New Methods to Improve Your Hi-Fi

POPULAR ELECTRONICS

MARCH
1957

35
CENTS

"Why I Chose a Career in Electronics"

Delores Startzel, AT3, U. S. Navy

- New Use for Infrared Light
- Beep Out FM Commercials
- Voices "Command" New Circuit
- Build Electronic "Stethoscope"

TEST 5 TUBES in 4 SECONDS each... ACCURATELY!

WITH THE NEW ADVANCED ENGINEERED

precise

MODEL 116

Gm. & Em. ULTRAFAST
TUBE & TRANSISTOR TESTER

Completely NEW!

PRECISE MODEL 116K in kit form	$69.95
PRECISE MODEL 116W factory wired	$119.95

Incl. Carrying Case & Cover

Servicemen know the Precise Model 111 (the winner in an independent survey) easily rates "the finest tube tester in the field" at any price, BUT FOR AN ON THE JOB QUICK-TEST . . . the fastest, most accurate is the PRECISE Model 116. What's more you test tubes the foolproof method inherent in the famous Precise Model 111.

Did you ever wish you could plug in 5 of the same type tubes at once and check each one individually by rotating a switch? YOU CAN WITH THE PRECISE MODEL 116—Plug in 5 IF tubes and let them heat up at once and then check each one separately by rotating the TUBE BANK switch. ACTUALLY CHECK 5 TUBES IN 20 SECONDS, 4 SECONDS PER TUBE.

The Precise Model 111 taught the lesson that IF amplifier tubes (like the 6BC5 or 6AU6) should be tested for Gm (mutual transconductance) while the power amplifiers (like the 6L6) should be tested for Em (emission)—that's ULTRAFAST Model 116 test! It checks each section of each tube separately . . . by rotating the FUNCTION SWITCH . . . each triode of a dual triode is checked individually . . . each diode and the triode of a duo-diode-triode is separately tested and not lumped as in other testers . . . and a pentode is tested as a pentode—not a diode. TRANSISTORS, SHORTS, GAS, LIFE, Em, Gm etcetera can be tested with the PRECISE Model 116.

You can inexpensively extend the Precise Model 116 to test filament current, etc. The Model 116 gives an accurate, ultra-fast (3 basic knobs for testing) check of television tubes!

No Surplus—An etched panel—beautiful Moleskin covered wood carrying case and cover and specially simplified instructions makes the PRECISE MODEL 116 THE FINEST FAST-CHECK TUBE TESTER AND DOLLAR EARNING TRAVELING COMPANION A TV SERVICEMAN EVER HAD.

Order NOW to insure early delivery.

SEE YOUR LOCAL DISTRIBUTOR FOR PROOF OF WHAT WE OFFER — OR WRITE US FOR DOCUMENTARY RESULTS OF AN INDEPENDENT SCIENTIFIC SURVEY.

THE FAMOUS MODEL #111

111K	$79.95
111W	$139.95

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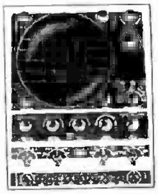

THE FIRST LOW PRICED 7" COLOR SCOPE

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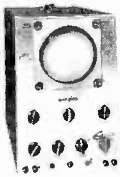

LOW PRICED 5" SCOPE

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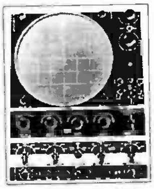
315W	$84.95



THE FIRST AND ONLY 8½" COLOR SCOPE

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909W	$37.50

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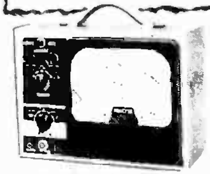
630K	$39.95
630KA*	$38.95
630W	$53.95



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K = KIT
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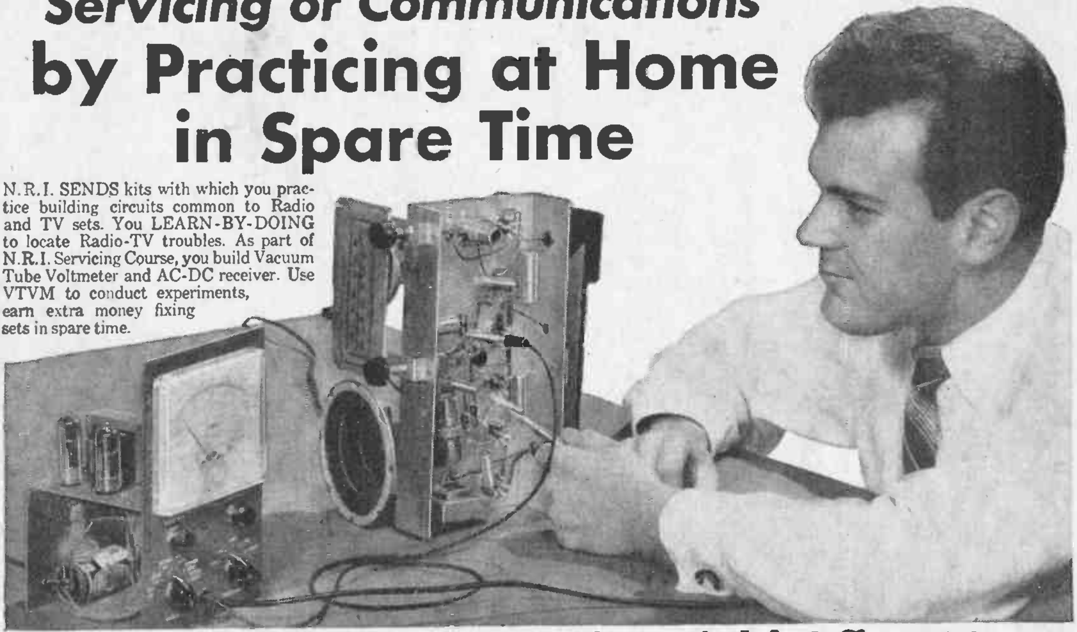

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J. E. SMITH
Founder

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POPULAR ELECTRONICS

CONTENTS

FEATURE Articles and Electronic Developments

A "Wave" in Naval Electronics.................*H. H. Fantel* 39
More Than Meets the Ear........................*Rafe Gibbs* 41
ON THE AIR with the Civil Air Patrol..........*Wayne Winters* 43
Young Scientist's Project................................ 45
Lissajous Had a Figure for It.................*Howard Burgess* 63

ELECTRONIC Build It Yourself Projects

Infrared Photocell System Uses Invisible Light Beam *Harvey Pollack* 47
Kit Builder's Korner..................................... 50
Transistorized Audio Photometer.................*Luis Vicens* 55
Power Supply Made from Filament Transformers *Frank H. Tooker* 56
The 21 SPECIAL...........................*William I. Orr* 58
Subminiature A.C. Power Supplies...........*Frank H. Tooker* 62
You'll Amaze Your Friends with an Electronic "Detectoscope" *Louis E. Garner, Jr.* 74
Transistorized "Command" Circuit..............*Lester Banks* 78
Transtopic Experiment No. 16—Loudspeaker Metronomes *Louis E. Garner, Jr.* 83

AUDIO and Hi Fi Features

Double-Duty Crossover..................*Robert J. Murray* 53
How to Beep Out FM Commercials..........*Donald L. Stoner* 67
Hi-Fi and the ELECTRONIC CROSSOVER......*Norman Eisenberg* 71
Sound Impressions.. 88

Miscellaneous Electronic News

Growing "Whiskers" on Metal.............................. 42
Improved Panelescent Lamps............................... 42
Organist at Work?.. 42
Turntable Rotates Autos.................................. 42
Doggone Electronics...................................... 57
Where Are We?—Ask D.R.T.................................. 57
Atom Rays Poison Parts................................... 66
Lost Chords Found—Electronically......................... 66
Watch That Radio!.. 66
Calling All Cows!.. 70
How Hard Does Champ Punch?............................... 70
Mobile Selling... 70
Tiny Portable.. 70
New V.H.F. Listing....................................... 98

(Also see page 6 for DEPARTMENTS)

Cover photo by Maynard Frank Wolfe
Oscilloscope by Knight-Kit

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IN ELECTRICITY

—ELECTRONICS

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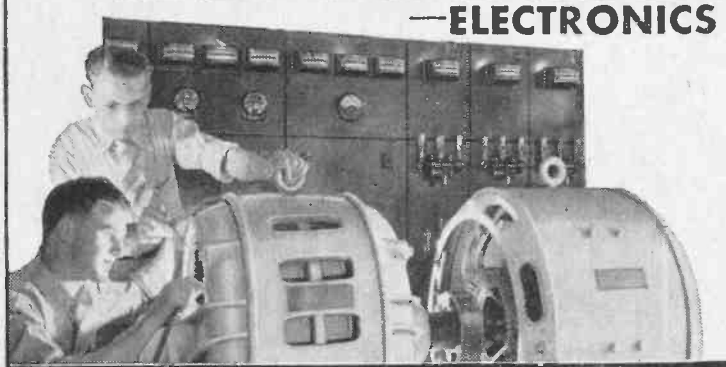

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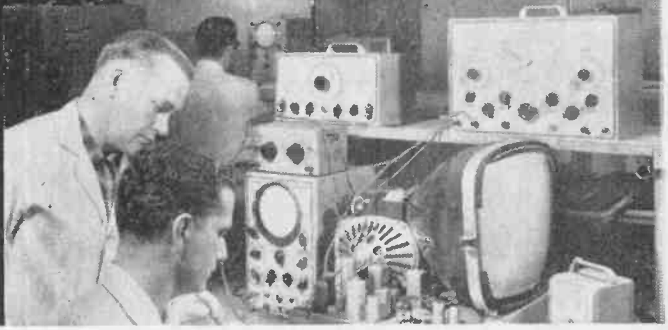
(Shown at left—Instructor explaining operation and testing of a large Motor Generator in our A.C. Department.)

AND TELEVISION-RADIO

On Real:

TELEVISION SETS
RADIO RECEIVERS
F.M.
(Frequency Modulation)
ELECTRONICS
RECORD CHANGERS
AUTO RADIOS
PUBLIC ADDRESS Systems

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



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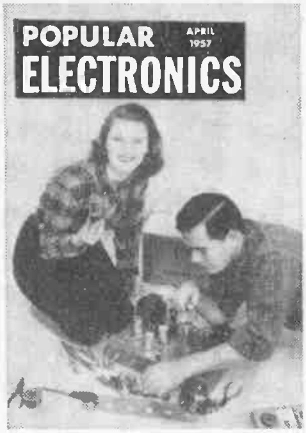
DEPARTMENTS

Carl & Jerry.....................John T. Frye 10
Letters from Our Readers..................... 24
Tools and Gadgets........................... 30
Tips and Techniques 32
POP'tronics Bookshelf 34
McWatts.........................Carl Kohler 36
The Transmitting Tower...........Herb S. Brier 80
Transistor Topics..................Lou Garner 82
Tuning the Short-Wave Bands....Hank Bennett 84
After Class 85

COMING NEXT MONTH (APRIL)



(ON SALE MARCH 19)

Electronic "thought control" is the theme of our lead article. For centuries dictators have been searching for ways and means to suppress the desire for freedom of speech and action. Unfortunately, electronics may provide the answer. The human brain can be controlled by introducing known wave patterns—some waves upset physical stability, others cancel emotions, and still others nullify thoughts about freedom and initiative. "Bio-control" is a word you will be hearing more about—should World War III ever occur.

We will also publish a detailed article on hi-fi amplifier kits, material on how to build a loudness control and to construct an electronic house lighting control unit, plus many other exciting articles.

IN THIS MONTH'S

RADIO & TELEVISION NEWS

(March)

Before You Call for Service—Check Your Own Hi-Fi System
Adding an FM Tuning Indicator
Why Do Amplifiers Sound Different?
Birth of the Electron Tube Amplifier
Turntable Speed Problems

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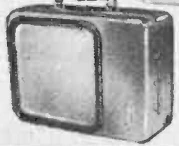

Special only 23.50

Use it as a table viewer or wall projector at home—school—club—sales meeting. Projects a sharp direct view image from color or black and white 35MM slides onto a self-contained ⅝" x ⅝" ground glass screen, or, if you wish, project your slides on a light-colored wall or projection screen and enjoy a 10 sq. ft. picture with the same sharp focus. Magazine holds 36 slides that change with the flick of a lever. Compact steel case with carrying handle measures 10" x 7" x 3½" deep. With standard 100-watt projection bulb, F3.5 lens, projection mirror, view screen, on-off switch, line cord and instructions. For 105-115V. AC-DC.

F-276—Shg. wt., 5 lbs. ....Net 23.50

COMPLETE STEREO CAMERA

- With Flash Unit
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Takes 16 single pictures or 8 stereo pairs in color or black and white. Uses standard 127 film. Matched, coated 45MM fixed focus lenses with F9 and F16 stops. Built-in flash synchronization. Shutter cocking lever prevents double exposure. Light weight body covered with black leatherette and trimmed with brushed aluminum. Genuine leather Eveready case with straps. Shpg. wt., 3 lbs.

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Frames for Stereo Viewing.

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Two F3.5 Coated Lenses

9 Speeds: to 1/200 Sec!

Precision, coupled focusing of fast F3.5/80 coated lenses with stops to F22, give excellent definition. Built-in flash synchronization (standard PC terminal) and standard cable release socket. Shutter speeds: 1/200, 1/100, 1/50, 1/25, 1/10, 1/5, 1/2, 1 sec. and bulb. Flip of finger erects or closes hood of ground glass viewer with magnifier. Also has built-in sports finder. Rugged, all metal covered case has tripod socket. Takes 12, 2¼ x 2¼ pictures from standard 120 roll film. Shpg. wt. 4 lbs.

F-205—Less Case..............Net 19.49
F-206—Leather Eveready Case..Net 3.95
F-207—Above outfit with Collapsible Flash Gun..........Net 26.39

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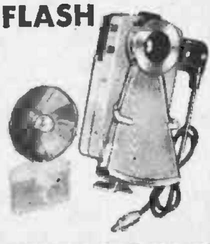
F-196—Camera, less Case..................................Net 34.95
F-197—Leather Eveready Case..............................Net 3.95
F-198—Outfit above with Folding BC Flash Gun..........Net 41.85

FOLDING BC POCKET FLASH



Unique, pocket size flash gun that folds like a fan to 4" x 2". Efficient 4½" diameter metal reflector has pebbled finish to eliminate hot spots. B-C combination for surefire and high voltage. Molded battery case with built in test lamp, bulb ejector and extension socket. Has adjustable standard shoe to fit all flash accessory clips. Uses standard bayonet base flash bulbs. Exposure guide built-in on rear of case. With cord for PC fitting and condenser. Shpg. wt. 1 lb.

