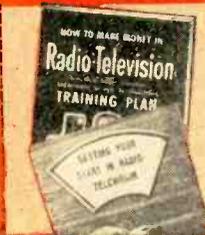
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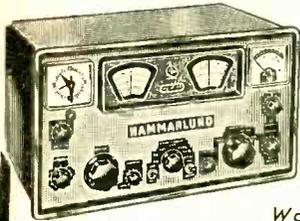
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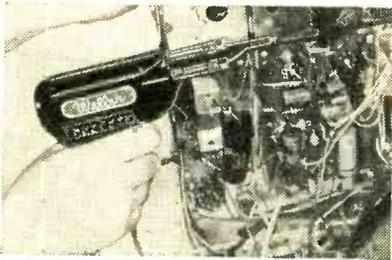
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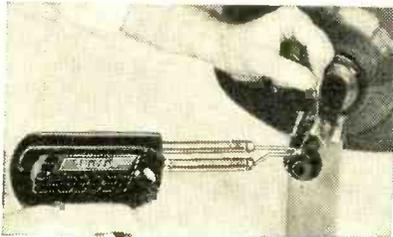
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Carl & Jerry (Continued from page 18)

made on us was all the stronger because of the masterful buildup. That, students, is teaching at its best."

AS HE FINISHED SPEAKING, Mr. Stagg started to pat the static machine affectionately. Almost with a reflex action, Jerry closed the switch of the transmitter in his pocket, and a singing blue flame leaped from the tips of Mr. Stagg's fingers to the machine. Fortunately the high-frequency currents produced by the Tesla coil were harmless, but the principal recoiled as though he had found himself petting a cobra.

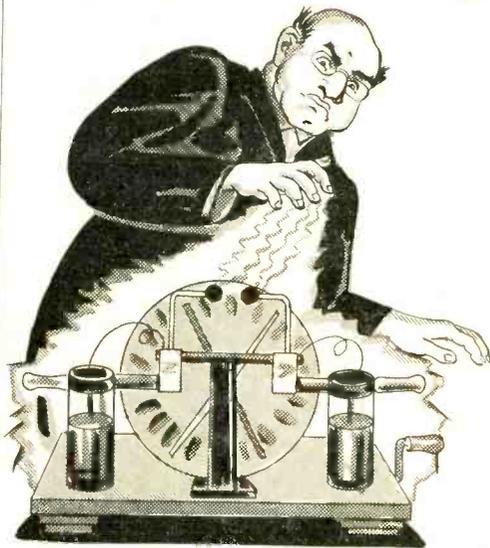
"That thing just won't die," he said, feebly joining in the laughter that swept over the class. "After this, anything would be an anticlimax; so I'll take the liberty of dismissing the class for the day."

It didn't take long for the eager students to empty the room, but in the confusion Jerry managed to break the fine wires loose from the machine. He and Carl were the last ones out of the door; as they looked back, they could see Mr. Paisley staring in puzzled fascination at the static electricity generator.

"I'm not sure if we did him a favor or not," Jerry muttered out of the corner of his mouth to Carl, "because he's not going to rest easy until he figures out what happened."

"Maybe so," Carl agreed; "but we certainly helped him put on one whingding of a demonstration!"

-30-



... Jerry closed the switch of the transmitter in his pocket, and a singing blue flame leaped from the tips of Mr. Stagg's fingers to the machine ...

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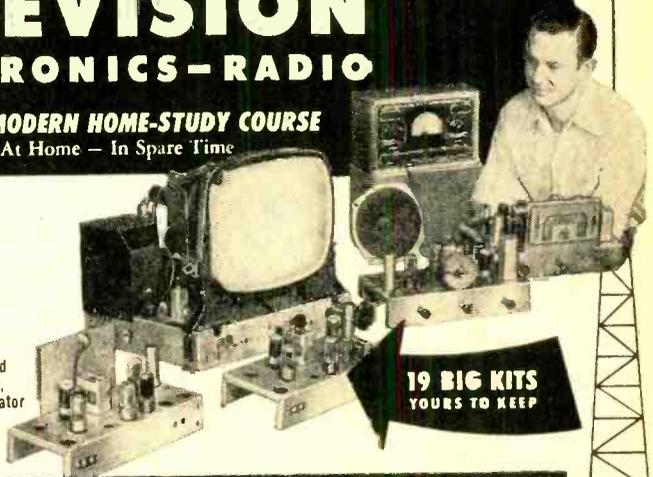
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LETTERS FROM OUR READERS

Home Construction

■ I built Art Trauffer's "Simplest Code Practice Set" (July '57, p. 48), grounding it to a heat pipe in our apartment. But when I pressed the key, instead of a "ground buzz" I received WQXR here in New York. I could think of no explanation. Maybe you can help me.

RONALD TEPPER
 Elmhurst, N. Y.

Apparently the key is acting as a detector. Perhaps your "ground" is acting as an antenna.

■ I have recently been experimenting with transistor short-wave radios. I would like to see a few two- or three-transistor projects.

JERRY SUPINO
 Seattle, Wash.

The article beginning on page 77 of this issue is for you, Jerry.

■ Recently I built a Heath amplifier and speaker system. Since then I have added a pair of electrostatic super-tweeters in accordance with an article in your June issue, and the results have far exceeded my expectations. Now I have acquired a 15" dynamic speaker. Could you send me a diagram of a crossover network of about 600 cycles?

JACK PALMER
 Huntington, N. Y.

See page 65 for construction of crossovers of any frequency.

■ In the August issue, you published an article called "Make Your Own \$5 Coax Speaker." I have a four-band receiver that has an 8" speaker. A few weeks before I received the August issue, I installed a 4" speaker in the set in much the same way you suggested in the article. I did not put a screen in front of the tweeter. I get good results from it without the screen.

FRANK SQUIRES
 Ocala, Florida

Perhaps if you use the screen, Frank, you might detect some difference.

Some Disa and Data

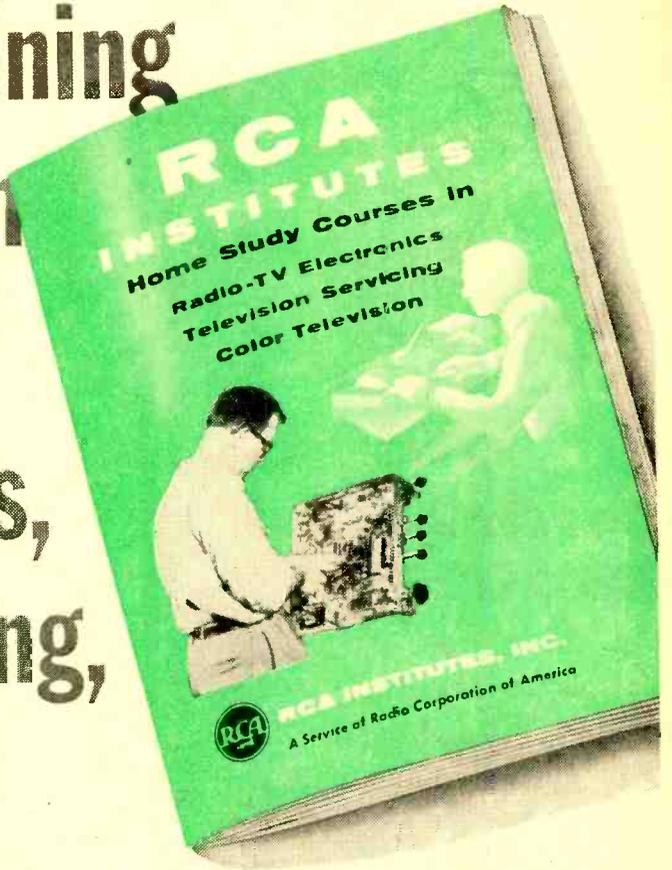
■ In what year did Hallicrafters stop making the S-38 receiver?

SANFORD HUTSON
 Stuttgart, Ark.

They didn't. It's now the S-38DB.

■ As an avid reader of POPULAR ELECTRONICS since its first issue, I am taking the liberty of asking you a favor. I am the owner of a commercial Echophone Model EC2 (Serial 211525) receiver which is badly in need of alignment and repairs. I have tried unsuccessfully to obtain a schematic from the Hallicrafters Company, and I am told it

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Letters

(Continued from page 24)

is no longer available. Would you therefore, please, in the *Letters* column, advise any person who will be kind enough to mail me a schematic or equivalent data that I will treat it carefully and return it promptly.

GEORGE R. PRICE
408 77th Street
Brooklyn 9, N. Y.

■ I am having trouble in locating a schematic of a receiver that I have and that I would like to get in working order. I have tried all over to locate the schematic and can't seem to find one. The receiver is an Echophone Model EC1A and is a 3-band commercial-type receiver. I would appreciate it very much if one of your many readers who has a schematic and alignment data on this receiver would like to part with it.

A/2c DANIEL C. BRANNAN
9th Radio Relay Sqdn.
Donaldson AFB., S.C.

The "Challenger"

■ I have solved the program to win against the "Challenger" (Sept., page 83) and you may come out from behind your bullet-proof steel plate. After about 10 futile tries on paper, the solution came to me—if the machine skips certain lights, I should also. So I made a list of the "stop" numbers, placing them in two columns labeled "Machine and Me," and the answer was obvious: Machine—2, 5, 9, 13, 17, 21; Me—4, 8, 12, 16, 20. I studied the plans for this machine for the past two nights, and hope to build one.

CARL F. GRAYEWALD
Oconomowoc, Wis.

■ Being ardent fans of your magazine, we read the article on the miniature electronic brain (The "Challenger"). We sat down to figure out how to beat the brain. In a shade over an hour, we came across the right combination. Provided that the machine goes first, we can beat it every time. For every single move that the machine makes, you make three; and for every two it makes, you make two; and for every three it makes, you make one. Needless to say, you would get beaten every time if you went first.

LARRY FEAZELL
DARYL GILMER

■ Within 10 minutes time, I figured out how a person can beat the machine. In order to win, the person or the machine has to light the lamps in the following order: 4, 8, 12, 16, 20—thus leaving the 21st lamp for the loser. In order for the person to win—if the machine moves first, the machine will light lamp number 2; then the person should light lamp number 4 and light the remaining lamps in the order stated above in turn. If the person moves first, he should light lamp number 1, the machine will light lamp number 2, then he should light lamp number 4 and the remaining lamps in the orders stated.

KENNETH BELL
Portland, Oregon

The only winning combination is the one in which the player completes a sequence of four. If he misses one such sequence, the machine seizes on

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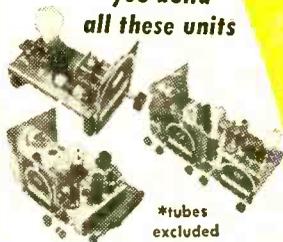
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At last, the quality performance of a turntable has been combined with flawless record handling convenience. The result is—the new Glaser-Steers GS Seventy Seven. Wow and flutter are virtually non-existent. Rumble, for all practical purposes, has been eliminated, and automatic features such as the amazing 'SPEEDMINDER' mark the GS-77 as the most advanced record changer of our time.

'SPEEDMINDER' does your thinking — prevents you from using the wrong stylus with your records; selects the correct turntable speed . . . and intermixes and plays 33 and 45 rpm records automatically, without regard to size or sequence.

Another important GS-77 feature is that the turntable pauses during change cycles and doesn't resume motion until next record has come into play position and stylus is in lead-in groove. This eliminates record surface wear caused by grinding action of record dropping on moving disc — a common drawback in other changers.

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Letters

(Continued from page 26)

it and will win. The winning sequences are as follows:

If the player starts first, he must take one jump. The machine then takes one, and the player must take the next two, completing a sequence of four. The machine then takes one, and the player takes three, continuing on in the same sequence.

If the machine starts first, it is programmed to take two. The player then takes two, and the sequence of four is completed. Then the machine takes one, the player three, and the game continues on as before.

Pardon Our Slip

■ There is one error or misinterpretation in "Push-Button Weather Man," (September '57 issue). I refer to the sentence beginning: "For this reason, Dr. Krick and other meteorologists . . ." on page 46. This statement *should* read: "For this reason, Dr. Krick and other meteorologists conducted a two-million-dollar Air Force project to compile 15,000 maps, showing the weather in the northern half of the world for every day back to 1899. Incomplete parts of weather maps and the logs of whaling vessels had to be consulted in plotting these complete surface maps, as prior to that time meteorologists had not been thinking in terms of world weather patterns." I think you can see that there is a considerable difference between the two statements.

RICHARD D. SHIVERS, Director
Weather Engineering Div.
Irving P. Krick Assoc., Inc.
Denver, Colorado

We regret the error. Thank you very much for calling this to our attention.

Pep Up Your TV

■ Here in Los Angeles we have the v.h.f. channels fairly well covered. But in a lot of places there are just one or two local TV stations with one or more stations that can just barely be seen or heard part of the time. In other words, how about an r.f. amplifier for our TV sets?

ALAN OGDEN
Sun Valley, Calif.

Commercial r.f. preamps are cheaper than building your own. You can get them in any radio supply house.

—50—

Out of Tune

Superregen Pocket Receiver (June, 1957, page 60): The coil used in this receiver is a Grayburn Vari-Loopstick Antenna, available from Radio Shack Corporation, 167 Washington St., Boston, Mass., for 60 cents. Modified trimmer capacitor C1 should have an approximate capacity of 50-380 μ fd. If C1 tunes too low on the band at full open, try a capacitor with a smaller minimum value.

—50—

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

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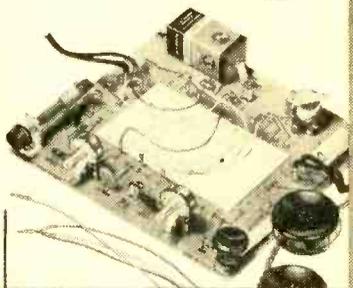
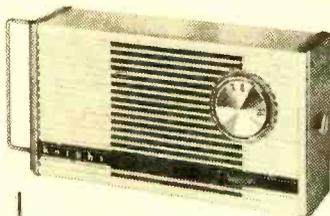
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Sensational transistor hobby kit! Assemble the basic parts once, then complete project after project (10 in all), just by plugging leads into proper jacks on printed-circuit board—no wiring changes needed. Make the following: AM radio; amplifier; wireless 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.

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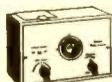
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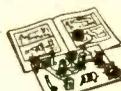
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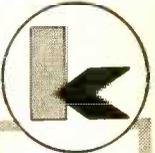
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Interruption of light beam triggers relay, to sound chime or bell, turn on lights, etc.

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Model Y-702. Relay Kit. Net. **\$1350**
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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-Scanner" 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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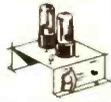
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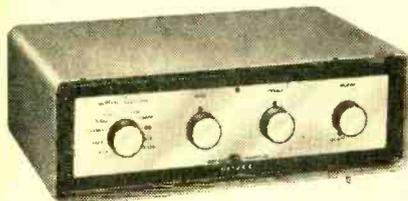
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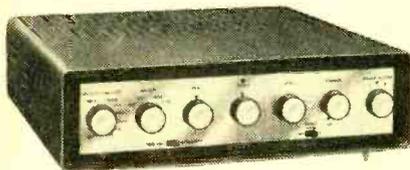
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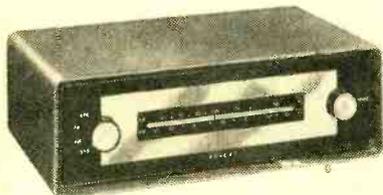
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Model Y-762. 30-Watt Hi-Fi Amplifier Kit. Net only..... **\$76⁹⁵**



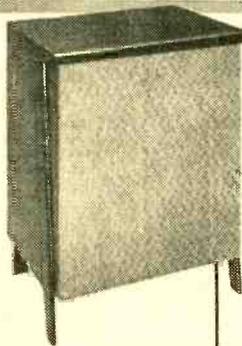
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- Advanced Custom Styling

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Model
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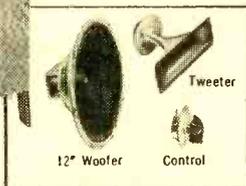
The best-looking, best-performing FM-AM tuner your money can buy! Covers full AM broadcast and 88 to 108 mc FM. Sensitivity is 2.5 microvolts for 20 db of quieting on FM; 3 microvolts for 10 db signal-to-noise ratio on AM. Features include: Inertia Flywheel Tuning for easy, accurate tuning; Automatic 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

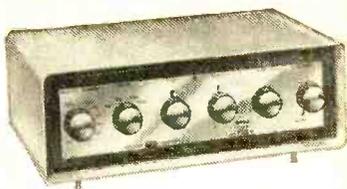
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Model Y-789. 2-Way Speaker System Kit.
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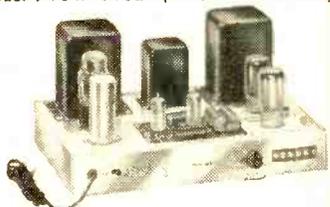


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Sensational Hi-Fi design at new low cost! Features precise record equalization guaranteed within 1/2 db of recommended accuracy! Exclusive new printed-circuit switches and 2 printed-circuit boards for easy, error-free assembly; built-in power supply; response, ± 0.5 db, 10-50,000 cps; 8 inputs (including Tape Head); separate Bass and Treble controls; separate Level and Loudness controls; Rumble Filter switch; DC on all tube filaments; cathode follower output. Beautiful custom-styled case, 4 x 13 x 8". Complete with case. Shpg. wt., 12 1/2 lbs.

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



Model
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\$44⁵⁰
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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. **\$4²⁵**



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

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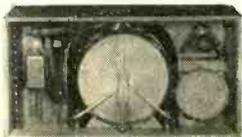
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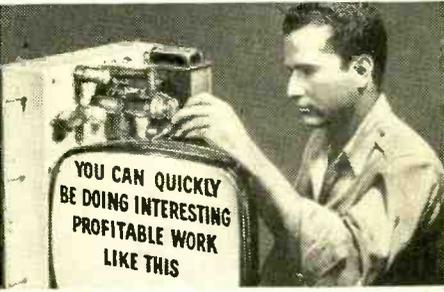
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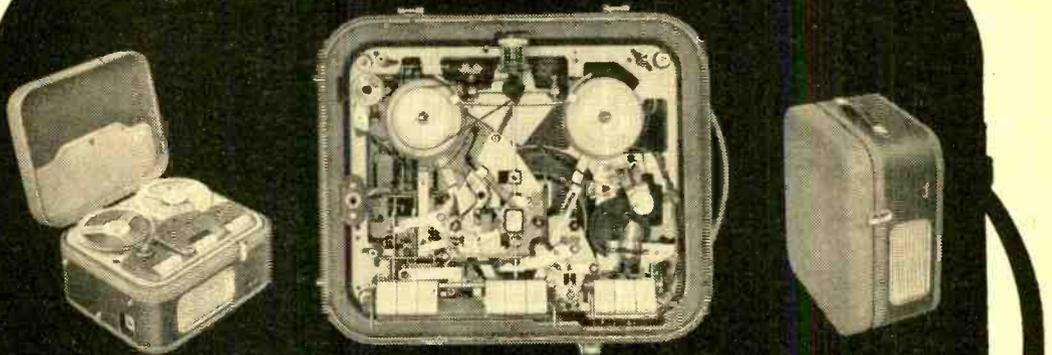
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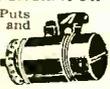
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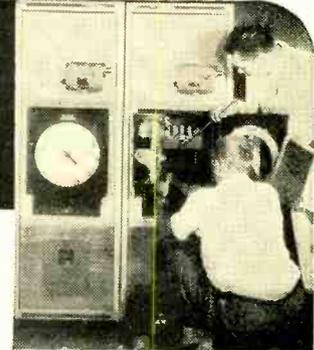
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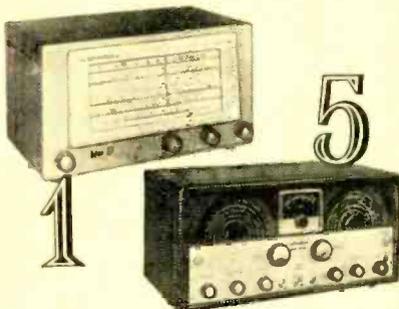
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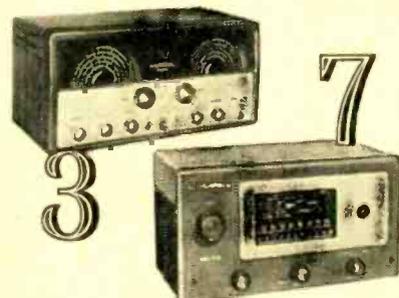
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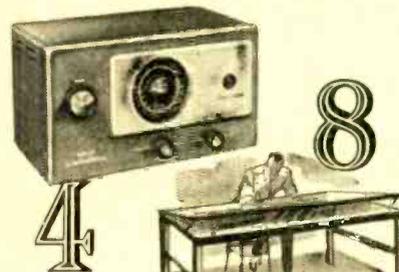
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VACUUM TUBE
VOLTMETER
#221
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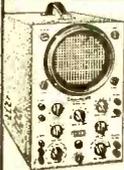


NEW! PEAK-to-PEAK
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#232 & UNI-PROBE
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1000 Ohms/Volt
MULTIMETER
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SCOPE #425
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Lowest-priced professional Scope



NEW! COLOR &
BLACK-&WHITE
S-MC TV
SCOPE #460
KIT \$79.95
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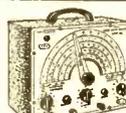
TUBE TESTER #625
KIT \$34.95 WIRED \$49.95



#666
NEW! DYNAMIC
CONDUCTANCE
TUBE &
TRANSISTOR TESTER
KIT \$69.95 WIRED \$109.95



NEW!
RF-AF SIGNAL
GENERATOR #324
(150 kc to 435 mc!)



TV-FM SWEEP
GENERATOR
#360
KIT \$34.95 WIRED \$49.95



MULTI-SIGNAL TRACER #145
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1000 Ohms/Volt
MULTIMETER
#556
(4 1/2" METER)
KIT \$16.90
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6V & 12V
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COMPARATOR #950B
KIT \$19.95 WIRED \$29.95



Test radio, hearing aid,
flashlight, photo-flash,
electronic equipment
batteries:
BATTERY TESTER
#584
KIT \$9.95 WIRED \$12.95



RETMA Res. Sub.
Box #1100
KIT \$5.95 WIRED \$9.95



RETMA Cap. Sub.
Box #1120
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HIGHEST QUALITY HI-FI at the lowest prices...

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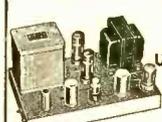
NEW! FM TUNER #HFT90
KIT, less cover: \$39.95*
WIRED, less cover: \$65.95*
Cover: \$3.95 *excise tax incl.



NEW MASTER
CONTROL
PREAMPLIFIER #HF61
KIT \$24.95 WIRED \$37.95
with Power Supply:
KIT \$29.95 WIRED \$44.95



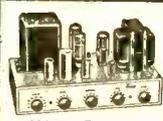
NEW!
60-WATT
Ultra-Linear
HIGH
FIDELITY
POWER AMPLIFIER
#HF60 with ACRO TO-330 OUTPUT XFMR
KIT \$72.95 WIRED \$99.95



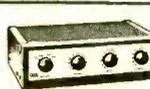
NEW!
50-WATT
Ultra-Linear
POWER
AMPLIFIER
#HF50
with
CHICAGO OUTPUT XFMR
KIT \$57.95 WIRED \$87.95



NEW!
20-WATT
Ultra-Linear
Williamson-type
INTEGRATED AMPLIFIER
#HF20
KIT \$49.95 WIRED \$79.95



NEW!
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INTEGRATED AMPLIFIER
#HF52
KIT \$69.95 WIRED \$109.95



NEW! 12-WATT Williamson-type
INTEGRATED AMPLIFIER
#HF12
KIT \$34.95 WIRED \$57.95



NEW!
COMPLETE with
FACTORY-BUILT
CABINET-2-WAY
HI-FI SPEAKER
SYSTEM #HF51
\$39.95

Listen to the Voices



of the

W
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Stations, programs and personalities currently heard on the short-wave bands



Well-known personalities include Miss Gun Hagglund, who announces for Radio Sweden, and Edward Startz, shown having his famous "nice cup of tea" during the Happy Station program of Radio Netherlands.

DO YOU WANT to take a trip around the world at the speed of light and never leave your comfortable armchair? The opportunity is yours with the aid of a short-wave radio receiver. Most countries broadcast on the short waves and many of them have English language programs that can be heard in North America. So just sit back and start tuning the dial of your receiver. You'll enjoy the interesting programs of news, music and entertainment from these far-off and fascinating lands.

Generally speaking, there are two types of listeners to short-wave broadcasts: (1) those relaxing after a hard day's work who want programs of entertainment and information; and (2) those listening for far off stations so that they can send in a reception report and receive a QSL, or verification card for their collection. This article has been written with both groups in mind.

With the information contained on these pages, you will know when and where to

By **STEWART WEST**

listen for certain stations. Of course, it would take a book to list all the stations that can be heard, so I have tried to select a representative cross section. Best-heard stations for listeners in Eastern North America are listed on pages 42 to 44; those for listeners in Western North America will be found on pages 45 to 47. News and "Mailbag" programs are listed under each station for easy reference. And the following paragraphs will give you a sampling of the various programs and personalities that can be heard on the short waves.

THIRTY YEARS ON THE AIR

One of the most colorful personalities of the radio world, the originator and polyglot speaker-producer of the world-wide "Happy Station" program is Edward Startz of *Radio Netherlands' Overseas Service*. Startz

ENGLISH LANGUAGE SHORT-WAVE BROADCAST STATIONS BEST HEARD IN EASTERN NORTH AMERICA

Readers in the eastern part of the United States and Canada will find the following list of stations helpful in tuning the short-wave broadcast bands. The left-hand column lists the hour in Eastern Standard Time for broadcasts in English only; in the middle column, the city and country from which the broadcasts originate are listed with the name the station uses for identification in parentheses; and on the right are the frequencies and call letters for stations using them during their broadcasts. When an asterisk appears before the name of the city, it indicates transmissions specifically beamed to North America; generally these will be the best-heard stations, though the others are often very well heard.

TIME (EST)	CITY, COUNTRY (NAME)	FREQUENCIES (kc.)
4:45- 5:45 a.m.	Georgetown, British Guiana (<i>Radio Demerara</i>)	5980
5:00- 6:00 a.m.	Port-of-Spain, Trinidad (<i>Radio Trinidad</i>)	6085, 3275
5:00- 6:00 a.m.	Cap-Haitien, Haiti (<i>The Evangelistic Voice</i>)	15400, 9630, 6105
5:50- 7:30 a.m.	Kingston, Jamaica (<i>Radio Jamaica</i>); News—7:00 a.m.	4950
6:00- 6:30 a.m.	Buenos Aires, Argentina (<i>Radio El Mundo</i>); News—6:25 a.m.	15290 (LRU)
6:00- 7:00 a.m.	Djakarta, Indonesia (<i>The Voice of Indonesia</i>); News—6:15 a.m.	9710
6:00- 1:00 p.m.	Johannesburg, South Africa (<i>South African Broadcasting Corp.</i>) English on Tuesday, Thursday, and Saturday only; News—11:00, 12:00 noon	25800
7:10- 8:45 a.m.	*Melbourne, Australia (<i>Radio Australia</i>); News—7:15, 8:15 a.m.; Mailbag—8:00 a.m. Sunday	11810 (VLC11)
7:15- 8:15 a.m.	*Warsaw, Poland (<i>Radio Warsaw</i>); News—7:15, 7:45 a.m.	15120, 11755, 11740
8:00- 9:30 a.m.	*Cap-Haitien, Haiti (<i>The Evangelistic Voice</i>)	15400, 9630
8:30- 9:00 a.m.	Lisbon, Portugal (<i>Lisbon Calling</i>); News—8:30 a.m.	21495, 17880
8:30- 9:30 a.m.	Delhi, India (<i>All India Radio</i>); News—8:35 a.m.	21580, 17845
9:00- 9:30 a.m.	*Stockholm, Sweden (<i>Radio Sweden</i>); News—9:00 a.m.	17840

TIME (EST)	CITY, COUNTRY (NAME)	FREQUENCIES (kc.)
5:15- 5:30 p.m.	Belgrade, Yugoslavia (<i>Radio Belgrade</i>); News—5:15 p.m.	6100
5:15- 5:35 p.m.	Dakar, Senegal (<i>Radio Dakar</i>) Tuesday, Thursday, and Saturday only; News—5:15 p.m.	4951
5:30- 6:00 p.m.	*Brussels, Belgium (<i>WFR—World's Fair Radio</i>) Sunday, Tuesday, Thursday, and Friday	15335, 11720, 11850 (ORU)
5:30- 6:00 p.m.	Leipzig, East Germany (<i>Democratic Germany Speaking</i>)	9730
5:30- 7:00 p.m.	Caracas, Venezuela (<i>Radio Libertador</i>); News—6:10 p.m.	3245 (YVKT)
6:00- 6:50 p.m.	*Tokyo, Japan (<i>Radio Japan</i>); News—6:00, 6:40 (Saturday only) p.m.	17855 (JOA23), 15325 (JOB21)
6:00-10:03 p.m.	*London, England (<i>General Overseas Service</i>); News—6:00; 9:00, 10:00 p.m.	15310, 11930, 9825
6:00- 1:00 a.m.	*Moscow, U.S.S.R. (<i>Radio Moscow</i>); News—Every hour on the hour	11940, 11890, 11820, 11740, 9665
6:00-11:10 p.m.	Kingston, Jamaica (<i>Radio Jamaica</i>); News—6:00, 6:50, 8:10, 10:00, 11:00 p.m.	4950
6:15- 7:00 p.m.	*Ankara, Turkey (<i>Radio Ankara</i>); News—6:15 p.m.	9515
6:15- 7:45 p.m.	*Monrovia, Liberia (<i>Radio Station ELWA</i>) Tuesday only; News—6:55 p.m.	21535, 15200
6:15- 8:00 p.m.	*Brussels, Belgium (<i>WFR—World's Fair Radio</i>) Saturday only; Mailbag—7:00 p.m.	11850, 9705 (ORU), 9655 (OTC)
6:30- 7:00 p.m.	Port-au-Prince, Haiti (<i>Radio Commerce</i>) Sunday only	9545 (4VC)
7:00-10:35 p.m.	Belize, British Honduras (<i>B.H.B.S.</i>); News—8:00, 10:30 p.m.	3300
7:00- 7:45 p.m.	Sao Paulo, Brazil (<i>Radio Aparecida</i>) Saturday only	9635 (ZYR83)
7:00- 9:15 p.m.	Grenada, Windward Islands (<i>Windward Islands Broadcast-ing Service</i>); News—9:00 p.m.	3365

9:00-10:00 a.m.	*Quito, Ecuador (<i>The Voice of the Andes</i>)	17890, 15115, 11915 (HCJB)	7:15- 7:35 p.m.	*Rome, Italy (<i>Italian Broadcasting and Television System</i>); News—7:15 p.m.	11905, 9575
9:00- 1:15 p.m.	*London, England (<i>North American Service</i>); News—12:00 noon	17700, 15310	7:30- 8:00 p.m.	*Brussels, Belgium (<i>WFR—World's Fair Radio</i>) Sunday, Monday, Tuesday, Thursday, Friday	9655 (OTC), 11850, 9705 (ORU)
10:30-11:30 a.m.	Peking, China (<i>Radio Peking</i>); Dictation News—10:30 a.m.	17860, 17680, 15095,	7:30- 8:00 p.m.	*Budapest, Hungary (<i>Radio Budapest</i>)	11910, 9833
12:15- 1:00 p.m.	Lisbon, Portugal (<i>Lisbon Calling</i>); News—12:15 p.m.	21690, 17895	7:30- 8:00 p.m.	*Prague, Czechoslovakia (<i>Radio Prague</i>); News—7:30 p.m.	11835, 9550
12:30-12:45 p.m.	Athens, Greece (<i>Radio Athens</i>); News—12:30 p.m.	17745, 15345	7:30- 8:30 p.m.	*Warsaw, Poland (<i>Radio Warsaw</i>); News—7:30 p.m.	15120, 11740, 9525
2:00- 3:00 p.m.	Djakarta, Indonesia (<i>The Voice of Indonesia</i>); News—2:30 p.m.	11770, 9865	7:55- 8:45 p.m.	*Montreal, Canada (<i>Radio Canada</i>); News—8:00, 8:30 p.m.; Mailbag—8:15 p.m. Sunday	15190 (CKCX), 11720 (CHOL)
2:45- 3:45 p.m.	Delhi, India (<i>All India Radio</i>); News—2:45 p.m.	17860, 15290, 15105, 11710	8:00- 8:15 p.m.	Karachi, Pakistan (<i>Pakistan Calling</i>); News—8:00 p.m.	15335, 11885
3:00- 3:20 p.m.	Cairo, Egypt (<i>Cairo Calling</i>); News—3:00 p.m.	17915	8:00- 8:30 p.m.	*Sofia, Bulgaria (<i>Sofia Calling</i>); News—8:00 p.m.	9700
3:00- 3:30 p.m.	Teheran, Iran (<i>Teheran Calling</i>); News—3:00 p.m.	15100 (or 17775)	8:00- 9:20 p.m.	*Oslo, Norway (<i>Radio Norway</i>) Sunday only; Norway This Week—9:00 p.m.	15175, 11735, 9540
3:00- 3:30 p.m.	Damascus, Syria (<i>Damascus Calling</i>); News—3:15 p.m.	15165	8:00- 9:30 p.m.	*Monrovia, Liberia (<i>Radio Station ELWA</i>) Tuesday only; News—8:40 p.m.	9650
3:00- 4:00 p.m.	*London, England (<i>North American Service</i>); News—3:00 p.m.	17700	8:00-10:30 p.m.	*Cap-Haitien, Haiti (<i>The Evangelistic Voice</i>); News—9:30 p.m. Saturday; Mailbag—9:30 p.m. Monday	15415 (4VWV), 9602 (4VEH), 6105 (4VE)
3:00- 5:00 p.m.	Tangier, Morocco (<i>Voice of Tangier</i>)	9415 (WTAN)	8:05- 8:30 p.m.	Recife, Brazil (<i>Radio Jornal do Comercio</i>)	9565
3:00- 5:15 p.m.	Accra, Ghana (<i>Ghana Broadcasting Service</i>); News—3:00, 4:00 p.m.	9640, 4915, 3366	8:15- 9:00 p.m.	*Brazzaville, French Equatorial Africa (<i>Radio Brazzaville</i>); News—8:15 p.m.	11975
3:30- 4:00 p.m.	Leipzig, East Germany (<i>Democratic Germany Speaking</i>)	9730	8:30- 9:00 p.m.	*Stockholm, Sweden (<i>Radio Sweden</i>); News—8:30 p.m.	11810 (or 9620)
4:00- 5:00 p.m.	Jerusalem, Israel (<i>The Voice of Zion</i>); News—4:00 p.m.	9008	8:30-10:15 p.m.	*Berne, Switzerland (<i>Switzerland Calling</i>); News—8:35 p.m.	11865 (HER5), 9535 (HER4),
4:00- 6:00 p.m.	*London, England (<i>General Overseas Service</i>)	17700, 15310			
4:00- 6:00 p.m.	Villa Louvigny, Luxembourg (<i>Radio Luxembourg</i>)	6090			
4:15- 4:45 p.m.	Tangier, Morocco (<i>IBRA—Radio Netherlands</i>); News—4:18 p.m.	14850, 11342, 9900			
4:15- 4:55 p.m.	*Hilversum, Holland (<i>Radio Netherlands</i>); News—4:18 p.m.	17775, 15425, 15220			
4:30- 5:00 p.m.	Peking, China (<i>Radio Peking</i>); News—4:30 p.m.	11650, 9460			
5:00- 5:30 p.m.	Port-au-Prince, Haiti (<i>Radio Commerce</i>) Sunday only; Mailbag—5:15 p.m.	9545 (4VC)			

(Continued on page 44)

ENGLISH LANGUAGE SHORT-WAVE BROADCAST STATIONS BEST HEARD IN EASTERN NORTH AMERICA

(Continued from page 43)

TIME (EST)	CITY, COUNTRY (NAME)	FREQUENCIES (kc.)	TIME (EST)	CITY, COUNTRY (NAME)	FREQUENCIES (kc.)
8:30-8:40 p.m.	Paramaribo, Surinam (AVROS) Monday only	15407, 4850	10:30-11:00 p.m.	News—10:15 p.m.; Mailbag—10:40 p.m. Thursday, Sunday	9585, 6130
9:00-9:15 p.m.	*Port-au-Prince, Haiti (Radio Commerce) Tuesday, Thursday, and Friday	5980 (4VB)	11:00-11:15 p.m.	*Copenhagen, Denmark (Voice of Denmark) No English on Sunday; News—10:30 p.m. Monday, Wednesday, and Friday; Mailbag—10:30 p.m. Saturday	9520 (OZF)
9:00-9:30 p.m.	*Copenhagen, Denmark (Voice of Denmark) No English on Sunday; News—9:00 p.m. Monday, Wednesday, and Friday; Mailbag—9:00 p.m. Saturday	9520 (OZF)	11:00-12:00	Forest Side, Mauritius (Mauritius Broadcasting Service)	15055
9:00-12:00	*Quito, Ecuador (The Voice of the Andes); News—10:15 p.m. Tuesday	15115, 11915, 9745 (HCJB)	11:15-12:00	San Jose, Costa Rica (Lighthouse of the Caribbean)	9645, 6037 (TIFC)
9:25-9:45 p.m.	*Rome, Italy (Italian Broadcasting and Television System); News—9:25 p.m.	11905, 9575	11:15-12:00	*Madrid, Spain (Voice of Spain); News—11:15 p.m.; Mailbag—11:40 p.m. Thursday, Sunday	9585, 6130
9:30-9:40 p.m.	*Cologne, Germany (Voice of Germany); News—9:30 p.m.	11795, 9640	11:15-12:00	*Berne, Switzerland (Switzerland Calling); News—11:20 p.m.	11865 (HER5), 9535 (HER4)
9:30-10:00 p.m.	*Port-au-Prince, Haiti (Radio Commerce) Wednesday only	5980 (4VB)	11:30-11:45 p.m.	Buenos Aires, Argentina (Radio Nacional); News only	9690 (LRA)
9:30-11:00 p.m.	Port-au-Prince, Haiti (Radio Haiti) Thursday only	6195 (4VHW)	12:15-12:30 a.m.	*Brazzaville, French Equatorial Africa (Radio Brazzaville); News only	15440, 9730, 5970
9:30-10:00 p.m.	*Warsaw, Poland (Radio Warsaw); News—9:30 p.m.	11740, 9525	1:00-2:00 a.m.	Accra, Ghana (Ghana Broadcasting Service); News—1:00 a.m.	4915, 3366
9:30-10:10 p.m.	*Hilversum, Holland (Radio Netherlands); News—9:33 p.m. except Sunday	9590, 6025	1:15-5:45 a.m.	Wellington, New Zealand (Radio New Zealand); News—3:30, 5:30 (except Sundays) a.m.	9540 (ZL2)
9:30-11:00 p.m.	*Hilversum, Holland (The Happy Station) Sunday only	9590, 6025	2:00-3:00 a.m.	Lagos, Nigeria (Nigerian Broadcasting Service)	4990
9:55-10:35 p.m.	*Montreal, Canada (Radio Canada); News—10:00 p.m.; The Northern Messenger—10:20-11:20 p.m. Sunday	15320 (CKCS), 9585 (CKLP)	2:00-3:00 a.m.	Kaduna, Nigeria (Nigeria Broadcasting Service)	3326
10:00-10:30 p.m.	*Bucharest, Rumania (Bucharest Calling); News—10:00 p.m.	11937, 9570	2:30-2:45 a.m.	Papeete, Tahiti (Radio Tahiti, the Voice of France in the Pacific)	6135
10:00-11:45 p.m.	Guatemala City, Guatemala (TGNA)	9668, 5952	4:00-4:15 a.m.	Manila, Philippines (The Call of the Orient) News only	15300, 11855, 9730
10:15-11:00 p.m.	*Madrid, Spain (Voice of Spain);		4:00-6:00 a.m.	Port Moresby, New Guinea (The A.B.C.); News—4:00 a.m.	6130 (VLT6)
			4:30-5:00 a.m.	Hanoi, North Vietnam (Voice of Vietnam)	15020, 11895, 9465

ENGLISH LANGUAGE SHORT-WAVE BROADCAST STATIONS BEST HEARD IN WESTERN NORTH AMERICA

Readers in the western part of the United States and Canada will find the following list of stations helpful in tuning the short-wave broadcast bands. The left-hand column lists the hour in Pacific Standard Time for broadcasts in English only; in the middle column, the city and country from which the broadcasts originate are listed with the name the station uses for identification in parentheses; and on the right are the frequencies and call letters for stations using them during their broadcasts. When an asterisk appears before the name of the city, it indicates transmissions specifically beamed to North America; generally these will be the best-heard stations, though the others are often very well heard.