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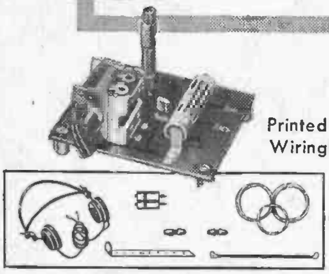

Fascinating knight-kit TRANSISTOR RADIO KIT

Model S-765 only $4.35 Experiment with the marvel of transistors! Printed circuit mounting board simplifies assembling. Just mount components, solder a few connections and enjoy excellent AM broadcast reception. Compact; fits in palm of your hand; operates from single penlight cell that lasts for months. Complete with all parts, transistor and penlight cell. Easy to assemble. Shpg. wt., 2 lbs.

Model S-765. Net only **$4.35**

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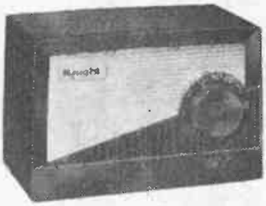
knight-kit "SPACE-SPANNER" BANDSWITCHING RECEIVER KIT

Model S-243 only $15.95 All-new 2-band receiver, easy to build—a great value. Bandswitch selects thrilling short wave, including amateur, aircraft, police and marine radio (6 to 18 mc), and standard broadcast. Highly sensitive regenerative circuit. Has 4" PM speaker and beam-power output for strong volume. Kit includes calibrated panel, punched chassis, all parts and tubes (less cabinet). Easy to build. 7 x 10½ x 6"; for 110-120 v. 50-60 cycle AC or DC. Shpg. wt., 4½ lbs.

Model S-243. Net only **$15.95**

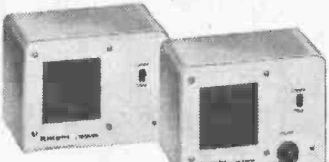
S-247. Matching cabinet for above **$2.90**



knight-kit "RANGER II" AC-DC SUPERHET RADIO KIT

Model S-735 only $17.25 Build this top quality table model radio at low cost! Tunes full AM broadcast, 540 to 1680 kc (includes police calls). Features Alnico PM dynamic speaker; automatic volume control; sensitive Superhet circuit; handsome plastic cabinet. Easy, step-by-step assembly. Complete with punched chassis, all parts and tubes, speaker and smartly styled bakelite cabinet (6 x 9 x 5"). For AC or DC. Shpg. wt., 8 lbs.

Model S-735. Net only **$17.25**



knight-kit TWO-WAY INTERCOM SYSTEM KIT

Model S-295 only $14.75 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 distant answering or baby-sitting. In "closed" position, Remote remains private, but can be called and can originate calls. High-gain 2-stage amplifier and 4" PM speakers. With tubes and 50-ft. cable. (Up to 200-ft. may be added.) Each unit 4¾ x 6½ x 4⅜"; antique white finish. For AC or DC. Easy to assemble. 7 lbs.

S-295. Net only **$14.75**

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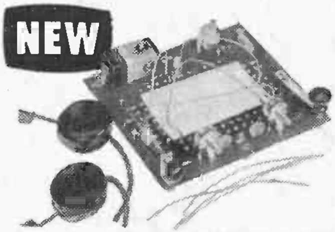

knight-kit TRANSISTORIZED ELECTRONIC 10-IN-1 LAB KIT

Model Y-299 only $15.45 Sensational—work with transistors! 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 broadcaster; code practice oscillator; electronic timer, switch, flasher; voice-operated, capacity-operated and photoelectric relays. Includes all parts, 2 transistors, battery, headphone, instructions for projects. 3 lbs.

Model Y-299. Net only **$15.45**

IDEAL KIT FOR THE HAM

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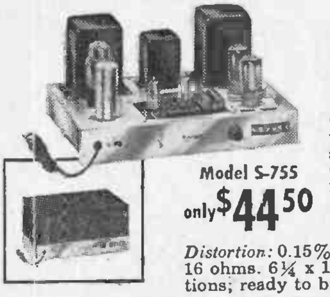

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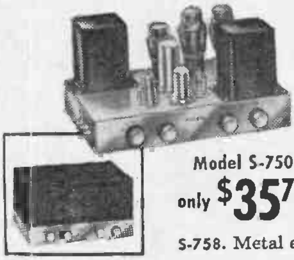

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Secret of Round Island

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"The pull of a big box kite like that one does give you a thrill," Jerry agreed, leaning back on his elbows and letting his eyes follow the graceful curve of the kite string out over the water of the lake and up to the kite, which was sailing gallantly against the blue March sky. "Let out a little more cord, though. I want the kite directly over Round Island when I push the button on this radio-control unit and trip the shutter of the camera up there in the kite."

"Why do you want a picture of the island out there?" Carl asked as he obediently let out some more line from the dangling ball of string wound figure-eight fashion on a stick so that the kite did a wild dance in mid-air.

"No particular reason. I just wanted to take a bird's-eye view of *something,* and Round Island in the middle of the lake seemed as good a subject as any. Then, too, I've always been curious to know what the center of that island looks like. None of us has ever been able to climb those rock walls that rise straight up from the narrow strip of sand around the base to get a good look-see."

"Think the camera will work?"

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"Yeah," Carl said sarcastically at this recital of a Rube Goldberg chain of events. "How can it miss? Well, you may as well

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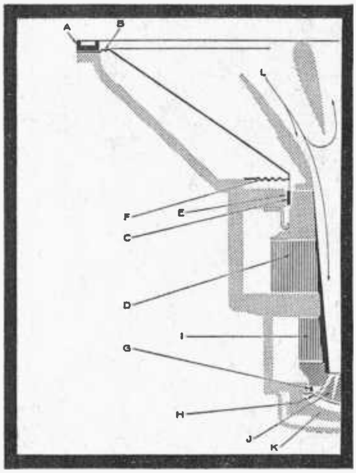

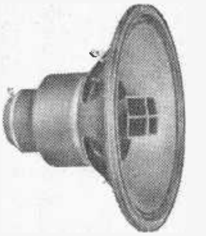

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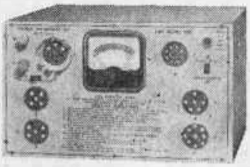

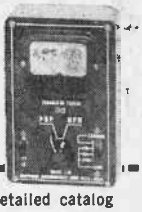

Carl & Jerry

(Continued from page 10)

push the button and find out. As near as I can judge, the kite is right over the middle of the island."

JERRY PUSHED the button on the little transmitter, and Carl immediately started winding in the several hundred yards of twine holding the kite. Sure enough, when the kite settled gently to the ground in front of them, the shutter control of the little box camera had been pulled down by the rubber band. The boys quickly collapsed the folding kite, mounted their bicycles, and started for home to develop the roll of film.

"We've got something, anyway," Jerry said an hour or so later as he held the strip of developed negative up to the light.

"Looks a lot like a fried egg," Carl observed disparagingly, peering over Jerry's shoulder.

The film was quickly dried and placed in the enlarger, and a short time afterwards the blown-up print loomed up at them out of the developing pan. It soon became apparent that the "fried egg" of the negative was actually a surprisingly clear and sharp picture of Round Island as seen from above. A dark fringe of vegetation around the rim of the island and a bare white area in the center gave it the look Carl had noticed in the reversed negative picture.

"Must have been a pond in the center of the island at one time," Carl observed, as they studied the still-wet picture. "Hey, look over here at the edge of the bare area! There are a couple of men."

"You're right!" Jerry said in astonishment. "And here's their boat pulled up on the sand on the far side of the island. What do you suppose they're doing? That thing between them with what looks like a stovepipe sticking out of it resembles an outdoor oven . . . but what a funny place for a picnic!"

"Let's go out there tomorrow morning and see what's cooking on that outdoor oven," Carl suggested impulsively. "If those guys can get into the middle of the island, so can we. We'll borrow a boat from a friend of Dad's who lives on the lake front, row clear around to the back side of the island where their boat is beached, and find out how they got in there."

"It's a date; see you about eight," Jerry agreed.

NINE O'CLOCK the next morning found Carl plying the oars of the small boat as it moved across the mirror-still waters

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Carl & Jerry *(Continued from page 12)*

of the lake toward the deserted shore of Round Island.

"It's a good thing we did our kite-flying yesterday," Jerry observed from where he lolled comfortably on the rear seat studying a print of the picture they had taken the previous day. "There's not a breath of air stirring, and that's something for March. If you'll pull in here, we should land just about where that boat was yesterday."

Their boat pulled up on the narrow beach. One boy started in one direction along the sand while the other went the opposite way in search of some means of climbing the sheer rock wall that rose some 75 feet from the edge of the water. Jerry had gone scarcely a hundred yards when he heard Carl calling. He hurried back down the strip of sand and found his chum busily engaged in pulling a pile of dry brush away from a narrow opening in the cliff.

"Here's how they got in," Carl said; "look at those footprints in the sand! I can see daylight on the other end of this natural tunnel through the rock. Come on. Let's find out what's in there."

"Maybe we'd better be a little quiet about it," Jerry whispered as they started edging their way along the crevice. "Those fellows may still be there; and if they went to all this trouble to be alone, maybe they don't want company."

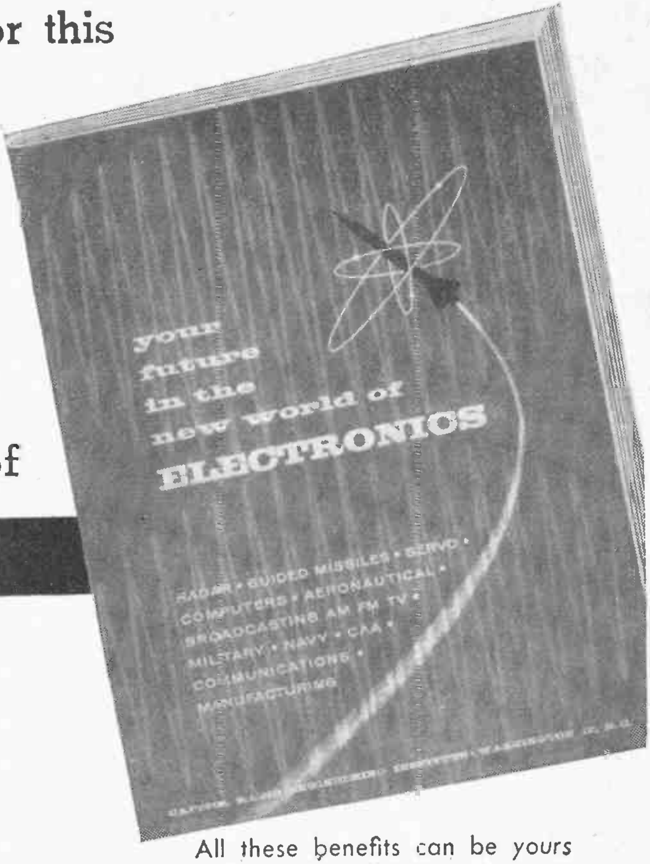
THE TUNNEL was not more than a couple of hundred feet in length, and the boys soon found themselves standing at the other end. The center of the small island was shaped like the inside of a bowl. Around the sharply sloping edge, brush and small trees were growing, but the flat bottom of the bowl was a circular expanse of white sand.

"No one here . . . but there's that outdoor oven we saw," Carl exclaimed, pointing to the right of the tunnel exit. "There's still a fire going in it, too; so those fellows must not have been gone long."

The boys walked over to a strange array of barrels, jugs, kettles, and stacked firewood almost concealed in the edge of the brush.

"Hey, Jer, look at the big tank coil in this barrel of water!" Carl called. "It's made of copper tubing and looks like it would handle a couple hundred kilowatts in a transmitter."

Jerry did not answer. He was too busy noting the rusty pipe that brought cold water from a spring up in the brush down into the barrel. He also noted the flexible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Carl & Jerry

(*Continued from page* 14)

piece of pipe leading from one end of the "tank coil" to a connection on top of the close-fitting cover of a large boiler over the fire of the outdoor oven. Finally he sniffed the air and eyed speculatively the earthen jug sitting beneath the open bottom end of the copper coil which emerged through a water-tight fitting near the bottom of the barrel. A clear fluid dripped from the coil into the open mouth of the jug.

"If you've got a cold, why don't you use your handkerchief?" Carl demanded somewhat irritably, as Jerry continued his audible sniffing.

"I've not got a cold, but I am getting an idea," Jerry retorted. "Take a good deep breath and tell me what the smell of this place reminds you of."

Carl obeyed and then said promptly: "Passing the doors of the saloons on Third Street on a warm summer evening."

"Your nose has a good memory," Jerry applauded. "This has to be a liquor still. The sour-smelling stuff in those barrels must be mash. Both the smell of the still and the small amount of smoke created by burning bone-dry wood stay cupped up in this depression and can't be detected from the outside."

"And dig that booby trap over the mouth of the tunnel," Carl said, pointing to a bunch of rocks restrained behind a log on the steep side of the bowl just above the tunnel opening. One end of the log was prevented from slipping by a short length of wood braced between it and a niche in the rocky slope. A strong rope was fastened to this piece of wood and led down to the floor of the basin. "With a slick setup like that, there's no telling how long this thing has been in operation. Those two guys must be rich by now."

"If they don't want company, all they have to do is yank that rope and a miniature rockslide comes down and seals off the tunnel," Jerry said admiringly. "Which reminds me—we had better get out of here *muy pronto*. Those fellows may come back any minute, and it's just possible they'd take a dim view of our snooping around. Let's hightail it back to town and tell the sheriff about all this."

THEY STARTED back through the tunnel, Carl leading the way, and had almost reached the other end when Carl suddenly halted and went into reverse so quickly that he flattened Jerry's nose against a bony shoulder blade.

"What's the idea?" Jerry demanded, dabbing at his nose and then peering at

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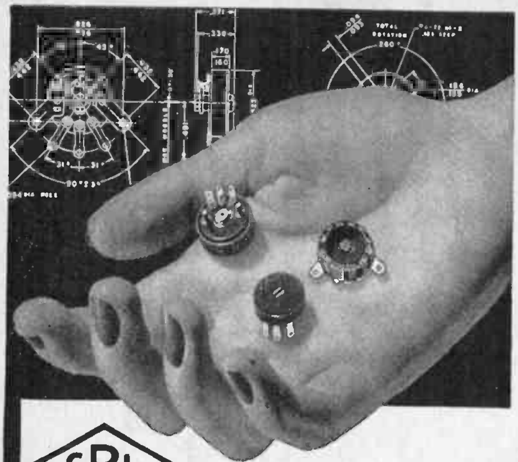

Carl & Jerry

(Continued from page 16)

his fingers in the dim light to see if there was any blood.

"Shut up and back up!" Carl hissed. "Two guys are just getting out of a boat out there—real Dogpatch-looking characters, too."

Jerry needed no further prodding. In a matter of seconds, the boys were back inside the bowl looking vainly about the steep sides for a possible place of concealment.

"Come on; grab this rope and help me pull," Jerry said suddenly, as he picked up the end of the rope leading to the trigger of the booby trap. "Maybe we can slow them down a little."

Both boys heaved on the rope, but the log did not budge. "Harder!" Carl urged as the growling voices of the men issuing from the nearby mouth of the tunnel grew louder. With a desperate effort, the two lunged in unison and the prop flew from beneath the log, sending both boys sprawling in the sand. Rocks clattered down over the opening and piled up until it was almost entirely closed.

Still sitting on the sand, the boys stared in fascination at the narrow opening that was still left between the top of the rock pile and the top of the tunnel. Suddenly two glaring, bloodshot eyes appeared in this opening and looked coldly down at the boys.

"What do you young punks think you're doing?" a grating voice demanded.

"Just hunting mushrooms," Carl said, without the least intention of being funny. As he explained later, he felt someone should say *something;* and that was the first thing that came into his mind. It didn't improve the situation much.

"We'll mushroom *you!*" the grating voice promised, as a hairy, dirty hand reached forth to clear away the rocks.

IN ALMOST a single motion, Carl sprang to his feet, grabbed up a rock the size of a baseball, and let fly at the hand. His aim was not too good, and the rock whammed against the stone wall; but the hand was instantly snatched back.

Jerry quickly got the idea, and the two boys kept up a steady fire of rocks at the opening every time a head or hand appeared.

"Aw, Bill," a second voice drawled, "let's quit fooling around. Let's just drag back some of the rocks from this side so the pile will cave in and we can get at those rock-chucking little devils."

"I declare, Hank, you *are* a brainy one!" Bill said admiringly; and from the sounds

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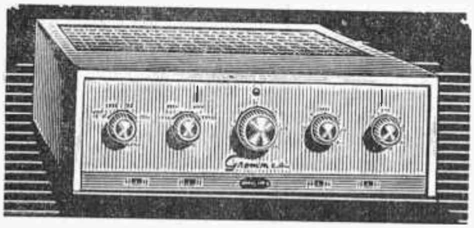
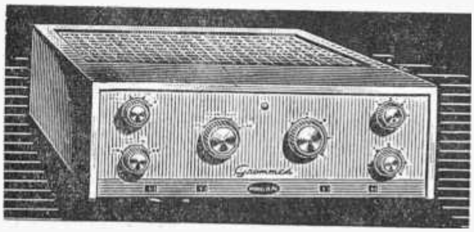




Carl & Jerry

(Continued from page 18)

they heard, the boys soon realized that the men were putting the plan into action.

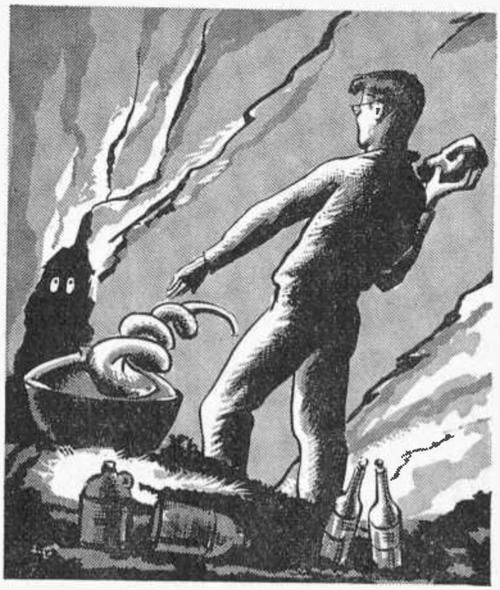
"Our goose is about cooked," Carl said desperately. "You'd better think of something, and fast!"

Jerry glanced wildly about for a moment and then threw down the rocks in his hands and began to scoop up damp leaves from around the overflow of the barrel.

"Keep throwing rocks through that hole to slow them down all you can," he told Carl as he opened the door of the furnace, tossed the leaves on top of the glowing bed of coals, and slammed the door shut. Then he ran around and closed the butterfly damper in the stovepipe that served as a chimney. In a few seconds, dark gray smoke was leaking from every crevice of the furnace. Suddenly Jerry opened the damper, and a puff of smoke shot up into the still air. Instantly he closed the damper, left it shut for a few seconds, and then opened it again. A second puff of smoke followed the first.

Carl, who had been watching this performance in popeyed wonder, now realized what his companion was trying to do. The three round puffs of smoke were followed by three longer columns, and then three more short puffs were allowed to escape.

"SOS," Carl spelled out to himself, automatically continuing to toss rocks at the opening. "Oh, brother, what a long shot that is! Probably no one in miles can read



. . . In almost a single motion, Carl sprang to his feet, grabbed up a rock, and let fly at the hand that was reaching from the tunnel opening . . .

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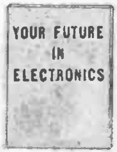

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Carl & Jerry

(*Continued from page* 20)

smoke signals in any fashion, let alone standing on end!"

But Jerry stuck at his smoke signals because he could think of nothing else to do. Carl kept throwing rocks into the opening, and now and then a yowl of pain or a curse told that he had scored a hit; but the men continued working away at the rock pile on their side, and an ominous settling of the rocks now and then proved that their plan was working. Suddenly the whole top of the pile rolled down into the tunnel, leaving the mouth of the tunnel half revealed. The boys could clearly see the two men gathering up rocks and preparing to rush the entrance.

"Come on, Jer," Carl yelled, as he grabbed a jagged chunk of stone in each hand. "They'll probably get us, but let's give them some lumps before they do!"

"Hold it, all of you!" a strange voice boomed from the tunnel. Peering past the figures of the men, the boys could see the familiar outline of the sheriff silhouetted against the light. A drawn revolver was in his hand.

In a few minutes, he had herded the men out into the basin of the island, where a strange posse waited. The sheriff's deputy was first, but behind him were a scoutmaster and eight rather small boy scouts.

AN EXPLANATION was quickly forthcoming. The boy scouts had been on the lake in a couple of boats on their way to an overnight camping site. Seeing the smoke signals, they correctly interpreted them as a call for help, and the scoutmaster went ashore to telephone the office of the sheriff. A radio call was sent out to the sheriff and his deputy, who luckily were patrolling nearby. Then the law officers joined the boy scouts, and circled the island until they spotted the two boats pulled up on the shore. Since the men had been in such a hurry to find out who had discovered their secret still that they did not take time to replace the brush across the tunnel opening, it was easy to locate.

As the sheriff and his deputy prepared to conduct the handcuffed moonshiners back to the boats, a small bespectacled boy scout stood squarely in front of Jerry and stared up into his face. "Were you the one who sent the smoke signals?" he asked.

"Why, yes, I guess I was," Jerry said modestly, preparing to be overwhelmed with fulsome praise.

"That was pretty sloppy spacing," the boy scout said curtly, as he turned on his heel and stalked away. -30-

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LETTERS FROM OUR READERS

Answers! Answers!

■ Information on Meissner Model 9-1065 recorder (requested in January by M. Ralph Berke) can be found in the Howard W. Sams Photofact Set 3, folder 15.

Terry Sandgeaf
Century Electronics
Blue Island, Ill.

■ Model T spark-coil capacitors (requested by J. K. Williams, January issue) can be from 0.002 to 0.008 µfd.

Robert Schaffer
Butler, Pa.

■ Model T spark-coil capacitor values range between 0.1 µfd. and 0.5 µfd. They can be removed by sliding open the door on the coil and digging it out of the sealing compound.

Edward Engelken
San Antonio, Texas

Here's an Oldie

■ Can any of your readers give me some information on the National FB7 receiver? I was given one a few months ago without a wiring diagram or instruction sheet.

Skip Clark
212 E. Belle Terrace
Bakersfield, Calif.

More Possible Projects

■ You can do us serious tape recordists a big service by publishing details on a heavy-duty de-gausser and a high-gain 4 or 6 channel mixer.

Phil Baskin
Brooklyn, N. Y.

■ How about a converter to tune in the police calls around 156 mc.?

John R. Cope
Wichita, Kansas

■ As a potential radio-control enthusiast, I would like to see some new ideas, new applications, etc., of control circuitry. I am working with an escapement to take candid camera shots in wild-life scenes. This should be radio-controlled.

R. Russell
Lowell, Mass.

■ I would be exceptionally interested in an electronic chronograph—something that would measure speeds of 500 to 5000 feet per second.

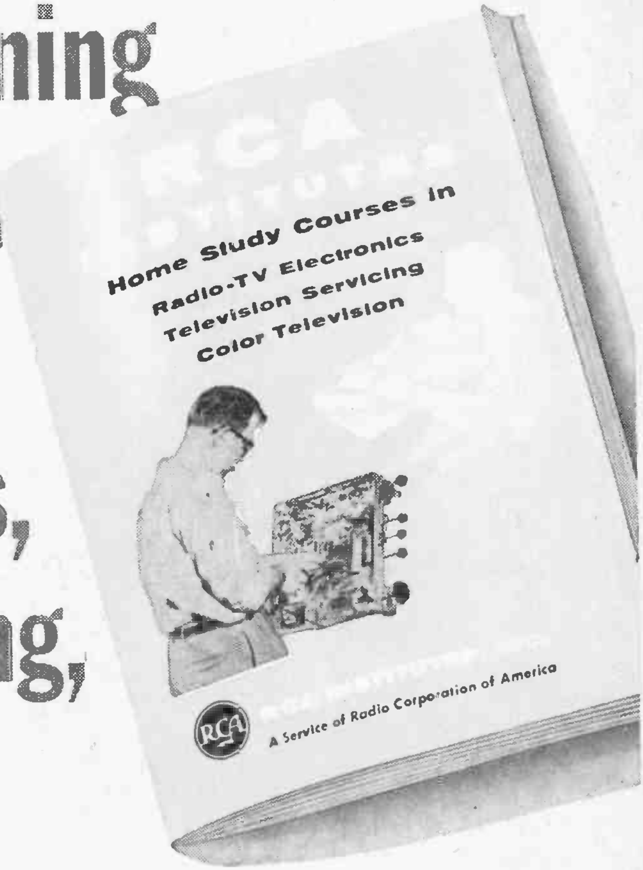
William Kinter
Uniontown, Pa.

These are a few of the projects that are being worked on by our staff. All of the above will probably appear in late spring issues.

Proximity Detector for Trucks

■ Mr. Maurice L. LaRose's suggestion about the use of a proximity detector circuit for parking cars or trucks (October, 1956, "Letters to the Editor," p. 28) would be feasible using present-day knowledge. May I point out my invention covered by

(*Continued on page* 28)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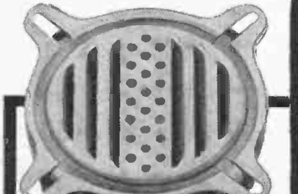

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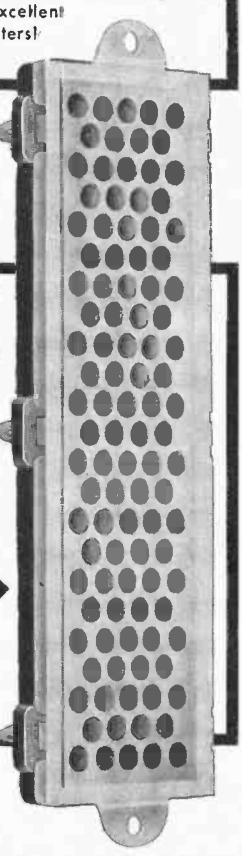

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MusiCraft high fidelity catalog

Letters

(Continued from page 24)

patent 2,708,746 for an approach signal system with self-adjusting controls. This could be developed further and I would appreciate hearing from interested parties.

JOSEPH D. SHAW
Cincinnati 29, Ohio

Kind Words

■ Seth Robbins and I have just completed the "Junkbox Parts Checker" (August, 1956, p. 83) and find that it works FB. I used a Minibox and Seth used a plastic chassis.

Publish more of Carl Kohler; his stories are immensely enjoyed by one reader—at least!

JIM BOYK
Toledo, Ohio

■ I have just completed the "Mini-Horn" (December, 1956, p. 71) and can report that it is a welcome addition to my portable record player.

WILLIAM GROSS
Cumberland, Md.

■ I built the "Mini-Horn" and found the sound to be surprisingly good when using two 5" speakers. Enlarged the "Mini-Horn" by 50%, used two 8" speakers, and found that it was terrific. Wonder if anyone else has tried that?

MIHKEL SALUSOO
Toronto, Ont.

■ Your *After Class* discussion in the January issue on quartz crystals was well worth the cost of a year's subscription. I collect articles and books on thermoelectric phenomena. Are there other readers with a like interest?

HERMON E. COTTER
15766 Blackstone
Detroit 23, Mich.

■ In looking through past issues of POP'tronics, I was pleased to see your fine article on tape-sponding (August, 1956). I became a member of World Tape Pals after reading your 1955 article and have received many interesting tapes.

ANDREW SPRANKLE
Leechburg, Pa.

More Assistance Needed

■ Perhaps some one can help me find parts for my wind direction and speed indicator (Signal Corps ML-204B). I particularly need a mast (ML-206A) and wind transmitter (ML-203B). This complete unit is called the AN/GMQ-1.

E. SIELER
Lambertville, Mich.

Good Question

■ Is there provision for a Citizens band in Canada similar to that in the United States? I'm speaking of the one around 465 mc.

ROY SMYTH
Toronto, Ont.

Can any of you Canadian readers come forth with the necessary dope? What about RC in Canada, as well as voice-operated Citizens band equipment?