TIME (PST)	CITY, COUNTRY (NAME)	FREQUENCIES (kc.)
6:00-8:00 a.m.	Manila, Philippines (<i>The Call of the Orient</i>); News—7:00 a.m.; Mailbag—7:15 a.m. Wednesday	17805, 15300, 11855, 9730
6:00-10:00 a.m.	Johannesburg, South Africa (<i>South African Broadcasting Corp.</i>) Tuesday, Thursday, and Saturday only	25800
6:00-7:00 a.m.	*Quito, Ecuador (<i>The Voice of the Andes</i>)	17890, 15115, 11915 (HCJB)
6:15-7:15 a.m.	Rangoon, Burma (<i>Burma Broadcasting Service</i>); News—7:00 a.m.	11765
6:30-7:30 a.m.	*Djakarta, Indonesia (<i>Voice of Indonesia</i>); News—6:45 a.m.	9710, 4910
6:45-7:15 a.m.	Hanoi, North Vietnam (<i>Voice of Vietnam</i>)	15020, 11895, 9465
7:15-8:15 a.m.	*Melbourne, Australia (<i>Radio Australia</i>); News—7:30 a.m.; Mailbag—7:45 a.m. Sunday	11770 (VLC11)
7:30-8:30 a.m.	Peking, China (<i>Radio Peking</i>); Dictation News—7:30 a.m.	17860, 17680, 15095
7:40-8:20 a.m.	Tokyo, Japan (<i>Radio Japan</i>); News—7:50 a.m.	15325 (JOB21), 11705 (JOA4)
9:15-10:00 a.m.	Lisbon, Portugal (<i>Lisbon Calling</i>); News—9:15 a.m.	21690, 17895
12:00-1:00 p.m.	*London, England (<i>North American Service</i>)	17700
1:00-3:00 p.m.	*London, England (<i>General Overseas Service</i>)	17700, 15310
1:15-1:55 p.m.	*Hilversum, Holland (<i>Radio Netherlands</i>); News—1:18 p.m.	17775, 15425, 15220

TIME (PST)	CITY, COUNTRY (NAME)	FREQUENCIES (kc.)
2:30-3:00 p.m.	*Brussels, Belgium (<i>WFR—World's Fair Radio</i>) Sunday, Tuesday, Thursday, Friday	15335, 11720, 11850 (ORU)
3:00-3:50 p.m.	*Tokyo, Japan (<i>Radio Japan</i>); News—3:00, 3:40 (Saturday) p.m.	17825 (JOA20), 15325 (JOB21)
3:00-7:03 p.m.	*London, England (<i>General Overseas Service</i>); News—3:00, 6:00, 7:00 p.m.	15310, 11930, 9825
3:00-12:00	*Moscow, U.S.S.R. (<i>Radio Moscow</i>); News—Every hour on the hour	17870, 17820, 15100, 11850
3:15-4:45 p.m.	*Monrovia, Liberia (<i>Radio Station ELWA</i>) Tuesday only; News—3:55 p.m.	21535, 15200
3:15-5:00 p.m.	*Brussels, Belgium (<i>WFR—World's Fair Radio</i>) Saturday only; Mailbag—4:00 p.m.	11850, 9705 (ORU), 9655 (OTC)
4:30-5:00 p.m.	*Brussels, Belgium (<i>WFR—World's Fair Radio</i>) Sunday, Monday, Tuesday, Thursday, Friday	11850, 9705 (ORU), 9655 (OTC)
4:55-5:45 p.m.	*Montreal, Canada (<i>Radio Canada</i>); News—5:00, 5:30 p.m.; Mailbag—5:15 p.m. Sunday	15190 (CKCX), 11720 (CHOL)
5:00-5:15 p.m.	Karachi, Pakistan (<i>Pakistan Calling</i>); News—5:00 p.m.	15335, 11885
5:00-6:30 p.m.	*Monrovia, Liberia (<i>Radio Station ELWA</i>); News—5:40 p.m.	9650
5:00-7:30 p.m.	*Cap-Haitien, Haiti (<i>The Evangelistic Voice</i>); News—6:30 p.m. Saturday; Mailbag—6:30 p.m. Monday	15415 (4VW1), 9602 (4VEH), 6105 (4VE)
5:00-9:20 p.m.	*Oslo, Norway (<i>Radio Norway</i>) Sunday only; Norway This Week—9:00 p.m.	15175, 11735, 9540
5:15-6:00 p.m.	*Brazzaville, French Equatorial Africa (<i>Radio Brazzaville</i>); News—5:15 p.m.	11975
5:30-7:15 p.m.	*Berne, Switzerland (<i>Switzerland Calling</i>); News—5:35 p.m.	11865 (HER5), 9535 (HER4), 6165 (HER3)

(Continued on page 46)

ENGLISH LANGUAGE SHORT-WAVE BROADCAST STATIONS BEST HEARD IN WESTERN NORTH AMERICA

(Continued from page 45)

TIME (PST)	CITY, COUNTRY (NAME)	FREQUENCIES (kc.)	TIME (PST)	CITY, COUNTRY (NAME)	FREQUENCIES (kc.)
5:30-8:30 p.m.	Colombo, Ceylon (<i>Commercial Service</i>); News—6:00 p.m.	15265	7:30-8:00 p.m.	*Copenhagen, Denmark (<i>Voice of Denmark</i>); News—7:30 p.m.	
6:00-6:15 p.m.	Port-au-Prince, Haiti (<i>Radio Commerce</i>) Tuesday, Thursday, and Friday	5980 (4VB)	8:00-8:30 p.m.	Monday, Wednesday, and Friday; Mailbag—7:30 p.m. Saturday, No English on Sunday	9520 (OZF)
6:00-7:35 p.m.	Belize, British Honduras	3300	8:00-8:30 p.m.	*Budapest, Hungary (<i>Radio Budapest</i>); News—8:00 p.m.	11910, 9833
6:00-9:00 p.m.	*Quito, Ecuador (<i>The Voice of the Andes</i>); News—7:15 p.m. Tuesday	15115, 11915, 9745 (HCJB)	8:00-9:00 p.m.	*Sofia, Bulgaria (<i>Sofia Calling</i>); News—8:00 p.m.	9700
6:25-6:45 p.m.	*Rome, Italy (<i>Italian Broadcasting and Television System</i>); News—6:25 p.m.		8:00-9:20 p.m.	San Jose, Costa Rica (<i>Lighthouse of the Caribbean</i>)	9645, 6037 (TIFC)
6:30-6:40 p.m.	*Cologne, Germany (<i>Voice of Germany</i>); News—6:30 p.m.	11905, 9575	8:00-9:20 p.m.	*Oslo, Norway (<i>Radio Norway</i>)	
6:30-7:00 p.m.	*Warsaw, Poland (<i>Radio Warsaw</i>); News—6:30 p.m.	11795, 9640	8:15-9:00 p.m.	Sunday only; Norway This Week—9:00 a.m.	15175, 11735, 9540
6:30-7:00 p.m.	Port-au-Prince, Haiti (<i>Radio Commerce</i>) Wednesday only	15120, 11740, 9525	8:15-9:00 p.m.	Berne, Switzerland (<i>Switzerland Calling</i>); News—8:20 p.m.	11865 (HER5), 9535 (HER4)
6:30-7:10 p.m.	*Hilversum, Holland (<i>Radio Netherlands</i>); News—6:33 p.m. except Sunday	5980 (4VB)	8:30-8:45 p.m.	*Madrid, Spain (<i>Voice of Spain</i>); News—8:15 p.m., Mailbag—8:40 p.m. Thursday	9585, 6130
6:30-8:00 p.m.	*Hilversum, Holland (<i>The Happy Station</i>) Sunday only	9590, 6025	8:30-9:00 p.m.	Buenos Aires, Argentina (<i>Radio Nacional</i>); News only	9690 (LRA)
6:55-7:35 p.m.	Montreal, Canada (<i>Radio Canada</i>); News—7:00 p.m.; The Northern Messenger—7:20-8:20 p.m. Sunday	9590, 6025	9:00-9:30 p.m.	*Bucharest, Romania (<i>Bucharest Calling</i>); News—8:30 p.m.	11937, 9570
7:00-7:30 p.m.	*Bucharest, Romania (<i>Bucharest Calling</i>); News—7:00 p.m.	15320 (CKCS), 9585 (CKLP)	9:00-9:30 p.m.	Tokyo, Japan (<i>Radio Japan</i>); News—9:00 p.m.	17855 (JOA23), 15325 (JOB21)
7:00-7:30 p.m.	Peking, China (<i>Radio Peking</i>); News—7:00 p.m.	11937, 9570	9:00-9:30 p.m.	Taipei, Taiwan; News—9:05 p.m.	15225, 11815
7:00-7:30 p.m.	Prague, Czechoslovakia (<i>Radio Prague</i>); News—7:00 p.m.	17745, 15118	9:15-9:30 p.m.	Brazzaville, French Equatorial Africa (<i>Radio Brazzaville</i>); News—9:15 p.m.	15440, 9730, 5970
7:00-7:30 p.m.	*Stockholm, Sweden (<i>Radio Sweden</i>); News—7:00 p.m.	11935, 9550	9:30-10:00 p.m.	*Madrid, Spain (<i>Voice of Spain</i>); News—9:15 a.m., Mailbag—9:40 p.m. on Thursday, Sunday	9585, 6130
7:00-8:45 p.m.	Guatemala City, Guatemala (TGNA)	11810 (or 9620)	10:15-2:45 a.m.	*Warsaw, Poland (<i>Radio Warsaw</i>); News—9:30 p.m.	11740, 9550
7:00-10:00 p.m.	Wellington, New Zealand (<i>Radio New Zealand</i>)	9668, 5952	11:30-11:45 p.m.	Wellington, New Zealand (<i>Radio New Zealand</i>); News—12:30, 2:30 (except Sunday) a.m.	9540 (ZL2)
		15280 (ZL4)		Papeete, Tahiti (<i>The Voice of France in the Pacific</i>); News—11:30 p.m.	6135

1:00-1:15 a.m.	Manila, Philippines (<i>The Call of the Orient</i>); News—1:00 a.m.	17805, 15300, 11855, 9730
1:00-2:30 a.m.	Suva, Fiji Islands (<i>Fiji Broadcasting Commission</i>)	3980
1:00-4:45 a.m.	Port Moresby, New Guinea (<i>The A.B.C.</i>); News—1:00, 3:00 a.m.	6130 (VLT6)
1:00-7:05 a.m.	Tokyo, Japan (<i>Far East Network</i>); News—1:00, 4:00, 6:00, 7:00 a.m.	11750
1:30-2:00 a.m.	Hanoi, North Vietnam (<i>Voice of Vietnam</i>)	15020, 11895, 9465
2:00-3:00 a.m.	Cap-Haitien, Haiti (<i>The Evangelistic Voice</i>)	15400, 9630, 6105
2:25-3:30 a.m.	Bangkok, Thailand (<i>Radio Thailand</i>); News—2:30, 3:20 a.m.	11670 (HSK9)
2:50-3:30 a.m.	Kingston, Jamaica (<i>Radio Jamaica</i>)	4950
4:00-6:15 a.m.	Kuching, Sarawak (<i>Radio Sarawak</i>); News—5:00 a.m.	5052

BUYING A SHORT-WAVE RECEIVER

If you are "new" to the joys of short-wave listening (or SWL'ing), you may be considering the purchase of a receiver. There is now a variety of short-wave receivers immediately available across the counter at most radio parts jobber stores. They range in price from \$54.95 (Hallicrafters S-38D) and \$59.95 (National SW-54) to well into the hundreds of dollars.

Obviously, you get what you pay for—as in all things—in a short-wave receiver. The more money you invest, the better the performance in terms of station-to-station separation and "pulling in the distant stations" power. For a start, the Hammarlund, National and Hallicrafters receivers advertised in the pages of POPtronics offer a wide variety of models to suit all purses. The beginning SWL should seriously consider a receiver of from \$125 to \$175 more than adequate for all present-day needs. The SWL specialist can use to full advantage a receiver costing over \$200, but the budget-watching beginner can often hear the voices of the world for under \$100.

If you're an old-timer, it might be worth your while to consider a retirement for that old "inhaler." Numerous radio stores now have a trade-in plan to enable you to take advantage of modern equipment. Also, keep in mind that most of the larger houses work an installment buying plan, if you need help to get over the Christmas season.

is a Dutchman who, for nearly 30 years, has been closely linked with the "Peace, Cheer and Joy" station (international call letters PCJ), broadcasting from Holland on the short waves. Startz's mission in life is, and always was, to spread peace, cheer, and joy, and he has made his one-man music, information and contact show known all over the world.

His career, like his personality, is a most colorful one. As a young man, after completing his studies of the classical languages, he left his home in Holland and went to the United States. For the next few years he was a wanderer on the face of the earth, going through the "mill of life," making his living by taking on all kinds of odd jobs from dishwasher to interpreter and commercial traveler.



Keith Glover conducts Radio Australia's "North American Mailbag" Sunday mornings.

In 1928 Startz returned to Holland where preparations were being made for short-wave broadcasts—which at that time were still a novelty. Having a clear voice and speaking seven languages fluently, Startz was the ideal selection as announcer and commentator when Station PCJ, then owned by the famous firm of Philips, went on the air with an experimental international radio service, the first on the continent. Since then he has never left the microphone—except during World War II—and for over 29 years has been the magic attraction that has made *Radio Netherlands* so popular.

At the outbreak of war in 1940, Startz retired from radio for the duration and went "underground." How he squirmed through the intricate net of Nazi trickery during occupation time is a story in itself. In the Dutch starvation winter of '44-'45, the retreating enemy pillaged and looted everything they could lay their hands on. The station's ample file of fine recordings, collected from all over the globe for the benefit of an international audience, were carried away, never to be seen again.

After Holland's liberation a huge task lay ahead—rebuilding the transmitters and recapturing the audience that for over five years had searched in vain for the lost signals from Holland. When PCJ became the Netherlands' official voice over the world



Graham Hutchins has prepared Radio Australia's popular "DX'ers Calling" for the past 12 years.

air, operating under the auspices of the Netherlands Ministry of Education, Arts and Science, Startz resumed his work as "Good-Will Ambassador of the Air," to broadcast once more his message of peace, cheer, and joy to the world, with even more stress than before. He made many trips abroad, and told his listeners about his experiences each time he returned.

Startz took an active part in the inauguration broadcasts from Holland at the occasion of Queen Juliana's ascension to the throne, for the Columbia Broadcasting System in America, and was on the spot when Holland was struck with the tragic catastrophe of the flood. In 1953, upon completion of his 25th year in radio broadcasting, Juliana bestowed a Knighthood (in the Order of the Royal House of Orange-Nassau) upon him for his outstanding work of promoting good will and understanding among the peoples of the world.

"Keep in touch with the Dutch" has been Startz's well-known slogan since the "Happy Station" began broadcasting. He himself continues to keep in touch with his listeners by visiting their countries and learning their characteristics, customs, likes and dislikes, so as to keep his programs constantly tuned to the pulse of the world. A colorful calendar, pictures, and other materials are sent to listeners who write to the Happy Station, P. O. Box 137, Hilversum, Holland.

INVITE JACKO IN FOR BREAKFAST

At breakfast time each morning Jacko, the Kookaburra, is heard starting the *Radio Australia* programs for the day. These programs from "down under" have been favorite morning listening in many American homes for years.

"My Song Goes Round the World" is a very popular live-artist program presenting listeners' requests every Saturday at 7:25 a.m. EST. And on Sunday mornings the "North American Mailbag," conducted by Keith Glover, and the "DX'ers Calling," prepared by Graham Hutchins, are programs that most short-wave listeners don't want to miss.

Many of *Radio Australia's* transmissions are heard well in this part of the world, though only those beamed to North America have been listed here. The latest program booklet, available from *Radio Australia*, Melbourne, Australia, has a colored photograph of Jacko on the cover.

ACROSS THE CONTINENTS

The following are some of the most popular short-wave broadcasts the world over
(Continued on page 110)

DX PROGRAMS

Several stations put on programs which give listeners the latest news from stations all over the world. These DX programs are being listed here separately in order to help you remember when they can be heard.

"DX'ers Calling" on *Radio Australia* has been prepared by Graham Hutchins every Sunday for the past 12 years, which is proof of its popularity with listeners.

Denmark's DX program is prepared by O. Lund Johansen, editor of the *World Radio Handbook*, and is presented each Tuesday evening.

"Sweden Calling DX'ers" is heard weekly as the last part of the Monday transmissions from *Radio Sweden*. Arne Skoog edits this program and also issues a bulletin for contributors.

Switzerland has a monthly program with Russell Henderson in charge. Germany and New Zealand also present monthly DX programs, and Germany issues a bulletin for contributors.

The times at which these DX programs may be heard are given at right for easy reference.

Australia (Every Sunday)

8:30 a.m. EST on 11,810 kc.

8:00 a.m. PST on 11,770 kc.

Denmark (Every Tuesday)

9:15 and 10:45 p.m. EST on 9520 kc.

6:15 and 7:45 p.m. PST on 9520 kc.

Germany (Second Monday of each month)

9:00 p.m. EST or 6:00 p.m. PST on 11,795, 9640 kc.

New Zealand (First Wednesday of each month)

4:30 a.m. EST or 1:30 a.m. PST on 9540 and 6080 kc.

Sweden (Every Monday)

9:25 a.m. EST on 17,840 kc.

8:55 p.m. EST on 11,810 kc. (or 9620 kc.)

7:25 p.m. PST on 11,810 kc. (or 9620 kc.)

Switzerland (First Thursday of each month)

8:50 p.m. EST or 5:50 p.m. PST on 11,865, 9535, 6105 kc.

11:35 p.m. EST or 8:35 p.m. PST on 11,865, 9535 kc.

CHANCES ARE you don't know it, but there's a quiet revolution going on in the television industry. Its success, as a matter of strict fact, depends on your knowing nothing about it.

What's been happening? The television networks have latched on to the video tape recorder. They are using it up to the hilt, and, while it's not expected to replace film completely, it is proving to be a powerful adjunct to bringing realism back to television.

You might wonder how a picture can be put on tape and rebroadcast at a later time. In theory, that presents no problem. Essentially it works on the same principle as the audio tape recorder.

How It's Done. The signal comes from the camera and is fed to the recording head of the video tape machine. It sets up a magnetic field in the head varying in proportion to the signal strength.

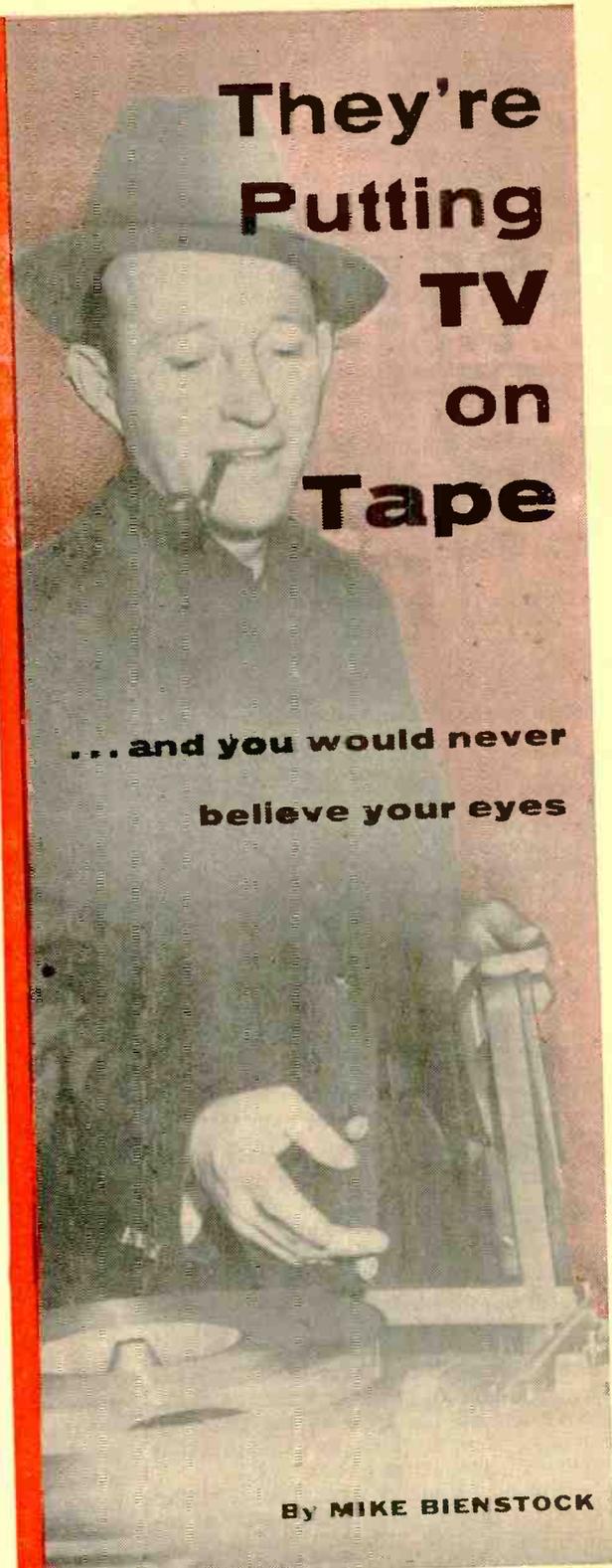
This in turn induces a magnetic pattern in the oxide coating of the tape which is a "replica" of the signal. In effect, this pattern is the picture, since, on playback, the differences in magnetic intensities are picked up and fed to the transmitter in exactly the same pattern as was originally sent by the camera. In other words, the tape takes the place of a reel of film, but instead of visual pictures, it carries "magnetic pictures" of the program.

The recorder puts both the video and audio portions of a transmission on the same tape, and rebroadcasts it when needed with close to the fidelity of live broadcasting. In that lies its tremendous advantage—it is said to be almost impossible for the home viewer to tell that he is not watching a live broadcast. As a matter of fact, it is sometimes impossible for a television technician to determine whether a program is taped or not.

Simultaneous or Delayed. Taping TV programs presents no

Bing Crosby financed some of the pioneer work on video tape recording machines in 1951. Since that time, the devices have made spectacular gains.

November, 1957.



They're Putting TV on Tape

... and you would never
believe your eyes

By **MIKE BIENSTOCK**

great problem. It is just an added step in the ordinary course of broadcasting. It can be done in two ways, both of which are in use today:

(1) During the ordinary course of broadcasting a TV program, the engineer can feed the signal to the video tape machine as well as to the transmitter. This allows the broadcast, which is being seen "live" in some sections of the country (the West Coast, for example) to be held on tape for rebroadcast later to other sections.

(2) The signal may be fed to the tape machine only, without broadcasting the live program. Then, at some later time, the program can be rebroadcast with "live" quality. This has its advantages for those programs which can only be picked up at odd hours and are to be seen at another time. (For instance, "Wide, Wide World" tapes some portions of its program which are

formation—changes in the magnetic oxide induced by changes of signal strength from the recorder head. In video tape, however, each inch must carry about 20,000 *bits* of information. The *bits* are much smaller, too. Wavelengths only 30 ten-thousandths of an inch long must be recorded. Any dust particle or imperfection in the oxide coating which is only one-tenth that long will cause signal "drop-out." (Drop-out is momentary signal loss which appears as small white, gray or black dots or "pips" on the television screen. It results from the loss of close contact between the tape and the recording head.)

In sound recording, imperfections up to three-thousandths of an inch may be permissible and not cause drop-out. In instrumentation recording, such as guided missile work, imperfections as small as three ten-thousandths of an inch may be permissi-

HOW VIDEO TAPING WORKS

Ampex faced a tough obstacle in designing the video tape recorder. In television, the signal must be at least 4000 kc. wide and better than 30 db "deep." A quarter-mil head gap, which will record a 15,000-cycle signal at 7½ ips, would need a tape speed of 2000 ips to reach a frequency of 4000 kc. At that speed, a tape reel 14 inches in diameter (4800 feet long) would last only about 30 seconds or less.

So the Ampex people did a revolutionary thing. Instead of recording along the length of the tape, as was customary, they recorded *across* the tape. And instead of using one head with the tape passing across it, they mounted a rotating drum with *four* heads on it so that the heads would pass the face of the tape in a *crosswise* direction, moving the tape only fast enough to avoid interference with each succeeding track. In this way, the tape speed was dropped to only 15 ips, and gave about an hour of recording on a 14" reel. Naturally, highly accurate synchronization is required since the head drum revolves at about 14,400 rpm. The net result was a speed of about 1500 ips.

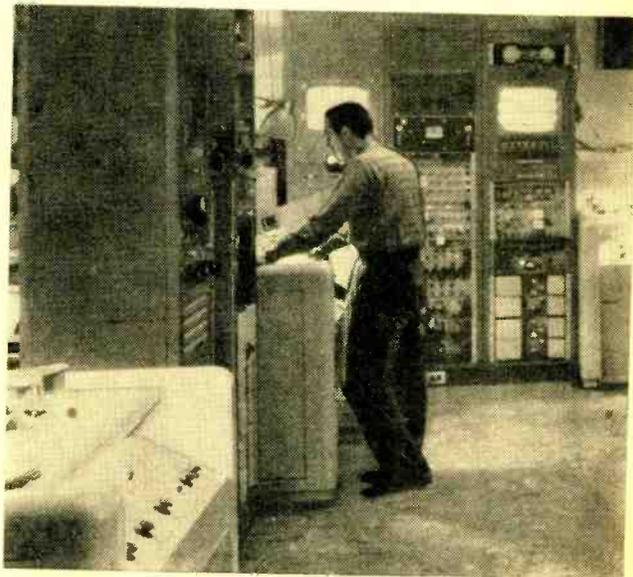
At the same time, a small band on the upper part of the tape is used to record the audio portion of the program in the conventional manner, in a longitudinal direction rather than transverse, and an equal band at the bottom is used as a control track. The latter band carries cues or other instructions for later playback.

only available for recording in early morning hours, and transmits them during the regular afternoon program.)

"Impossible" Tape. There are other things about video taping which present difficulties, however. The tape itself has proved a top obstacle to the success of the system. Also, the only manufacturer of video tape machines, Ampex Corp., is forced to charge \$45,000 for each machine. It must be able to pack ten times as much information on the tape as the ordinary sound-recording machine, and this presents enormous construction problems.

In the usual sound recording, a single inch of tape holds perhaps 2000 *bits** of in-

* A "bit" is the elementary quantity of information handled in electronic equipment (such as computers). In tape recording, a bit is a single pulse of electricity.



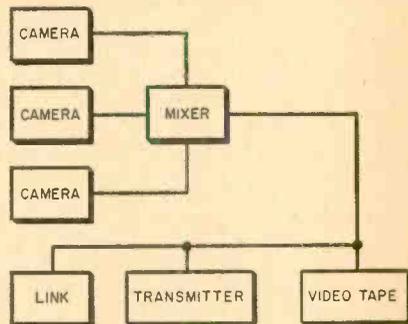
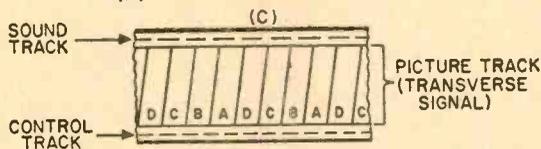
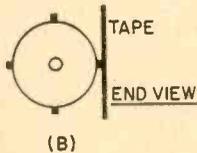
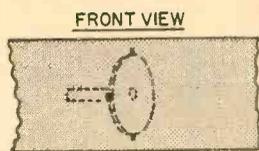
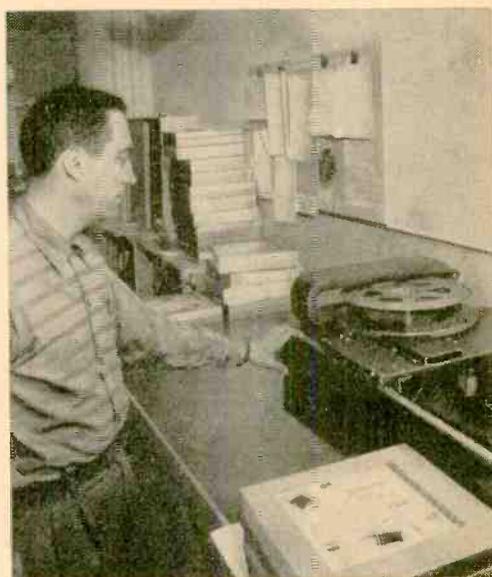
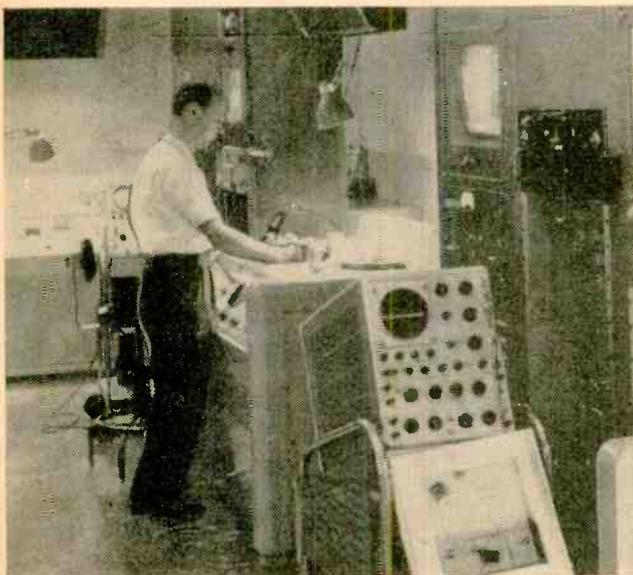
ble. But in video taping, imperfections as small as three hundred-thousandths of an inch will cause signal drop-out.

Minnesota Mining and Manufacturing Co. has done pioneer work in making video tape. The finished product, called "a tape that was almost impossible to make," involves coating tolerances up to two hundred-thousandths of an inch. A 2"-wide roll, 4800 feet long, sells for \$306 and has a useful life of about 200 playbacks.

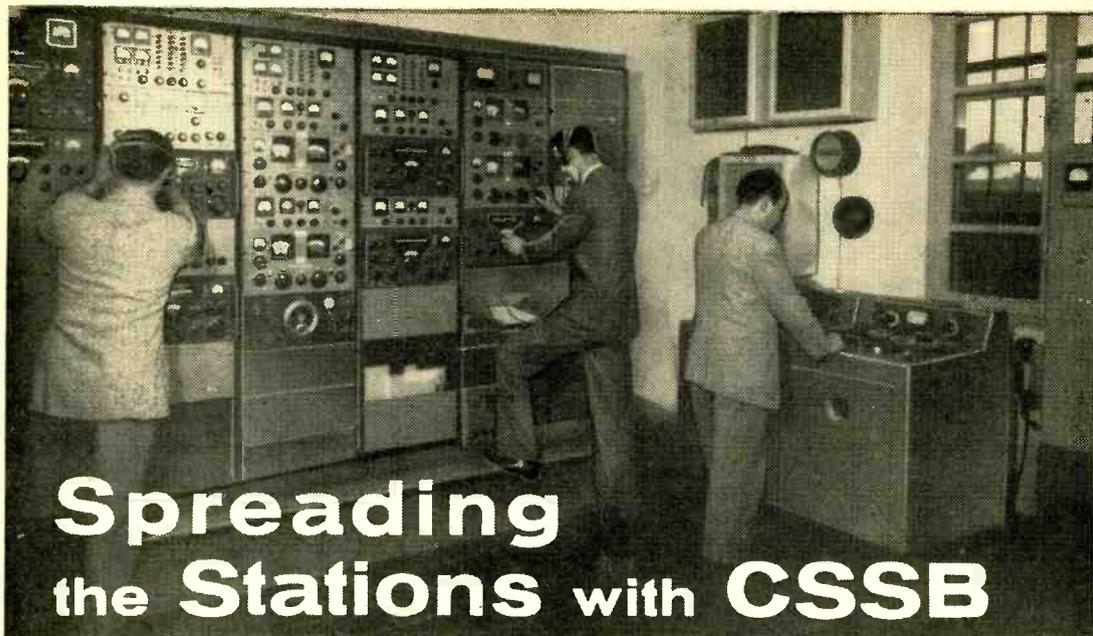
"Head" Problems. Drop-out can also be caused by the recorder head. That's why a tape may work the first time through a machine but cause drop-outs thereafter. The head must be perfectly smooth. If it isn't, it gouges the tape and starts picking

(Continued on page 117)

First color video recorder (right) was demonstrated by RCA in 1953. Tape traveled at 240 ips, requiring a 19" reel to hold a 15-minute program. Below is an over-all view of video recording room at CBS Television City in Hollywood, showing five recorders together with associated equipment. Below, right, a special degaussing unit automatically erases a roll of video tape in a matter of seconds. The tape has a life of 200 plays and/or playbacks.



Key to video tape recording is the tape head, shown in front (A) and end (B) views above, left. The greatly simplified sketches indicate how the four tape heads mounted on a wheel pass over the tape to give the transverse picture track in (C). Note longitudinal sound and control tracks on top and bottom of tape. Diagram at right shows how signal is fed to tape recorder simply as an additional step in the usual transmission. Link stage has connections available for additional facilities.



Spreading the Stations with CSSB

Compatible single-sideband system may double available

AM broadcast band space

By PHILIP JAMES

THE HARRIED Federal Communications Commission is keeping its fingers crossed. One of these days it may get a totally unexpected bonus in the way of doubled broadcasting space. Tests are under way with a completely new method of broadcasting that promises to allow "space" for many new stations.

The FCC's big trouble up to now has been those tricky little devils called "sidebands." Stations allotted an AM broadcast (or carrier) frequency must also be given added room on each side of the assigned frequency. This is because the two sidebands take up that room.

What Sidebands Are. These side frequencies normally are inescapable. They are created when the carrier is modulated with voice or music. It's because of the sidebands that you can pick up a station even if your receiver isn't tuned on the nose. However, if you were able to eliminate one of these sidebands, you would automatically cut down on the bandwidth needed for the station. That's what the new compatible single-sideband system (CSSB) does.

Developed by Leonard Kahn, a young research engineer, the system essentially filters out one of the sidebands of the signal on transmission, theoretically doubling the

bandspace available. Actually, because of technical complications, it would work out to only an 80% increase, which still would prove to be quite a help in relieving the overcrowded broadcast spectrum.

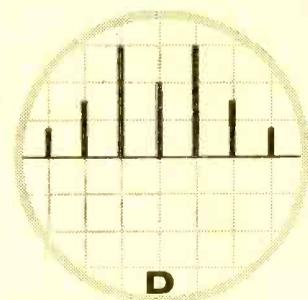
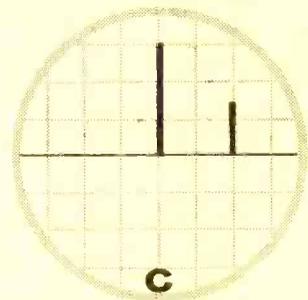
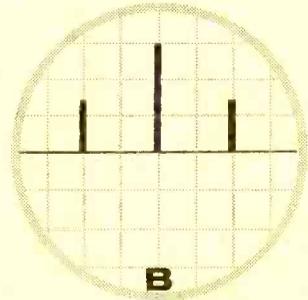
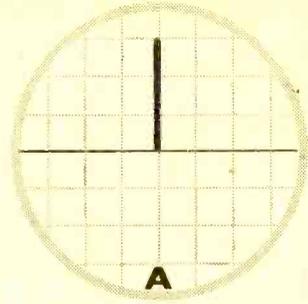
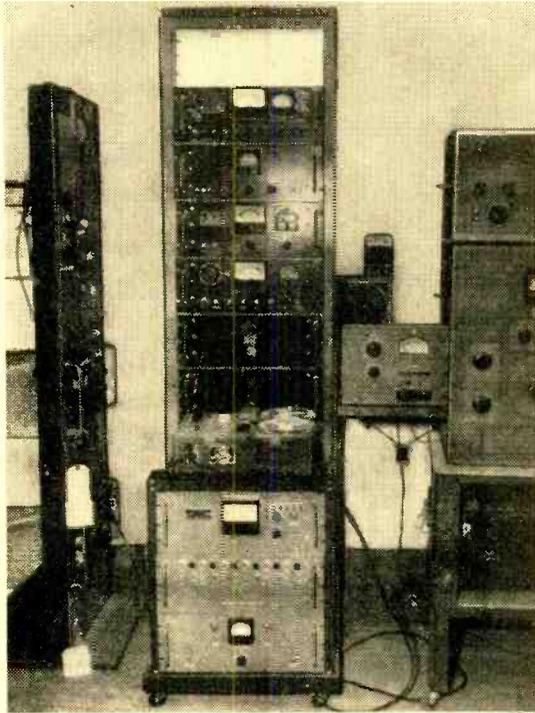
CSSB's most remarkable feature is that although it uses but one sideband, a broadcast will still sound the same to even the simplest home radio. It will be recalled that in standard single-sideband reception, receivers with a local oscillator to reinsert the carrier frequency must be used to receive an intelligible signal. Otherwise, you would get "Donald Duck" chatter.

Tested by VOA. One huge Voice of America station has been using CSSB in order to crack tough Russian jamming. They found that it reduces interference and manages almost to double signal strength without increasing the size of the transmitter.

The American Broadcasting Company (ABC Radio Network) has been so impressed with the new system that it is planning a thorough tryout. Should the network consider the system a complete success, it would probably kick off the biggest race for new station permits since the inception of broadcasting. Areas now considered "full up" would no longer be so.

(Continued on page 121)

Personnel at the Voice of America installation in Munich, Germany (left), adjust their receiving equipment. VOA is now using the new compatible single-sideband technique. This is one of the few pictures ever released of an overseas Voice installation. Below is the adapter equipment developed by Leonard Kahn to transmit CSSB; it is located in the Kahn Research Labs test center, Freeport, N. Y.



HOW CSSB WORKS

In the compatible single-sideband system, conventional SSB is first generated without a carrier in the usual manner. From this point, the system follows a new path.

The carrier is reinserted and then, with an adapter unit, the distortion which this process has introduced is cut out. It's done by changing the shape of the wave which has amplitude and phase modulation (and a high degree of distortion) into a non-distorted AM wave. The final result is a single-sideband wave with carrier almost completely lacking in distortion. Thus, it can be picked up by the ordinary AM receiver.

By using a spectrum analyzer, we see the ordinary c.w. or code signal as a single carrier in A (above, right). In B, we see the ordinary double-sideband AM wave with carrier as the taller center line and the two shorter lines on each side as the sidebands. C is the compatible single-sideband analysis. Actually, you get a choice of cutting off either the right or left sideband. In the conventional single-sideband analysis (not shown), the center (center line) would also be cut off; this, of course, requires a local oscillator to reintroduce the signal.

D shows a frequency-modulated wave analysis. Because of the constant change in frequency, however, these sidebands also change constantly, so that the picture is different at any given moment.

What is spectrum analysis? If a signal is examined using a relatively rare instrument known as a spectrum analyzer, we get a very different picture of what takes place during modulation, as seen in the scope traces above. Instead of the usual time-based trace, we get "spectra," in which the horizontal base line is a measure of increasing frequency rather than increasing time. A detailed description of the individual traces (A, B, C and D) is given in "How CSSB Works" at left.