—30—

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

FROM OUR MAIL BAG

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

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

CONSULTATION SERVICE

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

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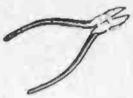
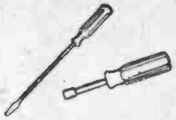
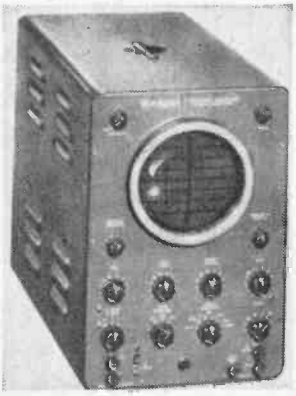




FIVE-INCH OSCILLOSCOPE KIT

Wiring time can be kept to a minimum with the Knight-Kit 5" oscilloscope kit, and assembly is simplified by the use of a printed circuit board and laced wiring harness. Designed for general-purpose use with AM, FM, TV receivers and other high-frequency applications, the 'scope has a sweep range from 15 to 150,000 cps in four steps. Its vertical sensitivity is 25 r.m.s. millivolts/inch; horizontal sensitivity, 70 r.m.s. millivolts/inch.



Detailed instructions and diagrams come with the kit, which is supplied complete with all tubes including the CRT and steel case with disappearing handle. Price, $49.50. (*Allied Radio Corp.*, 100 N. Western Ave., Chicago 80, Ill.)

PUSH-BUTTON PROPANE TORCH

Shown in the photo is a giant Bernz-O-Matic propane torch with jet blast flame. Using a self-sealing, propane gas-filled cylinder, it operates on a push-button principle and produces a large flame which maintains a consistent maximum temperature of 2010-2050° F. The flame is ignited by a steady-burning pilot light.

Possible applications for this king-size device include: heavy-duty brazing; burning tent caterpillars; spot weed killing; disinfecting seed flats; destroying gophers, moles and the like. The new torch is priced at $7.90, the propane gas cylinder at $1.89. (*Otto Bernz Co.*, Rochester, N. Y.) —30—

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TIPS and TECHNIQUES

GROUNDING REDUCES HUM

Hum and noise in radio receivers and audio amplifiers can sometimes be eliminated or reduced by grounding the chassis to a steam radiator or water pipe. However, such a ground should never be applied to the chassis of an a.c.-d.c. set. This is because one side of the 115-volt circuit is grounded by the utility company. A ground applied to the chassis which is sometimes connected internally to one side of the power line would short-circuit the 115-volt service if the power plug were inserted into the wall socket the "wrong" way. Depending on the set circuitry, the on/off switch—or even the tubes—may burn out before the building fuse lets go. Moral: Never place an a.c.-d.c. receiver on a radiator or other grounded surface. Even with a plastic cabinet, a ground may be picked up by the chassis screws protruding through the bottom. —*E.F.C.*

BETTER STARTING CUT FOR SAWING

The blade of a scroll saw will start into the work without jumping the line if two or three teeth at the starting end are thinned down with a hand grinder or file. Just grind the sides of the teeth to remove the set and to bring them to a very keen knife edge. —*K.M.*

CHECKING YOUR TV ANTENNA

Instead of climbing to check your television antenna for broken connections, loosened brackets, etc., use a pair of field glasses to spot trouble.

Here's another method of checking the antenna: disconnect the antenna lead from the set. With the set on, touch first one wire of the lead and then the other to one of the binding posts. The picture and sound should be of equal value or strength

(*Continued on page* 96)

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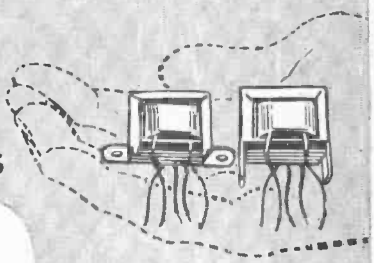

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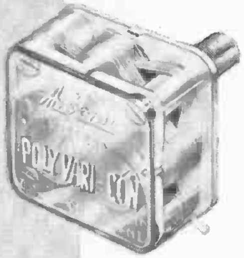

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3 GANG—13/16" x 1-1/16" Square Superhet. Ant. or RF: 11 to 235 mmf. Osc: 11 to 111 mmf.

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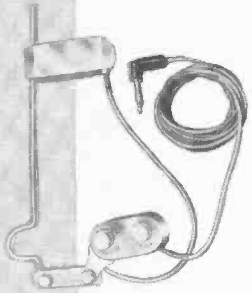

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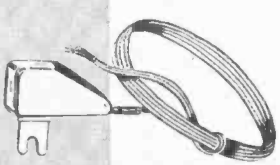
GUITAR PICKUP MAGNETIC MICROPHONE

COMPLETE WITH SEPARATE TONE AND VOLUME CONTROLS

High impedance contact type microphone mounts easily under strings of guitar without special attachments. While mounted, microphone unit can be raised or lowered easily on rod to create varying tonal effects. Supplied with 8 ft. cable and attached standard sized phone plug for connection to amplifer.

AR-35............................List Price **16.60**



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HARMONICA PICKUP MICROPHONE

Crystal contact microphone with high output. It can be connected to any PA system, or the audio section of phonograph or radio. Microphone bracket slips under screw on bass end of harmonica and leads connect to amplifier system. Supplied with 7 ft. shielded cable.

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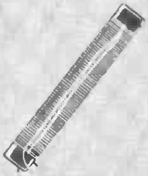

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AR-69—For use with variables up to 211 mmf.
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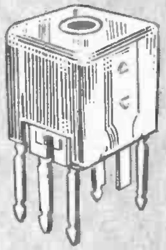
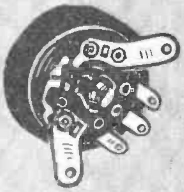
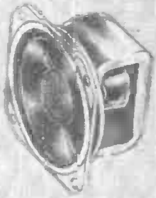


IF COILS



VOLUME CONTROLS



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What would you do if told to make a "coho"? . . . and after that, to check the "squitters" because some radar operators were complaining about excessive "fruit"? Unless you're in the know, you'd better head for the nearest dictionary. But even that probably won't be of much help, for these terms are part of the new microwave language that's springing up around us.

To unravel some of these unusual terms, Young and Jones have prepared a fairly good dictionary with adequate explanations of most of the unusual microwave phrases. Your reviewer differs with the authors on their interpretation of "scatter propagation," but this single error is one of omission rather than commission.

Recommended: to students and technicians going into industrial plants, and armed service personnel wanting to know more about u.h.f. equipment.

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Hi-fi components, including many kits, are listed and illustrated in carefully prepared catalog, available from MusiCraft, 48 East Oak St., Chicago 11, Ill.

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—30—

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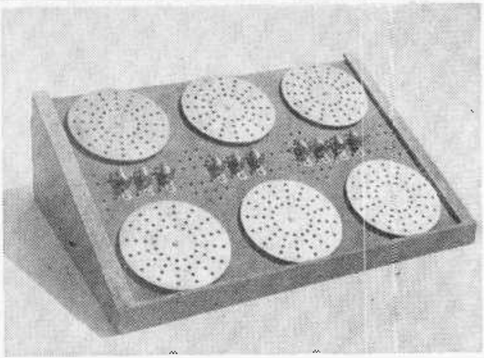

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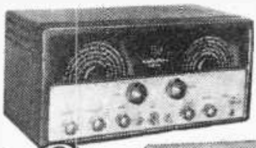
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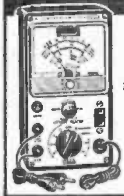
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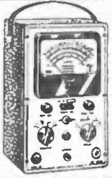
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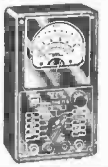
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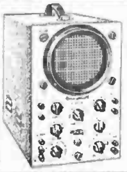
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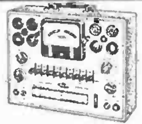
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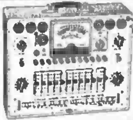
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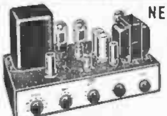
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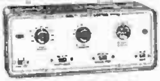
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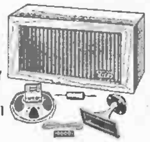
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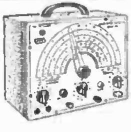
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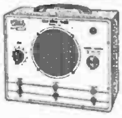
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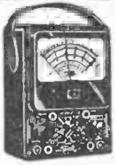
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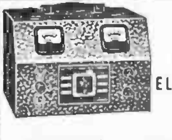
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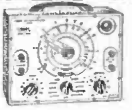
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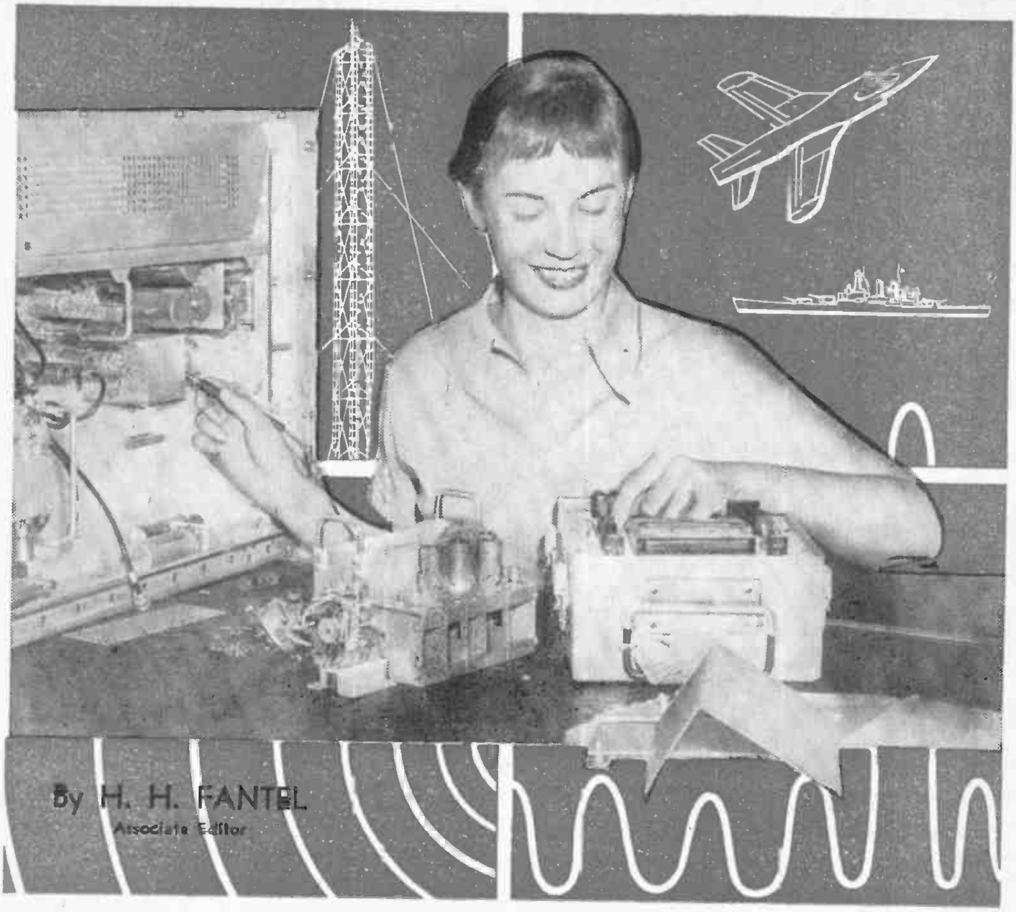


By H. H. FANTEL
Associate Editor

A "WAVE" in Naval Electronics

A PERT REDHEAD with blue eyes flashes her winning smile from the cockpit of a Navy fighter aircraft, and reports: "Radar i.f. bandwidth okay on all stages." No, this is no Hollywood movie, but actual proof that things are changing fast for the Navy, for electronics—and for women.

Proof became tangible in the form of Delores Startzel, Aviation Electronics Technician, USN. Even an "old salt" like John Paul Jones himself would have uncrusted a bit at the sight of such a charming sailor. But what would really have set him up on his sea legs is the fact that Delores has been doing an expert technical job on fully equal terms with Navy men. Her career reflects dramatically two important trends: the awakening of women to the opportunities of electronics, and their growing participation in the armed services at levels of high technical responsibility, qualified by thorough schooling.

Double-Barrelled Pioneer. Both in the Navy and in the field of electronics, Delores (Dee, for short) is somewhat of a pioneer. Of course, the WAVES have been a branch of the Navy for over a decade, yet they have had to sail against the blustery headwind of male prejudice. But by now it has dawned on even the most stubborn that men have no monopoly on brains. The female breakthrough on the technical front is a relatively recent development. In the Navy Electronics Training School at Memphis, Tenn., Dee was the only girl among more than a hundred marines.

Dee is proud to be among the first women doing advanced technical work in electronics. Like anything that smacks of engineering, electronics used to be an all-male preserve. But there just aren't enough qualified male technicians to take

On the job, our Wave traces through the stages of an intricate receiver (at left) with a VSM-29 frequency meter. On this month's cover, Dee runs checks on an oscilloscope. Below, she tackles with practiced skill that ultimate of all electronic instruments—the ubiquitous soldering gun.

care of the ever-increasing variety of electronic equipment in military and civilian life. Under the pressure of this need, the old barriers of sex prejudice are now caving in. The military and private industry are no longer just looking for women with soldering irons tied to their apron strings. Now they want girls to be equally handy with the slide rule, the spec sheet, and a quick deduction from a complex schematic.

Many women have the necessary keen intelligence for such work, but don't even realize it because they think of themselves as "feminine." Subconsciously they feel that having brains is like having pimples: they try to hide them or dry them up. Fortunately, the old saw that keen-minded women are unattractive no longer cuts any ice among intelligent men. Its teeth broke on the hard realities of modern life that make men and women equal partners in work and in marriage. Women who realize this no longer try to shrivel their brains. They feel free to make the most of their native intelligence and have it sharpened by thorough schooling. Electronics, since it requires more brain than brawn, seems a natural field for women's careers on the professional and semi-professional level.

Dee didn't want to go to waste. She wanted to train and use her abilities. But after the first year of college, her money gave out. Instead of heading for the usual dead end of an unskilled job, Dee looked into the technical training offered by the armed services. It offered an answer to the question of her future. With a bit of pay and plenty of technical savvy stowed away, a girl would have a better toe-hold on the world. Besides paid education, Dee, who comes from a small town in the state of Washington, wanted a bit of travel and adventure—so the recruiting posters made plenty of sense to her. Always willing to take the next logical step, she enlisted.