Computer Translates Directly into Perfect Morse Code



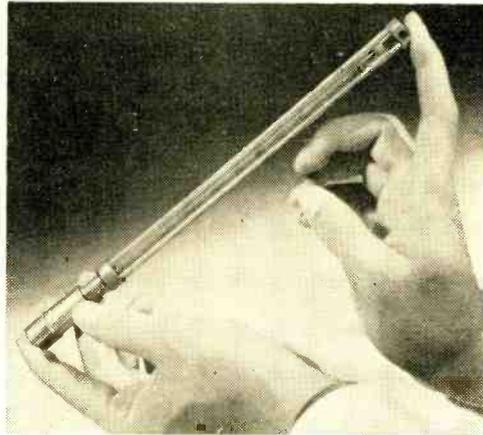
Machine-perfect code with typewriter ease in sending is possible when you use the new low-cost Codetyper developed by Codetyper Laboratories, 1027 Casa Vista Drive, Pomona, Calif. This "miniature computer" will automatically key a radio transmitter as any of the keys of the typewriter-like keyboard are depressed. Speed is continually adjustable from 10 to 75 words per minute. The unit has 12 miniature tubes, printed circuits and switches, and an internal power supply and keying relay. Operation can be a.c. or d.c.

The Codetyper is easy to set up, since the only connections are two leads which can be clipped across the hand key or directly to the transmitter. In addition, no typing skill is needed—one-finger operation is enough for the most-used code speeds. A built-in monitor allows signals to be heard as the instrument is operated. Besides the standard alphabet and numbers, there are also keys for such combinations as BT, AR, AS; and SK, as well as for the comma, period, query and error.

Lightweight Traveling-Wave Tube to Be More Reliable

Operating reliability of microwave relay and radar equipment may get a boost through an RCA development. Their radically new traveling-wave tube, now in the experimental stage, is also expected to cut the weight of such devices substantially. It eliminates the bulky electromagnetic focusing equipment used with many types of traveling-wave tubes and points the way to compact and reliable systems of new design for airborne and other applications.

External focusing electromagnets have been discarded and a compact electrostatic element built right into the tube. Not only does this cut weight 30 pounds or so, but it eliminates the critical alignment necessary with previous types—because the element is given a permanent proper alignment during assembly. While other traveling-wave tubes can be affected by vibration, changes in temperature, or other variations in environment, making realignment necessary for effective functioning, the new one will operate under a wide range of conditions without further alignment.



Assembly Machine Takes Orders from Itself for Changes

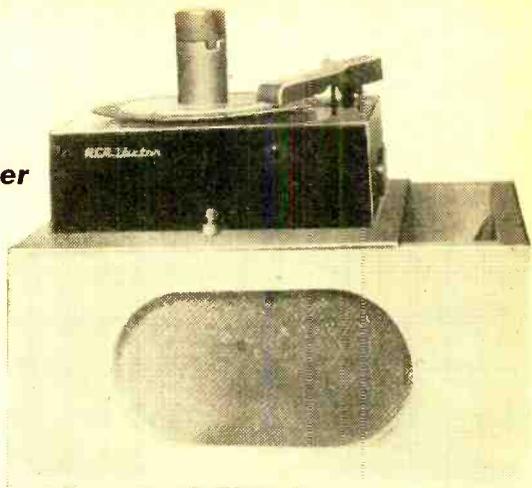


IBM has a new machine which takes orders from itself. It's an automatic assembler that fastens resistors, capacitors, and other small parts to printed-circuit panels before they're put into computers and other equipment. But it goes a step further. When a change in circuitry is needed, instead of waiting to be reset manually, the machine gets instructions from an IBM card and resets itself for the new operation. The Programmed Component Assembly System is assembling wiring panels for data processing equipment.

By HOMER L. DAVIDSON

Low-power phonograph amplifier

uses all-purpose transistor

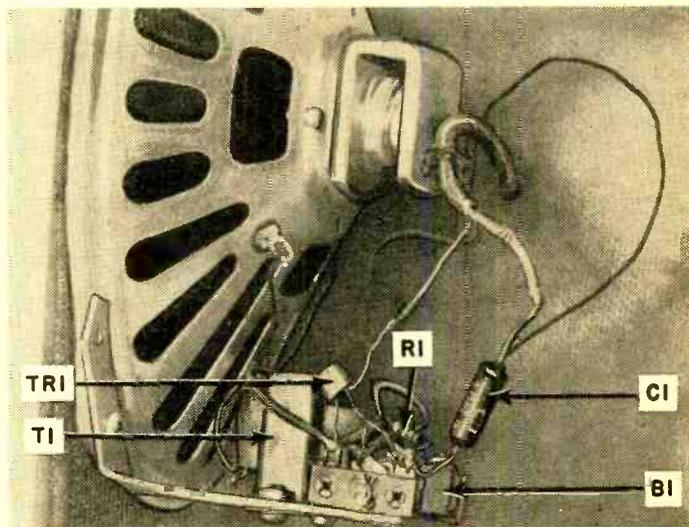


ONE TRANSISTOR RECORD PLAYER

PROBABLY the simplest phonograph amplifier ever designed, this *one-transistor* job serves to drive a full 6" x 9" oval speaker. It uses only six components in addition to a standard transistor. You should be able to complete construction in one evening, and there should still be time left over for a couple of hours of TV and a short beer (or long coke).

The **changer** used is the same compact RCA 45-rpm unit featured in previous construction articles. Costing little more than the price of a separate tone arm, turntable and base, its changing action is almost a free bonus.

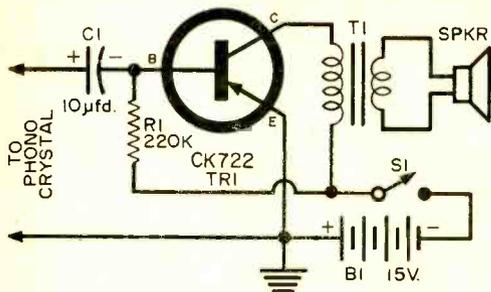
The high output (at least two or three volts) of the original crystal in the tone arm serves to drive the CK722 to an output adequate for quiet listening, but it won't shake the rafters. Don't expect to blast the windows out with this little job.



No volume control is included or necessary in the amplifier shown here. The transistor used may be a CK722, 2N107 or equivalent. The shielded phono lead connected to CI has its shield grounded to the speaker frame.

If more power is required, you can try the "Picnic PowerAmp" circuit in the June 1957 issue of POPULAR ELECTRONICS.

Any phono player can be used with this midget amplifier. However, the cartridge should be one of the high-output types, such as the Lafayette PK-80, Ronette TO-222, or Astatic L12, having at least a



Note the simplicity of the phonograph amplifier circuit. The tap on the secondary of the output transformer should be selected for highest volume.

PARTS LIST

- B1—15-volt, miniature B battery
- C1—10- μ fd., 15-volt electrolytic capacitor
- R1—220,000-ohm, 1/2-watt carbon resistor
- S1—S.p.s.t. toggle switch
- T1—Universal output transformer (Merit A 2900 or Stancor A 3822)
- TR1—CK722 transistor (Raytheon)
- SPKR.—6" x 9" oval PM speaker

2-volt output. On the other hand, too high a voltage may overload the transistor.

The amplifier chassis holds the output transformer and the battery clip. The other small components are wired by their leads into the circuit. As no socket is used for mounting the transistor, be very careful when soldering its terminals to the other components. The amplifier is mounted by the same bolts which hold the loudspeaker to the front panel.

A homemade cabinet houses the amplifier as shown. Common pine was used for the sides and cut to the correct dimen-

sions. The oval speaker hole in the front panel was sawed with a jigsaw. One side of the base was designed as a record holder—a dozen records can be stored here.

The top panel or mounting board is constructed of 1/4" tempered Masonite as is the bottom panel. Four small rubber feet attached by the same screws hold the bottom on the cabinet. A grille cloth with metal screen backing was placed over the oval hole before the speaker was mounted.

The screws which hold the plastic bottom on the 45-rpm changer can be used to mount it to the speaker assembly. It's a good idea to place an old tube carton over the crystal in the arm when working with the changer to prevent damage to the crystal.

Operation of the unit is simplicity itself. But check the wiring several times before

HOW IT WORKS

The high output of the crystal cartridge in the phono player is fed through the 10- μ fd. capacitor (C1) to the base of the transistor. The universal output transformer is connected to the collector terminal with one side of its primary tied to the negative side of the battery supply. The secondary winding of the output transformer is tapped and the connection providing the best impedance match between the transistor and speaker should be used.

throwing the toggle switch. Be sure that the small battery is placed into the holder with the correct polarity. Then throw the toggle switch and slowly rub your fingers over the needle. A scratching sound should be heard. Place a record on the turntable, and your player is ready to go. —30—

Push-Button Dialing for Rural Radiotelephones

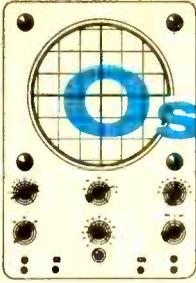
Radiotelephone users, who recently got a bonus in the way of dial systems in their cars, now have an extra added attraction in rural areas—push-button dialing. Developed by Motorola for the Rural Electrification Administration, the system is said to be ideally suited for the sparsely populated



areas. Tests in mountainous terrain showed reliable communication within a radius of 25 to 30 miles from the base station.

The new system is particularly attractive since it permits the use of automatic exchanges instead of operator-manned stations. As it employs specific tone sequences for dialing, it is practically impossible to receive a wrong number because of high ambient electrical noise levels. The equipment is designed to give no number rather than a wrong number in those rare instances when a tone is lost because of transmission difficulties.

As shown in the photo, the system is easy to operate. Lifting the handset and depressing the push-to-talk button automatically connects the phone to the base station. Then it is just a matter of pushing the buttons in the proper sequence to get the exchange and the party desired. A lock-out circuit insures complete privacy.



Oscilloscope Traces

Square Waves

This easy testing method helps us uncover a multitude of electronic "sins"

By HOWARD BURGESS

SQUARE-WAVE TESTING can be called the "buckshot" approach. One shot covers a lot of territory, and can bring down a whole flock of fast clues.

In many kinds of testing, a single frequency or tone is put into the input of an amplifier or system and the output waveform is checked for distortion and level. But when an amplifier is to be checked over a wide band of frequencies, this method can be long and tedious. It would save considerable time and provide a better overall test if a number of the desired frequencies could be checked simultaneously.

That's just what actually happens in cases where we employ a

square wave as a test signal. A quick look at the structure of a square wave shows why this is so.

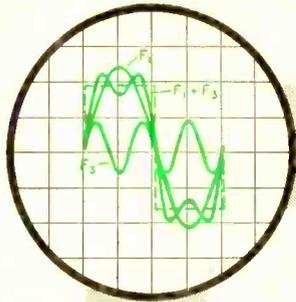
What Is In the Wave. The oscilloscope pattern in Fig. 1 is an example of a sine wave. This is a simple sinusoidal waveform which we will call $F1$. The square shown in the broken line is the desired shape of a "square wave."

In Fig. 2, we still have $F1$ but the third harmonic $F3$ (or $F1$ times 3) has also been added. This combination provides the waveform labeled $F1+F3$, which fills out a little more of the square-wave box. By adding the fifth harmonic, we get the wave $F1+F3+F5$ as shown in Fig. 3.

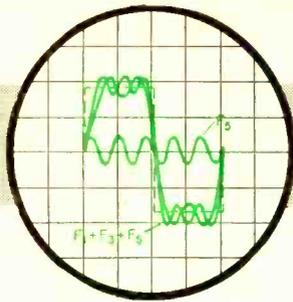
Using our imagination, we can see what



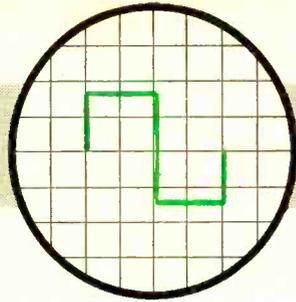
Even a simple square-wave generator used in conjunction with a scope will quickly show up defects in an audio system. Primarily it serves as a good indication of frequency response.



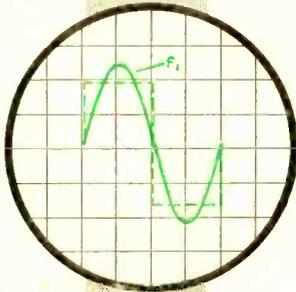
2



3



4



1

The first four figures illustrate the relationship between the square wave and its constituent sine waves. Fig. 1 compares the sine wave and square wave. In Fig. 2 is a sine wave and its third harmonic. In Figure 3 is a sine wave plus its third and fifth harmonics, which together begin to fill out the shape of the square wave. Figure 4 shows an ideal square wave containing a large number of harmonics.

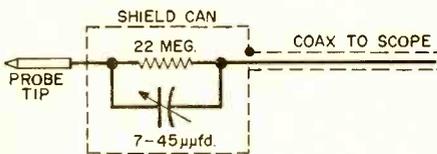
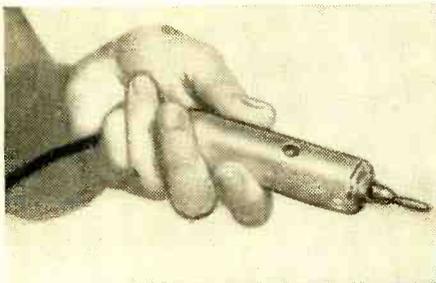
is happening to the original waveshape. With each harmonic added, the shape comes closer to that of the dotted line square. If the process of adding odd harmonics is continued, we finally arrive at a fairly acceptable square wave by the time about 10 harmonics are thrown in with the fundamental.

Yet, in many cases, 100 or more harmonics may be needed to produce the desired waveshape with the filled-out corners, as shown in Fig. 4. Suppose that a 1000-cps square wave which includes the 10th odd harmonic is used to test an amplifier. The amplifier must then be able to respond up to 21,000 cps or better to pass the waveshape without distortion.

By using a square wave as a test signal, it is not only possible to test the complete frequency response of an amplifier, but you can also show up troubles such as phase shift and instability resulting in oscillations and parasitics.

"Square Deal" Probe. When using a square-wave generator and oscilloscope in a test setup, keep these items in mind: (1) the generator must be properly matched to the input of the amplifier; (2) the amplifier output must be properly loaded; (3) the oscilloscope must be connected across the output of the amplifier under test in such a way that the 'scope leads themselves do not distort the waveshape of the signal. In most cases, simple leads to the 'scope are not adequate and will cause serious distortion. A simple probe, easy to make, is almost a necessity.

The circuit for such a probe is shown at left, and the photos will give a general idea of its construction. The low-capacity shielded line to the 'scope should be less



A low-capacity probe such as this one is needed for square-wave observation. Finished probe is shown in top photo, circuit and construction details in the two lower illustrations.

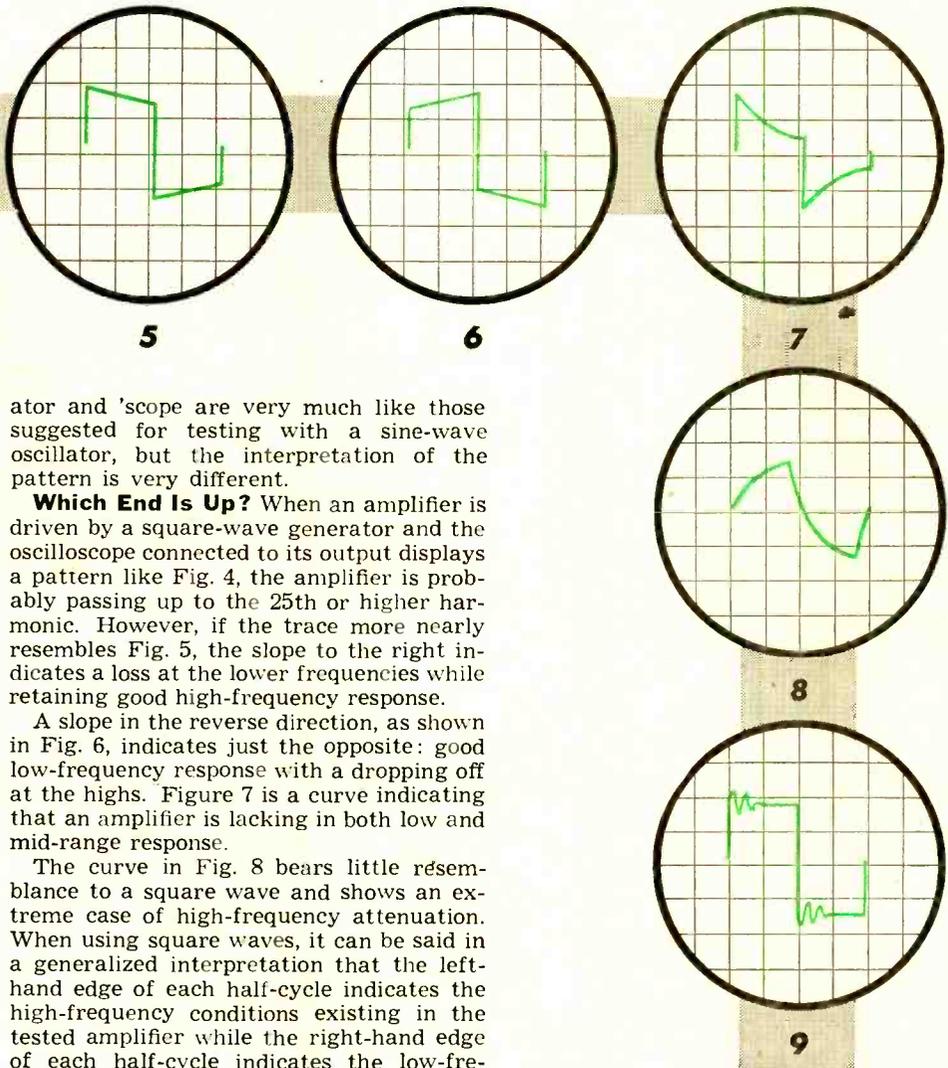
than two feet long and the entire probe must be kept well-shielded. The ceramic trimmer is adjusted by feeding a known square wave from a generator into the tip of the probe and tuning for the squarest wave possible on the 'scope. Once adjusted, this type of test lead is also excellent for use on video circuits. The probe, because of its method of operation, will normally attenuate the input signal somewhat, but you can compensate for this.

Connections of the square-wave gener-

ator conditions. Superimposed ripples on the leading (or high-frequency) edge as in Fig. 9 indicates the presence of oscillation or "ringing."

Complete books have been written about square-wave testing, and very limited ground can be covered in a few hundred words. However, even with the simplest kind of square-wave generator, such as the one shown, used only for the simple patterns given here, one can gain much experience and knowledge.

-50-



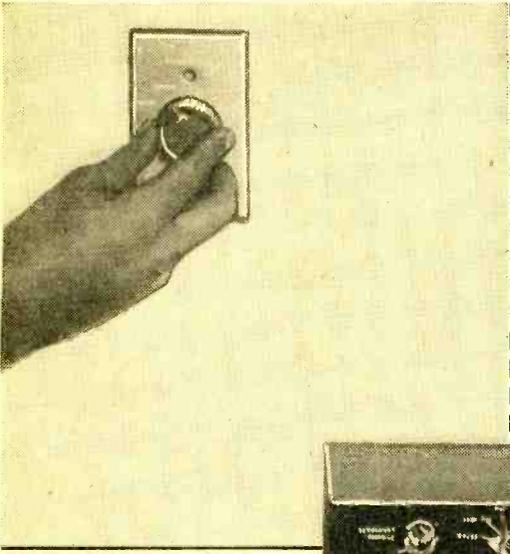
ator and 'scope are very much like those suggested for testing with a sine-wave oscillator, but the interpretation of the pattern is very different.

Which End Is Up? When an amplifier is driven by a square-wave generator and the oscilloscope connected to its output displays a pattern like Fig. 4, the amplifier is probably passing up to the 25th or higher harmonic. However, if the trace more nearly resembles Fig. 5, the slope to the right indicates a loss at the lower frequencies while retaining good high-frequency response.

A slope in the reverse direction, as shown in Fig. 6, indicates just the opposite: good low-frequency response with a dropping off at the highs. Figure 7 is a curve indicating that an amplifier is lacking in both low and mid-range response.

The curve in Fig. 8 bears little resemblance to a square wave and shows an extreme case of high-frequency attenuation. When using square waves, it can be said in a generalized interpretation that the left-hand edge of each half-cycle indicates the high-frequency conditions existing in the tested amplifier while the right-hand edge of each half-cycle indicates the low-fre-

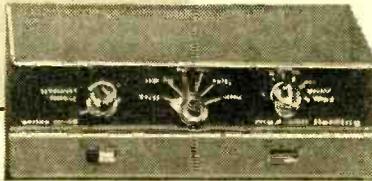
Square-wave patterns indicate conditions within the amplifier under test. The waveform in Fig. 5 indicates good high-frequency response but poor lows, while the waveform in Fig. 6 indicates good low-frequency response but poor highs. Figure 7 illustrates a case of poor low- and medium-frequency response, and Fig. 8 illustrates serious attenuation of high frequencies. The pattern in Fig. 9 betrays the presence of high-frequency instability or "ringing" in the system.



Speaking of EXTRA SPEAKERS

By
LEONARD FELDMAN

Simple wall-mounting switch controls speakers throughout house.



THE HI-FI SALESMAN who sold you your high-powered amplifier probably made a very good point. "Just think," he said, "with this one investment, you're on your way towards music in *every* room of your mansion. All you have to do is keep adding speakers. This twenty-watter will handle four and possibly more!"

"Good," you thought, "after I learn the quirks of all these watts and db's, I'm going to scrap all those 'kitchen model' four-tube midgets, mount a few speakers here and there, and pipe the classics around as they do in the elegant restaurants."

Well, perhaps the time has come. Perhaps your ears have become so attuned to clean and faithful reproduction that you just can't tolerate inferior radios in the bedroom or den. The problems confronting you at this point are twofold. First, how do you arrange your switching so that you can pipe the music where you want it. Second, what sort of speakers should you choose for those "secondary" outlets? Since the second problem is a bit more personal, let's deal with it first.

Outdoor Speakers. The first prerequisite for any outdoor speaker installation is that it be thoroughly waterproof. There is absolutely no way to protect a conventional paper-cone speaker from the elements and still have it couple sound to the air! The only solution, then, is to employ a good quality metal or plastic "trumpet" with a suitable driver system designed for outdoor use. Anyone who has

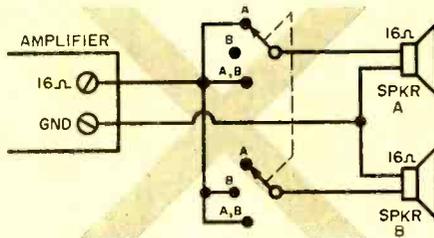


Fig. 1. A common but incorrect way of using two speakers separately or both together.

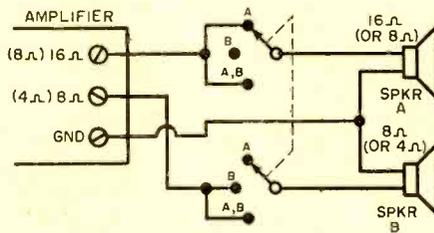


Fig. 2. This is the correct way to hook up two speakers which have different impedances.

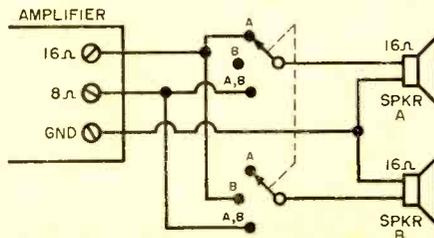


Fig. 3. Correct hookup for two 16-ohm speakers.

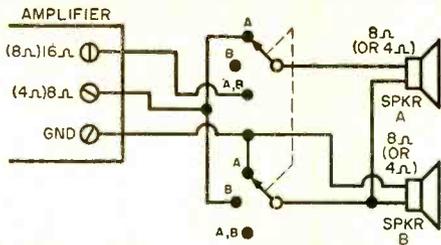


Fig. 4. Hookup for equal-impedance speakers.

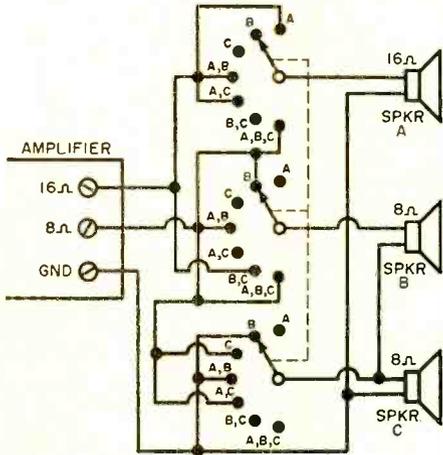


Fig. 5. Hookup for one 16-ohm and two 8-ohm speakers in every possible combination. Actual wiring is shown in the adjoining photo.

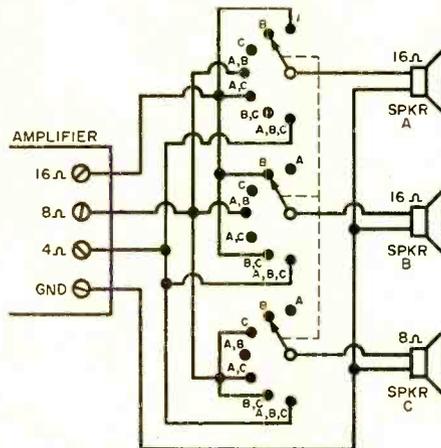
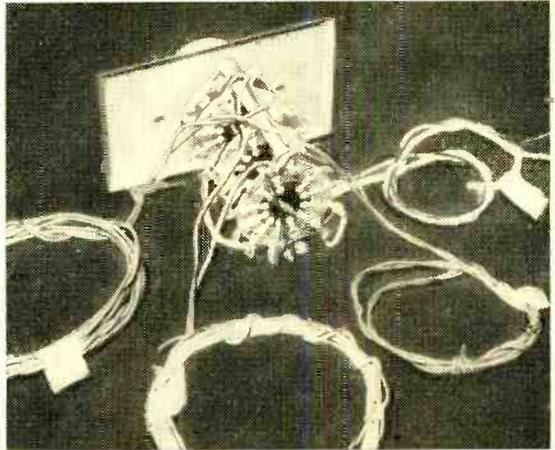
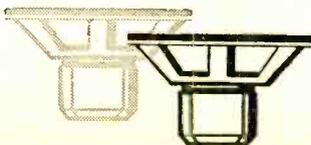


Fig. 6. Two 16-ohm speakers, one 8-ohm speaker.



ever seen an outdoor sporting event or concert will recall the type we mean. These systems are generally classified as Public Address speakers, but be careful. Most p.a. speakers do not have a frequency response even remotely consistent with hi-fi requirements. A typical p.a. speaker we found listed in the catalog has a response of only 300 to 10,000 cycles. Actually, it's a fine speaker for voice paging—not musical reproduction.

Two acceptable units manufactured by

University Loudspeakers are: Model BLC, which claims response from 70 to 15,000 cycles and sells for around \$50.00; and a much larger version of the same job, Model WLC, which sells for about three times that figure but goes down to 50 cycles. Electro-Voice's Model 848 claims good response from under 100 cycles to about 10,000 cycles, handles 25 watts and sells for under \$50.00. Jensen's Model VH-24 is recommended for music, handles 25 watts and claims fairly uniform response from 110 cycles to over 6000 cycles; it can be purchased for a little more than \$50.00.

Do not be alarmed at the seemingly conservative claims for bass frequency response of all these systems. Outside listening simply can't provide low bass, even if the speaker were capable of reproducing it, because of the missing room acoustics. There are no walls to bounce the bass around. The important things to listen for are "clean" reproduction and wide-angle coverage, so that you don't have to sit right in front of the speaker to get most of the music.

Kitchen Units. A lot depends here on just how far you want to go and how much room you have. Actually, a kitchen is seldom as large as a living room, and

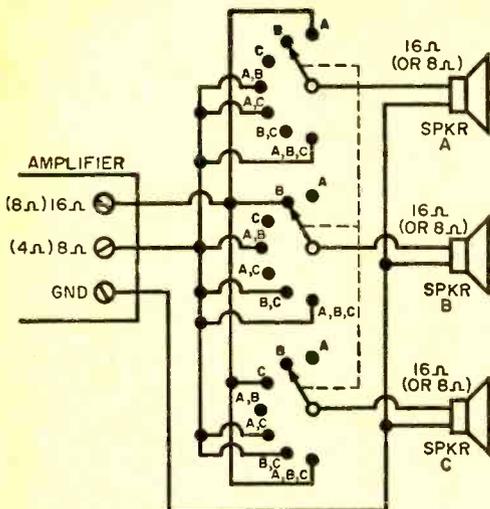


Fig. 7. Flexible switching arrangement for three 16-ohm speakers for single or simultaneous use.

is hardly a perfect acoustic chamber with its hard floor and walls, ceramic surfaces, etc. Furthermore, to our way of thinking, you're not going to do much serious listening in the kitchen, but will probably use your speaker for pleasant background music only.

For these reasons, it would probably pay to go easy here and settle for an 8" or 10" speaker in an attractive wall baffle. Virtually all speaker manufacturers have models in this category. Of course, even in these surroundings, you are still better off mounting the speaker itself right into the wall, which affords a true infinite baffle and much-improved frequency response.

The All-Important Den. If you have a den, and if you equip it with hi-fi, you'll find that you're spending a lot more time there than you did previously. Usually, a den is furnished in somewhat the "soft" manner of a living room, and so compares favorably acoustically with the more formal room. Lots of enthusiasts we know find it difficult to decide whether to put the "primary" or "show" speaker in the living room or den.

If your den happens to be in the basement, you will generally find plenty of wall surface separating the den from the utility room or garage, and such wall surfaces are, again, ideal for speaker mounting. If the room is of generous proportions, a 12" or 15" woofer is recommended. However, if you must resort to the added expense of a furniture enclosure, be certain to hear the speaker in the particular enclosure before you make up your mind. This is an excellent rule to follow in choosing any speaker system and enclosure.

The Bedroom. Here, too, the requirement is mostly for background music rather than extended serious listening. Ideally suited to these requirements are the small, bookcase-type enclosure-speaker combinations which have become so popular. The Heath SS-1, the University "Companionette," the R-J S8U, the "Hartsdale," and many more of similar size, have found homes in headboards and night tables.

Incidentally, you can avoid jumping out of bed on wintry nights to turn off the hi-fi set by investing in one of the many types of appliance-timers available. They'll do the job at a preset time and spare you a set of frozen toes.

Speaker Volume Controls. Chances are you will end up with loudspeakers having different degrees of efficiency. That is, speaker A may sound quite loud with the volume control of your amplifier turned up halfway, while speaker B may be just above a whisper. There's nothing wrong with either of them—it's just a question of how they were designed. Then,

(Continued on page 118)

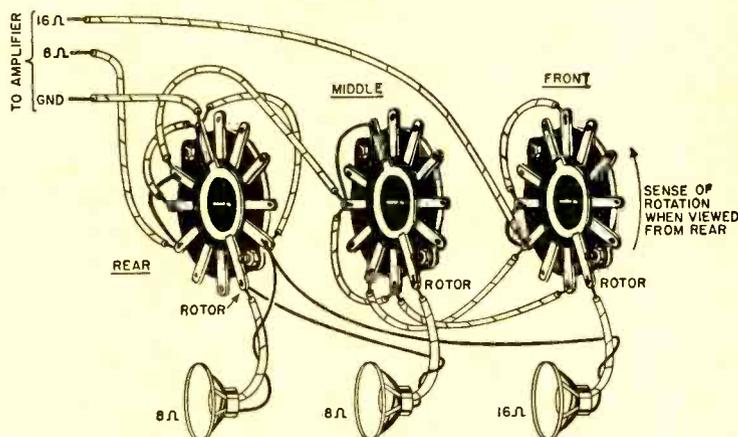


Fig. 8. Wiring layout for two 8-ohm speakers and one 16-ohm speaker (see circuit in Fig. 5). All decks shown are viewed from the rear. The lug marked "rotor" in the diagram may be placed differently on various manufacturers' switches. The Mallory switch which is described in the text has the rotor positioned on the reverse side of each deck. It may be necessary to reposition the wiring if the switch differs too radically from the diagram.

DO YOU have to strain to hear that short-wave broadcast? Do you fret and fume because London fades, or Paris just never shows up? Calm down. The answer to your problem will cost you peanuts (\$5 or less) and just a couple of hours of your time. It's called a Receiver Antenna Coupler, Low Cost, Mark I.

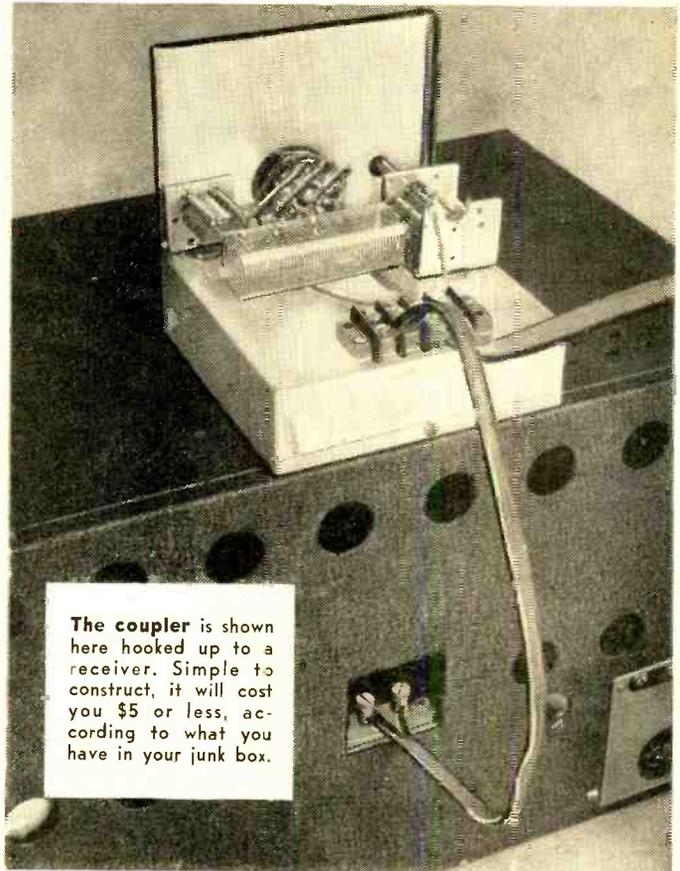
The device is the missing link between antenna and receiver. It will not only couple them together at the desired frequency, but it will automatically "uncouple" many types of interfering signals. It will be found particularly effective ahead of receivers which do not have a preselector stage ahead of the mixer tube, typical of many low-cost short-wave receivers.

Technically, it is a pi-section filter. There is no complicated switching involved from series resonance to parallel resonance, and it is simplicity itself to construct. Total cost will depend on how many parts you can salvage from your junk box.

Note that if your antenna, transmission line and receiver impedances are already closely matched, no antenna coupler will greatly increase the signal. But for the system which uses tuned feeders or an end-fed antenna, or a random-length antenna, this coupler will give surprising results.

Switching Operation. The values shown will provide good matching over a wide range of impedances from about 2 mc. to 30 mc. Taps on the coil enable you to peak on the 80-, 40-, 20- and 10-meter amateur bands by rotating switch *S1* through its five positions. Position 1 is a bypass position which automatically removes the antenna coupler from the circuit and shorts the input to the output terminals. Position 2 is for the 80-meter

Soup Up Your DX



The coupler is shown here hooked up to a receiver. Simple to construct, it will cost you \$5 or less, according to what you have in your junk box.

With an Antenna Tuner

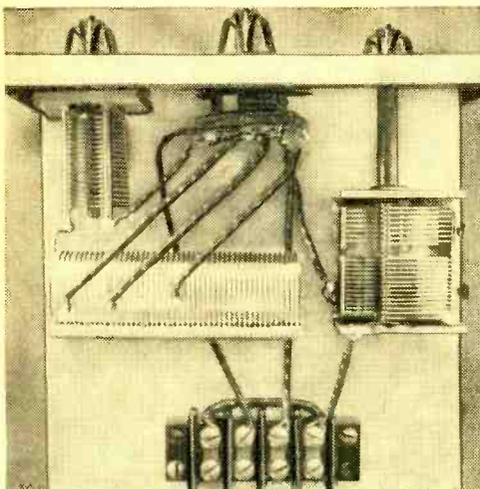
Cost is small, but results will amaze you

●●●●●●●●●●●●●●●● By JOSEPH W. DOHERTY, K2S00

band; 3 is for 40 meters; 4 for 20 meters, and 5 is for 10 meters.

Frequencies which lie between these amateur bands can easily be tuned with capacitors *C1* and *C2*. Generally, as the frequency increases, the tuning becomes more critical; and on the 20- and 10-meter positions, care must be taken not to tune the coupler to the image frequency.

The tap switch is of phenolic material and the terminal block is of molded Bakelite. They could be replaced with ceramic types, if desired. Mihiductor coil #3015

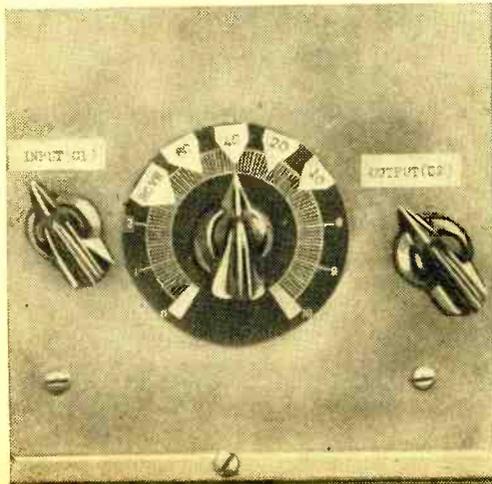


Top of unit shows placement of capacitors. Follow the schematic at right for proper wiring.

was chosen because it is easily tapped, due to the spacing between the windings, and because of its rigidity, which contributes to the ruggedness of the unit.

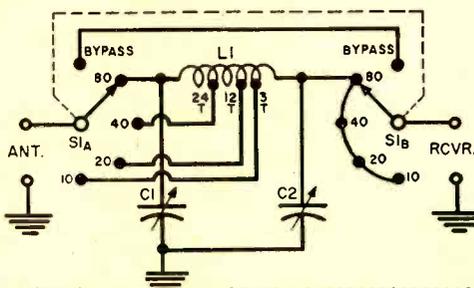
Note that the windings adjacent to the windings on which the taps are made are slightly depressed, making it easier to solder the connection. You can make these depressions with a screwdriver, but be careful not to let the tool slip, or the coil may be damaged. It is recommended that the windings be depressed before mounting the coil. Because of the rigidity of the coil, no separate mounting is needed. It is connected directly to the stator terminals of capacitors C_1 and C_2 as shown above.

Tap the coil as follows: for 80 meters, the full 48 turns; for 40 meters, 24 turns; for 20 meters, 12 turns; 10 meters, 3



turns. Follow the switch wiring exactly as shown in the schematic diagram.

Now To The Chassis. The chassis may be of any type. The one illustrated was a can which contained a small reel of 16-mm. film; its shape and dimensions made it ideal for a lightweight chassis. (Even a coffee can may be used, if necessary.) Looking at the top of the chassis from the rear (photo at left), the input capacitor,



- C_1 —360- μ f.d. variable capacitor
- C_2 —140- μ f.d. variable capacitor
- L_1 —B&W Miniductor #3015 (3" x 1" x 48 turns, tapped at 24 turns, 12 and 3 turns)
- S_1 —2-pole, 5-position shunting switch (Centralab #1404)

HOW IT WORKS

A maximum transfer of energy is made between antenna and receiver at any given frequency if the impedances of antenna and receiver are matched. The coupler acts as a transformer and provides matching over a wide range of impedances, such as is the case when using one antenna for all-band coverage. It may be noted that at some frequencies the coupler will provide no apparent improvement; these are frequencies at which the antenna impedance comes close to matching the receiver's input impedance.

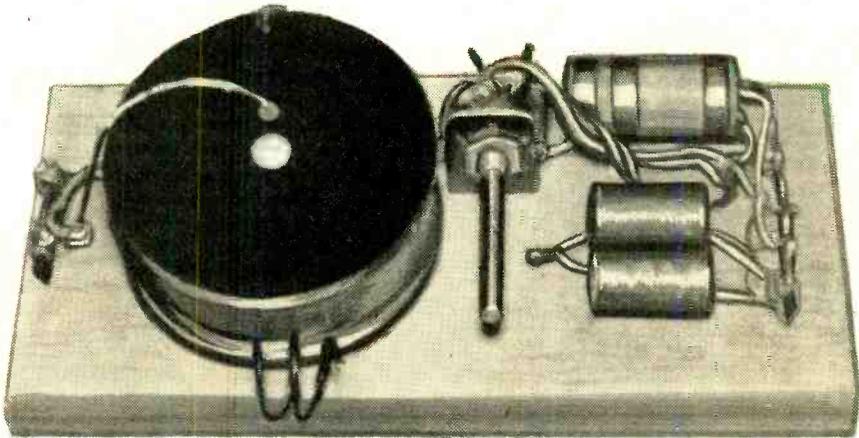
Another—perhaps more important—advantage of the coupler is in the additional selectivity gained, resulting in greater image and oscillator harmonics suppression. Since the r.f. stage is omitted in most inexpensive receivers, this leaves the path open for undesirable signals. Greater selectivity would cut down the interference. The coupler acts as an additional tuned circuit ahead of the mixer grid, thus increasing the selectivity of the receiver.

C_1 , is at the right, and C_2 , the output capacitor, is at the left.

One note of caution: If the receiver is of the a.c./d.c. type, do not—repeat—do not connect the coupler chassis to the receiver chassis. Both your receiver and antenna coupler chassis would then be connected to one side of the a.c. line. In the case of a two-wire feeder, one side of the feeder and, therefore, one side of the antenna might be "hot" to your roof gutters or vent pipe. This could result either in a blown fuse or a severe jolt—depending on how lucky you were. —30—

Front panel (left) should have indications showing bands and identification of capacitors.

Build Your Own CROSSOVER ... with Brilliance



SPEAK to the average hi-fi fanatic and he'll rattle off facts and figures about his amplifier and tuner, the unparalleled performance of his turntable, and the beautiful bass from his enclosure. He knows so much, it seems, that he's truly an expert. But if you want to be sure, give him the acid test.

"What," you should ask him, "about your crossover?"

Chances are, if he's Mr. Average, he'll respond with a blank look, and quickly change the subject to that new book he's reading.

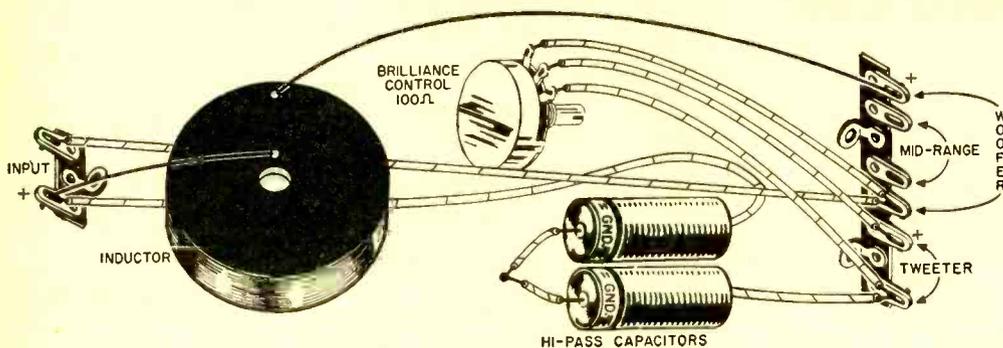
While many aficionados have a good *talking* knowledge of high fidelity, they lack almost completely an understanding of how a crossover functions. This article may help the average hi-fi'er to understand it better, and give him a chance to

build one tailored to his rig at very low cost. In addition, it will allow him to add two controls frequently lacking in commercial products—"brilliance" and "presence" controls.

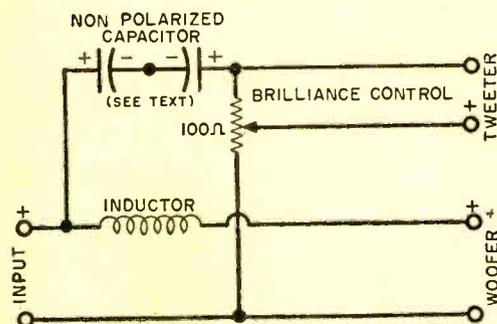
Traffic Cop. Basically, the crossover, or frequency-dividing network, directs the highs into the tweeter and the lows into the woofer, where they can do their proper jobs. Otherwise, you'll get serious distortions as the frequencies ram into each other and clash. In a three-speaker system, an additional filter sends the proper frequencies to the mid-range speaker. Normally, this is what you have in that little black box.

The more elaborate kinds of crossover, however, have added controls for "brilliance" and sometimes "presence," two rather vague terms which actually refer

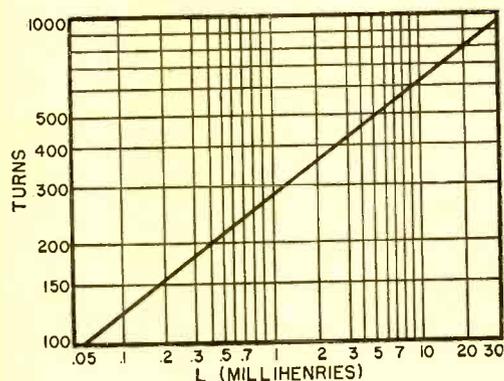
Addition of two controls which are frequently overlooked in making crossovers will contribute to your listening pleasure



Pictorial shows proper hookup of the crossover.



Schematic shows crossover with brilliance control.



Graph above gives number of "turns" (see text).

Table at right gives proper capacitance and inductance values for coil winding. Number of turns are determined from L by using the graph.

CROSSOVER FREQUENCY (cps)	REQUIRED CAPACITANCE AND INDUCTANCE					
	16 ohms		8 ohms		4 ohms	
	C	L	C	L	C	L
500	20	2.5	42	1.2	80	0.7
1000	10	1.8	22	0.9	41	0.45
2000	5	1.3	10	0.65	20	0.3
3000	3.5	0.8	7.5	0.4	16	0.2
4000	2.8	0.65	5.5	0.3	12	0.14
5000	2.2	0.5	4.4	0.25	9	0.12

C is in microfarads; L is in millihenries.

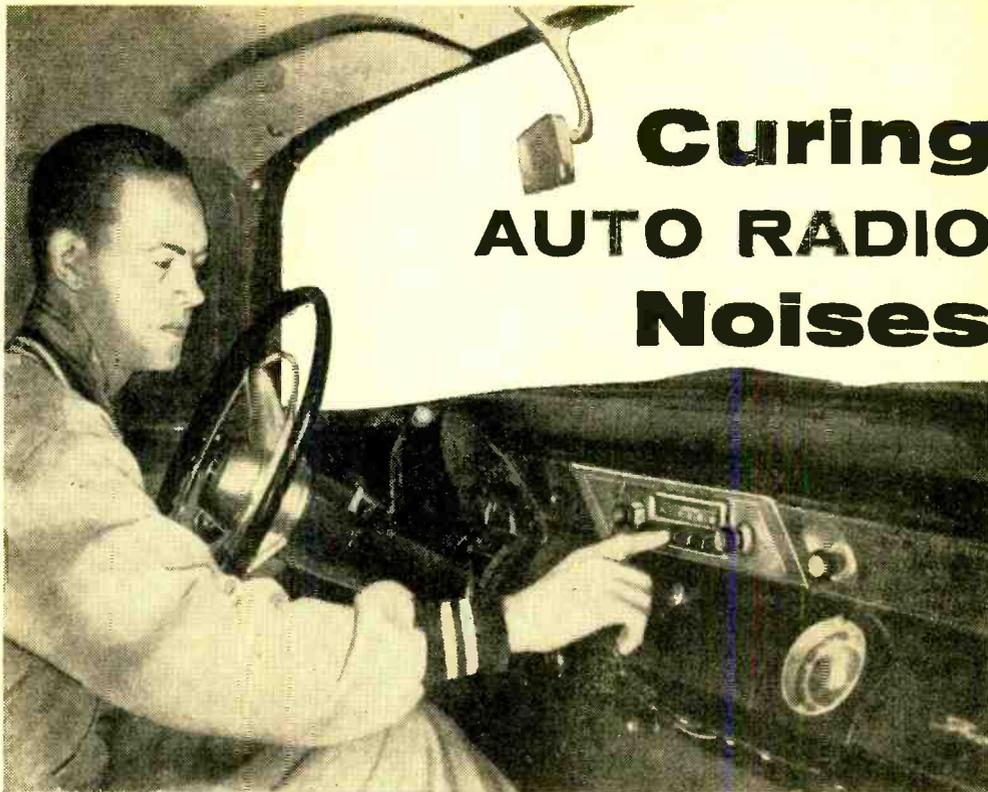
to emphasis on the upper frequency range (brilliance) and on the middle range (presence). If you accentuate the middle highs (say about 2000-4000 cps), you get the effect of bringing certain individual instruments right into the room with you; if you turn them down, the instruments recede into the background. Presence, therefore, adds an illusion of realism; it makes you feel as if you're listening to a "live" orchestra. The brilliance control determines the highs which add sparkle and shimmer.

Tackling the Job. Building the crossover is simple—just follow the schematics and pictorial. Costs are low: for about \$3 or so, you can build a two-speaker network; for another \$2.50, you can add a mid-range section.

The most difficult part is winding the coils, which are used to choke out the higher frequencies and pass the lows to the woofer and mid-range speaker. (Just the reverse is true in using the capacitors—they pass the higher frequencies to the tweeter.)

Use a cardboard bobbin from a roll of ribbon, or make one from a piece of dowel or broomstick. It should have a diameter of 1" and a length of about 1½". The bobbin will have ready-made supporting flanges; but if you make your own of wood, use Masonite or some such non-

(Continued on page 102)



Curing AUTO RADIO Noises

By **HERB CARRIER**

*Here's a step-by-step method
to put back the pleasure
in listening while you drive*

WHEN YOU SETTLE BACK in your car for a comfortable drive accompanied by some sweet music, does your radio give out with squawks, squeals, rattles, howls or chatter? If so, friend, don't fret. A few hours of careful noise suppression will work wonders on that set and on your nerves.

Most car radios are well engineered and, when properly installed, give no trouble. Occasionally, however, excessive interference is encountered, usually in older cars or in cars where the radio was an afterthought and never installed properly.

Types of Interference. Noise troubles generally fall into four categories: chassis or ignition circuit pickup; antenna pickup; generator whine; wheel static.

To eliminate this interference, various suppressors, capacitors and static arresters have been strategically installed in cars. For example, to prevent excessive ignition circuit interference, a suppressor has been installed in—or built into—the distributor high-tension wire.

To reduce generator whine, a capacitor is mounted on the generator frame (one side of the circuit), and the center lead is connected to the armature terminal. A capacitor is occasionally used on the dash

panel ammeter, connected to the same accessory terminal to which the radio battery supply lead is connected. Another capacitor is used on the voltage regulator, mounted on one of the regulator screws with the lead connected to the regulator armature terminal. (Note: these capacitors are generally about 0.5 μ fd., 200 volt, with metal case negative, pigtail center lead ending in spade lug.)

Adequate common ground connections are usually installed during the manufacture of the auto. They include a cylinder head ground strap, transmission ground strap and hood ground strap.

Locate the Noise. If a quick check shows that all the basic suppressors, capacitors, static arresters, and ground

straps are installed, yet excessive radio interference is present, you'll have to do some trouble-shooting in a step-by-step manner.

Most modern receivers are equipped with automatic volume control (a.v.c.). This increases the sensitivity of the receiver when weak signals or no signals are being received, and decreases it when strong signals are received. Therefore, maximum sensitivity is needed in conducting interference tests. So, when you tune the station selector between stations, turn the volume control on full.

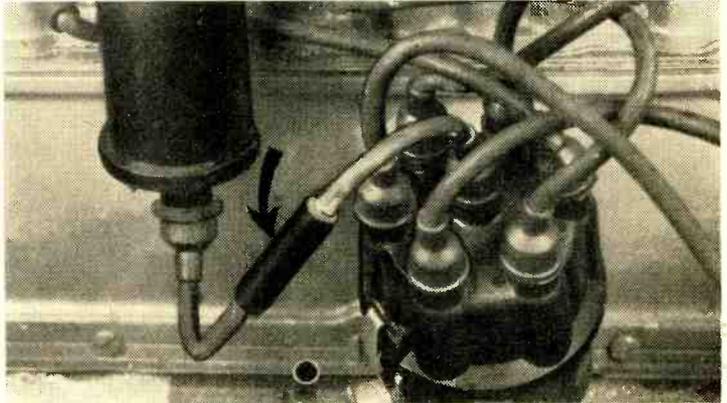
Chassis Pickup. To test for chassis pickup, have a friend pull the antenna lead-in connection from the receiver while

inspect the antenna lead-in shield ground. Paint, again, can cause trouble here, so make certain that the connections are clean and bright.

After making the above corrections, close the hood to prevent ignition system radiation. Plug the antenna lead-in terminal securely into its socket in the receiver. Then repeat the test.

Generator Interference. To test for generator interference, accelerate the engine and turn off the ignition switch. If a whine is heard, which decreases as the engine stops, the generator is causing interference. (Note: in some cars, the radio goes off when the ignition is off; connect fused power lead from the radio to the

To prevent excessive ignition circuit interference, many cars have a built-in suppressor in high-tension lead from the coil to the distributor. You can see this at the arrow in photo at right.



the engine is running and the car is in motion. If interference continues, it is an indication of chassis pickup.

To correct this condition, check for poor ground between receiver and instrument panel. Tighten all mounting bolts securely. Then check the ammeter capacitor and its connections—replace this capacitor if it is defective.

Bonding (grounding) is sometimes required to eliminate chassis pickup. In extreme cases, it may be necessary to bond all pipes, cables and rods which pass through the fire wall cowl. When bonding, use flexible copper braid. Solder one end of the braid to ground (dash panel, or fire wall cowl), and the other end to the pipes, rods, etc. Keep bonding material as short as possible.

Antenna Pickup. If, when making the above check, interference stops, or is greatly reduced, it is an indication of antenna pickup.

To correct this, be sure the cylinder-head ground strap connections are clean and tight. Paint sometimes insulates the ground strap. And be sure the strap actually has a metal-to-metal connection. Also,

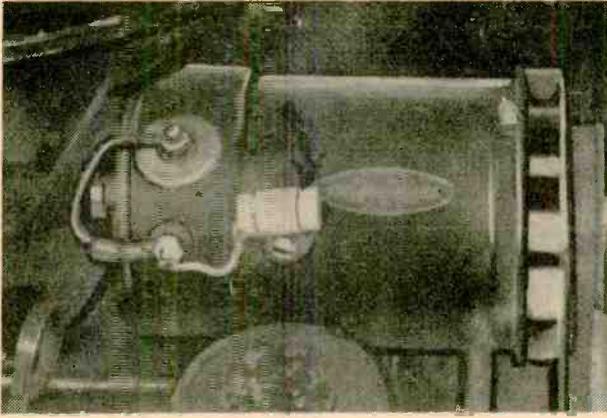
other ignition terminal for test purposes.)

To correct for such interference, clean and tighten all generator and generator-capacitor connections. Also clean and tighten all voltage regulator and regulator-capacitor connections. Replace either or both capacitors if they are defective. If noise persists, have your mechanic clean and undercut the generator commutator.

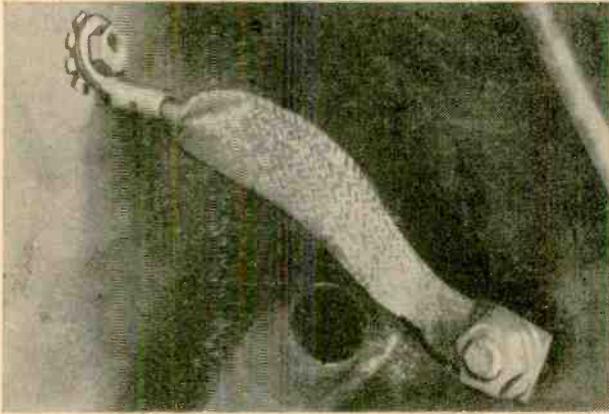
Wheel Static. Wheel static shows up most on a dry sunny day while traveling on an asphalt or concrete highway. It's seldom heard in damp weather, or when traveling on dirt or gravel roads. And, usually, wheel static (a continuous roar) increases as car speed increases.

To pinpoint wheel static further, accelerate to highway speed, and turn off the ignition (see note above). Depress the clutch pedal, or shift an automatic transmission into neutral. A continuous roar indicates wheel static. If static fades when the brakes are applied, the front wheels are causing the static. If the noise fades as power is intermittently applied, the rear wheels are at fault.

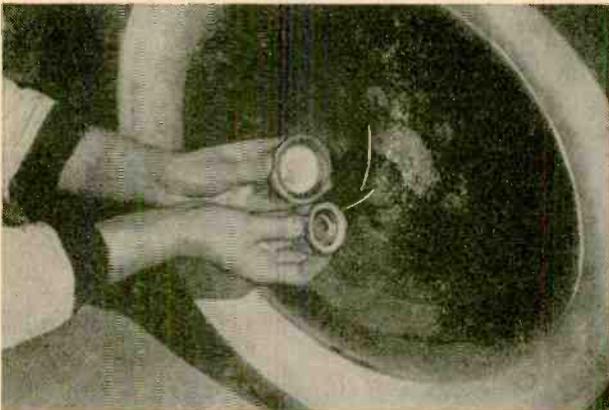
In either case, the trouble can be corrected by proper installation of static col-



To reduce generator whine, a capacitor is mounted on the generator frame, with the center lead connected to the armature terminal. Note hookup in photo at left.



Good ground connections must be provided, and they are installed at the time of manufacture. They should be secure and clean, as in photo at left, or they will lead to trouble in the way of noise.



Wheel static may be eliminated by adding small flat spring static collectors to the hubs of the wheels—normally only in the front, but in some cases to the rear ones, too.

lectors in the wheels. These collectors are usually small flat springs which conduct the static charge to the axles or the spindles. Occasionally, a special powder is blown into the inner tube along with the compressed air as a further aid in eliminating wheel static.

Normally, static collectors are installed on the front wheels only. However, in some cases where extremely sensitive re-

ceivers are used, it is necessary to install arresters on all four wheels.

Microphonic or Loose Tubes. If none of the above checks and corrections disclose or eliminate excessive interference, check all wires and connections. Tap each of the receiver's tubes with the end of a wooden-handled screwdriver. If a tube howls or chatters, or shows signs of being

(Continued on page 110)

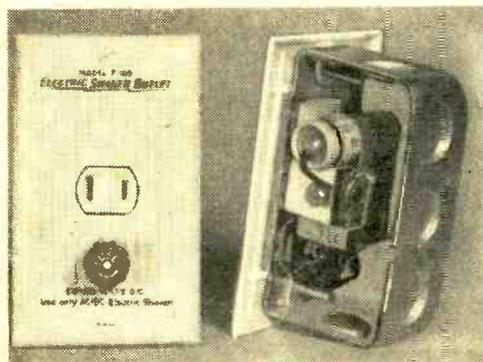
Two-Way Bus Radio

Ralph Kramden, the bus driver, is going modern up Rochester way. The transportation company there is testing a two-way radio system (left) which is expected to take out a lot of the headaches involved in jockeying the lumbering vehicles. If the test is successful, Stromberg-Carlson will equip the fleet of 300 buses with this equipment. When the dispatcher wants to call a specific driver, he broadcasts a call which will be heard over a tiny loudspeaker at the driver's ear in all buses. When the one who's called answers, the dispatcher switches over to communication with him only, cutting out the other buses. The driver responds using a regular telephone-type handset. Drivers will be able to report immediately any traffic delays, breakdowns, heavy passenger loads, accidents, or other things affecting the bus service.



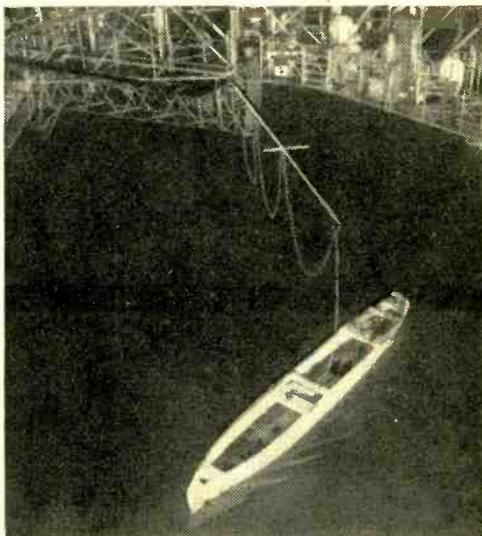
D.C. for Your Shaver

Since it is a fact that most electric shavers work better on direct current, Wellsco Electronic Products of Van Nuys, Calif., has introduced an electric shaver wall outlet (below) designed to replace the regular convenience outlet in the bathroom. It uses a selenium rectifier in a fused circuit in case any other appliance is accidentally inserted into the socket. The price is \$7.50 for the complete assembly.



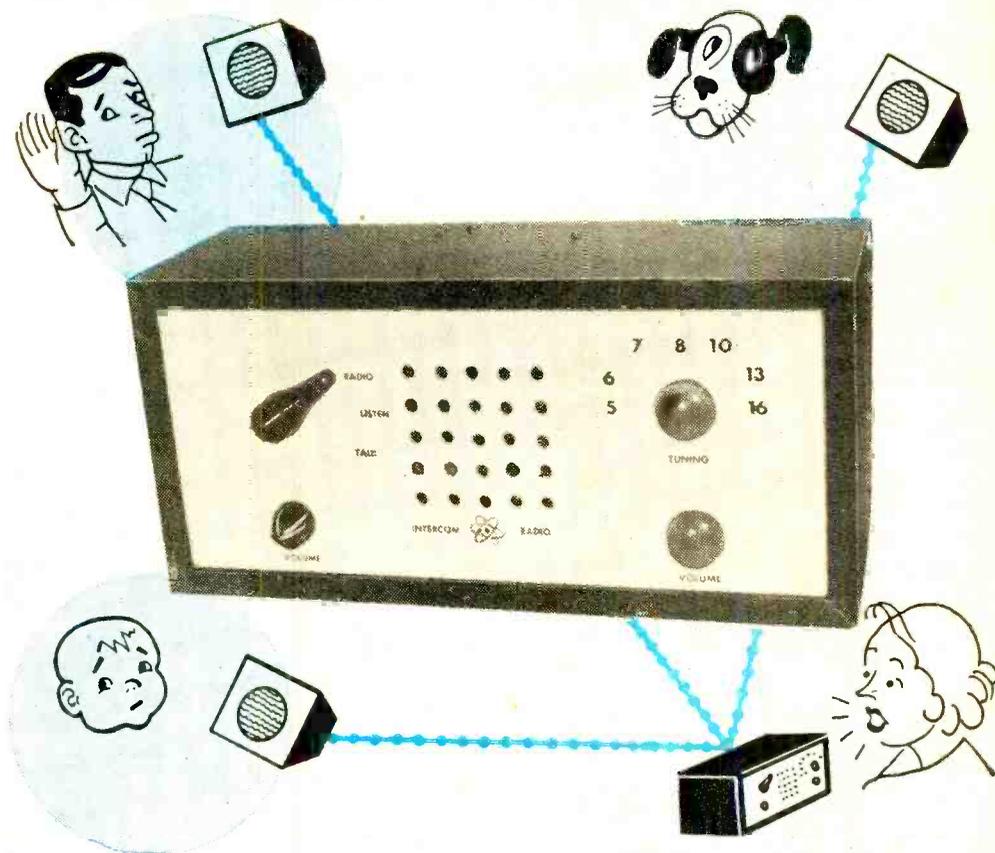
Talent Scholarships

Westinghouse Educational Foundation has increased to \$34,250—more than triple the amount formerly granted—the total value of 40 science scholarships and awards for which high-school seniors may compete in the coming school year. This is the organization's 17th annual nationwide Science Talent Search.



Computer Goes Boating

The Navy has put in an order for a UNIVAC-LARC, a three-and-a-half-million dollar computer designed to take the labor out of problems connected with nuclear reactors on ships. It will be installed at the Bureau of Ships' Model Basin (above) where testing of new ship designs takes place. Almost completely transistorized, the LARC is said to be able to do one man's mathematical work of a lifetime in only two minutes. It is actually two computers in one: the first does the arithmetic, the other controls the flow of data fed to the first. The Navy also plans to use the LARC in other fields, such as ship hull design, hydrodynamics, sonar and radar propagation and logistics planning.



Their Master's Voice

—a radio-intercom conversion

By R. L. WINKLEPLECK

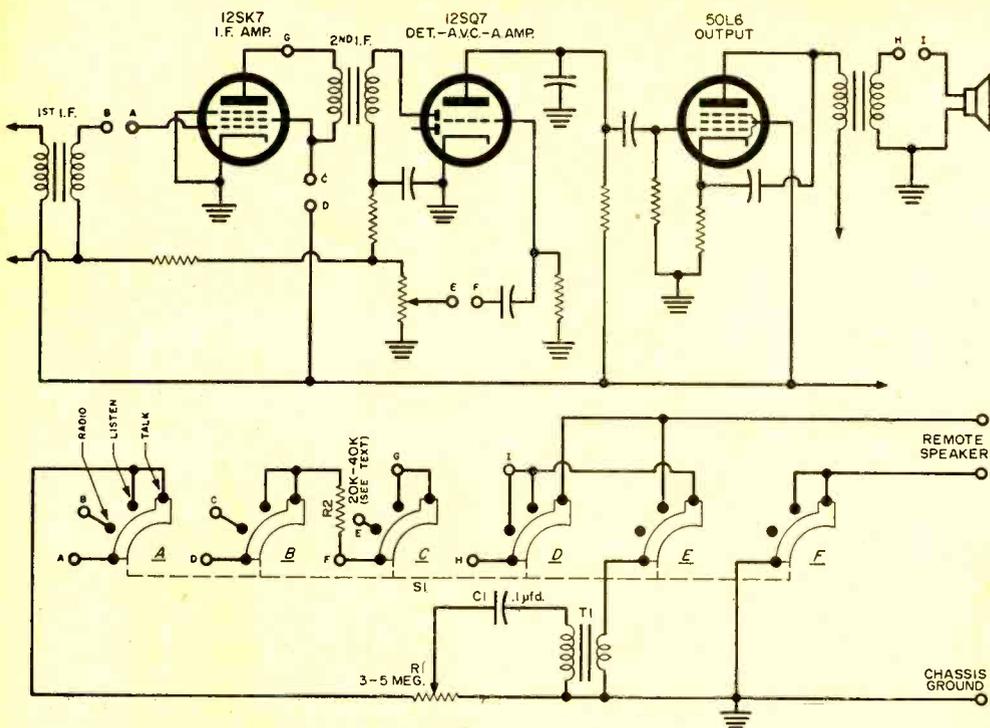
WITH A BIT of judicious rewiring, you can change your mild-mannered little bedroom or kitchen radio into the commanding "master's voice" of your household. What was once a quiet little stick-in-the-corner can become the transmitter of demands—summoning Dad from his workshop, the children from their TV, or even Rover from his bone. In addition, it will answer the door and question the salesman, all without Mom having to stir a step from her kitchen. This Jekyll-to-Hyde personality change can be simply accomplished by the technique described below.

A dual-purpose unit is not an original idea in itself as several intercom models of this type are commercially available. However, the commercial models usually feed the signal into the radio's *first* audio stage. This works well enough for the high output of a crystal pickup of a record player, but it's woefully weak for amplifying the out-

put of a PM speaker used as a microphone. It's especially unsatisfactory in the home where there's a need to carry on a conversation with the "called" party some distance from the speaker.

What's needed is a little more "soup." This can be easily added by wiring the switching circuit so that a five-tube radio becomes a *three-stage* intercom amplifier instead of a *two-stage* one. The schematic shows a portion of a typical a.c./d.c. radio with the comparatively few alterations necessary to make the change.

Assembly. For ease of assembly, a 6-pole, 3-position, non-shorting (spring return to one side) rotary switch has been selected. It not only makes the conversion from radio to intercom, but switches the local and remote speakers back and forth



PARTS LIST

- C1—0.1- μ fd. tubular capacitor
- R1—3.5-megohm potentiometer
- R2—20,000 to 40,000-ohm, 1/2-watt resistor (see text)
- S1—6-pole, 3-pos. non-shorting switch, spring return to one side (Centralab 1449)
- T1—Intercom input transformer, speaker voice coil to high-impedance input (Standard Transformer Corp. A-4744)

HOW IT WORKS

The signal from the remote speaker, which can be a 4" or 5" unit like the one in the radio, is fed into an intercom input transformer. From here it passes through a resistor/capacitor network to match the input impedance of the set's i.f. tube, which has been changed into a preamp.

Emerging at the plate of the i.f. tube, the amplified signal passes through a capacitor to remove the d.c., and proceeds through the radio's unmodified first audio and output stages, and thence to the speaker.

The switch, in its first position, restores the original radio circuit. Positions 2 and 3 change the radio into a three-stage amplifier with position 2 for "listen" and 3 for "talk."

Gang A isolates the front end and feeds the intercom input to the control grid of the i.f. tube. Gang B breaks the voltage supply to the i.f. tube and, through load resistor R2 and interaction with Gang C, feeds this voltage directly to the plate of the i.f. tube. Gang C also isolates the radio's volume control and feeds the signal, through a capacitor which removes the d.c., to the grid of the first audio tube.

Gangs D and E merely shift the local and remote speakers from the front to the rear of the amplifier in the customary intercom manner. Gang F is used to isolate the remote speaker leads completely when the unit is being used as a radio.

The partial schematic above is of a common type of a.c./d.c. home receiver. The lettered terminals on switch shown beneath it should be connected to similarly lettered points in receiver.

for intercommunication. This switch occupies very little space, and it should be possible to find room for it, the input transformer and the intercom volume control (if one is used) in the radio's present cabinet. You may, however, wish to design a special cabinet both reflecting the new character of your intercom-radio and providing plenty of space for the added components.

The conversion illustrated was made to an old chassis which had been resurrected from the junk box. It has the conventional a.c./d.c. circuit with a 12SK7 tube, a 12SQ7 detector/amplifier and a 50L6 power output tube. As can be seen, the function switch and new volume control are mounted on a piece of scrap aluminum which is bolted to the speaker frame. This results in a symmetrical arrangement of the controls and is quite attractive in the specially made cabinet.

One disadvantage of a switch with 24 contacts is the maze of wires serving it. However, by mounting the input transformer on the switch with an aluminum strap, we find that we can complete 90% of the wiring in the open before the switch assembly is installed. This pre-wiring may

look pretty complicated, but the worst is over when you have finished it. At this point, it's only necessary to attach ten color-coded leads to the set and two to the binding posts for the remote speaker leads, and the job is done.

The radio's volume control is deactivated by this conversion; the separate intercom volume control is shown in the schematic.

Precautions. Adjustment of the intercom gain is made by using *exactly* the correct plate load resistance ($R2$) for the preamp/i.f. tube. Because of the circuit employed, the tube manual cannot show the exact load value needed, so it is necessary to connect a potentiometer of at least 100,000 ohms in place of $R2$ temporarily. Adjust it until maximum gain with minimum distortion is achieved. Check the pot with an ohmmeter and then replace it with a resistor of the nearest value.

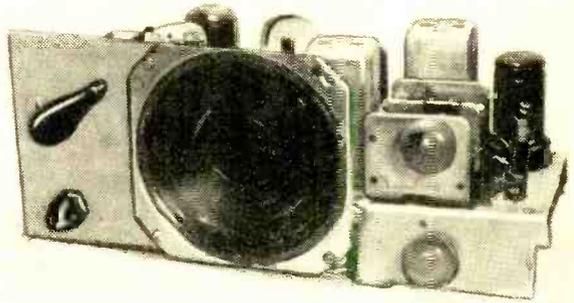
This is a rather tricky conversion in some respects. Wiring the switch is tedious and can be downright confusing. The leads *must* be color-coded or you'll become hopelessly lost.

If the set's output transformer is mounted directly on the speaker frame, it would be well to move it. On the "talk" position, there might be some feedback between it and the speaker voice coil if they're too close together. Not all sets have one side of the speaker voice coil grounded, and this must be done.

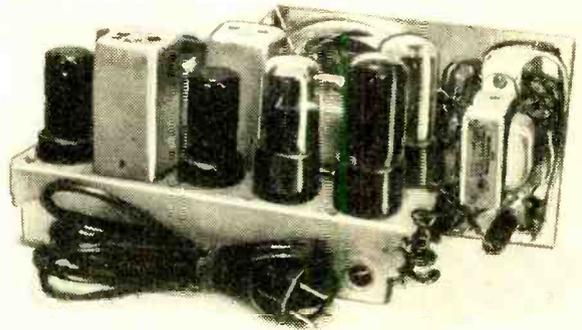
The switch should be mounted as far as possible from the converter tube (which may be a 12SA7, 6SA7, or 12BA7) to reduce noise pickup. Leads from the switch to various parts of the set should be as short as possible. A few holes through the chassis may sometimes offer the shortest route.

Each conversion presents its own special problems. Because of common tie points, some care and thought must be exercised in selecting the right place to break the circuit. Sometimes leads will have to be relocated

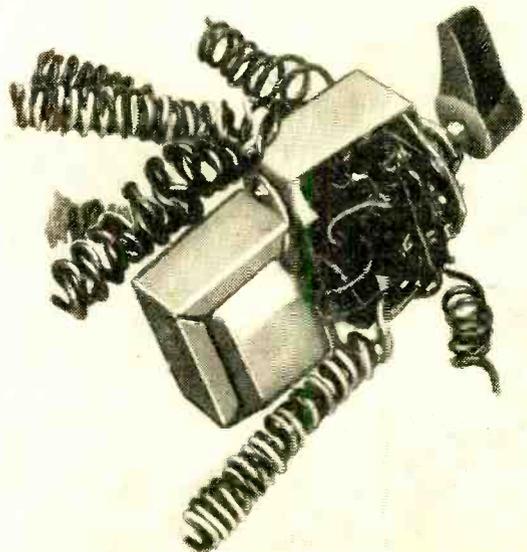
(Continued on page 124)



Front and back views of the radio-intercom show how the rotary switch may be added to an existing chassis. Switch and intercom volume control are mounted on a piece of scrap aluminum which is bolted to the speaker frame. The assembly will probably fit into your present cabinet, or you can design a new one.



In the close-up view below, you'll see how the input transformer is mounted on the switch with an aluminum strap. Most of the wiring can be done before the switch assembly is installed.





Transistor Topics

By LOU GARNER

"POWER" is rapidly becoming the "key word" in transistor design. Does that sentence sound familiar? It should, for it was the opening sentence of our August column. And power transistors *have continued* to make news!

Sylvania has announced a new low-cost power transistor for experimenters, gadgeteers and hams—the 2N307. Netting "across the counter" for only a buck-fifty (*that's right . . . only \$1.50*), this unit is rated to deliver 2 watts in single-ended Class A operation, with a pair delivering 8 watts in Class B push-pull.

But "top honors" as the lowest-priced power transistor still goes to the first of the low-cost power transistors—CBS-Hytron's popular 2N255. This transistor, featured in several POP'tronics articles in the

temperature of 25°C, 35 watts at 100°C. A single 2N451 in a Class A circuit is capable of 25 watts output at temperatures up to 30°C, while a pair in Class B will deliver 50 watts, even at temperatures up to 100°C!!! With a frequency cutoff of 400 kc., the 2N451 can be used in common-emitter amplifier circuits at frequencies up to 500 kc. . . . or as an oscillator at even higher frequencies.

Readers' Circuits. Although simple receivers continue to be the most popular projects with experimenters and home-builders, it is difficult to determine the *second* most popular project. On the basis of the letters and postcards received, I would guess that transistorized test equipment projects would be strong contenders for "place" position. This month we are fea-

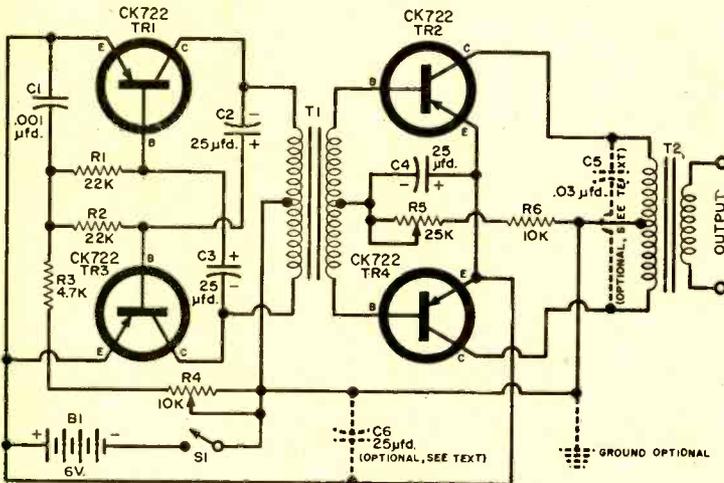
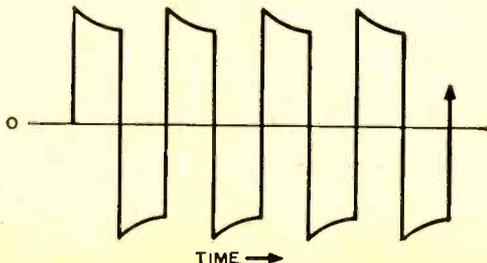


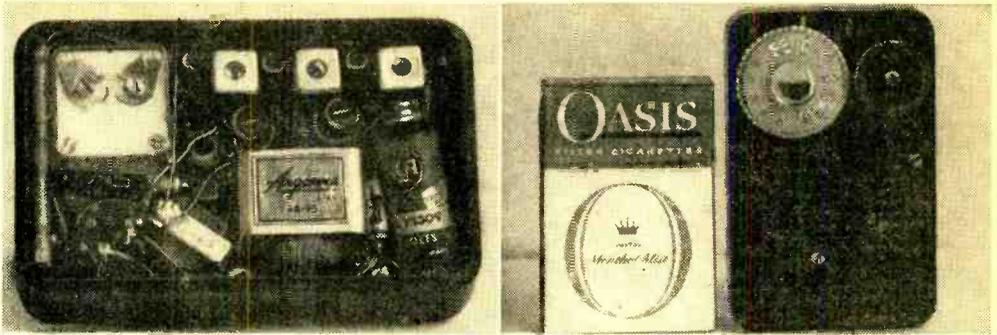
Fig. 1. Ronald Ives' "instant-starting" audio tone generator. Dotted lines represent optional parts.

Fig. 2. Waveform of the tone generator across a resistive load. This may be changed to a sine wave by adding capacitor C5.



past (see the June and October issues), *now nets for only \$1.35* (formerly \$2.95). The higher voltage version, the 2N256, now nets for \$1.50 (formerly \$3.25).

From a military-industrial viewpoint, G.E. has the "hottest" power transistor of all. The 2N451 *n-p-n* silicon transistor, manufactured with the vapor diffusion technique developed at G.E.'s Advanced Semiconductor Laboratory in Syracuse, N. Y., has a collector dissipation rating of 85 watts at a



This tiny six-transistor receiver was put together by reader John Jensen of Blair, Nebraska. Note the compact wiring in the interior view at left. The photo at right shows that the finished receiver in its case is not much larger than a pack of cigarettes. See page 125 for details.

turing one of each: a useful piece of test gear submitted by Ronald L. Ives of 251 Lincoln Ave., Palo Alto, Calif., and a transistorized *short-wave* receiver, developed by John L. Janning (W8QCN), of 1332 Central Park Ave., Dayton 9, Ohio.