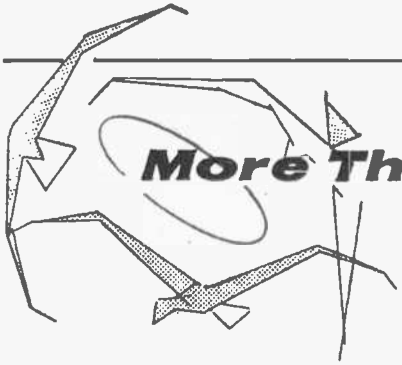
Boot Camp Ahoy! The Navy did not immediately surrender to Dee's ambition. Like all recruits, she had to steer through the military purgatory known as "boot camp." Dee maintains tactful silence about "the senseless things that come with boot," realizing that it takes a tough dose of sheer barefaced drill and discipline to fit a former civilian into the military mold. For better or worse, that's part of the bargain. As a mature and understanding person, Dee accepts this discipline in the context of military life without letting it encroach on her democratic feeling of inner freedom as a person.

After boot camp, electronics was still a long way off. First came Airman Preparatory School at Jacksonville, Florida, where Dee studied flight fundamentals and aircraft maintenance, and was also trained to act in emergencies. She can handle a crash truck at disaster scenes, fight fires, and service automatic weapons. And if war ever comes to the front door, mindless of the neat distinction between combatant and non-combatant troops, communications specialist Dee can rattle off an unmistakable message in 50 caliber slugs.

Electronics — At Last. After basic training and long sessions of aptitude testing and counseling, Dee was finally admitted to the Navy school for Aviation

(*Continued on page* 126)

More Than Meets The Ear



DOES A YOUNG FOX yipping at the moon have different sound effects than one yipping for its mother? Yes, it does—on recordings. Do sea gulls have a common "language"? Bill Cheney's recordings give that impression—at least in the grooves. Is the human voice affected by a bodily system that is giving out—affected so minutely that the ear cannot detect the change, but the eye can by studying the markings on a record?

The shade of Sherlock Holmes would no doubt enjoy dropping in at the Seattle diggings of W. C. (Bill) Cheney, who might be called a "sound detective." A manufacturer of custom-built furnaces and torches, in his spare time Cheney makes recordings—thousands of them. Then he studies the pattern of modulations or variations in the grooves. By applying a Sherlock-sized magnifying glass to recordings he has made of bird and animal sounds, and of human voices, Cheney has learned much.

Cheney's machine shop, where he both lives and works, stands at the water's edge of Puget Sound. Sea gulls prowl on the wing for food in the form of fish or floating waste just beyond his back doorstep. To Cheney, the squawking of the gulls makes sense. By peering through the magnifying glass at his recordings, he has found that gulls give forth certain sounds when hunting fish and other sounds when they are just having fun by gliding down air currents.

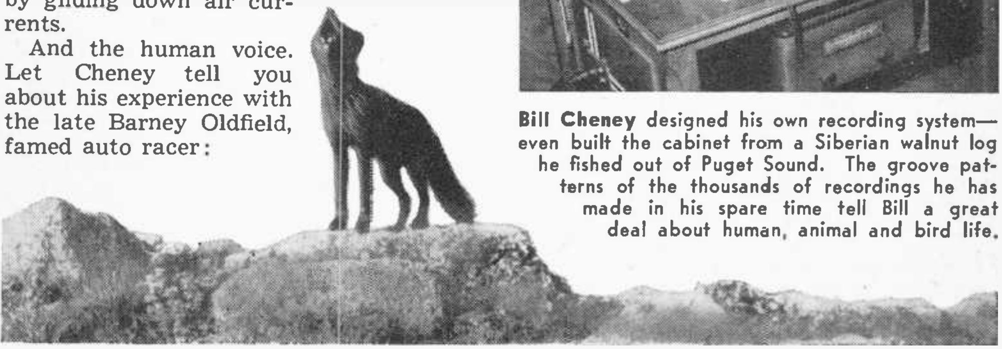
And the human voice. Let Cheney tell you about his experience with the late Barney Oldfield, famed auto racer:

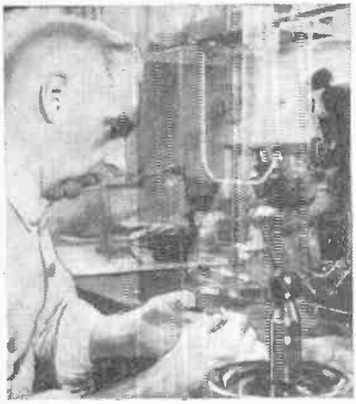
"I had made various recordings of Barney speaking over the radio, and in 1946 I became intrigued by a new one. I noticed odd, irregular, saw-toothed markings. Something was wrong with Barney, I decided. A few days later, he died of a cerebral hemorrhage."

With his main recording machine, Cheney has etched for posterity such famous news broadcasts as the announcement of the Japanese attack on Pearl Harbor and the description of the Bikini atomic bomb tests. So that he won't miss anything important, he has two other recorders ready to go at all times.

You might not be surprised to learn that although Cheney keeps a diary, it is not an ordinary diary such as you or I would keep. As Bill says: "I just talk into a recording machine and cut platters of experiences and thoughts I'll want to recall in years to come." —*Rafe Gibbs*

Bill Cheney designed his own recording system—even built the cabinet from a Siberian walnut log he fished out of Puget Sound. The groove patterns of the thousands of recordings he has made in his spare time tell Bill a great deal about human, animal and bird life.



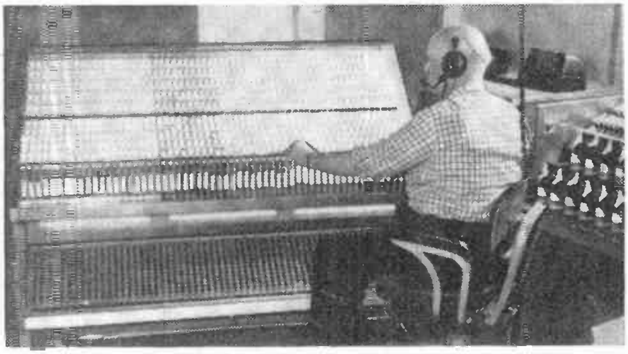


Growing "Whiskers" on Metal

Adjusting probe fitted into plastic shield surrounding microscope (left) is Bell Telephone Laboratories metallurgist S. M. Arnold, who is studying growth of "whiskers" on metal samples. Whiskers are hairlike strands that literally grow on certain metals. Originally discovered as cause of short circuits in telephone equipment, whiskers are now cultivated in laboratory to help find means of "whisker-proofing" various metals used in critical circuit parts.

Organist at Work?

Technician (right) is not looking for lost chord, but operating magnetic amplifier lighting control. Unit's 900 switches can be set up for 10 different scenes with 10 different intensities for each lamp. (Wide World Photo)

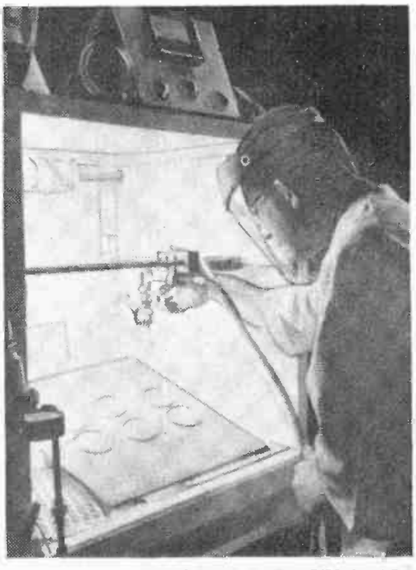


Turntable Rotates Autos

An electronically controlled automobile turntable (left) is in use at the drive-in branch of Chicago's National Bank of Hyde Park. As car starts onto table, electric eye activates a yellow light for "slow." When in position, car triggers another electric eye which flashes a red "stop" signal. Finally, when car drives off table toward teller's window, a third electric eye turns on a green light to signal next customer. Table turns at pre-set timed intervals.

Improved Panelescent Lamps

"Panelescent" is Sylvania's trade name for a device that provides light by the principle of electroluminescence—the excitation of certain phosphors placed in an electric field. The lamp—a thin luminous sheet that emits a soft, uniform glow—may be cut or stamped in any shape. After cutting, lamp receives coatings and firings (right). Tests (below) assure lamp will last 30,000 hours.



By Wayne Winters
Major, CAP

ON THE AIR with the Civil Air Patrol

ONE EVENING last September a man slipped behind the wheel of his car in Albuquerque, New Mexico, switched on a radio receiver and transmitter, and before he could back out of the driveway was halted by the urgent call: "Thunderbird 39 to any Albuquerque CAP station."

A quick reply to the Thunderbird (Arizona CAP station) operator brought no response, so switching off the car, the Albuquerque Civil Air Patrol member beat a hasty retreat to his house, fired up a 75-watt fixed station and, contacting Thunderbird 39, learned that the Arizona operator was worried about a plane overdue in isolated Monument Valley in the Navajo Indian reservation, where there are no phones for a hundred miles.

A check with Civil Aeronautics authorities in Albuquerque brought the disturbing news that the pilot had left Albuquerque at 4:02 that afternoon in a light plane, estimating two hours en route to his Monument Valley destination and carrying four hours of fuel aboard. . . . Now it was exactly 8:00 p.m. The craft must be down somewhere in the dark desert that would test a flyer's courage even in daylight.

Moments later, this disquieting information crackled back to Thunderbird 39, and

Cadet operator, below, works both high-frequency and very-high-frequency portable rigs at a practice mission. At top of page, another operator is shown handling traffic while numerous CAP personnel await further orders.

Control headquarters may be set up in any handy location to direct search and rescue operations. Above, the workshop of a communications officer was utilized during a flood mission.

The CAP member at top of page is talking into a lightweight v.h.f. packset which he designed and built; his car is equipped with a high-frequency transmitter and receiver. Directly above is a typical father and daughter team; Cadet Carrie Hopkins of Albuquerque operates the radio while Lt. Col. Tom Hopkins makes a log entry. Anyone over 14 years of age can join the Civil Air Patrol ranks.

Albuquerque began preparations for an aerial search at dawn. . . . Yet an hour later, even as alternate airfields were being checked, the Monument Valley station came back on the air with the information that the pilot had landed at an emergency field and walked over the desert to his destination. Plane and passengers were safe.

Two-way radio plays a big part in the Civil Air Patrol, the organization which is charged with a large part of the search and rescue operations for missing aircraft. Some 10,000 stations, operating on frequencies "loaned" by the U. S. Air Force, are distributed over the 48 states, Hawaii, Alaska, District of Columbia and Puerto Rico. By far the greater part of these stations are installed in cars and trucks. Many "fixed" stations exist at airfields, CAP unit headquarters, homes, and business offices. Not a few planes, either CAP-owned or private aircraft belonging to members of the organization, are also equipped with two-way radios operating on CAP frequencies. A number of walkie-talkie units are in the hands of ground rescue teams and prove invaluable in search operations to provide communications between aircraft flying cover, or to send information from a crash scene back to a base camp.

The radio equipment used in CAP activities varies from station-to-station and state-to-state. Some gear is supplied to the organization by the U. S. Air Force after it has been declared surplus. Other equipment is purchased by the various units from their own funds. Still more is the private property of individual members, not a few of whom are also "ham" operators.

In most cases power limitations are fairly low. A maximum of 400 watts output is provided for the one station in each state that is authorized to talk across state borders, while the various other units are allowed either 150 or 75 watts of power to the antenna. Most of the mobile units run from 10 to 50 watts, with center-loaded antennas being most common.

Seven frequencies are authorized as follows: Channel One, 2374 kc.; Channel Two, 2394 kc. (Freehold and Fort Monmouth, N. J., area only); Channel Three, 4325 kc.; Channel Four, 4507.5 kc.; Channel Five, 4585 kc.; Channel Six, 5500 kc. (one watt only); Channel Seven, 148.14 mc. An eighth channel, which will be in the v.h.f. band somewhere close to the amateur two-meter frequency, is planned.

Until the last three or four years, almost all CAP traffic was carried on the high frequencies with Channels Four and Five predominating. Now the use of v.h.f. Channel Seven is encouraged and an increasing number of stations have added v.h.f. equipment to supplement the h.f. gear. This frequency is especially valuable where short-range transmissions and air-to-ground communications are needed.

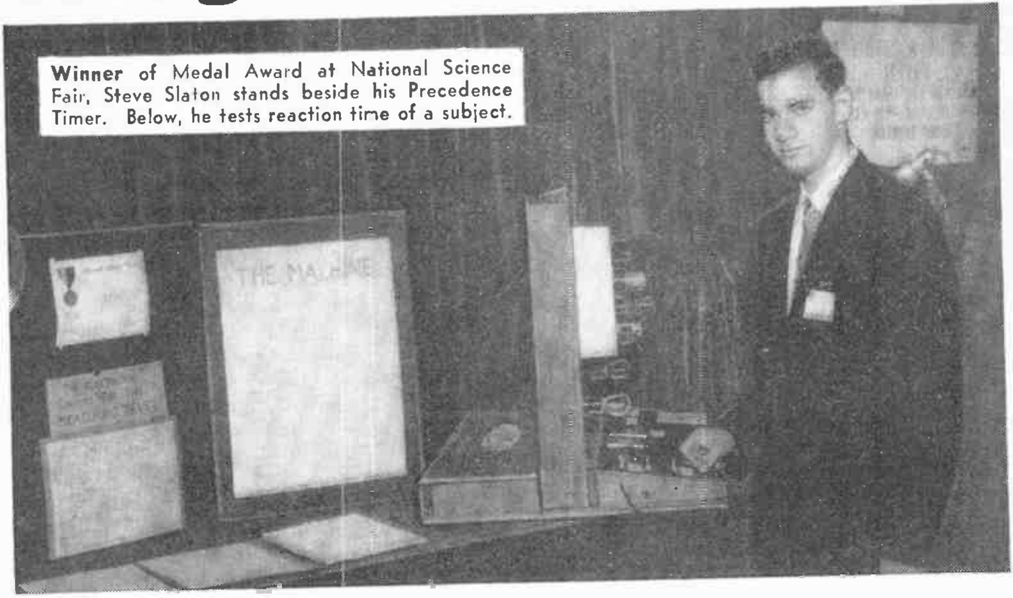
Civil Air Patrol transmitters must be crystal-controlled. Their operators must hold restricted radiotelephone licenses or higher. The operation of the stations must conform to all of the FCC regulations concerning frequency tolerances, type of emission, etc. Accurate logs are required of each station's operation.

All Civil Air Patrol communications operations are carefully regulated. "Hamming" is discouraged and an excessive amount of idle chatter is not tolerated. Regular state-wide nets are scheduled at definite times each day during which traffic information is passed from headquarters to local units and between individual stations.