Audio Tone Generator. A typical audio signal generator may require from 20 to 50 watts line power to deliver an audio signal of up to a few milliwatts, and may need a half-minute to five or ten minutes to reach a stable operating temperature. Ronald Ives set out to design a 1000-cycle audio tone generator which would: (a) require relatively little power and thus be economical to operate on batteries; (b) be "instant starting"; (c) be easy to build and to use; and (d) not "make like a cookstove" on the bench.

Referring to the schematic diagram (Fig. 1), we see that his tone generator consists of a modified LC multivibrator, TR1-TR3, followed by a transformer-coupled push-pull buffer amplifier, TR2-TR4. Power is supplied by a single six-volt battery, B1, with on-off switch S1.

In operation, transformer T1 acts both as the inductive collector loads of the multivibrator (by virtue of its center-tapped primary winding), and as impedance matcher for the multivibrator's output to the buffer amplifier's input. Cross-feed coupling capacitors C2 and C3 provide the

feedback necessary to start and sustain oscillation. Base bias for the first stage is provided by resistors R1, R2 and R3, R4, bypassed by C1. The common-emitter configuration is used.

The push-pull output stage is conventional. Output transformer T2 matches the buffer amplifier stage to the load; like the first stage, the buffer is a common-emitter amplifier. Neither layout nor lead dress is critical and you have considerable freedom of choice in assembly.

Oscillator transformer T1 is a 500-ohm CT to 500-ohm CT unit. Either the Argonne AR-62 or Thordarson TR-1 is suitable. Output transformer T2 is rated at 500 ohms CT to 1500 ohms; Ronald suggests the use of a Thordarson TR-4 here. Power may be supplied by a single 6-volt battery, such as a Burgess Type Z4 or F4P1, or by four flashlight or penlite cells connected in series.

Operating frequency should fall between 800 and 1400 cycles. The final value (1000 cycles) is obtained by adjusting R4. If you wish to change the basic frequency to another range, you can do this by using other values for C2 and C3. Bias resistor R5, in the output stage, serves as a fine control over output amplitude; for most applications, where a fixed level signal is desired, this control may be left fixed in position.

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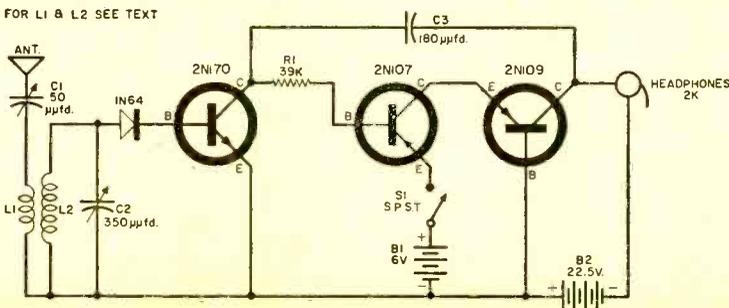
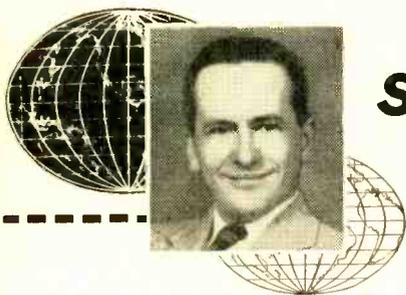


Fig. 3. John Janning's transistorized short-wave receiver. With this basic circuit, John has received DX up to 4000 miles.



Short-Wave Report

By HANK BENNETT

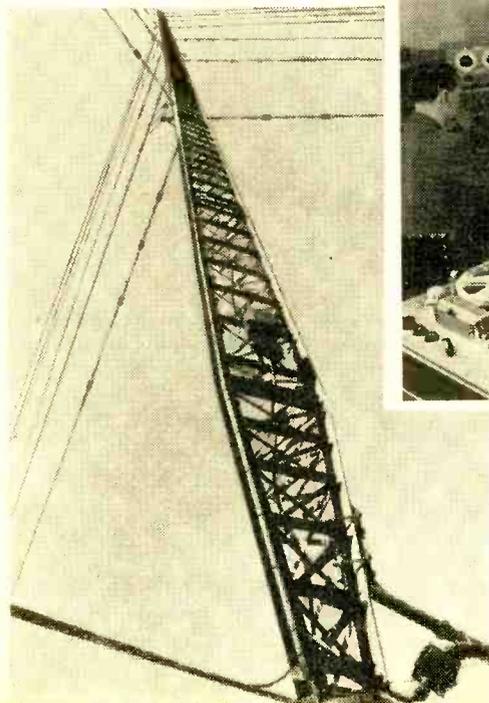
LAST MONTH we told you about the origin, purpose, and aims of *Radio Free Europe*, in addition to various facts about the programming. This month we'll discuss *RFE*'s monitoring stations, relay points, studios, transmitters, and antennas.

The Schleissheim monitoring station in Germany has often been called the "ears" of *RFE*, and it is from here that the programs are produced. Stations behind the Iron Curtain are monitored, as are the satellite stations, while the American stations provide up-to-the-minute news. The Schleissheim monitors use 50 communications receivers for general listening and triple-diversity receivers for picking up programs from Press Wireless in New York City. Teletype and telephone also play important parts in the functioning of the Schleissheim station. Antenna-wise, there

are a number of rhombics (including reversible and inverted types), long-wave, open-V, Yagi, and Beverage antennas, and a cross-loop and goniometer arrangement.

Some 200 miles northwest of Munich and 50 miles south of Frankfurt, we find an abandoned airstrip that is now the home of the Biblis transmitting center. The transmitters include four 10-kw. units, one 20-kw. unit, and three 50-kw. units. Commercial power is brought in at 20,000 volts and reduced to 380 and 460 volts for operation of the transmitters and other equipment. In all, a total of 750 kw. is required at Biblis. Rhombic and curtain antennas are used here; the curtains consist of one, two, or four elements, each with a tuned parasitic reflector.

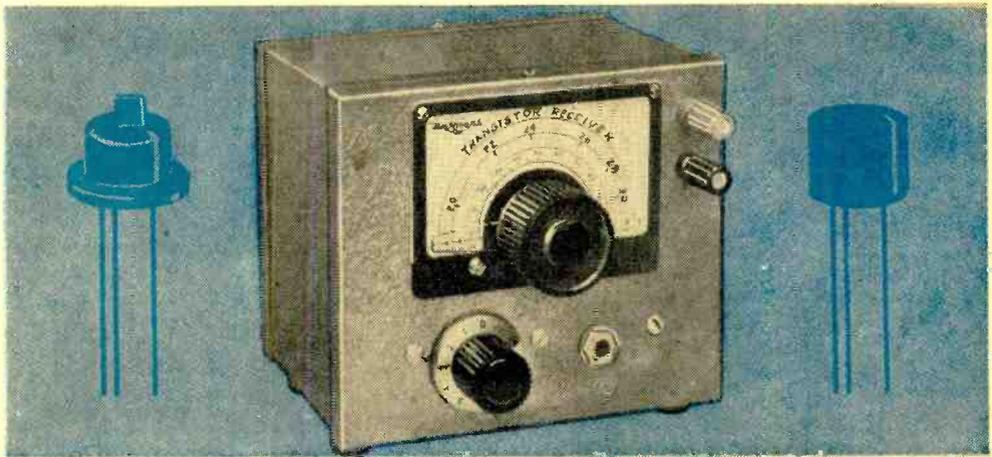
In Holzkirchen, Germany, is a relay station
(Continued on page 134)



Technicians check radio equipment in maintenance laboratory at Munich. The machine in the foreground is an Ampex tape recorder. *RFE* uses three Ampex machines in each of its 24 studios.

This giant tower is one of the four antennas of the powerful *RFE* short-wave transmitter at Holzkirchen, Germany.

TRANSISTORIZED



SHORT-WAVE "TWO-LUNGER"

**Introducing RCA's new 2N247 in a two-transistor receiver
for the 10-meter band**

By DONALD L. STONER, W6TNS

BACK in the good old days of ham radio, one-tube radio receivers were affectionately referred to as "one-lungers." Although this phase in the development of amateur radio will never return as such, we are now at a similar point in time with respect to the development of transistors. So it seemed quite apropos that this high-frequency transistorized receiver be tagged a "two-lunger."

Some of you may recollect the year 1932 when the first screen grid tube—the revolutionary 24A tetrode—was announced. The tetrode transistor is just as spectacular today as the first screen grid tubes were in those bygone days.

The "Ten-Meter Two-Lunger" utilizes an amazing semiconductor, the RCA 2N247 drift transistor. All of the 2N247's that I tried worked well beyond 50 mc. By replacing *L1* (as will be described later), it is usually possible to receive signals as high as 40 or 45 mc. However, if your 2N247 doesn't "cut the mustard" near 40 mc., don't sue the company. Anything above 30 mc. is par for the course.

Putting It Together. Chassis layout is straightforward and the circuits are not critical. The chassis in the model was constructed from a sheet of 6" x 5 7/8" 18-gauge aluminum. This size is neatly accommo-

dated by an LMB box, UC-972. The midget 15-volt battery (*B3*) located on top of the chassis supplies power to the 2N44 audio amplifier stage.

Components are arranged so that there is only one terminal strip, located between the 2N247 and the battery holders. The primary and secondary leads of transformer *T1*, the disc capacitors *C2* and *C5*, and one end of *L1*, *RFC1* and *C6* are all secured to this terminal strip. Note from the bottom view of the receiver that *T1* is held in place with an aluminum bracket and a single screw.

One word of caution regarding earphone jack *J3*—be sure to use the insulating shoulder washers that are supplied with the jack and check to see that there are no burrs around the mounting hole that could short through to the jack frame.

In the photograph of the top of the chassis, you will see another aluminum bracket, fabricated to secure *B3*. This photo also shows the "gimmick" capacitor (*C1*) used to control antenna coupling. A 2" piece of busbar wire (stiff and tin-plated) was soldered to the left terminal of the capacitor and bent parallel to the chassis. Around this were wound approximately 13 turns of insulated wire, and the free end was soldered to the antenna binding post. The

HOW IT WORKS

The "Ten-Meter Two-Lunger" uses two transistors to form a complete 10-meter receiver. A single *p-n-p* RCA drift transistor, Type 2N247, functions as a tunable superregenerative detector and the common base configuration is employed. Incoming r.f. signals are applied to the collector and at the same time coupled to the emitter through internal transistor capacity and capacitor *C4*. The signal is amplified in the transistor and again appears in the collector circuit, this time highly amplified. With the 2N247 functioning in this manner, a feedback loop is created and oscillation takes place.

In addition to the oscillation at the incoming signal frequency, another oscillation occurs at approximately 17 kc. due to the time constant of *C3* and *R1*. This secondary oscillation tends to pulse the high-frequency oscillations off and on at just the right instant for maximum sensitivity. This type of circuit is also known as a superregenerative oscillating detector.

Transformer *T1* is used to couple the audio and match the impedance between *TR1* and *TR2*. *TR2* is wired as a high-gain class A amplifier and uses a Type 2N44 *p-n-p* transistor. Resistor *R3* provides base bias for the transistor and, in effect, controls its operating point. The audio output is direct-coupled to the headphones and provides more than adequate volume.

turns of wire are free to slide on the busbar, and the amount of wire in proximity with the busbar controls the degree of coupling between the antenna and the receiver.

Firing It Up. If you follow the schematic faithfully, the receiver will probably work the first time around. However, if you're like me, you may be too eager to hear it perform and rush the job a wee bit. So it's a good idea to make a few checks just to protect the transistors and batteries. There's nothing like a molten mass of germanium to put a damper on one's spirits. And that's just what will happen to the transistors if you hook them up wrong.

First, insert the batteries *but not the transistors*. Check with the schematic to make sure that you get the polarities cor-

TRANSISTOR RATINGS

Most transistor manufacturers rate the high-frequency performance of their units in terms of "alpha cutoff" and in megacycle units. As the transistor tries to amplify higher and higher frequencies, efficiency starts to fall off and the amplitude of the output signal decreases. At some high frequency, the output signal will be reduced to half the value of a low frequency (say 1000 cycles) which the transistor can easily amplify. This frequency is known as the alpha cutoff frequency.

RCA, however, rates its units differently. As we attempt to amplify beyond the alpha cutoff frequency, the output drops even more. At another frequency, considerably higher than alpha cutoff, a point will be reached at which the output signal is of the same amplitude as the input signal. This is known as the unity gain cutoff frequency, the frequency at which the transistor has neither gain nor loss. (It should be noted that these ratings are established using the common emitter configuration rather than the base configuration. Also, unless specified, the alpha cutoff or unity gain frequency is an *average* figure and not a guaranteed *minimum*.) The RCA 2N247 drift transistor has a unity gain cutoff frequency of 132 mc. and the alpha cutoff frequency is about 30 mc.

rect. Once you are sure they are right, place some plus and minus marks on the chassis for future reference. With the switch *off*, measure the resistance between the chassis and the frame of *J3*. It should be extremely high. If the resistance is low, the jack is shorted.

Next, couple the negative lead of the voltmeter on coil *L1* and the positive lead on the chassis. With good batteries, the meter should read 4.5 volts. If it does not, see if the coil is shorted to the chassis, or if the transformer leads are shorted. Then place the positive lead of the voltmeter on the emitter connection of *TR1*. Turn the switch on and rotate *R1*. The meter should read a little over a volt. Now, insert the phones in the jack and again check from the frame (negative meter lead) to the chassis. With a fresh battery, the voltage should be 15 volts. Then check the voltage between the base terminal of the 2N44 socket (negative meter lead) and the chassis. It should be below 15 volts.

If the meter reads down scale during any of the above checks, it means that a battery is reversed. Assuming that all the checks are satisfactory, turn *off* the power switch and insert the transistors correctly. It is possible to pop a transistor if it is inserted when the power is turned on.

With the headphones inserted in the jack and the antenna disconnected, turn on the power switch and slowly advance the regeneration control, *R1*. You should hear a scratchy sound as the control is turned, and at about half rotation the 2N247 will start to oscillate. The oscillations are heard as a sizzling sound known as hiss. When you hear this sound, you have arrived. It is time to connect an antenna.

As you tune capacitor *C3*, you will probably hear stations across the dial. Their strength can be increased by sliding more turns of wire on the busbar. If you get too much coupling between the two wires, the detector will quit oscillating, or else it will pop in and out of oscillation across the dial. If it quits as soon as the antenna is connected, you have too much coupling to start with.

Making Replacements. If you don't like winding your own r.f. chokes, you can purchase commercial units in the form of television peaking coils. Any choke in the vicinity of 70 microhenries will work. However, the handmade one wound on the 1-megohm resistor will be more than satisfactory, although not quite as pretty as a commercial unit.

As mentioned earlier, replacing coil *L1* with one containing less turns will usually allow you to receive signals almost up to the six-meter amateur band. The technique goes something like this. With the plates

PARTS LIST

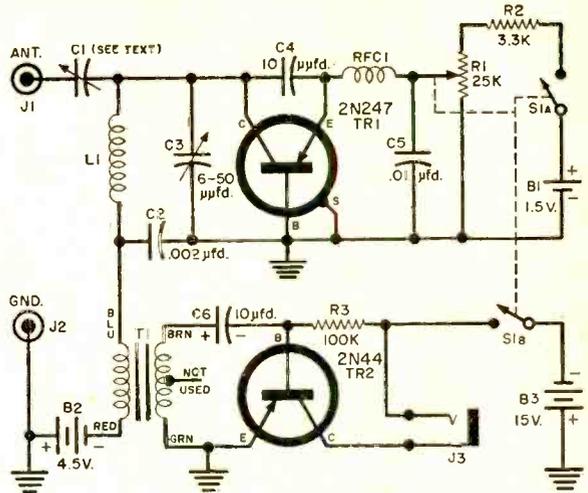
- B1—1½-volt penlite cell
 B2—4½-volt battery, three penlite cells
 B3—15-volt hearing-aid battery (Eveready 411)
 C1—1.5 μ fd. adjustable "gimmick" capacitor (see text)
 C2—0.002- μ fd. disc ceramic capacitor
 C3—6-50 μ fd. variable capacitor (Johnson 50R12)
 C4—10- μ fd. mica or disc capacitor
 C5—0.01- μ fd. disc ceramic capacitor
 C6—10- μ fd., 25-volt electrolytic capacitor
 J1, J2—Binding posts (Johnson 111-102 red and 111-103 black)
 J3—Open-circuit headphone jack
 L1—14 turns #20 wire wound on ½" form, spaced the diameter of the wire (14 turns of Air Dux #416 or B & W 3003 "Miniductor")
 R1—25,000-ohm potentiometer, linear taper
 R2—3300-ohm, ½-watt resistor
 R3—100,000-ohm, ½-watt resistor
 RFC1—Homemade choke consisting of 50 turns \pm 34 wire scramble-wound on a 1-megohm, 1-watt resistor (see text)
 S1a/S1b—D.p.s.t. switch (part of R1)
 T1—Transistor interstage transformer, 20,000 ohm to 1200 ohm (Triad TZ-15 or equivalent)
 TR1—2N247 drift transistor (RCA)
 TR2—2N44 transistor (General Electric)
 I—Case (LMS \pm UC-972)
 I—Vernier dial (National MCN)
 I—Knob (National HRS-3)
 I—3-pin transistor socket
 I—4-pin transistor socket

of C3 one-quarter meshed, remove a turn at a time from coil L1 until the detector refuses to oscillate. If you are inclined to experiment, you can also adjust the turns on RFC1 for best high-frequency oscillations. This choke is optimum for 30-mc. operation, but it is possible to pick up an extra four or five megacycles on the high-frequency end with a smaller choke.

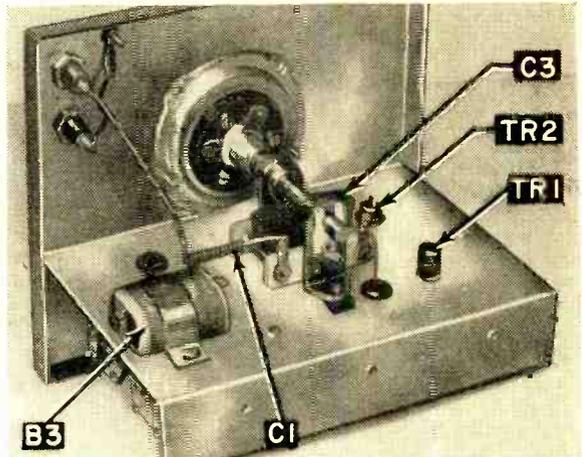
For use on the six-meter band, the 2N247 can be replaced with a Philco SB-103 which features an alpha cutoff of 90 mc. And RCA has just announced a developmental transistor similar to the 2N247 that will have a unity gain cutoff frequency of 250 mc. With such a transistor, the "Ten-Meter Two-Lunger" would also work on the six- and two-meter amateur bands. Watch for the announcement of the commercial version of this developmental device.

You pocketbook pinchers like myself will be very happy to know that the 2N247 is not so expensive that you will have to finance it. This unit is available at your RCA distributor for approximately \$3.29, amateur and experimenter net price.

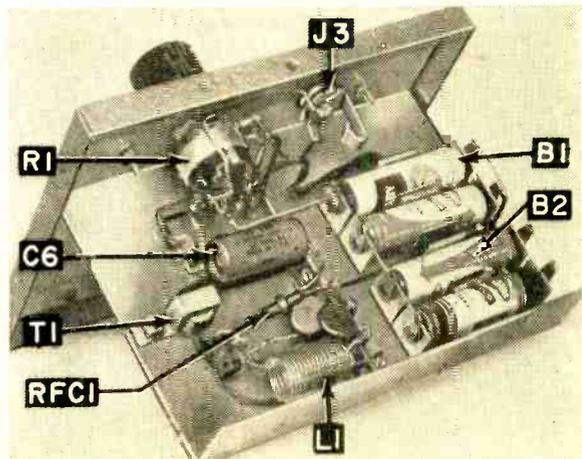
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Although the receiver is very sensitive, you'll find it simple to construct if you follow the schematic diagram above.

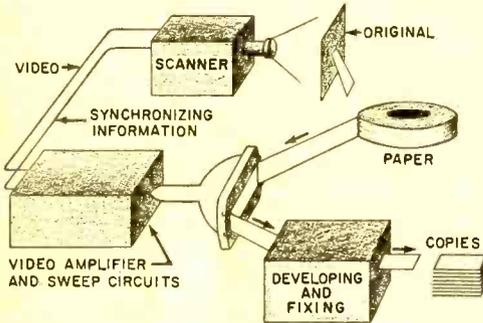


Top and bottom views of the "Two-Lunger." C1 is a "gimmick" capacitor which allows a wide range of frequencies to be received. Aluminum brackets hold T1 and B3 in place.



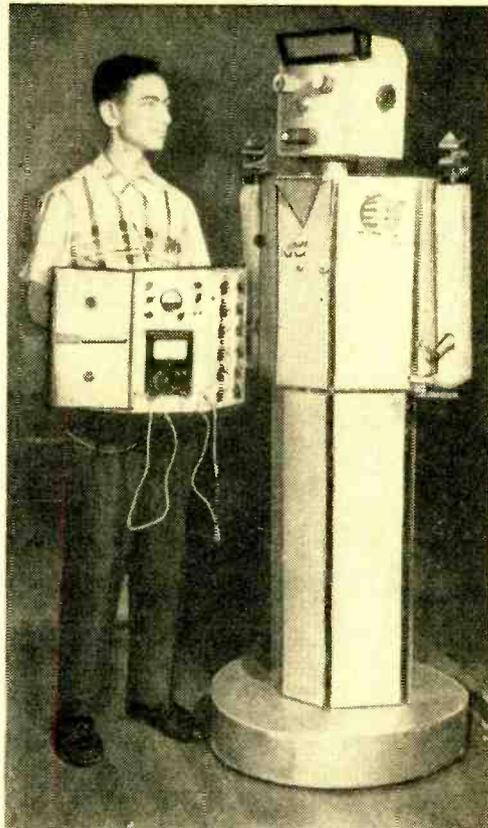
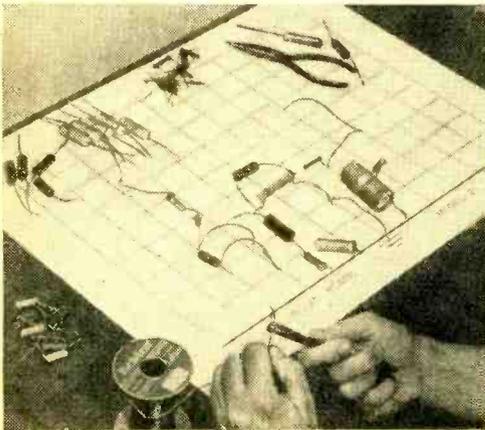
TV Does Office Work

Closed-circuit TV may become a form of standard office equipment if the Stanford Research Institute continues its development of a new type of electronic duplicating device. The diagram below shows the transition from the original document to be duplicated to the completed copies. One distinct advantage of the device is that it can, without any extra equipment, directly duplicate line drawings. It also eliminates the need for duplicating stencils and the labor involved in preparing them.



Cut Down on Soldering

The photo below shows a new system of breadboarding by Van-Dee which eliminates soldering of connections. Since circuits may be assembled without solder, clips, screw connections or specialized accessories, a number of developmental circuits can be checked in the time it would ordinarily take to assemble one circuit. The circuit board contains cells or "pockets" of conductive material, which automatically connect components inserted into them. Components may be replaced without damaging leads or loosening contacts. The grid lines do not enter the circuitry, but simply serve to locate the cells.



Boy-Power Robot

A six-foot robot capable of "seeing" an object and "sensing" the presence of a human was built by 13-year-old Donald Rich of Queens, New York. He gave "Robetron" the ability to move its arms, pick up objects magnetically, or manually, make decisions by use of a computer, roll forward or backward or turn in any direction by means of motorpower wheels. Some parts for the project were donated by Westinghouse Electric Corporation. A photocell is used for "seeing," a capacity-operated relay for "sensing," and a microphone in the nose is the communications system. The computer, which adds, subtracts, multiplies and divides, fits the robot like a vest. In the photo above, Donald is about to fit the computer on his friend, who seems a likeable, patient sort of fellow for a robot.

Servicemen's Awards

General Electric has instituted "All-American Awards" to honor the 11 television servicemen who have performed the most outstanding community service. Each will get a \$500 check for his favorite charity or public service, plus a trophy.

AFTER CLASS

Special Information on Radio, TV,



Radar and Nucleonics

THE PARTICLE ACCELERATORS

I've begun to wonder where electron physics is going. There are so many different synchrotrons, betatrons, cosmotrons, etc., that the list seems endless. What are they all about and how do they work?

WE'LL BEGIN with the cyclotron, not because it was the first atom-smasher but because it was the grand-daddy of all the modern particle "whirlers." The idea was to impart a very high velocity to an

ion—trically heated filament in the position shown provides an abundance of electrons which serve to ionize the gas in the chamber.

Suppose that at a given instant $A1$ is made positive with respect to $A2$ by the high-frequency voltage; a positive ion from the source F will be attracted toward $A2$, but instead of moving directly toward $A2$, it will move in a circular path due to the action of the uniform magnetic field pro-

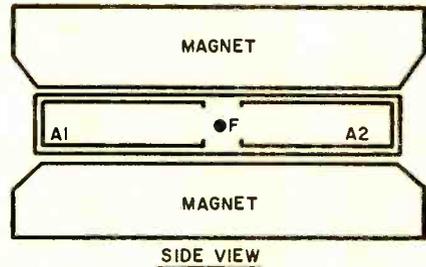
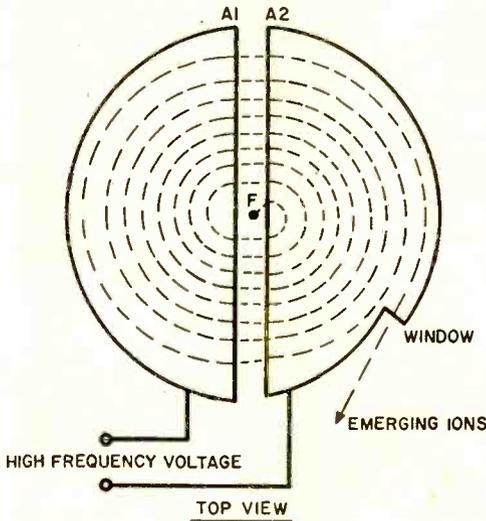
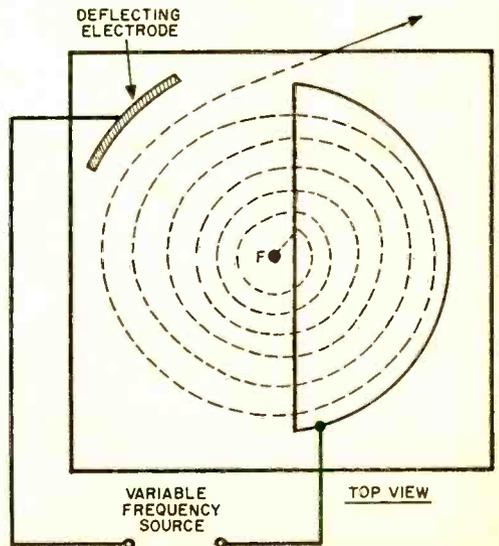


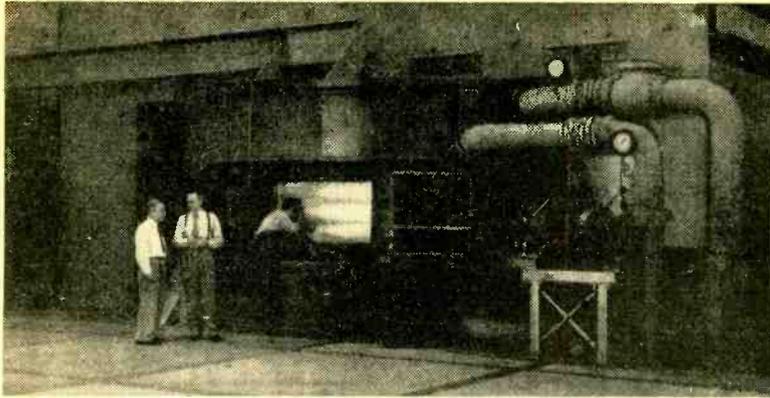
Fig. 1. Fundamental cyclotron construction. Top view is at left, side view above.

Fig. 2. The synchrocyclotron. One dee is used instead of the two in the cyclotron.

ion—to supply it with oodles of kinetic energy. Then it could be electrically directed to wallop an atom and blow it apart. Heavy positive particles like protons, deuterons (double protons), and alpha particles (two protons plus two neutrons) were selected as projectiles because their large masses help provide large impact energies.

The Cyclootron. Dr. E. O. Lawrence and Dr. M. S. Livingstone built the first cyclotron (Fig. 1) in 1931. Picture a flat circular pill-box cut vertically down the middle—separated into two "D"-shaped halves. The hollow half-boxes or *dees* are connected across a source of high-frequency voltage and enclosed in a gas-filled chamber. The whole assembly is then mounted between the poles of a powerful magnet. An elec-





Columbia University's huge synchrocyclotron produces alpha particle energies of over 400 million electron volts.

duced by the pole pieces. As it reaches the gap between the two dees, it is accelerated by the strong electric field at this point and proceeds into the opposite box with increased velocity.

If you whirl a stone attached to the end of an elastic band around your head, the stone will gyrate in ever-widening circles as you make it go faster and faster. So it is with the speeding particle; each time it crosses the gap, it is given another violent kick which causes it to spiral outward with more and more speed until at last it emerges from the "window" endowed with tremendous kinetic energy. Its target may be a cloud chamber or a photographic emulsion in which the effect of its atom-disruption may be observed and measured.

The first cyclotron accelerated protons to a little over 1 million electron-volts (1 m.e.v.) of energy. (An electron-volt is the kinetic energy acquired by any particle carrying one unit of electric charge when it has been accelerated through one volt of potential.) As larger cyclotrons were built, the available particle energy rose steadily until, in 1946, the cyclotron peak of 40 m.e.v. for alpha particles was obtained.

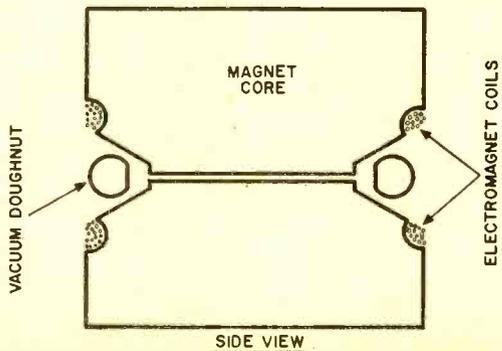
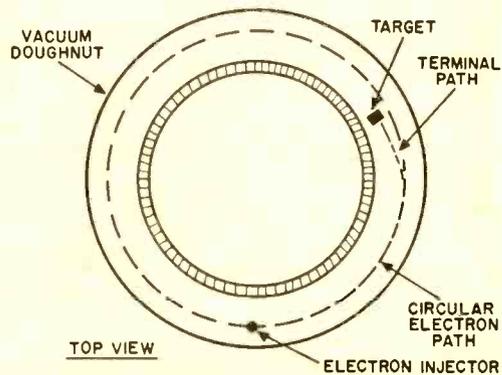
The limit was achieved at 40 m.e.v. because one of the famous scientific principles finally proved by Dr. Albert Einstein began to push its insistent proboscis into the picture: *as any body moves at increasing speed, its mass also increases*. Up to about 40 m.e.v., this increase in mass is very slight and does not affect the cyclotron's operation; beyond this energy value, however, the ions begin to gain mass. This slows them down enough so that their spiral paths fall out of synchronization with the high-frequency voltage on the dees and they no longer receive their accelerating shoves at the right instant.

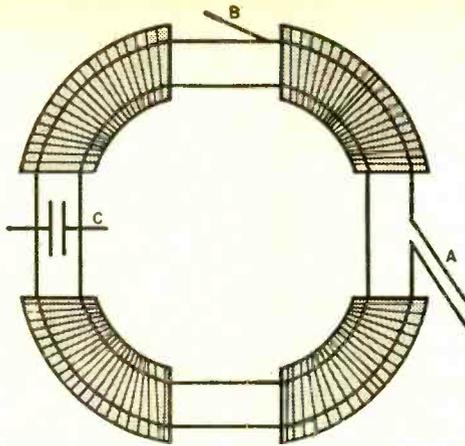
Synchrocyclotron. To compensate for the increasing mass of the whirling protons or alpha particles, the frequency of the accelerator voltage can slowly be

changed so that it keeps step with the diminishing speed increment of the ions. In 1950, the huge Columbia University synchrocyclotron went into operation using this synchronization principle. The most significant departure in construction from prior cyclotrons was the use of a single rather than a double dee.

In the synchrocyclotron, a grounded deflecting electrode serves as the second side of the applied high-frequency voltage. Recent reports in-

Fig. 3. The betatron. Note how the pole pieces go into the center of a vacuum "doughnut."





MAGNETS (PLATES ABOUT 9 FT. IN DIAMETER ARRANGED SIDE BY SIDE AROUND QUADRANTS)

A—PROTONS INJECTED HERE
 B—DEFLECTOR FOR REMOVING ACCELERATED PROTONS
 C—CAVITY RESONATOR

TOP VIEW



SIDE VIEW

Fig. 4. Plan view of the Berkeley betatron. Brookhaven's cosmotron follows a similar pattern.

indicate that the Columbia synchrocyclotron produces alpha particle energies in *excess of 400 m.e.v.* An ion having this energy travels at approximately *93,000 miles per second* or at a speed high enough to carry it to the sun in about 10 seconds flat!

Thus far, no mention has been made of electrons, since the cyclotron and synchrocyclotron are positive-charge acceler-

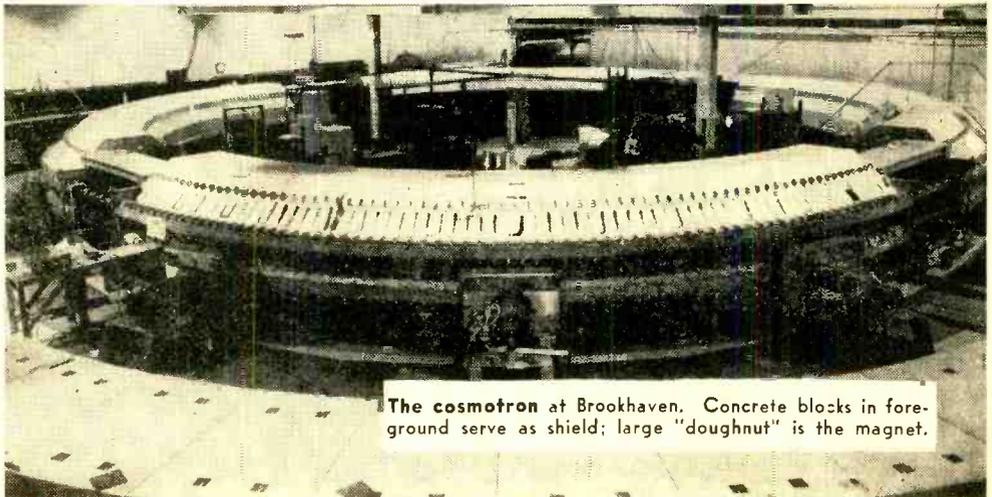
ators. Why can't they be used for accelerating electrons? If we remember that an electron has a rest mass of about 1/1800th that of a proton, it is evident that we would have to speed it up far more than a proton to obtain the same kinetic energy from it. (Kinetic energy depends upon both mass and velocity. If we want a large k.e. in a body of small mass, the velocity must be made very much greater.)

To get an electron up to an energy level of only 1 m.e.v., we must make it travel at a speed *more than nine-tenths that of light!* At this velocity, its mass increases 2.5 times over its rest mass, and even a modern synchrocyclotron cannot compensate for such a large increase. Hence, it became apparent that another type of machine was required.

The Betatron. The first successful betatron—the "beta" prefix comes from *beta rays* which are streams of electrons—was designed and built by D. W. Kerst in the United States in 1940. Its operation is similar to that of an ordinary step-up transformer.

As illustrated in Fig. 3, the major features of the betatron include a large electromagnet whose pole pieces protrude into the center of an evacuated glass-tube "doughnut." Electrons are produced outside the betatron by thermionic methods and are given a preliminary acceleration by an external electric field of about 50,000 volts potential. They are then fed or injected into the doughnut. The current through the electromagnet coils is alternating so that the magnetic field is a varying one; the injection process occurs at the precise time when the magnetic field is building up in the right direction. The effect of the field is to induce a voltage within the

(Continued on page 133)



The cosmotron at Brookhaven. Concrete blocks in foreground serve as shield; large "doughnut" is the magnet.

Parasitic Transistor Power Supply Replaces Batteries

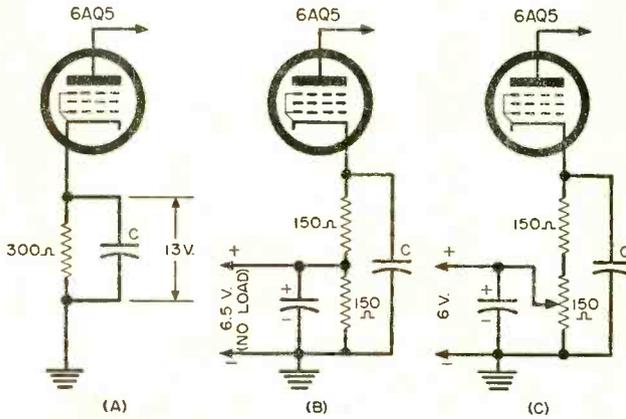
In mixed electronic equipment, employing both transistors and vacuum tubes, batteries are often installed when they are not needed. In many instances, the tran-

sistors can be "parasited" onto existing potential sources, eliminating the need for batteries and the ever-present threat of their going dead at inopportune times. A convenient source of low voltage at low current is the cathode resistor of a power amplifier tube, such as the 6AQ5. The conventional cathode circuit of this tube is shown in (A) of the circuit diagram. Any voltage lower than the maximum can be tapped off by means of a voltage divider. The method of obtaining approximately 6.5 volts, d.c., at low current (a couple of milliamperes) is shown in (B).

If a very accurate voltage is required, this can be obtained by using a potentiometer, as in (C). The capacitor filters out small a.f. variations that may be present. Even better filtering can be produced if a series resistor is inserted between the potentiometer arm and the filter capacitor.

Use of a parasitic voltage supply for transistors not only eliminates the need for batteries but also makes power switching a single operation, as the transistor power is automatically turned on when the main power is on, and turned off when the vacuum-tube circuit is de-energized.

—Ronald L. Ives



sistors can be "parasited" onto existing potential sources, eliminating the need for batteries and the ever-present threat of their going dead at inopportune times.

A convenient source of low voltage at low current is the cathode resistor of a

CROSSWORD PUZZLE

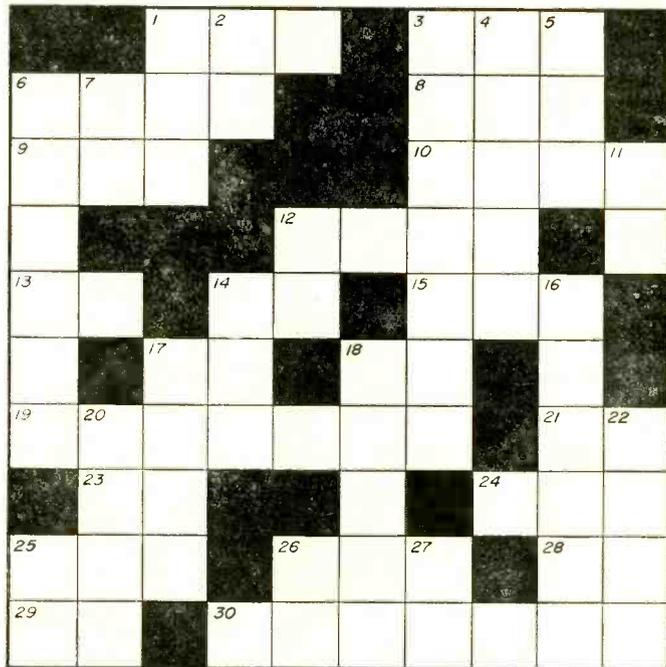
By Arthur L. Branch

ACROSS

- 1 Impedance unit.
- 3 Snake.
- 6 Electrical conductor.
- 8 Conductance unit.
- 9 Number represented by brown in the color code.
- 10 Places.
- 12 Type of oven.
- 13 Frequency modulation.
- 14 Type of current used in a transformer.
- 15 Belonging to it.
- 17 Chemical symbol for tin.
- 18 Frequency in audio output transformer.
- 19 What a diode does.
- 21 Power formula: d.c.
- 23 Current unit: Abbr.
- 24 To terminate.
- 25 Part of a tube.
- 26 Color that represents a multiplier of 100 in color code.
- 28 Man's nickname.
- 29 Pronoun.
- 30 Vapor used in tubes.

DOWN

- 1 Unrefined metal.
- 2 That man.
- 3 To increase power.
- 4 Type of circuit connection.
- 5 Cooking utensil.
- 6 Part of a hi-fi system.
- 7 Within.
- 11 Chemical symbol for a photosensitive element.
- 12 Broadcast frequency: Abbr.
- 14 Insect.
- 16 Black eye.
- 17 Look for.



- 18 At a later date.
- 20 To give off electrons.
- 22 Useless current in a transformer.
- 25 Greek letter used as a mathematics constant.

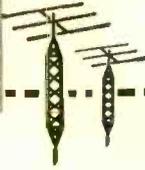
- 26 Prefix denoting restoration to a previous state.
- 27 Rectified current.

(See page 121 for solution)



Among the Novice Hams

By **HERB S. BRIER, W9EGQ**

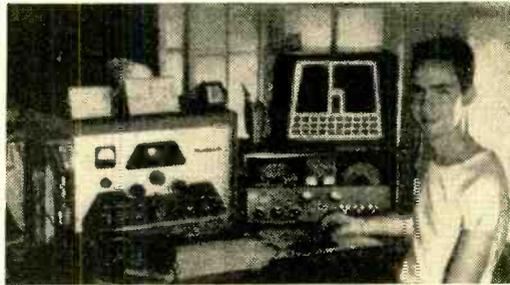


IN OCTOBER we discussed some of the fundamental properties of current, voltage, and resistance, and how the relationship between them is expressed concisely by Ohm's law: $E = IR$, $I = E/R$, $R = E/I$. We also talked about the formulas for calculating the power in electrical circuits, $P = EI$ and $P = I^2R$, and how to use them in answering simple questions involving Ohm's law and power calculation that may be found in the Novice examination. Now, we'll go over the information necessary to understand and answer questions that might appear in the General/Technician/Conditional exam.

In the General Class examination, there are usually a couple of questions based on the diagram in Fig. 1 (see page 87), such as: "What is the bias voltage on the tube?" And: "What is the resistance of $R2$?" It is important to read each question separately and then study the diagram to determine which of the data given is pertinent to that question. Once this is done, the problem is half solved.



Fred Beyer, KN9HFP, made 200 contacts in 35 states in five months as a Novice. His transmitter is a DX-20 feeding a dipole; his receiver is an NC-98.



Ken Grimm, KN5KBH, works 16-meter c.w. with a DX-100 transmitter cranked down to 75 watts at Baylor University Radio Club.

For example, there is nothing difficult about determining the resistance of $R2$. From Ohm's law, $R = E/I$; therefore, you simply divide the voltage across $R2$ by the current flowing through it. Both of these quantities are given. Remembering to change milliamperes to amperes, the solu-

WHAT IT'S ALL ABOUT

"Among the Novice Hams" is devoted to the beginning radio amateur. If you are familiar with amateur radio, it speaks for itself. If not, the following may help you understand what it is all about.

Amateur radio is a hobby in which a quarter million people throughout the world, from grade school boys and girls to men and women, operate their own officially licensed radio stations. They communicate with each other over distances ranging from a few miles to 12,000 miles.

The simplest amateur license to obtain is the Novice license. It is issued by the Federal Communications Commission, Washington, D.C., to any citizen who has not previously held an amateur license and who can send and receive the International Morse code at a speed of five

words a minute—actually a very slow speed. In addition, it is necessary to pass a simple written examination on elementary amateur radio theory and regulations. The license is valid for one year, during which time the licensee must qualify for a permanent license or leave the air.

Full information on how to obtain the various classes of amateur licenses may be found in a packet of booklets called "Gateway To Amateur Radio." The booklets are available for \$1.50, postpaid, from the American Radio Relay League, Inc., West Hartford, Conn., or from any of the amateur supply houses that advertise each month in **POPULAR ELECTRONICS**.

Read "Among The Novice Hams" for up-to-date news and discussions of interest to all beginning amateurs.

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, % 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.

K1/W1 CALL AREA

Bob Kowal (16), 11 Jackson St., Northampton, Mass. (Code, theory and selection of equipment)

Don Pandolf (14), 169 Beverly Rd., Wethersfield, Conn. Phone: JA 9-4398. (Code and theory)

Ronald Simonton, 19 Leavitt St., Skowhegan, Me. (Code and theory)

Roger Tomes, 16 Belden Ave., Norwalk, Conn. Phone: VO 6-5214. (General Class theory)

Howard Coleman (15), 17 Eaton St., Providence 8, R. I. (Code and theory)

William A. Dodge, Jr., P.O. Box 723, N. Attleboro, Mass.

Augustus Dent, Jr. (16), 21 Fernboro St., Dorchester 21, Mass.

Edmund Mendoza, 20 Grant St., New Bedford, Mass. (Code and theory)

Thomas P. Wilson, 2703 Easton Turnpike, Fairfield, Conn. Phone: EDison 9-7577. (Code and theory)

K2/W2 CALL AREA

John Perz, 34 Arthur St., Brentwood, L. I., N. Y. Phone: BR 3-9085. (Code, theory and selection of equipment)

Brian Davey, 31 Arthur St., Brentwood, L. I., N. Y. (Code, theory and selection of equipment)

Jay Turner, 226 Porterfield Pl., Freeport, N. Y. (Code and theory)

John Maikisch, 166 Washington St., Freeport, N. Y. (Code and theory)

John Firth (16), 25 N. Harrison Ave., Blackwood, N. J. Phone: CAnal 7-1655. (Code and theory)

David Griffiths, 38 Lowell Ave., Summit, N. J. Phone: CR 3-2289. (Code and theory)

Alvin Wolff, 521 Firth Ave., New York 17, N. Y.

Richard P. Auletta (15), 154 Stratford Rd., New Hyde Park, L. I., N. Y. (Code, theory and selection of equipment)

Douglas Waterman, 81 Greenway East, New Hyde Park, N. Y. Phone: PI 6-7725. (Code and theory)

S. Selowentchich, 135 Colfax Ave., Clifton, N. J. (Code and theory)

Joseph Shapiro, 67-22 214th St., Bayside 64, N. J. (Code and theory)

Alan Luger (15), 33 Park West, New Hyde Park, L. I., N. Y. Phone: Pioneer 2-6457. (Code and theory)

George Freed (15), 43 Greenway, New Hyde Park, N. Y. Phone: PI 6-6389. (Code and theory)

Robert F. Welch, 115 Arbour Lane, Buffalo, N. Y. Phone: TR 9306.

Stephen Lyons, 59 Schubert St., Binghamton, N. Y. Phone: Binghamton 7-4879.

Roy Winfield, 33 Robertson Rd., West Orange, N. J. (Code and theory)

Stephen Pincus, 2191 Creston Ave., Bronx 53, N. Y. (Code, theory and selection of equipment)

K3/W3 CALL AREA

Dave Withersty, 93½ Sharpville Ave., Sharon 17, Pa.

Clarence B. Vaughn, M.D., 3500 21st St., S.E., Washington, D. C.

Thomas Shelton, M.D., 3814 Hayes St., N.E., Washington, D. C.

Charles Callan, 415 Center St., Washington Grove, Md. (Code and theory)

Charles M. Griffin, 520 W. Grove St., Clark's Summit, Pa. Phone: 6-6167. (Code, theory and regulations)

William S. Behrends, 3605 Tatnall St., Wilmington 2, Del. (Code and theory)

Russel P. Wueschinski, Jr. (15), R.D. #2, Dover, Pa. (Code)

Martin Alfonsi, Rt. 885, Box 308, Clairton, Pa. (Code and theory)

K4/W4 CALL AREA

Ronnie J. Thompson, Rt. 2, Box 363, Henderson, N. C. (Code and theory)

David Beals (14), 1625 Fairfield Dr., Kingsport, Tenn. Phone: CI 5-2144. (Code, theory and selection of equipment)

Marshall DeBruhl, Jr., 3333 Murray St., Columbia, S. C. Phone: ALPine 3-0133. (Code and theory)

V. Miller, Jr. (16), Rt. #4, Lafayette, Tenn. (Code)

Mickey Jackson, 635 Maple St., Mount Airy, N. C. (Code and theory)

Conley Ingle, 124 Asington St., Rockingham, N. C. (Code and theory)

Dale Cochran (13), 1830 Patton Dr. #2, East Point, Ga. Phone: PL 5-7870. (Code and theory)

Randy Prewitt, 1425 Perkin, Alcoa, Tenn. (Selection of equipment)

Timmy Casteen (13), 3401 Lyles St., Columbia, S. C. (Code and theory)

Kenneth L. Coomes, 1100 Helm St., Henderson, Ky. (Code, theory and selection of equipment)

Donald Graham, P.O. Box 273, Bedford, Va. Phone: 9393. (Code and theory)

Athel Matthew Ballowe, P.O. Box 92, Scottsville, Va.

P.F.C. Wilfrid H. Kelley, Jr., US 55 557 738, Co. A, 326th Engr. BN, Ft. Campbell, Ky. (Code and theory)

Robert Pittman (13), 11361 S.W. 49th St., Miami 55, Fla. (General Class code and theory)

K5/W5 CALL AREA

Jim Landureth (14), 1124 Third Ave. N., Texas City, Tex. (Code and theory)

Howard Hammons, Box 141, Kilbourne, La. (Code, theory and selection of equipment)

Russ W. Copping, 6425 Calbert St., New Orleans, La. (Code and theory)

Donald C. Castle, 137 Anderson, W. Helena, Ark. (Theory)

Bill Deland, 511 E. Center, Searcy, Ark. Phone: 804. (Code, theory and regulations)

Ronnie Womack, 519 Watson, Fort Worth, Tex. Phone: JE 5-7643. (Code, theory and selection of equipment)

Randolph Lemelle, Jr. (17), 216 S. Olive St., San Antonio 3, Tex. Phone: CA 3-5913. (Code and theory)

Roy Weinedel, P.O. Box 52, Columbia, Miss.

K6/W6 CALL AREA

Larry Goldsmith (10), 6428 Ben Ave., N. Hollywood, Calif. Phone: PO 1-4288. (Code, theory and selection of equipment)

Gary Andersen (15), 936 Anza Dr., Pedro Valley, Calif.

Marcella H. Pettis, 11415 S. Starlight Ave., Whittier, Calif. (Code and theory)

Eileen K. McBreen, 11425 S. Breckenridge Dr., Whittier, Calif. (Code and theory)

Michael Young, 1336 Hermosa Ave., Pedro Valley, Calif. (Code)

K7/W7 CALL AREA

Neal Precht, Box 1068, Milton-Freewater, Oregon. (Code and theory)

Jim Kendrick (15), Qtrs. # 2505-F, Fort Lewis, Wash. (Code)

K8/W8 CALL AREA

Bob Epstein (11), 16039 Curtis Ave., Detroit 35, Mich. (General code and theory)

Dick Graham, Jr., 5118 Bainbridge Rd., Toledo 13, Ohio. Phone: LU 2-5174. (Code and theory)

Paul Wolfe, Rt. 87, Novelty, Ohio. Phone: ED 8-6334. (Code)

Robert Lewis, 36200 W. 8 Mile, Farmington, Mich. Phone: GR 4-4039. (Code and theory)

Maurice H. Davidson, 28521 Stuart, Southfield (Royal Oak), Mich. (Code and theory)

Michael Coleman (13), 1069 W. Woodruff, Toledo 6, Ohio. Phone: CH 4-1131. (Code and theory)

Leon Carter (13), 645 Woodland, Toledo 2, Ohio. Phone: CH 6-0465. (Code and theory)

Larry Goelz, 536 Hedgewood Ave., Zanesville, Ohio. Phone: GL 3-2268 (Code and selection of equipment)

Carl D. Avers (15), 121 Orchard St., Keyser, W. Va. Phone: 2-8491. (Code)

Robert B. Strang (15), 310 Manistique Ave., Detroit 15, Mich.

Donald Reed (16), R.R. # 7, Chillicothe 3, Ohio. Phone: MOhawk 3-2258. (Code, theory and selection of equipment)

Don Fisher, Rt. 1, Carroll, Ohio. (Theory)

Pat Rankin, 22009 Kramer, St. Clair Shores, Mich. (Code, theory, regulations and selection of equipment)

Ronald Kendall, 1940 Manhattan Ave., Youngstown 9, Ohio. Phone: SW 9-6151. (Code and theory)

G. Scott Henninger (14), 7817 List Lane, Parma 30, Ohio. Phone: VI 3-7809. (General code and theory)

Frank Pierce (15), 4122 17th, Ecorse 29, Mich. (Code and theory)

K9/W9 CALL AREA

Charles Guillory (15), 1153 Union St., Marseilles, Ill. (Code and theory)

Dennis J. Lunsford, Box 11, Milton, Ind.

Hank Wolfa (13), 8333 Park Ave., Indianapolis 20, Ind. Phone: CL 5-9650. (Code and theory)

Bill Riley, 812 N. Ninth St., Mattoon, Ill. (Code, theory and regulations)

Richard Harmon, 1009 Third Ave., Mendota, Ill.

Bruce Stuffebeam (14), Box 56, St. David, Ill. (Code and theory)

Robert Zurick, P.O. Box 321, Beloit, Wis. (Code and theory)

Bob Saville, 1206 Kansas, Peoria, Ill. Phone: 5-9082. (Code and theory)

Buddy Carter, Box 117, Kewanna, Ind. (Code, theory and selection of equipment)

Dave Bunte, 507 S. Williston, Wheaton, Ill. (Code and theory)

Joe Kovarik (15), 2131 W. 50th Place, Chicago 9, Ill. (Code and selection of equipment)

K0/W0 CALL AREA

Daniel S. Shaffer, Hawkeye, Iowa. (Code, theory and regulations)

John Davis, 503 W. Main, Washington, Iowa.

Dell Random, Oakdale, N. Dak. (Code and theory)

Kirk Fitzner, Rt. # 3, Estherville, Iowa. (Code and theory)

K. A. Posthuma, 529 Ply St. N.W., Le Mars, Iowa. (Code and theory)

Lawrence I. Coen, P.O. Box 9003, Kansas City 18, Mo. (Code and theory)

Tom Braunger, 3241 Virginia, Sioux City, Iowa. Phone: 7-1682. (Code, theory and selection of equipment)

Gene Consolvo, 1517 S. Pinecrest, Wichita 18, Kans. (Code and theory)

VE CALL AREA

Gordon Burleson (14), 1344 Thurlow Rd., Victoria, B. C., Canada. (Code and theory)

Lyn Irwin, 9216 146th St., Edmonton, Alberta, Canada. (Code, theory and regulations)

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 33 1/3 rpm) and a Novice Theory Course for \$10.00, postpaid. The complete course or more information on it is available from RETMA, 1721 DeSales St., N. W., Washington 6, D. C.

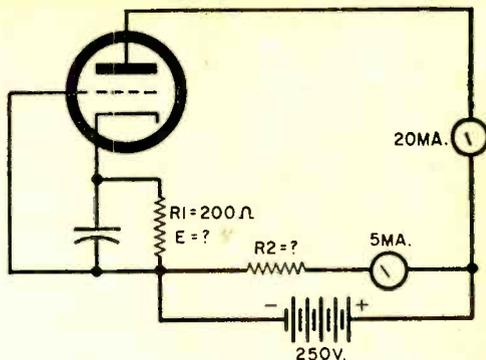


Fig. 1. This diagram, with different component values, is the basis for several questions on Ohm's law which appear in the General Class Amateur exam.

tion will be: $R2 = 250/0.005 = 50,000$ ohms.

The bias voltage on a tube is the fixed voltage applied to its control grid with reference to its cathode. In this circuit, the voltage across the cathode resistor $R1$ establishes the bias voltage. The problem, therefore, is to determine what this voltage is. From Ohm's law, $E = IR1$. $R1$ is given as 200 ohms. I is the 20-ma. plate current of the tube, which flows from the negative battery terminal, through $R1$, through the tube, and back to the positive battery terminal through the milliammeter. Thus, $E = IR1 = 0.02 \times 200 = 4$ volts. The bias voltage is 4 volts.

Resistances in Series. Figure 2(A) shows three resistances connected in series. From it, it is obvious that for an electric current to travel from one end of the string (Continued on page 128)

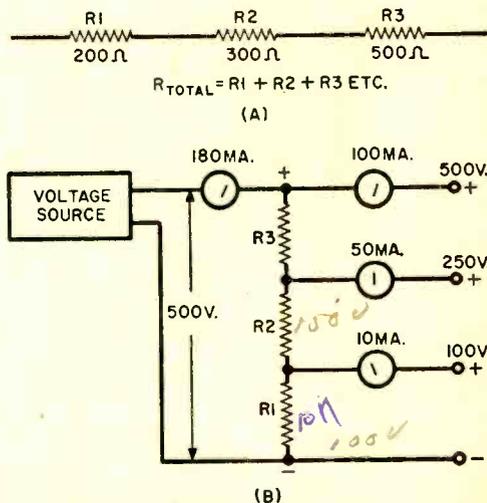
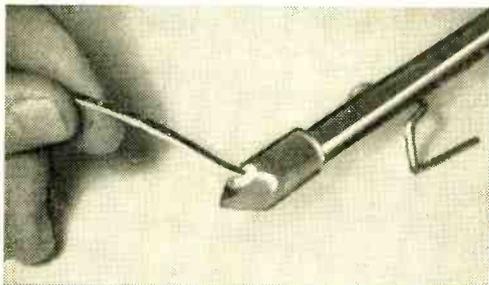


Fig. 2. How resistances connected in series (A) can be used as a voltage divider (B) to deliver several voltages from a single power supply (see text).

TIPS and TECHNIQUES

IRON HAS SOLDER RESERVOIR

A small shallow hole drilled in one face of the tip of your soldering iron makes a handy "reservoir" to hold a drop or two of



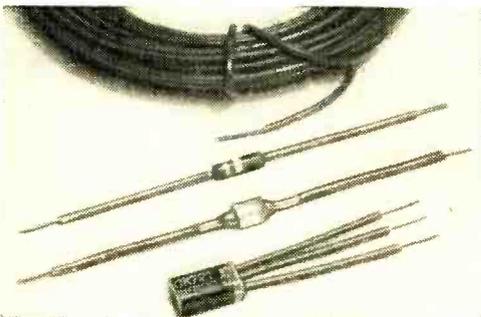
solder. When you work in hard-to-get-at places, the solder will flow from the reservoir onto the part being soldered. It's also handy for tinning tips of wires.—*J. A. C.*

PHOTOELECTRIC STANDARD

You can calibrate your photoelectric devices using an ordinary frosted 40-watt light bulb. At 25 inches, the direct light of a new 40-watt bulb is 10 footcandles. The error due to line voltage will not exceed 10%. Be sure that the only light reaching the photoelectric cell is from the lamp—for accurate calibration.—*J. M.*

SMALL SPAGHETTI TUBING

You can use the plastic insulation of bell wire and solid hookup wire as small-diameter spaghetti tubing. It's fine for insulat-



ing wire leads on transistors, germanium diodes, and other components with thin connecting leads.—*A. T.*

DON'T FLIP YOUR LID!

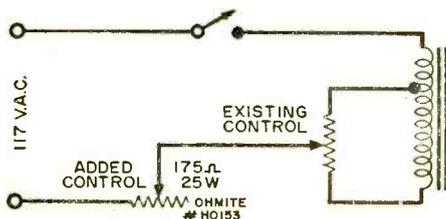
Ever have somebody sit on the lid of your recorder while it's open but still on the machine? Hinges aren't made strong enough to take that kind of treatment. Try running a short length of sash-weight



chain from the recorder case up to the lid, and fasten it at both ends with small screw eyes. Leave one screw open so that chain will unhook for cover removal.—*R. A.*

TUBE TESTER "LINE ADJUST"

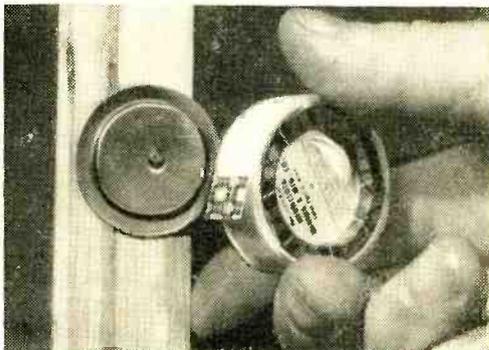
Since line voltages vary widely in many parts of the United States, you may have difficulty setting the "line adjust" on your



tube tester low enough. If you're troubled with high line voltage, try adding another line adjust control as shown.—*E. H. J.*

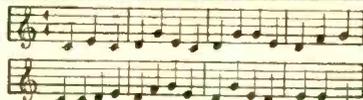
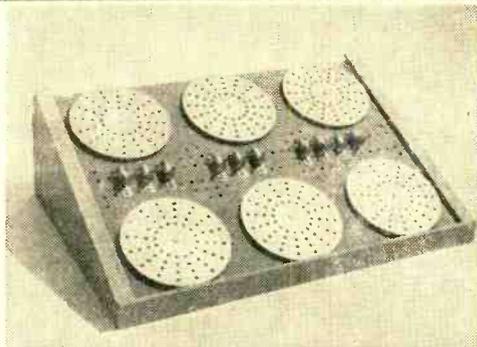
HOLDER FOR CELLULOSE TAPE

Cellulose tape will always be at hand if you use one of the lid-shaped spool ends



as a bracket. Nail it to a convenient location, such as the edge of a shelf. The spool of tape can then be slipped on and off the bracket quite easily.—*K. M.*

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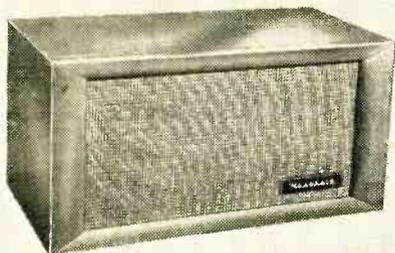
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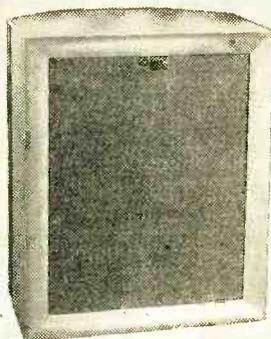


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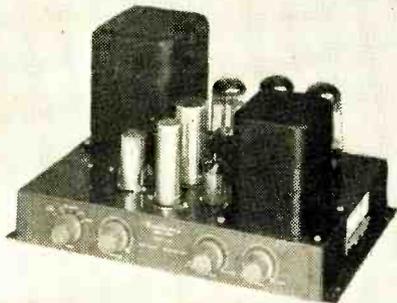
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\$25⁹⁵
Shpg. Wt. 8 lbs.
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Tunes standard AM band from 550 to 1600 kc with fine sensitivity and broadband characteristics. Features include built-in power supply and low-distortion detector. All RF circuits prealigned for simplified construction.

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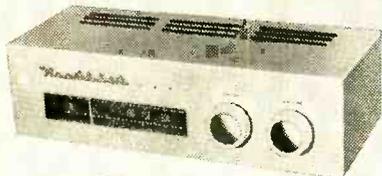
Provides extra amplification, selection of inputs, volume and tone controls, and turnover and rolloff controls, for Williamson-type amplifiers. Beautiful satin-gold enamel cabinet. Derives operating power from amplifier.

Model WA-P2
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Shpg. Wt. 7 lbs.
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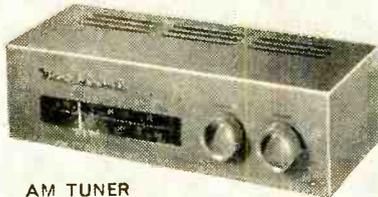
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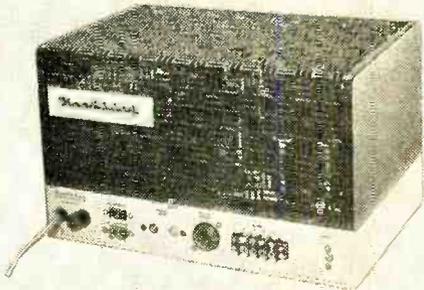
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Covers 550 to 1600 kc with good sensitivity and selectivity. Has 5 1/2" PM speaker for good tone quality. Features transformer power supply and built-in antenna. Signal generator recommended for alignment. Cabinet, as shown, available separately. Shpg. Wt. 10 lbs.

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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

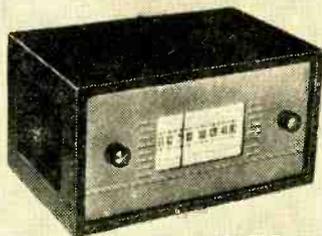


TABLE-MODEL RADIO



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

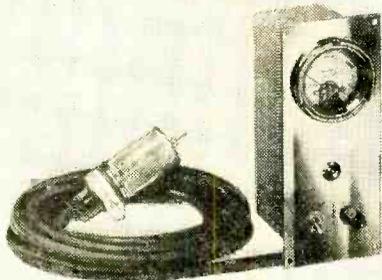
HEATHKIT TRANSISTOR RADIO DIRECTION-FINDER KIT

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 5¾" H x 5¾" D. Supplied with slip-in-place mounting brackets, which allow easy removal from ship bulkheads or other similar places. Shpg. Wt. 4 lbs.

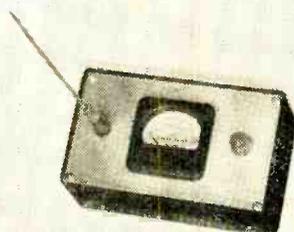
Model DF-1
\$49⁹⁵

(Available after
November 15)

NEW! Heathkits for the boating enthusiast



FUEL VAPOR DETECTOR



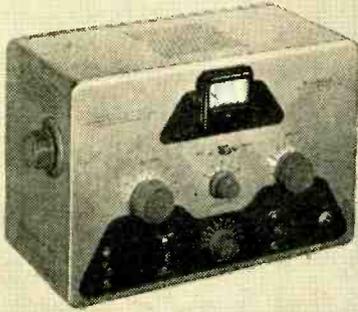
POWER METER



RADIO DIRECTION-FINDER

AVAILABLE AFTER
NOVEMBER 15

HEATHKIT



DX-20 TRANSMITTER



RF SIGNAL GENERATOR



GRID DIP METER



HANDITESTER

HEATHKIT DX-20 CW TRANSMITTER KIT

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

Model DX-20
\$35⁹⁵

Shpg. Wt. 18 lbs.

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
\$19⁹⁵

Shpg. Wt. 4 lbs.

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. Preamplified coils eliminate the need for calibration after completion.

Model SG-8
\$19⁵⁰

Shpg. Wt. 8 lbs.

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
\$14⁵⁰

Shpg. Wt. 3 lbs.

HEATHKIT ETCHED-CIRCUIT VTVM KIT

Sensitivity and reliability are combined in the V-7A. It features 1% precision resistors, large 4 1/2" 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
\$24⁵⁰

Shpg. Wt. 7 lbs.

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
\$29⁹⁵

Shpg. Wt. 12 lbs.

(less cabinet)

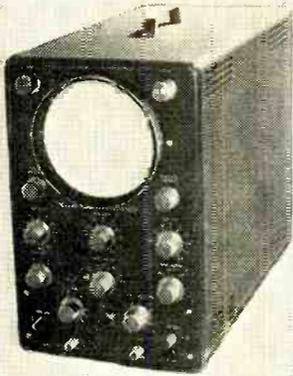
HEATHKIT "GENERAL PURPOSE" 5" OSCILLOSCOPE KIT

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
\$42⁵⁰

Shpg. Wt. 21 lbs.

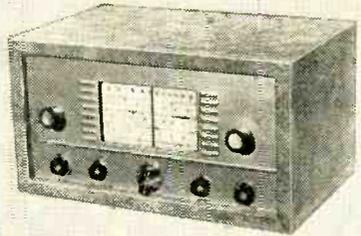
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Quantity	Item	Model No.	Price

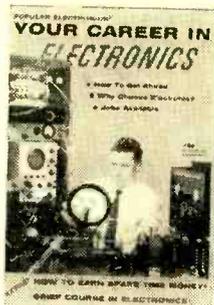
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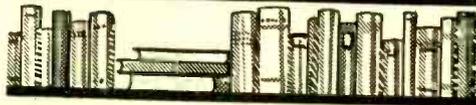
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BOOKSHELF

"TV CONSULTANT" written and published by Harry G. Cisin, Amagansett, N. Y. 69 pages. Soft cover. \$2.00.

This book is an enlarged second edition and contains over three hundred classified TV troubles and solutions. In addition, streamlined alignment methods are included which permit TV sets to be aligned in the shortest possible time using a sweep generator and an oscilloscope.

Recommended: to the serviceman or part-time trouble-shooter for whom "time is money."

"TV TUBE LOCATOR," Vol. 2. Written and published by Harry G. Cisin, Amagansett, N. Y. Soft cover. 14 pages plus 22 pages of diagrams. \$1.50.

Each tube in a TV set has a certain job to do, and when the tube becomes faulty, the particular job remains undone. This recently published volume contains tube trouble location guides covering thousands of recent TV models from 1955 up to and including the newest 1957 sets. Each guide gives the location and type designation of every tube in the TV receiver, plus an explanation of each tube function. This volume is ideal for trouble-shooting from symptoms alone.

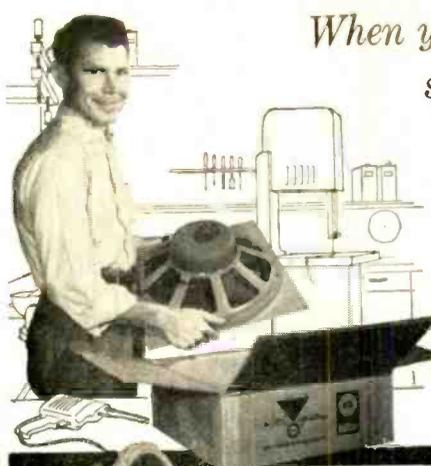
TV Trouble Tracer, (Vol. 6, 45 pages, soft cover, 50 cents), the sixth volume of the TV Trouble Tracer series is also available. It specializes in the new portable TV models and does the same job for them that Vol. 2 does for standard receivers.

Recommended: for fast trouble-shooting on current models.

"BASIC MATHEMATICS FOR RADIO AND ELECTRONICS" by F. M. Colebrook and J. W. Head. Published by Philosophical Library Inc., 15 East 40 St., New York 16, N. Y. 359 pages. Hard cover. \$6.00.

Previously published under the title *Basic Mathematics for Radio Students*, the new edition is wider in scope and includes much new material. Written in an easy "talky" style, starting with elementary algebra, the reader is led step by step through indices and logarithms, series, limits, geometry, trigonometry, vectors and

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MODEL D130—15" extended range loudspeaker The only 15" extended range speaker made with a 4" voice coil is the world-famous JBL Signature D130. The large voice coil stiffens the cone for crisp, clean bass; smooth, extended highs. Your basic speaker, the D130 works alone at first, later becomes a low frequency driver when you add a JBL Signature high frequency unit and dividing network to achieve the ultimate excellence of a JBL Signature two-way system.



MODEL D208—8" extended range loudspeaker A precision transducer in every sense of the word, the famed JBL Signature 8" D208 is made with the same care and precision as the larger units in the James B. Lansing Sound, Inc., line. If space and cost are major considerations, the D208, properly enclosed, provides the most lastingly satisfactory sound you can get. It is widely used in top quality systems where extension speakers are desired for areas other than the main listening room.



MODEL D123—12" extended range loudspeaker With outstanding "presence" and clean response throughout the entire audio spectrum, the D123 features an unusual shallow construction. Only 3 3/4" deep, it is designed to mount flush with the wall, between studding, in any standard wall or partition. Frequently, the D123 is used in multiples in "infinite baffle" wall installations. In this case the JBL Signature D75 is a logical high frequency unit to add when you advance to a two-way system.

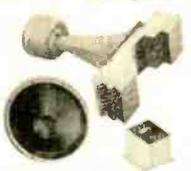


MODEL 175DLH high frequency assembly The acoustical lens is only available on JBL Signature high frequency units. The 14 element lens on the 175DLH disperses sound within the listening area over a 90° solid angle, smoothly, with equal intensity regardless of frequency. The acoustical lens is the greatest contribution to lifelike high frequency reproduction in 20 years, and it was developed for use with high fidelity equipment by James B. Lansing Sound, Inc. In addition to the lens, the 175DLH consists of a high precision driver with complex phasing plug and a machined aluminum exponential horn. Designed for crossover at 1200 cycles with the JBL Signature N1200 Network.



MODEL 075 high frequency unit Another exclusive for James B. Lansing Sound, Inc. is the ring radiator in the JBL Signature 075 high frequency unit. A ring, rather than a diaphragm, radiates into the annular throat of an exponential horn. The result is high frequency reproduction of unmatched smoothness and clarity, absolutely free of resonances and strident peaks. The horn is beautifully machined from aluminum, the entire unit a gratifying, solid piece of fine craftsmanship. Designed for crossover at 2500 cycles with the JBL Signature N2500 Network.

JBL Signature two-way systems are available as kits



006 KIT This two-way system is made up of units which have been acclaimed by impartial authorities as the finest available anywhere today. Included in the kit are the 150-4C Low Frequency Driver, N500H Network, 375 High Frequency Driver, 537-509 Horn-Lens Assembly. These are the same units — including the serpentine acoustical lens — which are used in The Hartsfield units designed originally for installation in the most modern theaters in the world.



002 KIT Including some of the newest speakers made, the JBL Signature 002 Kit includes a D123 for low frequency reproduction, N2500 Network, 075 High Frequency Unit. The 002 Kit is moderately priced, yet gives the user all the advantages of a two-way system made with independent drivers.



001 KIT Probably the most popular high quality two-way system on the market, the JBL Signature 001 system consists of a 130A Low Frequency Driver, N1200 Network, 175DLH High Frequency Assembly. The D130 may be substituted for the 130A without disturbing the balance or coverage of the system.

There are many more kits and loudspeakers in the JBL Signature line. Whatever your needs, you will find exactly the right unit or system in the complete JBL Signature catalog. Send for your free copy. A limited number of technical bulletins are also available. Please ask only for those in which you are vitally interested.

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into calculus. In chapter 7, "The Application of Mathematical Ideas to Radio," we come to the electronic application section where all our previous math study pays off.

Recommended: to those wanting to delve deeper into the mathematics of this fascinating field of electronics.



"ALL ABOUT FM ANTENNAE AND THEIR INSTALLATION" by L. F. B. Carini. Published by Apparatus Development Co., Inc., Wethersfield 9, Conn. 16 pages plus 8-page directory of FM stations. Soft cover. 25 cents.

This little, non-technical book was prepared especially for the FM listener. Aimed at providing a better understanding of the practices and problems of FM antenna installation, the topics covered include preamplifiers, FM-DX, impedance matching and antenna rotors. As an extra bonus, a list of commercial FM stations is included. This is a fine buy at its modest price.

Recommended: to the hi-fi'er with reception problems and to those who just want to know more about FM.



"AUDIO AMPLIFIERS AND ASSOCIATED EQUIPMENT" compiled and published by Howard W. Sams & Co., Inc., Indianapolis 5, Ind. 226 pages. Soft cover. \$3.95.

Covering the 1956 models of preamplifiers, amplifiers, and AM-FM tuners, this new volume is the ninth of the specialized Howard W. Sams high-fidelity servicing manuals. The material is presented in a uniform manner and is based on the Sams company's own analysis of the equipment.

All information found necessary for servicing, including listings of recommended standard replacement components, is presented in an easy-to-use tabulated form. Also included in this volume is a cumulative index to all equipment listed in Sams' previous specialized hi-fi manuals.

Recommended: to anyone interested in the circuitry and servicing of the latest in high-fidelity audio equipment.



"TV ANTENNAS" by M. Schwartz. Published by American Electronics, 1230 Bryant Ave., New York. 28 pages. Soft cover. 50 cents.

Discussing TV antenna installation and repair, this non-theoretical volume is written for the do-it-yourselfer. The various types of antennas available are listed and discussed.

Recommended: to anyone considering a climb over the rooftops with his conical, folded dipole or stacked Yagi antenna in hand.

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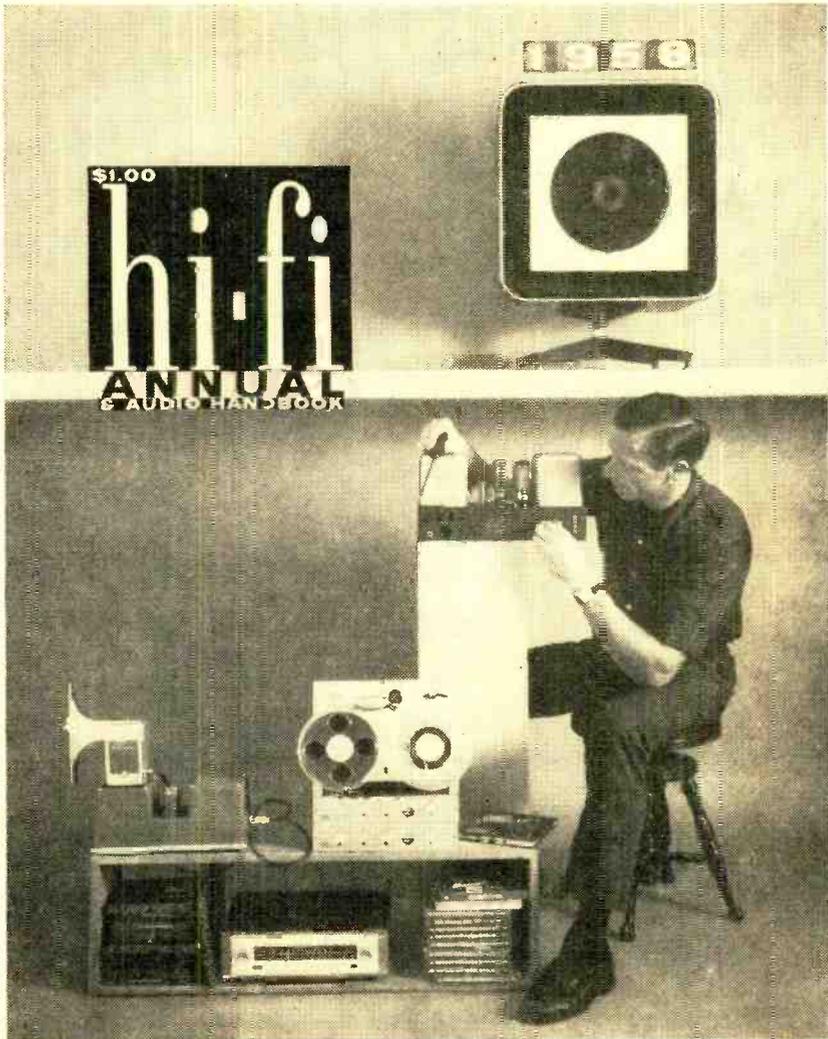
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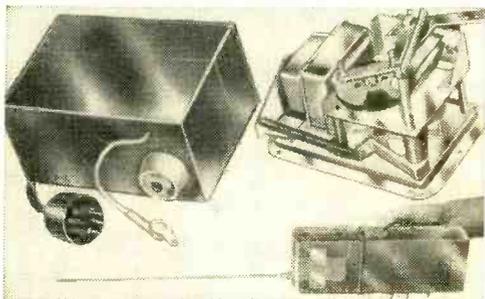
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TOOLS and GADGETS



THREE R/C UNITS

Lafayette Radio has available three new, inexpensive R/C units: a crystal-controlled, single-channel transmitter; its companion receiver; and a motor-driven electric servomechanism for quick, positive steering. The transmitter, which measures only 8½" x 2¾" x 1¾", has a range of one mile or more; price, \$14.95, fully assembled and including 27.255 crys-

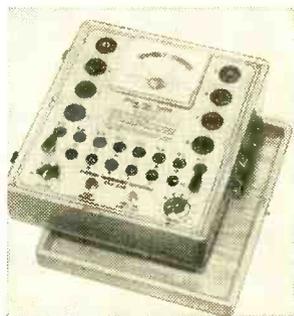


tal and tube. Completely enclosed, the 3" x 2¼" x 1½" receiver is sensitive and stable; net price, \$8.95, fully wired and including 3S4 tube. Single pulse operation and electronic return to neutral plus rugged construction are features of the actuator (\$5.95), which works equally well with model boats or land vehicles. (Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y.)