In case of an actual mission or an emergency, talking between states is permissi-

(*Continued on page* 127)

Young Scientist's Project



Winner of Medal Award at National Science Fair, Steve Slaton stands beside his Precedence Timer. Below, he tests reaction time of a subject.

Teenager wins fame with a timing machine that shows left-handers to be faster

MANY of electronics' important developments started as youthful experiments in basements and attics. In recent years, closer attention to the art has been paid by high schools, in whose physics laboratories inquisitive minds and nimble fingers can reach out to new horizons.

An outstanding example is the case of Steve Slaton. Two years ago, Steve —then 15—was a student at Forest Hills High School in Flushing, Long Island, N. Y. One day he surprised his physics instructor, Harvey Pollack, by saying:

"Why do you suppose there are so many top left-handed ball players in the big leagues? Considering that right-handed people outnumber left-handers in the general population by a large margin, it seems to me that 'lefties' are more numerous in baseball than they should be—unless, of course, southpaws have something that right-handers don't have."

Pollack—intrigued by his pupil's question but not very impressed with the relation of baseball to high school physics—suggested offhandedly: "Why don't you investigate it? Sounds like it might have possibilities."

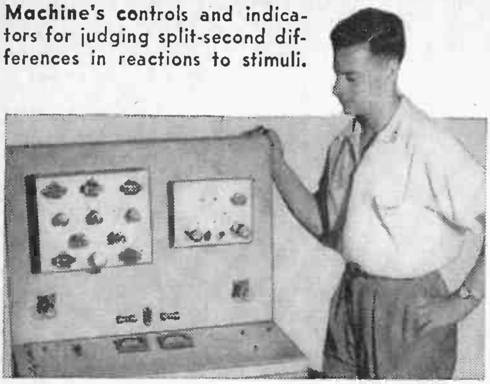
Steve "investigated it"—and proceeded to design and build an ingenious electronic device which won him nation-wide recognition as a budding genius as well as scholarships to Princeton University where he is now studying.

Seeking the Answers. The youthful scientist set out to find answers to the following questions:

1. Does natural "handedness" mean that a person reacts faster with the hand he favors?
2. Do left-handers have faster reaction times than right-handers? Or is it the other way around?
3. If so, in either case, how much faster?
4. Does right-hand or left-hand reaction time depend on the kind of stimulus used in provoking the reaction?

After several weeks of work, research,

Machine's controls and indicators for judging split-second differences in reactions to stimuli.

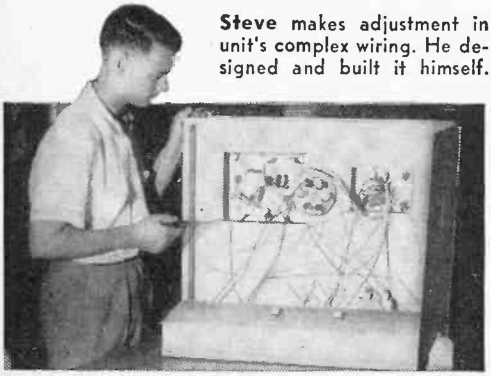


and experimentation, Steve overcame his first problem: he designed a circuit that could tell which hand of a subject reacts first to a given stimulus. This circuit, built around the infinitesimal ionization time of a small thyratron radio tube, could determine the precedence of two almost simultaneous actions—even when the precedence of hand movement was as little as one microsecond! It would infallibly light a "right" or "left" lamp. The device could answer question 1 reliably!

Next, Steve worked out a circuit which would time the interval between stimulus and reaction accurately in terms of small fractions of seconds. He finally settled on an arrangement using the measurement of the charge time of a capacitor. To check his circuit, he got permission from the Fairchild Camera Corp., Jamaica, N. Y., to visit its laboratories and use its impedance bridge for measurements.

Once his figures were accurate, Steve built his timing device—a complex instrument in which a capacitor charges through a resistor in series with a regulated voltage supply. Its state of charge is read as a bias voltage on the grid of a home-made, built-in VTVM. Timing interval is controlled by a pair of fast-acting relays. By using a time-constant equation, and the grid-transfer curve of the vacuum tube in the VTVM, Steve was able to translate current readings into precise time measurements. Now his machine could answer questions 2 and 3!

Steve makes adjustment in unit's complex wiring. He designed and built it himself.



For question 4, Steve installed a clever light-and-buzzer switching arrangement that permitted him to provide any combination of aural and visual stimuli to provoke a hand-raising reaction.

Tests Lead to Success. More than 800 students at Forest Hills—including the school baseball team—were tested on Steve's device over a period of eight months. They were tested in the morning, before classes, then later in the afternoon, after school, to determine if fatigue played a part in left- or right-handed response. The morning tests showed no significant differences between left-handed or right-handed people. However, the afternoon tests produced interesting results. Of the total number tested, about 15% showed a distinct precedence with one hand or the other. Normally left-handed students showed a preference for reacting first with their right hands, while normally right-handed students showed a preference for reacting with their left hands.

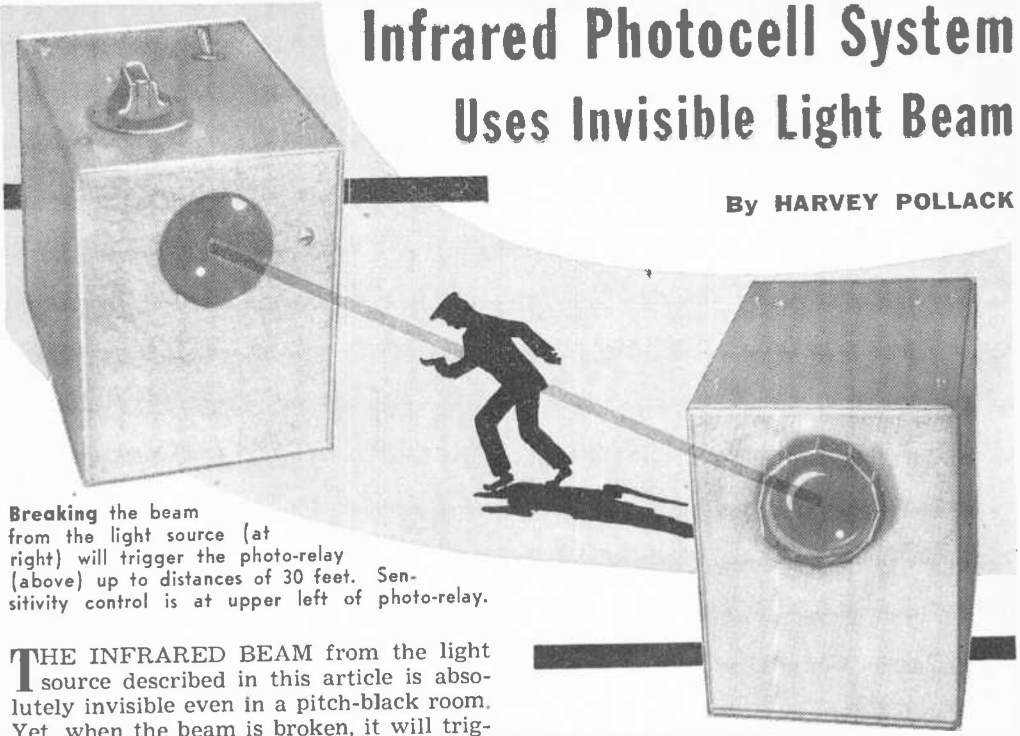
Most revealing were the results of the absolute reaction timing tests: these demonstrated that left-handed students are, on the average, 15% "faster on the draw" than right-handed students! In the course of these tests, it became apparent that the machine's use was not limited to right-handed or left-handed precedence timing. The device could be applied to any situation involving two events which appear to be simultaneous but actually are not. Thus, it points to a kind of instrument for making super-precise measurements of the actions and reactions of people as well as machines.

Devices like this are not new. But neither are they generally known. For a 15-year-old to design and build one from scratch—answering his own questions as he went along, solving equations he had never seen before, digging into texts advanced beyond his years, and even cutting his own panels and fashioning his own chassis—was something remarkable.

How remarkable it was can be judged by the fact that for his work Steve was awarded first prize in the New York City Science Fair of 1955. He then won a New York State scholarship as well as honorable mention in the Westinghouse "Talent Search" Contest and a Medal Award at the National Science Fair. In addition, he was named Regional Winner of a contest sponsored by The Young Scientists of America. —30—

Infrared Photocell System Uses Invisible Light Beam

By **HARVEY POLLACK**



Breaking the beam from the light source (at right) will trigger the photo-relay (above) up to distances of 30 feet. Sensitivity control is at upper left of photo-relay.

THE INFRARED BEAM from the light source described in this article is absolutely invisible even in a pitch-black room. Yet, when the beam is broken, it will trigger the transistor-solar cell relay at a distance of 30 feet.

This equipment is particularly adaptable as a secret burglar alarm, an invisible lamp-lighter in a child's room, or as a trigger for animal traps. It may also be used for door-openers, overhead garage-door controllers, annunciators in professional offices, and driveway floodlight controllers. Although the photocell amplifier is a.c.-operated, the current drain is so minute that a 22½-volt battery may be substituted for the power supply.

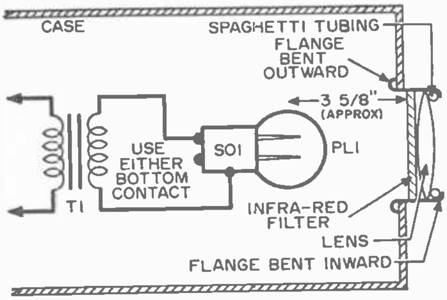
CONSTRUCTION

Both the photo-relay and the light source will fit into 4" x 5" x 6" aluminum boxes. Any type of case is suitable for the photocell amplifier since it generates no heat. The automobile lamp used in the light source does give off heat but a metal cabinet dissipates it easily. No ventilation holes are necessary; thus, there are no light leaks to advertise the location of the source in a secret installation.

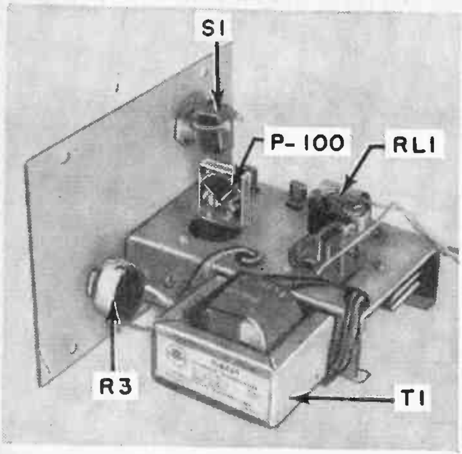
Photo-Relay. The chassis selected as the foundation for the relay unit measures 3" x 6⅛" x 1¼". The first step in the construction is to cut it down to fit the Minibox. In the final adjustments, the chassis is slid into a position where the beam received by the photocell lens is focused sharply on the face of the solar cell.

A holding bracket is next on the construction list. It is 2" long and 1⅛" high, and is fastened to the front apron of the chassis by means of two small machine

PL1—6-volt auto headlight lamp, double filament, 32 cp each
SO1—Auto headlight socket for double-filament lamp
T1—Transformer, 117-volt primary, 6-volt at 6-amp. secondary (Thordarson 21F11)
1—4" x 5" x 6" grey hammertone aluminum cabinet (ICA #29812)
1—Galvanized iron battery clip, size #27
1—1⅝"-diameter lens, 3⅝" focal length, in plastic frame (Lafayette Radio Corp Catalog #F-46)
1—Infrared filter in adapter holder (Maurer MC-430—available from Barry Electronics, 512 Broadway, New York 12, N. Y.)

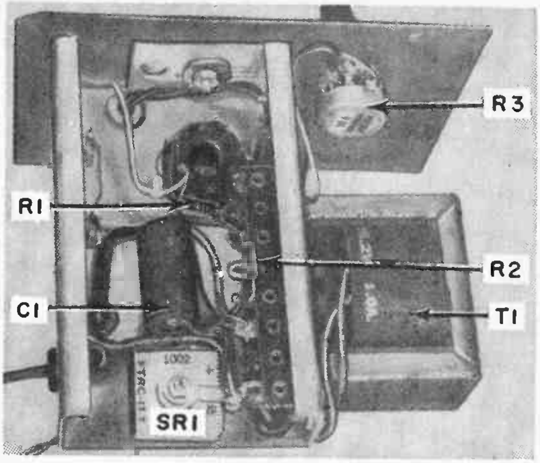


General layout, wiring and parts list for the infrared light source.



The above view of the photo-relay shows the transformer mounting clearly and the relative positions of R3, s.p.s.t. switch S1, and the Sigma relay, RL1. You can also see the front of the solar cell (P-100) which is plugged into holes #4 and #6 of the octal socket.

Completely wired chassis of the photo-relay. A seven-lug terminal strip supports the small resistors and serves as a tie strip for transformer wires, etc. Transformer T1 and sensitivity control R3 must be placed so that they do not obstruct the light beam path.



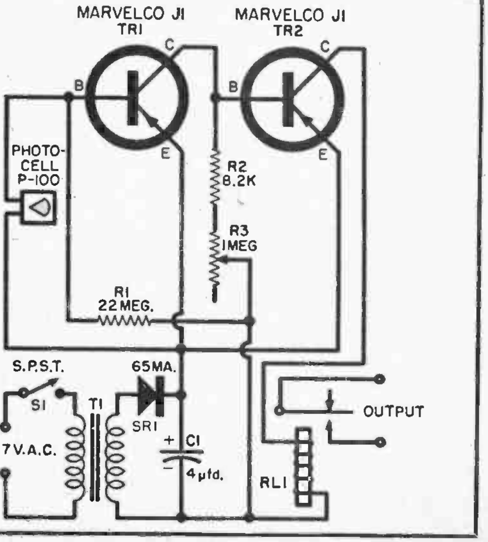
screws. It may be slotted to make chassis movable by drilling small holes side by side and using a file to clean up the lines, or by using a "nibbling" tool starting from a 5⁄16" hole. The latter procedure was used in the model; it does a very neat, quick job.

Bear in mind, while laying out the chassis, that the light from the lens must have unobstructed passage to the face of the NATFAB solar cell. Assuming that you have purchased the lens specified in the parts list, a 1⅜" hole should be punched in the front panel of the photo-relay case with its center about 3½" from the bottom of the case. The lens is supplied mounted in a plastic frame which is used as a convenient support. With the lens held over the panel opening, locate the spot for the supporting screw that will go through the hole in the handle of the frame and drill a #27 hole at this point.