"SPEEDI" TUBE TESTER

Tubes can be checked in seconds with the EMC Model 301 tube tester—for

shorts, leakages, and quality. It checks octals, loctals, miniature and 9-prong socket tubes. Operation is simple—there are only two settings to make. When used with a picture tube adapter,



it will also check and rejuvenate picture tubes. The Model 301 is shown here with a 4½" plastic front meter, in an oak carrying case (price, \$47.50). It is also available in a sloping counter case or in

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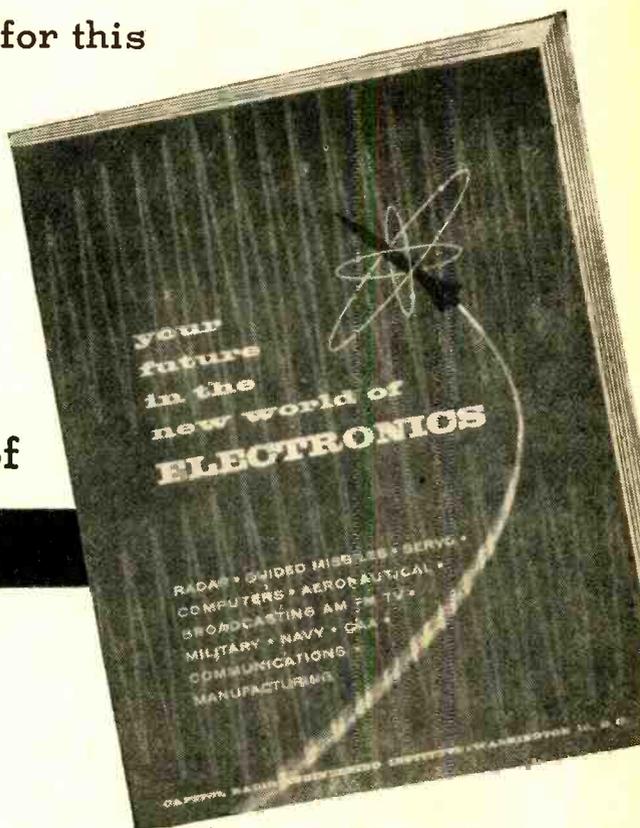
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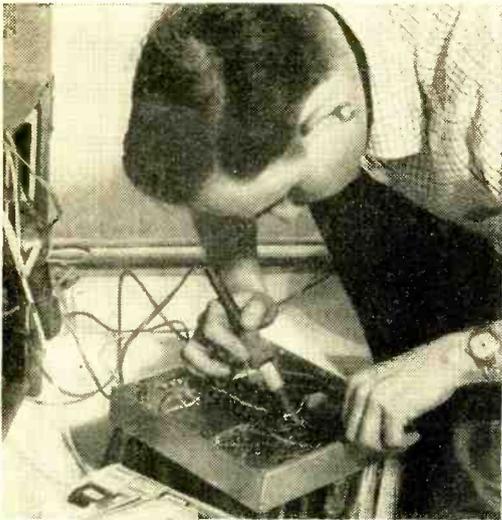
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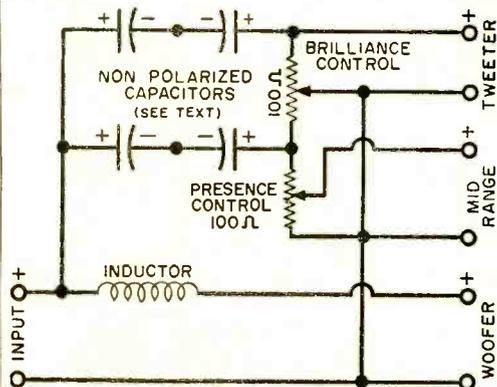
(Continued from page 66)

metallic material for the flanges. Attach them with brass screws, as steel might cause waveform distortion.

Drill a hole through one of the flanges, insert the wire, and start winding. When you have sufficient turns, drill another hole and bring the wire out. Use #18 enameled wire, and no insulation will be needed. Mount the coil on a piece of wood and hook it to terminal lugs. Then mount your capacitors, brilliance and presence controls, and you're in business.

Despite the warnings against using electrolytic capacitors, you can do so if you hook them back-to-back to make them non-polarized. You can splice negative to negative or positive to positive, then wire them as a single capacitor. When they're hooked this way, however, in order to get the single value you need, you'll have to use two capacitors, each of which has twice the value desired. For instance, if you want 8- μ f.d. capacitance, use two 16- μ f.d. units. Choose capacitors of a high enough voltage so that they will handle the peak output voltage of your amplifier. About 150 volts will do nicely.

For the control of presence and bril-



This schematic shows presence control addition.

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liance, you must then insert potentiometers. (The pictorial on page 66 shows the brilliance control placement, the schematic proper hookup.) The potentiometers should be at least five times the load impedance. With a 16-ohm speaker, you should use about 100-ohm potentiometers.

Math Simplified. Now you come to the problem of calculating values. This is simplified by the use of the table and the graph on page 66.

After you've determined your crossover point or points, follow the table for the correct values of capacitance (*C*) and inductance (*L*) for your speaker or speakers. The table gives values for 4-, 8- and 16-ohm speakers. *C* is read directly in microfarads, which gives the proper capacitor value; but since *L* is in millihenries, you must then determine the number of turns for your coil. You can do this by running a line on the graph from the *L* value up to the heavy black diagonal, then from that point across to the left edge, which will give you the number of turns.

Here are two examples, one for two speakers, the other for three.

Choosing 1000 as the cutoff point for the two-speaker system (16-ohm speakers), we find that the *C* value is 10 μ fd., and the *L* value is 2.5 mh. Therefore the

capacitor value is 10 μ fd. But we still need the number of turns for our coil. Going to the graph, we find that we get a value of 400 turns (approximately).

For a three-speaker system (16 ohms each), with arbitrary cutoffs of 500 and 5000 cps, we find values of 20 μ fd. and 500 turns at the lower cutoff, and 2.2 μ fd. and 225 turns at the higher cutoff.

Final Adjustment. You'll have to phase your speakers before hooking them to the crossover. Do this by connecting a flashlight cell across the voice coil of one speaker, noting the direction the cone travels on the instant of contact, and marking the terminal to which the positive line was attached. Then follow the same procedure with the other speaker. In connecting the speakers to the crossover, make certain that these common terminals are hooked to the same line. (On horn tweeters, you'll have to check terminal coding for the proper terminal to use.)

After you've built and hooked up your system, you'll want to adjust for what you consider the best presence and brilliance values. These, of course, are arbitrary, and will depend only on how you like your hi-fi. Go ahead and play with them, and have fun.

—W. McCormick

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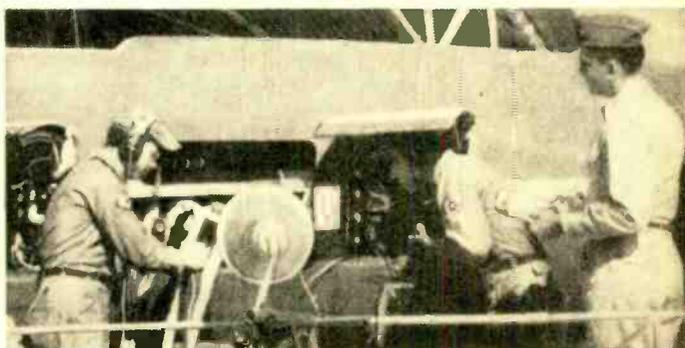
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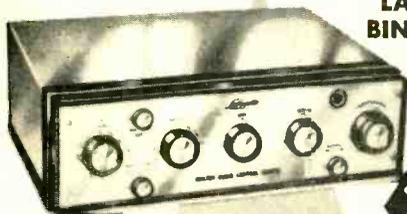
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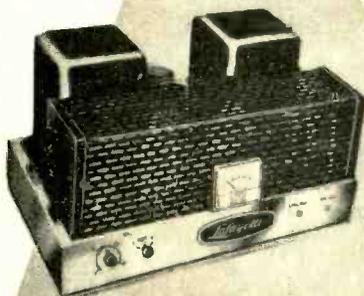


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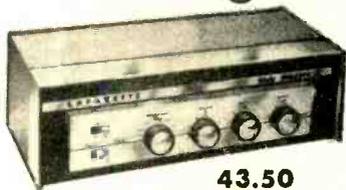
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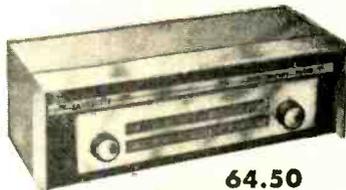
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LAFAYETTE MODEL PK-300 PROFESSIONAL TRANSCRIPTION TURNTABLE

New 3-speed instrument with built-in stroboscope and viewer for exact speed determination, and magnetic brake for instantaneous speed variation. Precision engineered to meet professional standards for wow, rumble and flutter content. Heavy 12" cast aluminum rim-driven turntable. Variable speed control permits adjustment of each speed within ± 7% using efficient frictionless magnetic brake. Heavy-duty constant speed 4-pole induction motor freely suspended and isolated by shock-mountings to eliminate vibration transferral. R-C filter network suppresses "pop" in speaker. Truly a delight for the connoisseur. Size: 13 1/2" x 14" and requires 3/4" clearance above and 3/4" below motorboard. For 110-130V and 60/50 cycle AC. Power consumption 12 watts. Handsome hammertone gray finish. Shpg. wt., 20 lbs.

PK-300.....Net 49.50

PK-90 VISCOUS-DAMPED TONE ARM

This transcription arm assures dependable and stable operation, utilizing the "floating action" principle of "viscous-damping." The arm is supported at a single point by a pivot and jewel bearing having negligible friction. Damping is accomplished by a silicone fluid occupying the gap between a ball and socket. This damping control permits high compliance and negligible tracking error, and prevents damage to either record or stylus should the tone arm be accidentally dropped. Low frequency resonance, skidding and groove-jumping are likewise minimized. The tone arm accepts all records up to 16" and accommodates virtually all hi-fi cartridges by means of precisely engineered adapters which simplify installation and provide proper stylus pressure. This tone arm is a quality companion to the PK-300 with matching finish. Shpg. wt., 2 1/2 lbs.

PK-90—12" Transcription Tone Arm.....Net 11.95

PK-170—16" Transcription Tone Arm.....Net 17.95



PK-300

ILLUMINATED BUILT-IN STROBOSCOPE & VIEWER

COMBINATION DEAL

PK-300 TURNTABLE
PK-90 TONE ARM
G.E. CARTRIDGE
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PK-90



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TRANSCRIPTION-TYPE MANUAL PLAYER

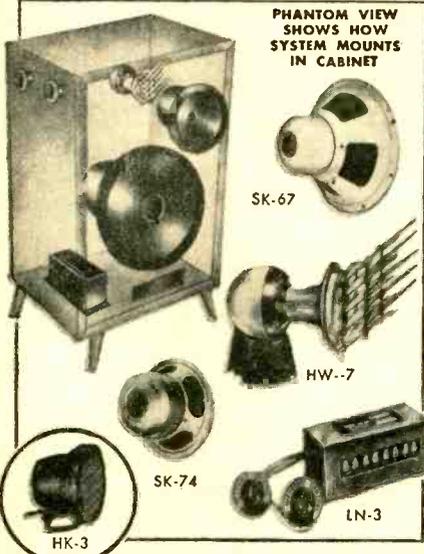


PK-160 with TONE ARM and TWO PLUG-IN HEADS

- MAGNETIC BRAKE FOR FINE ADJUSTMENT OF EACH SPEED
- 4-POLE, HEAVY DUTY TRANSCRIPTION-TYPE MOTOR
- STYLUS WEIGHT ADJUSTMENT SCREW ON TONE ARM
- ACCOMMODATES ALL POPULAR CARTRIDGES

All the important features of professional transcription players have been incorporated in this precision turntable. Extremely smooth and quiet heavy duty 4-pole motor plays 78, 45 and 33 1/3 RPM records. Exclusive magnetic brake, controlled by knob on base plate, permits instantaneous fine adjustment of each speed. Stroboscope disc included checks speeds. Speed selector safety switch protects mechanism by making it necessary to pass through OFF position when switching from one speed to another. 10" weighted turntable has rubber traction mat. Mounting plate has pickup rest and ON-OFF switch. Size: 12-15/16" left to right, 10 7/8" front to rear. Requires 2 3/4" clearance below motor board and 3" above. With AC line cord, 2 plug-in heads, output cable, 45 RPM adapter. For 105-120V., 60 cycles AC. Shpg. wt., 12 lbs. (NOTE: For protection in shipping, tone arm is separate. Just fasten to mounting plate.)

- PK-160—Less cartridge and base.....Net **25.95**
- PK-164—Same as above except equipped with new genuine GE VRII Triple Play Magnetic Cartridge with diamond-sapphire cartridge.....Net **37.50**
- PK-162—Wood base for PK-160. Shpg. wt., 5 lbs.....Net **3.95**
- PK-163—Unfinished mounting board only. Shpg. wt., 1 lb.....Net **.95**



PHANTOM VIEW SHOWS HOW SYSTEM MOUNTS IN CABINET

SK-67

HW-7

SK-74

LN-3

HK-3

3 WAY SYSTEM WITH 15" WOOFER . . . 8" MID-RANGE SPEAKER . . . HORN TWEETER . . . CROSSOVER NETWORK

- 15-INCH WOOFER WITH 31.5 OZ. MAGNET (SK-67)
- 8-INCH MID-RANGE SPEAKER (SK-74)
- NEW HIGH-FREQUENCY ACOUSTICAL LENS TWEETER (HW-7)
- 3-WAY CROSSOVER NETWORK (LN-3)

Lafayette presents this outstanding 3-way speaker system designed for the high fidelity enthusiast who desires performance formerly possible in multi-speaker systems costing many times this price. You won't believe your ears when you hear the superb reproduction throughout the entire audio spectrum. The SK-67 15" woofer provides phenomenal bass response, the SK-74 8" speaker delivers full bodied, mid-range frequencies, and the HW-7 high frequency acoustical lens tweeter faithfully reproduces the highest audible frequencies. Crossover points at 350 and 5000 cycles are provided by the LN-3 3-way inductance-capacitance network with continuously variable presence and brilliance controls that adjust tone balance to personal taste. Shpg. wt., 25 lbs.

SY-93. Complete System as listed above.....Net **55.50**

2 WAY SPEAKER SYSTEM 40-16,000 CYCLES

- 25 WATT WOOFER
- IMPORTED HI-FI TWEETER
- CROSSOVER NETWORK
- LEVEL-BRILLIANCE CONTROL

This 2-way speaker system is another excellent buy for the moderate purse. It is basically the same as the SY-85 system described at the top of the page, but incorporates the deluxe SK-68 speaker with 21.5 oz. Alnico V magnet. This results in more efficient reproduction and extension of the lower register. Complete system includes the SK-68 12" 25 watt woofer, HK-3 cone type tweeter and LN-2 crossover network with level-brilliance control. Range of system 35-16,000 cycles. Shpg. wt., 18 lbs.

SY-87—Complete System.....Net **27.50**

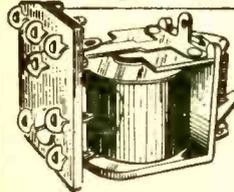
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New, powerful, motor driven R/C actuator. Delivers positive, instantaneous action. Provides selective steering and electronic, automatic return to neutral: Extremely efficient when used with model boats and land vehicles. Only 2 1/2" x 2" x 1 1/2". Includes instructions and linkage. F-327.....Net **5.95**

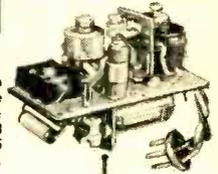


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Completely assembled—tested—and guaranteed R/C transmitter: Includes tube and 27.255 MC crystal, 6 sect. telescoping antenna. Size: 4" x 4" x 12". Approx. 1 mile range. Shpg. wt., 3 lbs. Less batteries. F-249.....Net **14.95**



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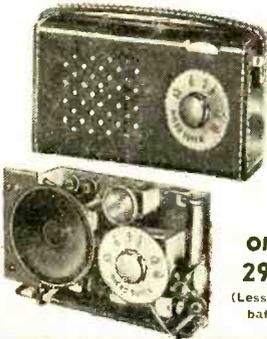
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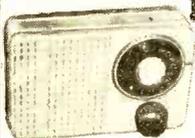
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Lafayette is proud to present its 6 Transistor Superhet Receiver Kit KT-119. This kit represents the optimum in sensitivity, selectivity and stability. You'll be amazed at its superior commercial quality! You'll be elated with its surprising performance! The circuit uses 3 high frequency RF Transistors, 3 dependable audio Transistors and Crystal Diode and features a specially matched set of 3 I.F.'s, Oscillator, High-Q Loop, Class B Push-Pull Audio Amplification, and Transformer Coupling in audio and output stages. Special care has been taken in the design for exact impedance matching throughout to effect maximum transfer of power. Has efficient 2 1/2" speaker, and earphone jack for private listening. Complete with all parts, transistors, pre-punched chassis, battery and easy-to-follow step-by-step instructions. 6" x 3 3/4" x 1 1/4". Shpg. wt., 3 lbs.

KT-119—Complete Kit—Less Case.....	Net	29.95
MS-339—Sturdy, attractive brown leather case with carrying strap for KT-119		
Shpg. wt., 1 lb.....	Net	2.95
MS-279—Sensitive matching earphone.....	Net	2.39

3 TRANSISTOR SUPERHET POCKET RADIO KIT



A TRUE POCKET SUPERHET RECEIVER—NO EXTERNAL ANTENNA
NO EXTERNAL GROUND

A remarkable sensitive, super-selective pocket superhet receiver with astonishing performance over the complete broadcast band. Uses 2 high-frequency and one audio transistor plus efficient diode detector and features 2 specially matched IF transformers for maximum power transfer. The components are housed in a professional looking beige plastic case.

The receiver's appearance enhanced by attractive maroon and silver station dial. Sensitive built-in ferrite antenna eliminates need for external antenna. A designer's dream in a true pocket superhet receiver! Complete with all parts, transistors battery, case, dial and easy to follow step-by-step instructions. 4 1/2" x 2 5/8" x 1-1/16". Shpg. wt., 1 lb.

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

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- 30 DAY TRIAL PERIOD! FULL REFUND IF YOU ARE NOT SATISFIED FOR ANY REASON

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

Highly stable special circuit design. Fine adjust RF control. AF output 2-3 volts, input 4 volts, across 1 megohm. 5 inch etched dial plate — protected by clear plastic bezel. Common AF terminals for EXT-MOD input and INT-AF output eliminates need for special connectors. Gray metal case — carrying handle — complete with leads, line cord and plug. For 105-126V. 50-60 cycle A.C. Shpg. wt., 8 lbs.

LSG-10 — Signal Generator	22.50
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TRANSISTOR CODE PRACTICE
OSCILLATOR KIT



For those interested in mastering the International code, an audio tone oscillator is essential. The circuit of this transistorized feedback oscillator has the simplicity of the neon glow, the signal strength of the vacuum tube, and requires only two penlite cells for weeks of service. It may be used for solo practice, or two may send and receive with the same unit. Kit comes complete with Transistor, Telegraph Key, Resistors, Condensers, Masonite Board, etc., and Schematic Diagram.

KT-72	Net	2.99
Cannon ECI—Single Headset	Net	1.13

20,000 OHM PER VOLT MULTISTEM SEMI KIT

- 20,000 OHMS PER VOLT DC—5 000 OHMS PER VOLT AC
- 40 MICROAMPERE 3" D'ARSONVAL METER MOVEMENT
- HIGH INPUT RESISTANCE ON ALL DC AND AC RANGES



A new kind of kit—the difficult work is already done—you wire in only a few multipliers and mount the battery holder to complete the unit. A fine high sensitivity (20,000 ohms per volt DC —5000 ohms per volt AC) instrument employing a 3" 40 microamp movement. Has 4 DC voltage, 4 AC voltage, 2 DC current, 3 resistance and 2 db ranges. Complete with test leads and detailed instructions. Size 3 3/4" x 4 3/4" x 1 1/2". Shpg. wt., 3 lbs.

TK-20—Kit	Net	11.95
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| 1F4 | 6AF4 | 6SA7 | 12BA6 |
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| 1LAG | 6N8 | 6SH7 | 12SG7 |
| 1LCS | 6AQ5 | 6SJ7GT | 12SH7 |
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| 1S4 | 6AT6 | 6SQ7 | 12V6GT |
| 1S5 | 6AU4GT | 6SV7 | 12X4 |
| 1T4 | 6AU5GT | 6SS7 | 14A7 |
| 1U4 | 6AU6 | 6T8 | 14B6 |
| 1U5 | 6BV5GT | 6U4GT | 14C7 |
| 1V2 | 6AV6 | 6U7 | 19B6G |
| 1X2 | 6AX4GT | 6V3 | 19T8 |
| 2A7 | 6BA6 | 6V6GT | 24A |
| 2D21 | 6AX5GT | 6W4GT | 25AV5GT |
| 2X2 | 6BC5 | 6W6GT | 25B06GT |
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| 3AL5 | 6BG5G | 6X8 | 25L6GT |
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| 3CB6 | 6BK5 | 7A7 | 35L6GT |
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| 3Q5GT | 6BN6 | 7B7 | 35Y4 |
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them with life in Japan. (While in the Navy in 1954, I had the opportunity to visit *Radio Japan* and spent a pleasant afternoon touring the six floors of the NHK Building. I was in the studio when the North American transmission was on the air.) Try to tune in *Radio Japan* and write them about your reception. You'll find it well worth your while.

Radio Station ELWA at Monrovia, Liberia, broadcasts primarily for listeners in Africa. This year they have inaugurated a special service to North America which can be heard twice on Tuesdays. At 6:30 and 8:15 p.m. EST (3:30 and 5:15 p.m. PST), you can "Meet The Staff" and hear of the different work each of the missionaries is doing. The happenings of the week are given on ELWA Time, for those who are interested in the operation of a missionary short-wave station (7:20 and 9:05 p.m. EST, 4:20 and 6:05 p.m. PST).

The South African Broadcasting Corporation is heard three mornings a week in the 11-meter band with an interesting variety of programs in the African Service. On the other days the programs are in Afrikaans.

Latin America—There are a few stations with programs in English in South and Central America. But very few of these stations are beamed to North America and thus reception is not always good. HCJB (*The Voice of the Andes*) Quito, Ecuador, is the strongest station with English in South America.

Radio Commerce, at Port-au-Prince, Haiti, has a program called "Glimpses of Haiti," which presents four different looks into various aspects of Haitian life each week. These are heard Sundays at 5:00 p.m. EST, and Tuesdays, Thursdays, and Fridays at 9:00 p.m. EST (6:00 p.m. PST).

The *Evangelistic Voice* of the West Indies presents English programs daily except Thursdays. Your author is on the staff of this station and answers the mail from SWL's on the "Listeners' Post" every Saturday at 5:00 and 9:30 a.m. EST (2:00 and 6:30 a.m. PST) and every Monday at 9:30 p.m. EST (6:30 p.m. PST).

North America—Canada has a program of news and features for listeners in the United States beginning at 7:55 p.m. EST, 4:55 p.m. PST. Later in the evening, The Northwest Territories Service is beamed to listeners in Northern Canada from 9:55 p.m. EST, 6:55 p.m. PST. This program is extended during the winter to include the "Northern Messenger," in which greetings are broadcast to the listeners in the north.

There are several low-powered short-wave stations in Canada which operate in parallel with the regular medium-wave

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- 6 6 Ft. ac. LINE CORDS with PLUG
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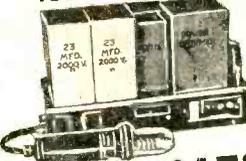
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Model AN-VX-1X for 12/24 VDC 100 watt SEC. **\$45.00**

Brand New. Wt. 60 lbs. Flash visible for miles. Operates on auto battery or any 12/24 V DC source. Complete with ignition coil, trigger, housing plate and strobe light. Assembly includes 20 ft. cord, Sylvania A-1073 200 watt bulb. (Similar to Sylvania 4330) Extra parts kit, spare 1073. Fuses, vibrator and instruction manual.

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69¢

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stations. These are well heard in parts of the United States and Canada within 600 miles or so of their location. Some of them are: CBNX, St. Johns, Newfoundland, on 5970 kc.; CJCX, Sydney, Nova Scotia, on 6010 kc.; CFVP, Calgary, Alberta, on 6030 kc.; CFRX, Toronto, Ontario, on 6070 kc.; CKFX, Vancouver, British Columbia, on 6080 kc.; CHNX, Halifax, Nova Scotia, on 6130 kc.; CBUX, Vancouver, British Columbia, on 6160 kc.; and VE9AI, Edmonton, Alberta, on 9540 kc. For more distant listeners, reception may be good at times, but is not regular due to the low power of the stations.

In the United States, there are four organizations broadcasting on the short waves: The *Voice of America*, The United Nations, The Armed Forces Radio and Television Service, and The World Wide Broadcasting System (WRUL). Since most of our readers want to listen to short-wave stations in other countries, we will not include detailed information on these stations here.

With a short-wave receiver, the correct time can be obtained by tuning in either WWV of the National Bureau of Standards located near Washington, D. C., or CHU of the Dominion Observatory at Ottawa, Canada. WWV gives a voice announcement of the time in Eastern Standard Time every five minutes over 2500 kc., 5000 kc., 10,000 kc., 15,000 kc., and 20,000 kc. CHU has a voice announcement each minute in Eastern Standard Time on 3330 kc., 7335 kc., and 14,670 kc. Both of these stations operate 24 hours a day.

HELPFUL PUBLICATIONS FOR SWL'S

The *World Radio Handbook* is now considered a "must" by most short-wave listeners. It is published annually and contains a wealth of information on stations around the world. The 1958 edition is expected to be obtainable from Gilfer Associates, Box 239, Grand Central Station, New York 17, N. Y., on the first of January. The price is \$2.00 plus postage and it is well worth it. *World Radio Handbook* also publishes a bulletin every two weeks and a booklet called "How to Listen to the World." In May/June, 1958, a small summer-supplement to the *Handbook* is to be published.

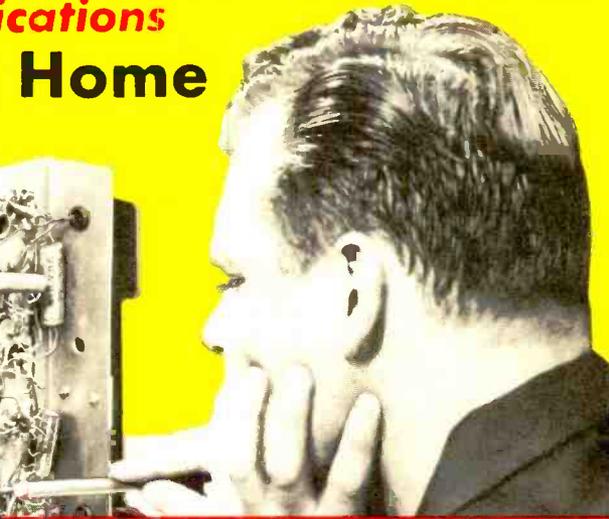
There also are several clubs which publish excellent bulletins to keep you informed of the latest short-wave information. Write to these clubs for further information, if you would like to become a member and receive their bulletins. The Newark News Radio Club, 215 Market St., Newark 1, N. J., covers every type of radio and television DX-listening in a monthly

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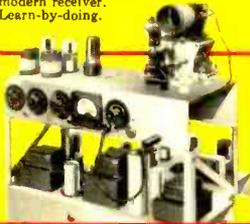


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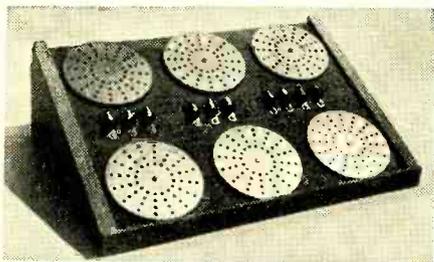
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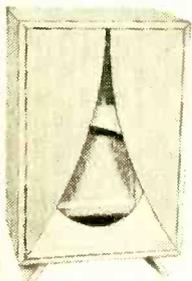
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Speaking of Extra Speakers

(Continued from page 62)

too, in different rooms, different levels of sound may be required.

It's a good idea to equip each speaker with a level control, located right at the speaker in question. These "pads" are available commercially either from Labtronics Corporation or P. R. Mallory Corporation. Be sure to specify 4- 8- or 16-ohm types, depending upon the impedance of the speaker you wish to control.

Switching Choice. The biggest pitfall of all multiple speaker installations is found right at this point. Don't fall into it! A 16-ohm *speaker* belongs across the 16-ohm *terminals* of your amplifier. If the amplifier is to perform correctly, provide the most usable, undistorted power, proper damping, proper feedback and other criteria essential to hi-fi, there *must* be a correct impedance match between amplifier and speaker.

Yet, many multiple speaker fans think nothing of slapping a second or even a third 16-ohm speaker across the same terminals of the "amp" when they wish to have all three playing at the same time in different rooms. Two 16-ohm speakers in parallel look like an 8-ohm impedance to the amplifier (just as two 16-ohm resistors in parallel add up to 8 ohms). With only two speakers connected this way, a 2-to-1 mismatch exists between amplifier and speaker systems. Distortion occurs at much lower power levels and considerable power is wasted.

Okay, you say, hook the pair of speakers across the 8-ohm terminals of the amplifier and everything will be fine. It will, so long as you listen to both at once. But if you open one up in the course of your switching hookup, you'll now have a 16-ohm impedance across the 8 ohms, still a mismatch of 2 to 1. Figure 1 shows a typically incorrect switching arrangement.

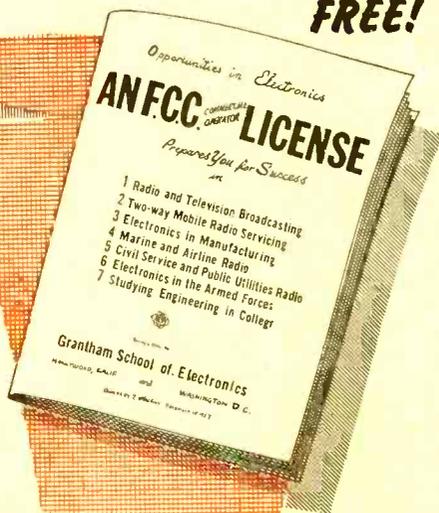
Mixing Speakers. There is a way of switching two and even three speakers of different impedances in and out of a system and maintaining virtually perfect impedance match at all times. After all, your amplifier has several output impedance taps, and there's no reason why you can't use more than one in your proposed switching setup.

As one of the common "mixed setups" probably consists of one 16-ohm main speaker and one 8-ohm secondary system, let's consider this hookup first (Fig. 2). You'll notice that when speaker *B* is used, it's connected across the 8-ohm taps on the amplifier. When speaker *A* is used, it's connected across the 16-ohm terminals. And, finally, when both are in use, each is

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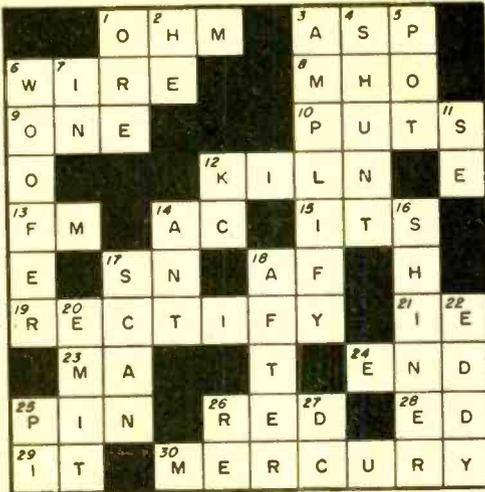
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Solution to crossword puzzle appearing on page 84.

may find any number of ways of conveniently wiring up any one of the three circuits just by following the schematics themselves.

The most practical place for mounting your new switch is probably at or near the equipment, but there is no reason why it cannot be mounted anywhere you find it convenient. —30—

Spreading Stations with CSSB

(Continued from page 52)

Although the FCC could not permit too many new stations to go on the air, since that would defeat CSSB's purpose of wiping out interference, it would probably allow quite a few new ones.

Finer Tuning. For the listener, CSSB would mean that much finer tuning of a receiver is necessary. Right now you can pick up most stations 2 or 3 kc. away from the station's authorized frequency. That is, if a station is broadcasting at 1500 kc., you can get a pretty fair signal anywhere from 1498 to 1502 kc.—although the optimum signal is still at 1500 kc.

A station broadcasting with CSSB would use either the lower or upper of the two sidebands available to it. It could use either the area from 1490 to 1500 kc. or from 1500 to 1510 kc.—depending on which sideband it picks. If it picks the upper—1500 to 1510 kc.—the listener would get optimum signal strength at about 1502 or 1503 kc., thus detuning slightly from the station's authorized frequency. However, if you should stay at 1500 kc., you would still get as good a signal as if the station were transmitting a standard double-sideband signal. —30—

November, 1957

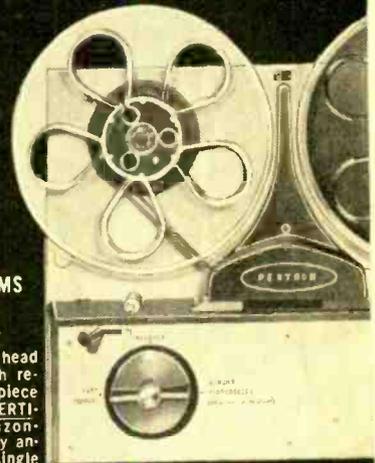
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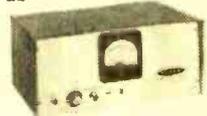
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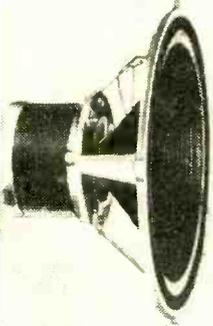
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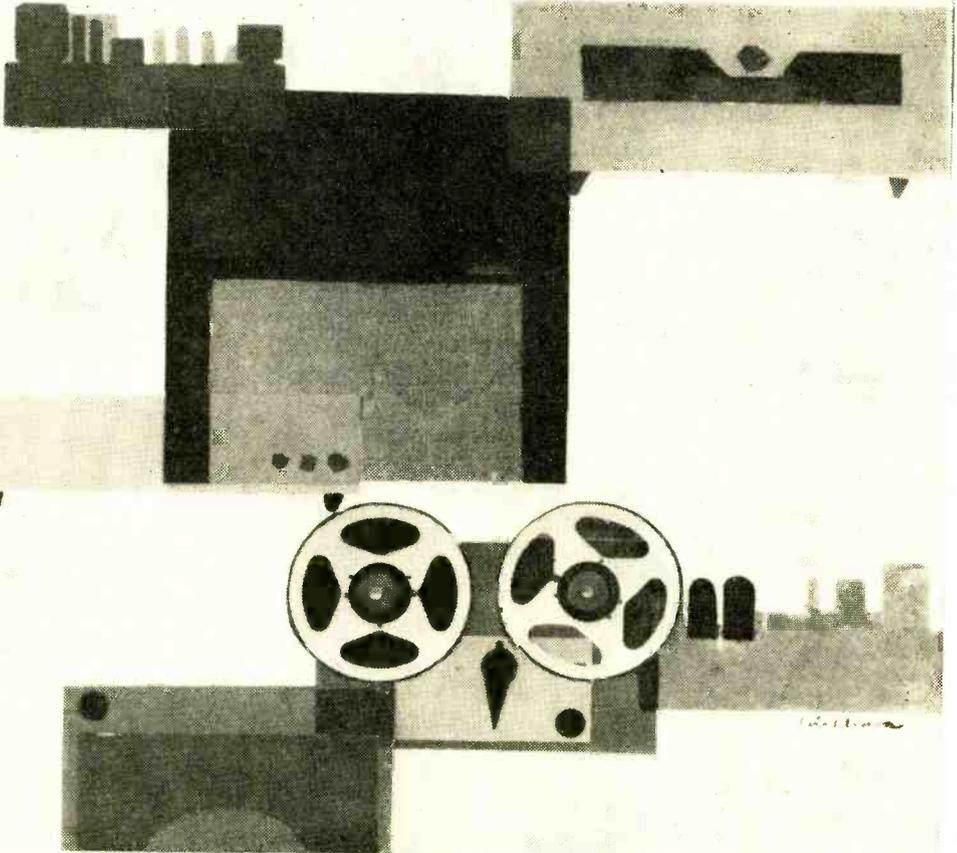
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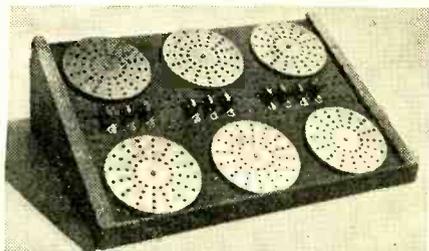


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SCIENCE KITS, Dept. PE-117D, Oliver Garfield Company
126 Lexington Avenue, New York 16, N. Y.

Their Master's Voice

(Continued from page 73)

to reduce hum pickup or feedback squeals. However, with an understanding of the principles involved, the conversion becomes an interesting and challenging project.

Remote Speaker. The remote unit consists of an ordinary PM speaker housed in any manner which suits the situation. Since the switching during conversations is done at the master station, and since the sensitivity is excellent, the remote speaker can be inconspicuously mounted high on a wall or on the ceiling.

One of the remote speaker leads may be "hot" in an a.c./d.c. transformerless set. It is important, therefore, to use insulated wire to connect the remote speaker. Shielding should not be necessary. Usually an ordinary twisted pair, such as telephone wire, is satisfactory for this purpose.

—30—

Transistor Topics

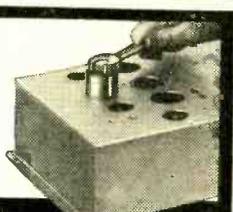
(Continued from page 75)

You'll find that the *output signal is not a sine-wave*. The approximate waveform across a resistive load is given in Fig. 2. If you prefer a sine-wave for your tests, connect an additional capacitor across the primary of the output transformer (C_5). One other optional component may be used in the circuit—power supply bypass capacitor C_6 ; where good quality batteries in good condition are used, this anti-blocking capacitor is not necessary.

Short-Wave Receiver. We've received many, many requests for circuit data on simple transistorized short-wave receivers. Actually, almost any of the simpler detector-amplifier receiver circuits featured in past columns may be used as short-wave receivers if their tuned circuits are modified to resonate to higher input frequencies. John Janning (W8QCN) has submitted a basic circuit of this general type (Fig. 3). With it, using only a four-foot external antenna, John indicates that he has received DX of 3000 to 4000 miles.