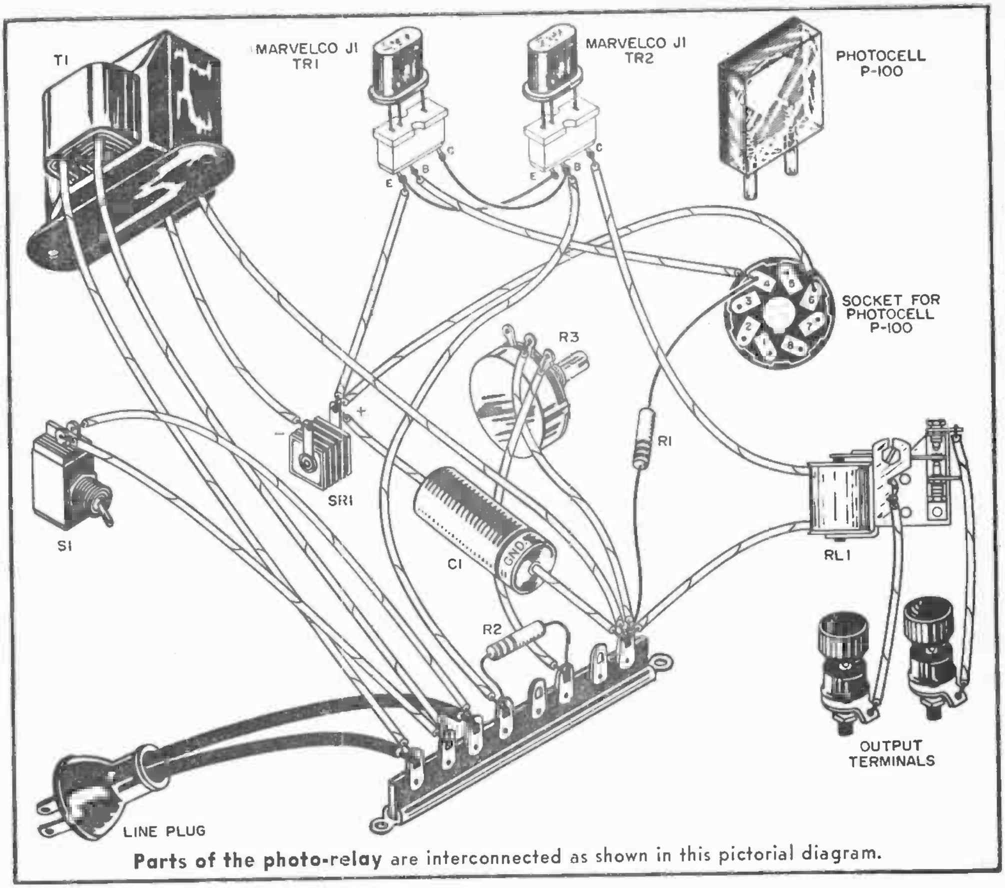
The wiring is straightforward, as shown in the schematic diagram. Wire lengths are not at all critical. Particular attention should be given to the voltage polarity on the transistors. Be sure that the minus lead of the power supply connects to the first transistor (*TR1*) collector through the resistors *R2* and *R3* and to the collector of the second transistor (*TR2*) through the relay coil.

This photocell alarm relay, originally designed as a burglar alarm, operates when

C1—4-μfd., 150-volt electrolytic filter capacitor
P-100—Silicon solar cell, equipped with prongs for mounting in octal socket (National Fabricated Products)
R1—22-megohm, ½-watt carbon resistor
R2—8200-ohm, ½-watt carbon resistor
R3—1-megohm linear taper potentiometer (Mallory U-54)
RL1—Sigma 4F relay, adjusted to pull in at 2 ma.
S1—S.p.s.t. toggle switch, 120-volt, 3-amp. type
SR1—65-ma., 117-volt selenium rectifier
T1—Transformer, 25.2-volt, 1-amp. secondary, primary 117 volts a.c. (Stancor P-6469)
TR1, TR2—Transistor (Marvelco Type J1 or equivalents such as G.E. 2N76, G.E. 2N45, or RCA 2N109)
1—4" x 5" x 6" grey hammertone aluminum cabinet (ICA #29812)
1—3" x 6⅛" x 1¼" aluminum chassis, miniature open-end type (ICA 29080, cut down to fit)
1—1⅝"-diameter lens, 3⅝" focal length, in plastic frame (Lafayette Radio Corp. Catalog #F-46)



Schematic and parts list for the photo-relay.



Parts of the photo-relay are interconnected as shown in this pictorial diagram.

the beam is interrupted by an intruder. For this kind of application, the *normally open* contacts are brought out to two insulated binding posts at the rear of the case. For the reverse action, the *normally closed* relay contacts may be brought out to the posts.

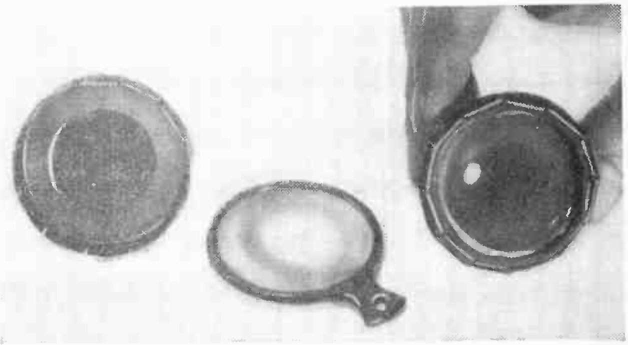
Light Source. The light source case contains the 6.3-volt, 6-ampere filament transformer and a double-filament 32-candlepower auto headlight lamp. The headlight socket is held between the jaws of a #27 battery clip so that either filament is

(*Continued on page* 120)

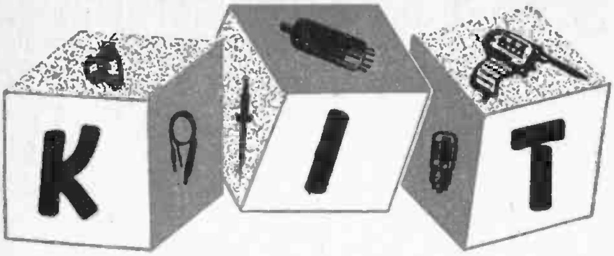
HOW IT WORKS

An infrared light beam will develop a voltage across a NATFAB silicon cell. The current in the transistor (*TR1*) base-emitter circuit is very small and very little collector current flows. Bias on *TR1* is established by setting the control *R3*, and is adjusted so that the collector current of the second transistor, *TR2*, is too small to pull in the relay.

Interruption of the infrared beam removes the bucking voltage developed by the silicon cell. A current then flows through the base-emitter circuit of *TR1*, increasing the collector current. This current produces a voltage drop across the *R2-R3* combination which reduces the bias on *TR2*. Its collector thus passes enough current to pull in the relay armature.

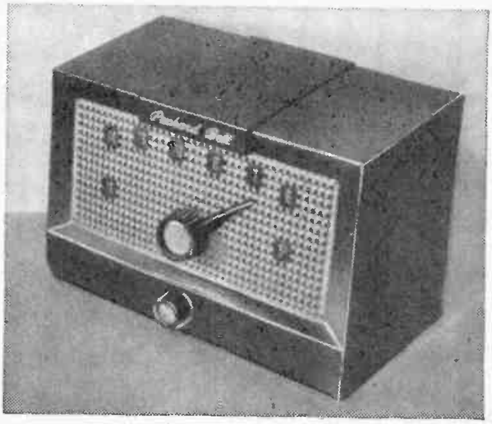


Assembly of the infrared optical system. The frame of the lens (center) is snipped off with diagonal pliers, and the lens set into the flange of the infrared filter holder (left). A piece of spaghetti tubing, about 1/8" in diameter, is fitted around the edge of the lens, and the serrations of the flange are then bent inward to hold the lens in place (right).



KIT BUILDER'S KORNER

Packard-Bell 5R1 Kit 540-1620 kc. Receiver



OKAY! OKAY! OKAY! We surrender! Here it is—at long last! A new monthly department devoted exclusively to the thousands of our readers who build electronic equipment from kits! You've been asking for this particular editorial treatment. According to your claims, it will assist you in making your selection of kits to build, trusting our judgment to bring to light any glaring deficiencies or assembly difficulties.

With the above thoughts in mind, we have designed "Kit Builder's Korner." Each month we will review two or more kits. Some of them will be brand-new, some will have been on the market for a while, and some will be mentioned because they are unusual. All of them will have been built by writers assigned to the POP'tronics staff, and all of them will meet our basic standards. We will be looking for utility, performance, lack of tricky wiring and, finally, dollar value.

Kits to be reviewed will not be chosen in any particular order. Editorial presentations will be made on the basis of reader requests. So, if you have a kit in mind, drop us a card and we will try to fit it in.

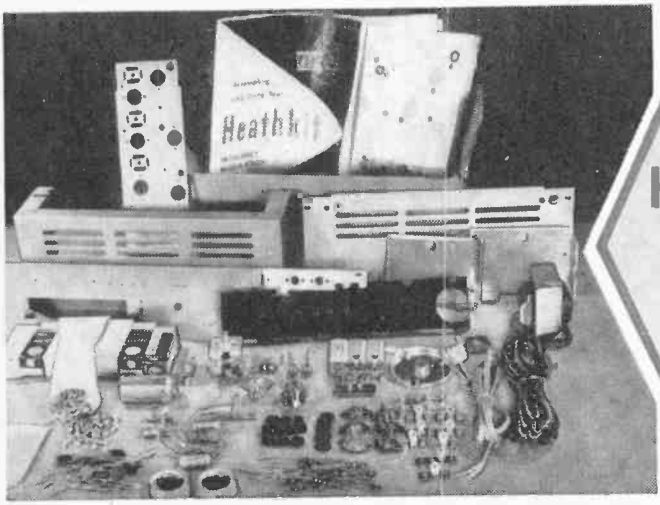
THE 5R1 KIT

The first report this month concerns the Packard-Bell Model 5R1 receiver kit, distributed by the Electronic Kits Supply Co., 1727 Glendale Blvd., Los Angeles 26, Calif.

Model 5R1 is a five-tube superheterodyne receiver, covering the AM broadcast band (540 to 1620 kc.). Miniature tubes are used throughout, including a 12BE6 converter, a 12BA6 i.f. amplifier, a 12AV6 detector-first audio, and a 50C5 power output tube, delivering a maximum of 1.7 watts to a 4" PM loudspeaker; d.c. voltage is supplied by a 35W4 half-wave rectifier.

Tube filaments are connected in series, with the set designed for operation from 110-120 volts a.c. or d.c. Power consumption is 26 watts. A built-in loop antenna is employed, but provision is made for connecting an external antenna if you wish.

Putting It Together. There's nothing unusual about the circuit employed . . . it is a minor variation of the circuit used in building literally hundreds of thousands of a.c/d.c. five-tube superhet receivers . . . one so popular, in fact, that it is sometimes called an "All-American" circuit.



Heathkit FM-3A Kit 88-108 mc. Receiver

The FM-3A is designed to fit same cabinet dimensions as the Heath WA-P2 preamp and BC-1 AM broadcast-band tuner. They may be stacked as shown.

When you open the package, do not be surprised at the lack of small hardware. Very little will be needed. The i.f. transformers are "snapped" in place with clips, tube sockets have been pre-riveted in position, and a minimum of screws are used for mounting other parts. As a result, the mechanical assembly is quick and easy.

The pictorial diagram supplied is quite adequate and wiring is straightforward. No particular troubles should be met.

Special Features. There are several impressive things about this kit. First, assembling a kit around a standard, commercially available receiver (the Packard-Bell 5R1) is a good idea. When the assembly is finished, the builder actually has a commercial receiver—something he can be proud to own and use. Outside appearance of the completed receiver and cabinet is attractive.

Instead of the usual "step-by-step" assembly instructions, simple experiments and tests are outlined for the builder to follow at various stages during wiring. Thus, this kit has real educational value . . . but without distracting from the fun of assembling a commercial receiver. You can skip these steps if you want and go right ahead with assembly, but for the student and learner, the tests represent a sort of extra "bonus."

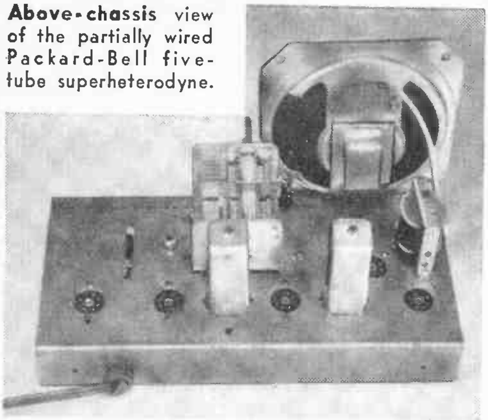
Finally, alignment is completely noncritical. In fact, the receiver will generally work when first turned on. Of course, the alignment of any superhet should be checked with a signal generator, but the Packard-Bell 5R1 requires relatively few adjustments. The i.f. transformers have already been "peaked" to maximum output at 455 kc., using a modulated r.f. signal; the oscillator trimmer has been peaked at 1620 kc., with the tuning capacitor plates open, and the r.f. trimmer has been peaked at 1500 kc., with the plates partly meshed.

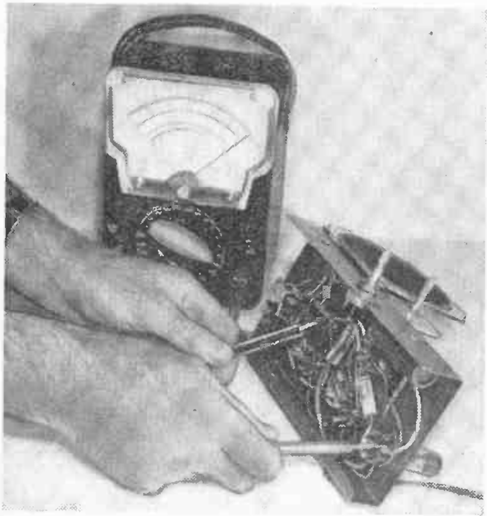
Comment. The Model 5R1 kit is a good buy at the advertised price of $11.95. It is suitable for the advanced worker who wants another home receiver . . . or as a "first superhet" project for a beginner who has cut his eyeteeth on a crystal set and a couple of one- or two-tubers.

THE FM-3A KIT

Our second report is about the Heathkit FM-3A tuner. The FM-3A is the Heath Company's latest model frequency modulation tuner kit, superseding all of

Above-chassis view of the partially wired Packard-Bell five-tube superheterodyne.