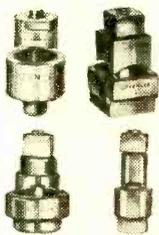
W8QCN's circuit includes antenna tuning capacitor C_1 , input r.f. transformer L_1-L_2 , and main tuning capacitor C_2 . The signal picked up by the antenna and selected by the tuned circuit, L_2-C_2 , is detected by a simple diode, then applied to a three-stage direct-coupled audio amplifier. A common-emitter complementary amplifier (using $n-p-n$ and $p-n-p$ transistors) is used for the first two stages, with its output driving the final stage, a common-base amplifier. Two batteries—a 6-volt unit (B_1) and a 22½-volt unit (B_2)—supply

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operating power. A pair of standard magnetic headphones (2000 ohms impedance) serves as the output load.

Since the receiver is used at higher frequencies, some care in layout and wiring is necessary. Keep signal leads reasonably short and direct. All parts, with the exception of the input r.f. transformer L1-L2, are standard and readily available. According to John, you can have maximum fun with this circuit by experimenting with different coils. As a start, however, he suggests that L1 consist of 9 turns and L2 of 24 turns of No. 28 enameled wire on a 3/4" form. The two windings should be spaced about 3/16" apart.

If you duplicate W8QCN's circuit, don't install the batteries or turn the receiver "on" until after you've double-checked all connections for possible wiring errors. And pay particular attention to the polarity of battery connections. The length of the external antenna used with this receiver may be varied. In general, of course, the higher and the longer the antenna lead, the better your pickup.

In use, C1 is adjusted either for maximum pickup or to "tune out" any interfering local broadcast station. C2 is adjusted to tune in desired stations. If you assemble a similar receiver and pick up any unusual

DX, drop a note to *Transistor Topics*. We'd like to hear about your results.

Readers' Projects. In our August column, we included photographs of an interesting project assembled by a POP'tronics reader—a transistor receiver in a hand-made leather case submitted by F. E. Bassett of Wilmington, Calif. Since then we've received other reports—and photos.

John R. Jensen, of 60 West Grant, Blair, Neb., has sent in photos of one of the most compact receiver assemblies we've seen. Using a standard Lafayette *six-transistor* receiver circuit, John made a few minor modifications in the interests of more compact wiring. He used a small (1 1/2") Argonne loudspeaker in place of the slightly larger speaker specified in the original circuit, and a UTC SS0-8 interstage coupling transformer. And he used RCA 2N140 and 2N139 transistors in the r.f. stages.

Using special care in wiring and, probably, a healthy dash of patience, John assembled his receiver in a case measuring only 4 1/8" x 2 5/8" x 1 1/8", or only slightly larger than a package of cigarettes! The completed receiver gives excellent performance . . . John says he can receive a broadcast station 70 miles away regularly and with good volume.

Another reader, Ian Cameron, of 318 Mel-

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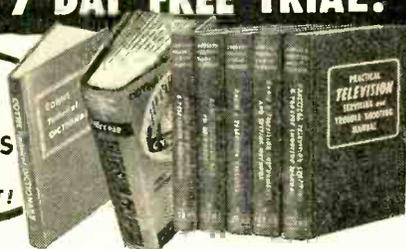
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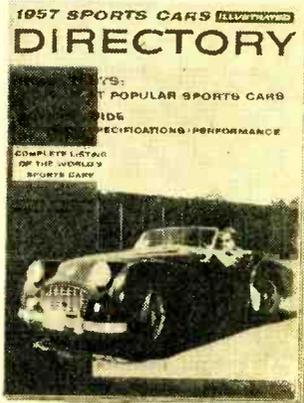
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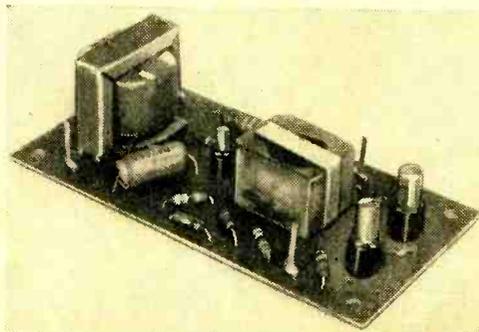
rose Ave., Toronto 12, Ontario, reports an unusual case of DX reception with a receiver he assembled from a circuit published some time ago in *Transistor Topics*—he picked up Moscow, Russia. Distance: about 5000 miles.

Product News. Lafayette Radio (165-08 Liberty Ave., Jamaica 33, N. Y.) has introduced a new universal output transformer for power transistors. A tapped primary provides impedances of 8, 12, 16, 24, 32, or 48 ohms, allowing a good match to practically any power transistor, whether connected for single-ended Class A or Class B push-pull operation. Secondary impedances of 4, 8, or 16 ohms are available. The unit will handle unbalanced d.c. primary currents up to 500 ma. (*1/2 ampere!*). Type number is TR-94. Net price, \$3.75 each, plus postage.

Both G.E. and Philco have announced *price cuts* in several of their industrial and military transistors. The biggest cut is a 68% drop in the cost of G.E.'s 4JD1B4 transistor. As time goes on, we can expect even more "miniaturization" of prices.

RCA (Semiconductor Division, Somerville, N. J.) has introduced quite a number of new transistors, including eight new *p-n-p* junction types intended for compact entertainment receivers (2N407, 2N408, 2N409, 2N410, 2N411, 2N412, 2N405 and 2N406) . . . a new medium-speed switching transistor (2N404) . . . and three high-frequency r.f. transistors for all-wave battery portable receivers (2N370 as an r.f. amplifier, 2N371 for the local oscillator, and 2N372 as a mixer).

Burstein-Applebee Co. (1012 McGee St., Kansas City, Mo.) is offering a *pre-wired* three-transistor audio amplifier. Designed originally for use as a phonograph amplifier, the unit should have many general-purpose applications in the home or shop. The circuit appears similar to that employed in Philco's portable transistorized phonograph, introduced some time back. You'll find a description of this circuit, plus a schematic and parts values, in the Octo-



Burstein-Applebee's transistorized audio amplifier.

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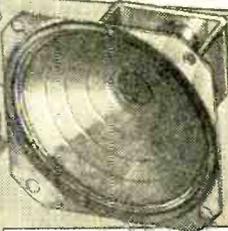
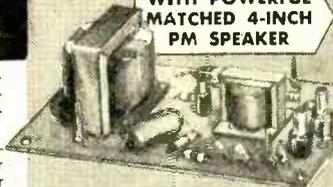
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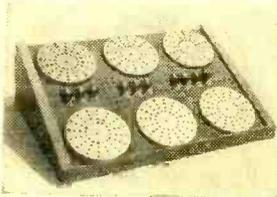
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ber 1955 issue of RADIO & TV NEWS (see page 41).

Transistor Manual. The General Electric Company (Electronics Park, Syracuse, N. Y.) has released the Second Edition of its pocket-sized *Transistor Manual*. Still priced at only fifty cents a copy, the Second Edition is approximately 75% larger than the first. Be sure to pick up your copy of this valuable booklet . . . you'll find it chock full of useful technical data, circuits, and reference material.

That's all for now, fellows. See you next month.

Lou

Among the Novice Hams

(Continued from page 87)

to the other, it must flow through each resistance in turn; therefore, the total resistance must be the sum of the individual resistances, or $R_{total} = R_1 + R_2 + R_3$, etc. For the values shown, the total resistance is 1000 ohms.

Resistances connected in series across a voltage source are usually called *voltage dividers* because, by proper choice of the individual resistances, any desired percentage of the total voltage can be obtained at the taps between them. A voltage divider is often used across the output terminals of a power supply; there it serves the dual purpose of keeping a minimum load on the supply and furnishing intermediate voltages to the associated equipment.

For practice, let's design a voltage divider to do a specific job. Assume that we have a transmitter requiring 500 volts at 100 milliamperes (0.1 ampere) for the final amplifier tube plate circuit, and 250 volts at 50 ma. (0.05 amp.) and 100 volts at 10 ma. (0.01 amp.) at other points. A power supply capable of delivering 500 volts at a maximum of 200 ma. is available.

Referring to Fig. 2(B), the first step in calculating the resistances in the voltage divider is to decide on how much "bleeder current" to allow to flow through it. Normally, about 10% of the current capacity of the power supply is allocated for the purpose. Ten percent of 200 ma. is 20 ma. When added to the 160 ma. drawn by the transmitter, this makes the total key-down current drain on the supply 180 ma.

Starting at the bottom of the divider, the only current that flows through R_1 is the bleeder current, while the voltage across it is obviously 100 volts. Substituting these values in the appropriate Ohm's law formula gives: $R_1 = 100/0.020 = 5000$ ohms.

Proceeding to R_2 , the current through it is the 20-ma. bleeder current, plus the 10

ma. drawn from the 100-volt tap, or 30 ma. The voltage across it is the difference between the voltages at the two taps: 250 volts—100 volts = 150 volts. Solving for the resistance of R_2 using these values gives: $R_2 = 150/0.030 = 5000$ ohms.

To calculate the value of R_3 , we add the 50 ma. drawn from the 250-volt tap to the 30 ma. already accounted for, making the current through it 80 ma. The voltage across it is 250 volts (500 volts - 250 volts). Solving Ohm's law with these values gives: $R_3 = 250/0.08 = 3125$ ohms.

Then add the three resistance values together: $5000 + 5000 + 3125 = 13,125$ ohms. One large resistor (13,000 ohms would be close enough in an actual circuit) with adjustable taps or three separate resistors could be used.

To complete the calculations, determine the current that will flow through the divider with no connection to the taps by dividing the supply voltage by the resistance: $I = 500/13,125 = 38 +$ ma. Because the supply voltage will undoubtedly increase somewhat under no-load conditions, the actual current will probably be at least 40 ma. This is more current than flows through R_1 and R_2 when power is being delivered to the transmitter; therefore, R_1 and R_2 must be large enough to carry this

current without overheating. Use either of the power formulas to determine the wattage rating of the resistors.

Under no-load conditions, the voltage at the divider taps will be higher than when they are under load. The main advantage of a voltage divider over series dropping resistors is that voltage variation between the load and no-load conditions is minimized.

Resistances in Parallel. Figure 3 (page 130) shows three resistances in parallel. The formula for calculating the effective resistance of such a combination is:

$$R_{eff.} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots}$$

If you are a whiz at algebra, you know exactly how to solve this formula and need not worry that you may be asked about it in the examination. If not, you will probably say: "Fine, but what does it mean?" Fortunately, it's easy to understand with a bit of explanation.

Referring to Fig. 3 and taking each resistance in turn, we know from Ohm's law that the currents through them are: $I_1 = E/R_1$, $I_2 = E/R_2$, and $I_3 = E/R_3$. Furthermore, the total current is the sum

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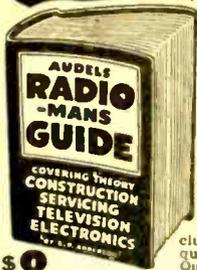
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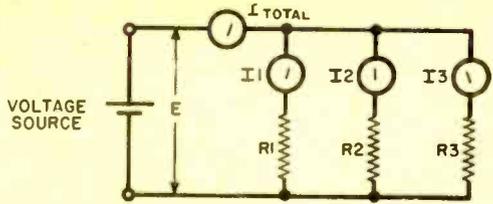


Fig. 3. How to calculate the effective resistance when three resistances are connected in parallel.

of the individual currents: $I_{total} = I_1 + I_2 + I_3$, or $I_{total} = E/R_1 + E/R_2 + E/R_3$. Reverting to the fundamental Ohm's law again, the effective resistance of the three resistances in parallel is:

$$R_{eff} = \frac{E}{\frac{E}{R_1} + \frac{E}{R_2} + \frac{E}{R_3}}$$

Of course, we can make E any value we wish, as long as it is the same in each part of the equation. For convenience, E is usually made equal to one volt in parallel-resistance calculations, making the last equation the same as the first one given here.

The effective resistance of 2-, 4-, and 5-ohm resistors in parallel is 1.05 (to two decimal places). I suggest you verify this answer for practice and then make up a few practice problems of your own. In checking your answers, remember that the effective resistance is always less than that of any of the individual resistances.

News and Views

Ken, KN40KV/2, has installed a 10-position crystal selector and an antenna-changeover relay for his Heath DX-20 transmitter, and an S-meter for reading the signal strength of incoming phone signals to his Heath AR-3 receiver. He uses the S-meter circuit from the ARRL *Radio Amateur's Handbook*. Both transmitter and receiver modifications work fine. Ken also suggests that amateur clubs willing to help prospective amateurs should have their programs listed in our column.

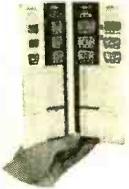
Bob, KN1CVH, received help in getting his license from KN1BOC, who teaches electricity at his school. Bob, in turn, offers to help other beginners. In a week on the air, KN1CVH's WRL Globe Chief and 66' antenna has made eight contacts in five states.

Jacob, WN6GCU, reports that his 15-meter "folded dipole" antenna gets out much better since he installed a set of balun coils between his Johnson Adventurer transmitter and the antenna feed line. It should. His receiver is an AR-3.

Bill, WN6OQU, has been getting excellent results on 40 meters with his home-brew 20-watt feeding a dipole and receiving on a Heath AR-2. He is ready to give 80 meters a whirl after having put up a 30' steel-pipe

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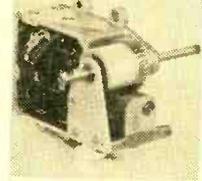
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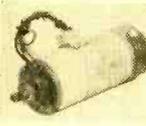


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pole to support it at a cost of \$6.00. Bill offers to help prospective hams. . . . **Red, KN2ZSP** (father) and **Bob, KN2ZSQ** (son) have been on the air for three months with the 2-meter phone rig described in the booklet, "How to Become a Radio Amateur." It runs 18 watts to a 2E26 and feeds a "ground plane" vertical antenna. DX on this band has been about 100 miles. Bob has also been on 80 meters with 38 watts and an antenna 15' high, working six states in 2 1/2 weeks on the band. Red is still building his 75-watt, 3-band c.w. (code) rig. . . . **Ted, VE5EH**, reports from Moose Jaw, Sask., that he operates on 7154 kc. with a 6AG7-6L6 transmitter feeding a 132' antenna plus an Ocean Hopper receiver. He offers to listen for Novices. He also favors 2 meters and would like to hear from W7's who are interested in that band.

Larry, K4LXV, started as a Novice with a Heath AT-1 transmitter and an AR-3 receiver, and worked 29 states and Puerto Rico. Now, as a "General," he uses a Heath DX-35 and a Hallicrafters S-40 receiver with an added Q-Multiplier, which he recommends highly to all hams with inexpensive receivers for increased selectivity. . . . **Derry, K4KWG**, who uses a converted ARC-5 transmitter at 75 watts into a Windom antenna and receives on a Hallicrafters S-38D, made 130 contacts in 12 states on 80 meters. . . . **Terry, W6SDR**, works 40 meters only running 35 watts to a home-built transmitter feeding a folded dipole antenna, 20' high. He receives on a Hallicrafters SX-99. His record is 41 states, Japan, Australia, New Zealand, Okinawa, Hawaii, Cuba, Canada, and Mexico in a year and a half on the air. Terry offers to help any prospective amateur obtain his license.

Ron, WN7IYJ, doesn't think his record of 25 contacts in four weeks on the air is very good, but his six states worked are all confirmed. He uses a Globe Chief running 75 watts to a 75' wire on 80 meters and a folded dipole on 40 meters. Both antennas are 15'. He receives on an AR-3, plus Q-Multiplier, but he has his eyes on a new Hammerlund HQ-150. . . . **Stu, KN2YYQ**, couldn't stay away from his rig in the four months he has had his license until he went to camp, probably to rest up. His Hallicrafters SX-20, a single-wire antenna, and a National NC-98 receiver have accounted for 25 states, 21 confirmed, and several Canadians. He QSL's (confirms contacts) 100% and has received 63 QSL cards. . . . **Jim, KØBVN**, has been a General for four months and now habitates the 10- and 11-meter phone bands with his WRL Globe Scout, running 50 watts, and a Hallicrafters S-40A receiver. He uses a 10-meter doublet antenna, ten feet high. His best DX has been Puerto Rico, Uruguay, Haiti, Dutch West Indies and most sections of the United States. Not bad, especially considering that most of it was done during the "dead" summer months on "10."

For those of you who would like a real DX pen pal who needs help with radio theory, try: **Ho Ik Yum, #304-583 Sin Dang Dong**, Sung Dong Ku, Seoul, Korea. . . . **Jim, KN3-ACM**, has made 125 contacts from coast to coast—17 states—with his 6L6 transmitter running 30 watts, in three months on the air.

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Short-Wave Report

(Continued from page 76)

tion for program link to Portugal. There are six 10-kw. units for relaying programs from Munich to Portugal, and a 135-kw. medium-wave transmitter beamed to Hungary and Czechoslovakia. The usual array of rhombics and curtains is installed.

Maxoqueira, near Lisbon, Portugal, is the receiving point for programs being relayed from Holzkirchen. Triple-diversity receivers and three rhombic antennas make up the basic equipment, while three more rhombics are beamed to New York for picking up any "hot" items. From Maxoqueira, the signals are fed on 462, 463, 464, and 467.5 mc. to Lisbon. There is also a c.w. circuit to Holzkirchen for handling frequency changes. Incidentally, all operations in Portugal are conducted by the *Sociedade Anonima de Radio Retransmissao*, called *RARET* for short.

The main studios for Portuguese operations are in Lisbon. Some 450 people are employed here. Full-time programming, from 0500 to 0000, is carried out in Polish, Hungarian, and Czechoslovakian. In addition, there is a saturation broadcast at 0000-0110, and another seven hours daily

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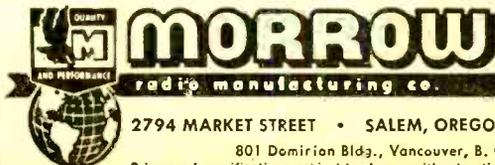


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cated here. Later eight RCA 50-kw. units
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Current Station Reports

The following is a compilation of the latest
reports received by your Editor. All times
shown are Eastern Standard and the 24-hour
system is used. If you have been sending in
reports and fail to see them listed, please bear
in mind that we receive hundreds of reports
each month and that it is impossible to use
all of them.

Aden—This rarely heard country can be
tuned on 7170 kc. at fair level from 1030 with
Arabic chanting. The schedule runs to around
1045-1115. (286)

Albania—Tirana has moved from 6818 kc.
to 6900 kc. and carries Eng. at 1700-1730. The
earlier Eng. xmsn, at 1530-1600, is parallel to
7848 kc. (27, 166)

Although many DX'ers report hearing
Tirana on 9700 kc., your Editor is of the opin-
ion that a verification from this station would
not be a true Albanian confirmation. Evident-
ly the program is being transmitted by *Radio
Sofia* (Bulgaria) xmtrs and not by any within
Albania proper.

Brazil—ZYZ99, *Emissoras Cacique*, Sorocaba,
is another tough one to locate. On 2460 kc.,
the schedule is 1200-2200, and there will be
plenty of interference noted from other ser-
vices. Reports should be sent to *Radio Cacique
de Sorocaba*, Rua Miranda Azevedo 311, Soroc-
aba, S. P., Brazil. (91)

Agencia Nacional, Rio de Janeiro, is sched-
uled at 2130-1800 on 7935 and 10,220 kc. They
QSL by letter. (27)

Cook Islands—*Radio Rarotonga* has shifted
from 5050 kc. to 4965 kc. to avoid QRM from
a Venezuelan that has extended its sked past
0000. It is being heard on the west coast at

2330-0015 (Wednesdays only) with an Eng. and language session. (31)

Costa Rica—TIFC, *The Lighthouse of the Caribbean*, San Jose, operates a religious station with Eng. programs at 2300-0000 on 9645 and 6037 kc. For a good DX catch, try to log the parallel outlet on 995 kc., medium-wave. (JC, RM, 107)

Denmark—*The Voice of Denmark*, OZF, Copenhagen, 9520 kc., continues to be well heard in most areas of the USA. Widely reported is the N.A. xmsn at 2030-2130 (repeated at 2200-2300), the first 30 minutes of which is in Danish and the rest in English. This xmsn is noted daily except Sundays. (JB, SS, 277)

Ecuador—Another widely heard program is "Morning In The Mountains," broadcast daily except Mondays over HCJB, Quito, on 17,889 kc. at 0900-1000. (JW, 282)

Egypt—*Radio Cairo* can be heard daily on 9745 kc. at 1830-1900 (Arabic), 1900-1930 (Spanish), and 1930-2000 (Czechoslovakian). There has been very little Eng. noted on this outlet. (NR)

Cairo has also been noted, very strongly, on 9890 kc. at 1515, 1627, and 2230 in Arabic. (59, 166)

An Associated Press dispatch reports delivery, by Communist Czechoslovakia, of a new 300-kw. xmtr to Egypt. There is no information available at this time as to the frequency or beam to be used. (226)

French Guinea—The latest sked for *Radio Conakry* reads: 0130-0230, 0800-1315, 1330-1630 (Saturdays to 1700), and Sundays at 2000-1315 on 3376, 4910, and 6155 kc. The 4910-kc. outlet is being noted in the eastern states. (27)

Germany—The East German *Radio DDR*, Berlin, can be heard daily in Eng. on 9730 kc. (dual with 7150 and 6115 kc. which are heard irregularly) at 1530 and 1730. The 1730 xmsn on 9730 kc. is received at excellent level. (104)

Greece—*Radio Athens* can be heard in Greek at 1700-1730 (repeated at 1800-1830) on 17,778 kc. The second xmsn is usually the best one. (23)

Greenland—*Godthaab Radio* is off the air due to a breakdown of the s.w. xmtr. (27)

Haiti—As of this report, 4VEH, Cape Haitien, is operating on the following sked: on 9642 kc. (daily except Thursdays) at 0500-0600 (Tuesdays at 0515-0600); on 9632 kc. (daily except Thursdays) at 0800-0930 (Saturdays to 1030), at 1500-1700 (Saturdays from 1530); on 9600 kc. (daily except Wednesdays and Thursdays) at 1830-1900, 2000-2230 (Saturdays from 2030). "Listener's Corner" may be tuned Mondays at 2145-2215 with POP'tronics Monitor #4, Stewart West, announcing. (CH, BW, 228)

Radio Commerce, Port-au-Prince, has moved from 6091 to 5980 kc. and from 9485 to 9545 kc. It operates weekdays at 0600-0930 on 9545 kc., and at 1700-2230 on 5980 kc. On Sundays the sked is 0600-1900 on 9545 kc. Eng. programs are at 1700-1730 on Sundays and at 2100-2115 on Tuesdays, Thursdays, and Fridays. (156)

Honduras—HRN, *La Voz de Honduras*, Tegucigalpa, has moved back to 5875 kc. from 5960 kc. HROW has left 5880 kc. and the new channel has not yet been located. (100)

Iceland—*Ut Varp Reykjavik*, 12,175 kc., has



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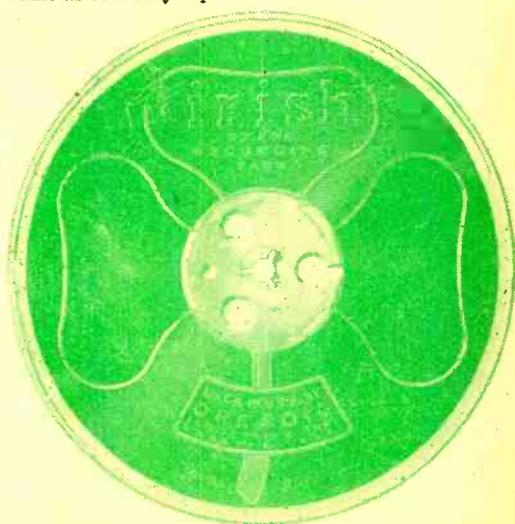
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reportedly moved the former Sunday xmsn of 1115-1130 to 1500-1600. This is beamed to Denmark and is in the Icelandic language. The station has also been noted at 0815-0835. (11, 61)

Italy—English xmsns from *Radio Roma* are as follows: at 0400-0430 on 21,560, 17,800, and 15,325 kc.; at 1035-1055 on 21,560 and 17,770 kc.; at 1915-1935 on 15,400 and 11,905 kc.; at 2125-2145 on 11,905 and 9575 kc. The 1915-1935 English/French xmsn to the USA and Canada on 15,400 kc. is well heard. (61, 279)

Malaya—DX'ers needing this country should listen for Singapore on 7280 kc. around 0630-0700 for the best signal. Forty-meter ham radio QRM often mars reception after that time. (286)

Mauritius—V3USE, Forest Side, is noted on 15,037A kc. from 2220 with music, 2230 news in French, 2246 music, 2300 news in English, 2318 s/off. (275)

Mexico—A new station is XEQM, Merida, Yucatan. Operating on 6105 kc., it is heard at 1900-2300, relaying XEMQ. (100)

Mozambique—*Radio Clube de Mozambique*, 15,083 kc., is noted in Portuguese with excellent music from 0000 to 0100 s/off, at 0930-1000, and at 1430-1515. Frequent ID follows a 4-note gong. (61)

The 11,762-kc. channel is noted with usual Eng. Commercial Service at 0915, with QRM from Burma on 11,764 kc. A new outlet has

MORE ON RADIO CLUBS

In the September issue, we listed several of the existing radio clubs that you might like to join. Here are two more.

Teen Shortwave Club (TSWC) is the newest of the two and the dues are \$1.00 per year. They are currently issuing bulletins at three-month intervals. Further details and application blanks may be obtained from Tom Watkins, President, 261 So. Adams St., Mansfield, Ohio, or from Silas Dunn, Vice-President, 712 So. Cedar Street, Little Rock, Arkansas.

DX Listeners Club (DXLC), with headquarters in Norway, issues a publication every two weeks, and dues are \$2.50 yearly. This club also has report forms, various awards, and a QSL Bureau. Further information can be obtained from the USA Representative, Jon Arild, 841 Madrid St., San Francisco 12, Calif.

been noted on 4945 kc. at 0000 (formerly 4911 kc.), also in English. (31)

Nicaragua—*Radio Atlantico*, YNCA, Bluefields, has been heard on 7753 kc. from 2145 to 2300 s/off with Latin-American music and anmts in Spanish. This one is often difficult to hear due to the weak signal and some QRM. (FC)

Nigeria—A most unusual IS is that of the "Talking Drums" which can be heard from Lagos on 4990 kc. at 0100. BBC news relay is noted to 0115; the station often fades out shortly after that time. (23)

Pakistan—*Radio Pakistan*, Karachi, is heard from 1430 to 1500 s/off on 11,670 and 15,230 kc. The 1430-1435 Eng. newscast is followed by music. (WA, 166)

Peru—*Radio El Sol*, Lima, has moved from 15,190 kc. to 15,403 kc. and is well heard at

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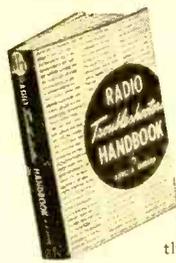
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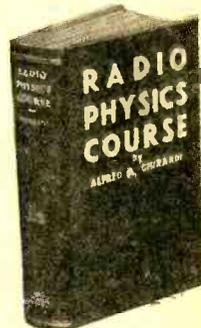
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Poland—The current sked for *Radio Warsaw* to N.A. is: 1930-2030 and 2130-2200 on 11,740, 15,120, and 17,800 kc.; 0030-0100 and 0600-0630 on 11,740 and 15,120 kc.; and 0715-0815 on 11,740, 11,755, 11,785, and 17,800 kc. (CK, 61)

Reunion—Another rarely heard station is believed to be St. Denis, Reunion, noted on 7170 kc. around 2350 in French or German. Heavy QRM prevented positive identification. (98)

Rumania—Bucharest operates to N.A. as follows: at 2200-2230 and 2330-0000 on 11,937, 9570, 9254, 6210, and 5980 kc. Programs are in English. They are asking for remarks and suggestions concerning their broadcasts. (182)

Sao Tome—The *Radio Clube de Sao Tome* is reported to have ceased operations on s.w. Watch 7157 kc. for the opening of another station shortly. (27)

Sarawak—*Radio Sarawak*, Kuching, is noted on 5052 kc. at 0800 with a BBC relay and at

SHORT-WAVE ABBREVIATIONS

A—Approximate frequency
ann—Announcement
BBC—British Broadcasting Corporation
Eng.—English
ID—Identification
IS—Interval signal
kc.—Kilocycles
kw.—Kilowatts
L.A.—Latin America(n)
N.A.—North America(n)
QRM—Interference
sked—Schedule
s/on—Sign-on
s/off—Sign-off
xmsn—Transmission from station
xmtr—Transmitter used by station

0000 with *Radio Australia* news in English. The IS is a simple guitar melody. (286)

South Korea—In addition to frequencies of 9640, 7935, 5980, 7180, and 3910 kc., HLKA, Seoul, also has 17,895, 15,255, and 11,925 kc. allotted for use. The 9640- and 7180-kc. outlets are scheduled as follows: 0000-0430 on 9640 kc. and 0700-1515 on 7180 kc. During the latter xmsn there is an Eng. session at 0930-1000. (27, 206)

Spain—An experimental station is operating on 6950 kc. with a test broadcast at 2000-2200. (206) (Editor's Note: With no other details available at time of writing, it is possible that this station could be either *Radio Juventud de Almeria*, listed at 6945 kc., or *Radio Alerta de Valencia*, listed at 6960 kc.)

Sweden—*Radio Sweden* has a DX program to 2100/close. Reports go to DX Editor, *Radio Sweden*, Stockholm 7, Sweden. This was noted on 11,810 kc. (BU)

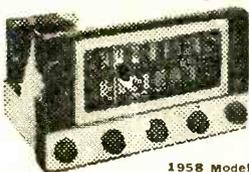
Tanganyika—Dar-Es-Salaam operates on 7167 kc., replacing 5050 kc., at 2215-2340, except Saturdays (100)

Tangier—WTAN, P. O. Box 2219, Tangier (Socco), Morocco, has been experiencing considerable QRM on 9485 kc. and lately has been noted on 9418 kc. at 1430-1715. They are asking for reports on the new frequency. (27, 280)

Trinidad—A not-too-distant but often difficult station to hear is VP4RD, Port-of-Spain, on 6085 kc. It has been heard in Ohio around 1600 with news in English. (98)

Turkey—*Radio Ankara* is well heard in the

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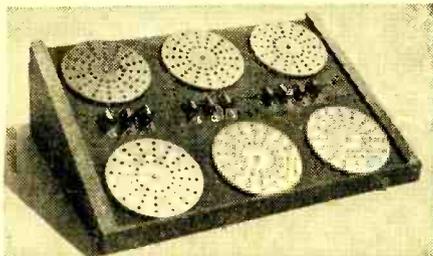


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west during the 1815-1900 xmsn on 9515 kc. News, a short talk, and music make up the format of the program. (61)

The outlet on 15,160 kc. has resumed the "Mailbag" program on Sundays during the 1600-1645 xmsn to England and Western Europe. Reports and questions about Turkey should be sent to Mailbag Program, S.W. Service, English Section, Ankara, Turkey. (SF, 226)

Uruguay—Radio *Sarandi* operates at 1000-2100 on 9515, 11,885, and 15,385 kc., three days to the USA and three to Europe. All xmtrs are 10-kw. units. (27)

Venezuela—New stations announcing in Eng. as "This is Caracas" and using Government xmtrs are being heard on 9366 kc. at 0725-0800 and on 11,900 kc. from 2100. No other details are available as yet. (11, 27)

YVQL, El Tigre, 3255 kc., has been noted from 2120 to 2157/close with music, commercials, and ID as *La Voz de El Tigre*. QRM was noted from ZFY until s/off at 2145. (59)

YVXJ, Barquisimeto, 9510 kc., is well heard at 2000-2200 with pop L.A. music and anmts

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Les Downes (280), London, England
Bob Kapsch (282), Roselle Park, N. J.
Maurice Ashby (286), Wichita, Kans.

in Spanish. Programs continue after 2200 but with QRM. This one presumably signs off at 2300. (FC)

Windward Islands—The Windward Islands B/C Service, Grenada, is using two new outlets as follows: 4760 kc. at 1600-1730 (then moving back to 3365 kc. for the 1730-2215 period); and 9550 kc. at 0815-0900 Tuesdays and Thursdays only, for school broadcasts. (100)

Clandestine—A station, presumably Clandestine Russian, signing as *Goverit Baikal*, has been noted on 17,815 kc. at 2200 s/on in Russian. Within a few seconds it is usually jammed and unreadable. This might be a Far East outlet operating from near the Mongolian border. Details requested. (31) —30—



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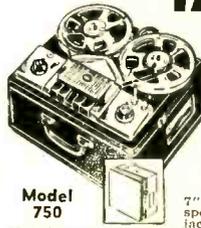


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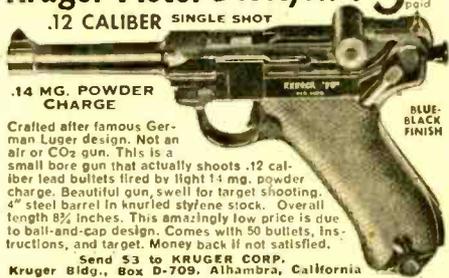
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Model TD-55

Terms: \$6.95 after 10 day trial then \$5.00 per month for 4 months.



Model TW-11

Terms: \$11.50 after 10 day trial then \$6.00 per month for 6 months.



Model TV-12

Terms: \$22.50 after 10 day trial then \$10.00 per month for 5 months.

Superior's New Model TD-55 EMISSION TYPE TUBE TESTER

FOR { The Experimenter or Part-time Serviceman, who has delayed purchasing a higher priced Tube Tester.
The Professional Serviceman, who needs an extra Tube Tester for outside calls.
The busy TV Service Organization, which needs extra Testers for its field men.

Speedy, yet efficient operation is accomplished by: 1. Simplification of all switching and controls. 2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Novol and Sub-Minor types.

You can't insert a tube in wrong socket. It is impossible to insert the tube in the wrong socket when using the new Model TD-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

"Free-point" element switching system. The Model TD-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum.

Checks for shorts and leakages between all elements

The Model TD-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals.

Elemental switches are numbered in strict accordance with R.M.A. Specifications.

The 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

Complete with carrying case **\$26⁹⁵ Net**

Superior's New Model TW-11 STANDARD PROFESSIONAL TUBE TESTER

• Tests all tubes, including 4, 5, 6, 7, Octal, Lockin, Hearing Aid, Thyatron, Miniatures, Sub-miniatures, Novols, Subminors, Proximity Fuse Types, etc.

• Uses the new self-cleaning Lever Action Switches for individual element testing. All elements are numbered according to pin-number in the RMA base numbering system. Model TW-11 does not use combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

• Free-moving built-in roll chart provides complete data for all tubes. Printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE
SEPARATE SCALE FOR LOW-CURRENT TUBES. Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

Housed in hand-rubbed oak cabinet **\$47⁵⁰ Net**

Superior's New Model TV-12 TRANS-CONDUCTANCE TUBE TESTER

★ 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.

EXTRA FEATURE:

Model TV-12 Also Tests 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.

Housed in hand-rubbed oak cabinet **\$72⁵⁰ Net**

USE APPROVAL FORM ON NEXT PAGE →

We invite you to try before you buy any of the models described on this and the following pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

TRY FOR 10 DAYS

before you buy! then if satisfactory pay in easy, interest free, monthly payments. See coupon below.



Model 70

Terms: \$3.85 after 10 day trial then \$4.00 per month for 3 months.

Superior's New

Model 70

UTILITY TESTER®

AS AN ELECTRICAL TROUBLE SHOOTER

• Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakage, etc. • Will measure current consumption while the appliance under test is in operation • Incorporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, motors, etc. • Leakage detecting circuit will indicate continuity from zero ohms to 5 megohms (5,000,000 ohms) • Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Fans, Switches, Thermostats, etc. • Will test all TV tubes for open filaments, inter-element shorts, burned out tubes, etc. (Will not test TV tubes for quality. An emission type tester such as the Model TD-55, TW-11 or TV-12 is required to test tubes for quality.)

AS AN AUTOMOTIVE TESTER

• Tests both 6 Volt and 12 Volt Storage Batteries • Generators • Starters • Distributors • Ignition Coils • Regulators • Relays • Circuit Breakers • Cigarette Lighters • Stop Lights • Condensers • Directional Signal Systems • All Lamps and Bulbs • Fuses • Heating Systems • Horns • Also will locate poor grounds, breaks in wiring, poor connections, etc.

Model 70 comes complete with 64 page book written in plain easy-to-understand language. Explains laws of electricity, how to proceed with repairs of appliances and automobile circuits, how to test TV tubes, etc. Only.

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Net

Superior's New

Model 670-A

SUPER-METER

A Combination VOLT-OHM MILLIAMMETER PLUS Capacity, Reactance, Inductance and Decibel Measurements

A.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 • D.C. CURRENT: 0 to 1.5/15/150 Ma. to 1.5/15 Amperes • RESISTANCE: 0 to 1,000/100,000 Ohms to 10 Megohms • CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad-scale for

checking quality of electrolytic condensers.) • 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. Complete with test leads

\$28.40
Net



Model 670-A

Terms: \$7.40 after 10 day trial then \$3.50 per month for 6 months.

Superior's New

Model TV-40

PICTURE TUBE TESTER

NOT A GADGET—NOT A MAKE-SHIFT ADAPTER, BUT A WIRED PICTURE TUBE TESTER WITH A METER FOR MEASURING DEGREE OF EMISSION—AT ONLY \$15.85

Tests ALL magnetically deflected tubes . . . in the set . . . out of the set . . . in the carton!!

Tests all magnetically deflected picture tubes from 7 inch to 30 inch types.

Tests for quality by the well established emission method. All readings on "Good-Bad" scale.

Tests for inter-element shorts and leakages up to 5 megohms.

Test for open elements.

EASY TO USE: Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube case (Ion trap need not be on tube). Throw switch up for quality test . . . read direct on Good-Bad scale. Throw switch down for all leakage tests.

Only **\$15.85**
Net



Model TV-40

Terms: \$3.85 after 10 day trial then \$4.00 per month for 3 months.

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Model 76

Terms: \$6.95 after 10 day trial then \$5.00 per month for 4 months.

Superior's
New
Model

76

IT'S A CONDENSER BRIDGE

IT'S A RESISTANCE BRIDGE

IT'S A SIGNAL TESTER

IT'S A TV ANTENNA TESTER

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. Will also measure the power factor of all condensers from .1 to 1000 Microfarads.

✓ RESISTANCE BRIDGE SECTION

2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms.

✓ SIGNAL TRACER SECTION

With the use of the R.F. and A.F. Probes included with the Model 76, you can

make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc.

✓ TV ANTENNA TESTER SECTION
Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? Locates a break in any TV antenna and measures the location of the break in feet from the set terminals.

Complete with R.F. and A.F. probes and test leads **\$26⁹⁵ Net**



Model TV-50

Terms: \$11.50 after 10 day trial then \$6.00 per month for 6 months.

Superior's New

Model TV-50

GENOMETER

7 Signal Generators in One!

✓ R.F. Signal Generator for A.M.

✓ R.F. Signal Generator for F.M.

✓ Audio Frequency Generator

✓ Marker Generator

R. F. SIGNAL GENERATOR: 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: Provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

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✓ Bar Generator

✓ Color Dot Pattern Generator

✓ Cross Hatch Generator

BAR GENERATOR: Pattern consists of 4 to 16 horizontal bars or 7 to 20 vertical bars.

DOT PATTERN GENERATOR (FOR COLOR TV): The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence.

CROSS HATCH GENERATOR: The pattern consists of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect. **\$47⁵⁰ Net**
Complete with shielded leads

TRY FOR 10 DAYS

BEFORE you buy! **THEN** if satisfactory pay in easy, interest free, monthly payments. See coupon inside.

We invite you to try before you buy any of the models described on this and the preceding pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate. (See other side for time payment schedule details.)

**NO INTEREST
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