Point-to-point wiring can be used below the chassis of the Model 5R1 receiver. A few checks with an ohmmeter will double-check your progress.

this company's previous models. Some refinements have been added and some deficiencies corrected. Automatic gain control has been built in and the oscillator is carefully stabilized by temperature-compensated components.

Model FM-3A uses a 6BQ7A in a sensitive cascode r.f. stage, followed by a 6U8 mixer and oscillator. Two i.f. stages with 6CB6 tubes drive a 6AL5 ratio detector. This all feeds a 6C4 audio stage with provisions for a hi-level or lo-level output. The rectifier is a 6X4. The FM-3A must be used with an external antenna—preferably one composed of 300-ohm twin-lead.

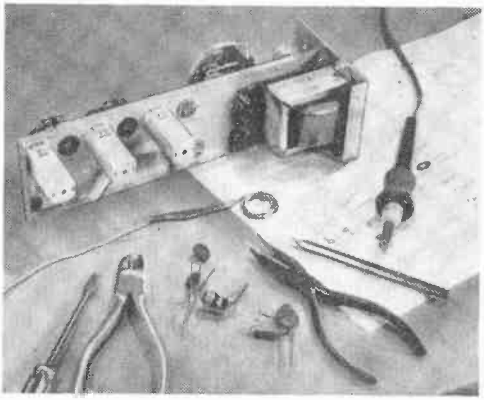
Putting It Together. The construction has been broken down into discrete sections consisting of first mounting the hardware (this took about 46 minutes) and then getting involved in the wiring. We earnestly recommend that the wiring be split up between several evenings. After about three hours, you find your work getting sloppy—and in an FM tuner that may mean trouble. Total wiring time here was 9 hours and 50 minutes.

The last phase is installing the dial plate and back plate with output jacks. Also included is the business of putting on the dial cord, which can be a maddening job—ask any radio-TV technician. You can win this battle in 10 minutes, but most likely it will take close to 30 minutes.

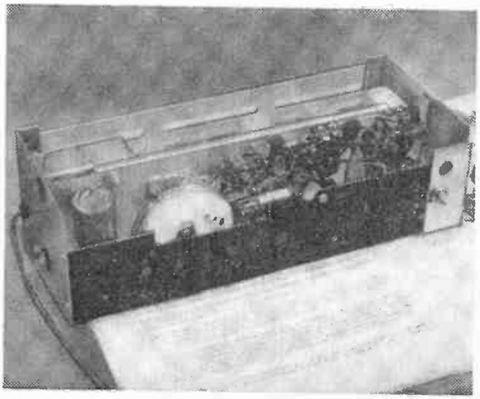
Putting on the top, bottom and front covers will take another 25 minutes, bringing the construction time to a grand total of about 11 hours and 30 minutes. This may be a little under par for the course, so don't be too exasperated if it takes you closer to 13 hours.

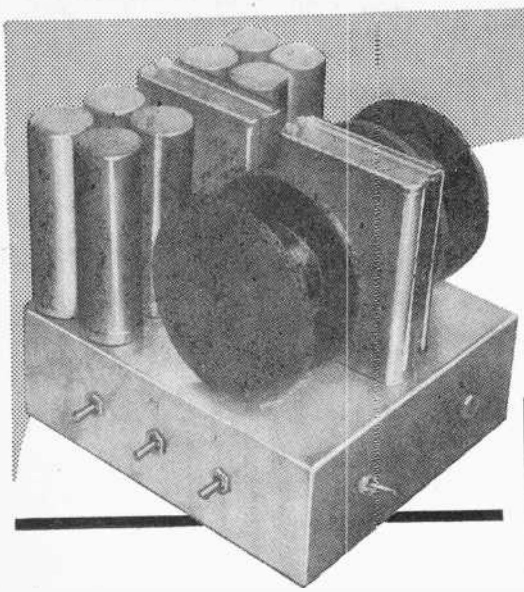
Special Features. We are impressed by the Heathkit packaging. It seems utterly miraculous that so many parts can be compressed into such a small box. But, it is done, and we dare you to try and reassemble their packaging.

(*Continued on page* 130)



The Heathkit chassis is fashioned to permit access to all spots where wiring might be difficult. The constructor follows a step-by-step program to finish up with a completely wired receiver.

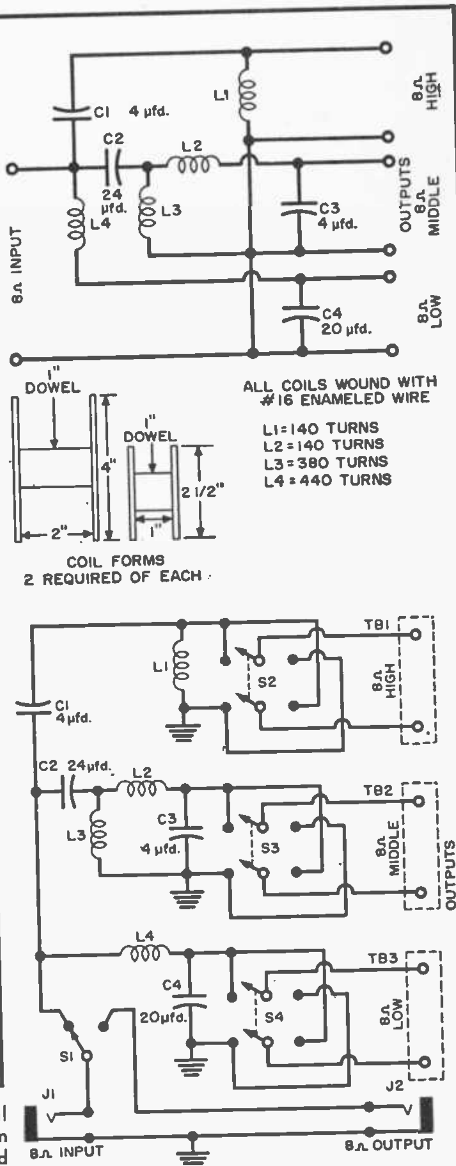




By ROBERT J. MURRAY, W1FSN

Double-Duty Crossover

Home-Built Network Serves in Hi-Fi Systems and Ham Communications



Schematic diagram at upper right shows original circuit and coil-winding data for network. Diagram directly at right shows same circuit with jacks and switches added to provide "double-duty" feature.

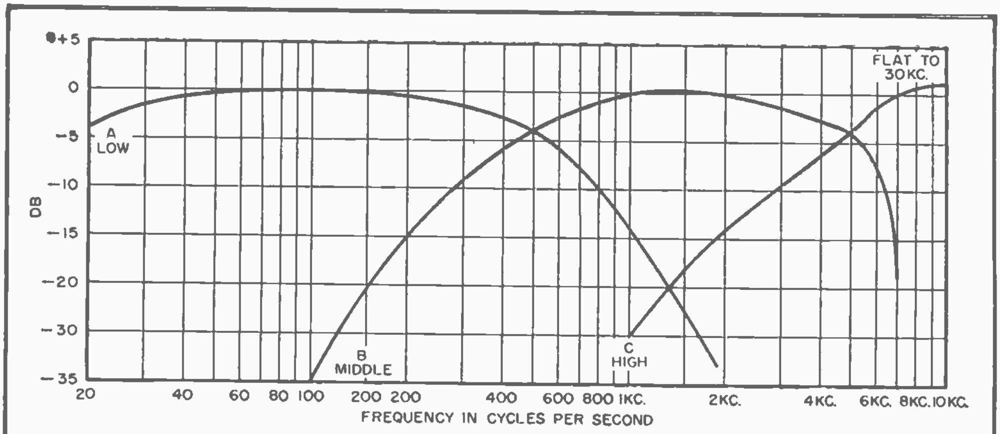
MANY RADIO AMATEURS interested in hi-fi must often get their installations to do double duty as communications systems as well as radio phonograph setups. The conflicting requirements can be met by creating a three-way speaker system.

On hand was a National Horizon 20-watt amplifier and three loudspeakers—a 15" speaker in a suitable enclosure, a 10" speaker similarly enclosed, and a 5" cone tweeter.

Dividing Network. The first "must" was a dividing network for furnishing suitable crossover points so that each speaker would handle the frequencies for which it was primarily designed. Paper capacitors were chosen for this network because, as a rule, they tend to be more correct as to their indicated capacity than do electrolytics. Paper capacitors also maintain a more nearly uniform capacity.

Coils for the network were wound by hand. The spools for the coils were made from sections of an old broom handle, to whose ends plywood flanges were attached with brass wood screws.

The components were then wired to-



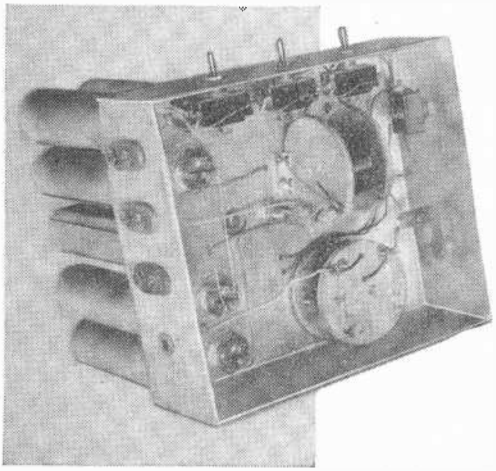
Graph shows response curves of home-built "double-duty" crossover network.

gether on a table top and the amplifier connected.

Unexpected Effects. Then came the inevitable messing around with placement of the speakers, phasing, and cutting speakers in and out of the circuit. The effects were duly noted and the network was then connected to the 8-ohm output of the HRO-60 communications receiver, more as an anticlimax than anything else.

This receiver, of course, is far from high fidelity—which is what we expected. But what we didn't expect was the effect that the speaker system provided in the readability of the various phone and c.w. signals in the presence of QRM and QRN by switching one or more speakers in and/or out of the circuit.

Under-chassis view of crossover network. Coils are oriented as shown to prevent coupling between them. Note how toggle switches used for speaker phasing are mounted on chassis apron. Terminals for speaker connections are shown on left apron of chassis, with jack for 8-ohm output next to them. Jack for 8-ohm input is on opposite apron, together with S1. Functions of parts are given in text.



It was possible to compensate, with the various speaker combinations, for the characteristic of the received signal—be it high, medium or low or a combination of any of the above on phone work. With c.w., it was possible to place a signal into any of the speakers at will, to the detriment of QRM and QRN.

In the final version of the network, provision has been made to use any or all of the three speakers with the network's cutoff and crossover potentialities, or a separate "all-around" speaker for comparison purposes. While the unit cannot compare with the more selective crystal filter or low-frequency i.f. strings, it does contribute to much more intelligible communications work.

Switching Gimmicks. To make things somewhat easier for the uninitiated, the switches have been labeled "phono" so that various members of the household will not offend our golden ears by neglecting some of the audio spectrum when using the unit for playing records.

The three d.p.d.t. switches shown have an off-center position, so that any or all of the speakers can be switched in or out of the system. The reversing feature was included so that the phasing of the speakers could be changed for the benefit of the Doubting Thomas perfectionist, of which there is always one, who will swear that the speakers are not working in phase.

This unit can be made somewhat smaller by the use of lower working voltage capacitors. We used the 600-volt type because they are a handy value to have around—and who knows when a capacitor in the 75-watt rig might break down, making it necessary to snitch one for emergency replacement! —30—

Front view of the "Audio Photometer." Note size comparison with conventional light meter shown at its right.

Transistorized Audio Photometer

IN SCIENTIFIC RESEARCH, one of electronics' most important jobs is converting energy from one form to another so that it can be conveniently measured by standard instruments. Most electronic instruments use a meter as the indicating device. But here's a really off-beat instrument—a light meter or "photometer" which employs *sound* to indicate the light level. In use, light falling on a sensitive photocell is converted into an audible signal, heard from a subminiature loudspeaker. The more intense the light, the higher the frequency (pitch) of the audio note.

The "Audio Photometer" has many potential applications. You'll find such an instrument valuable for scientific demonstrations or as an electronic toy. An experienced photographer could learn to approximate his camera settings on the basis of the audio note heard, a paint salesman could use the instrument for demonstrating the difference in the "whiteness" of different samples, and so on.

Construction. Circuit details are given in the schematic diagram. Only standard, readily available components are needed, and neither parts arrangement nor lead dress is critical. You can follow the general layout of the model, as shown in the photographs, or make up a new layout.

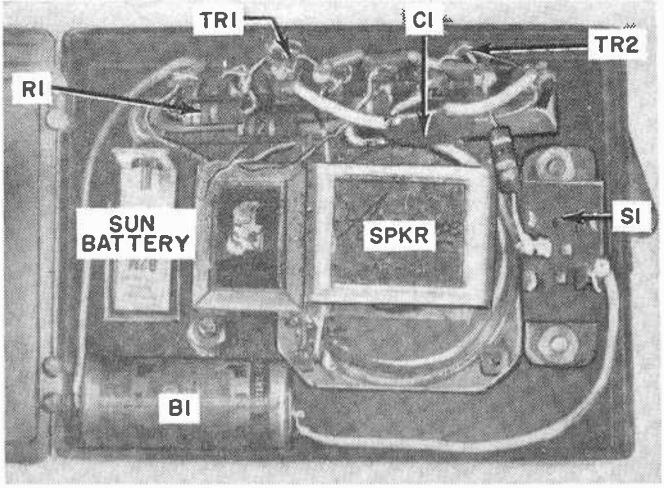
A transparent plastic case was used in assembling the model. You can obtain a professional appearance by spraying colored Krylon plastic on the *inside* of the case. A "window" for the selenium photocell may be made by covering a small area of the plastic with masking tape before spraying.

Construction and wiring are simplified by mounting all small components along an eight-position terminal strip. The transistors are wired permanently in position. You can use a similar scheme, or provide

HOW IT WORKS

The audio photometer uses two *p-n-p* junction transistors as common-emitter amplifiers. The first stage is coupled to the second stage through capacitor *C2*. Output of the second stage is coupled back to the input of the first stage through capacitor *C1*, which supplies the in-phase signal feedback necessary to sustain oscillation. Unbypassed emitter resistors *R1* and *R4* raise the effective input impedances of their respective stages. Base bias for the second stage is supplied through *R3*.

In operation, the bias for the first stage is determined by the selenium Sun Battery connected between the base electrode and circuit ground. When the Sun Battery is dark, a low bias is applied to the first stage and the oscillator operates (multivibrates) at a low frequency. As more and more light falls on the photocell, the bias applied to the first stage increases, and the frequency of operation goes higher and higher.



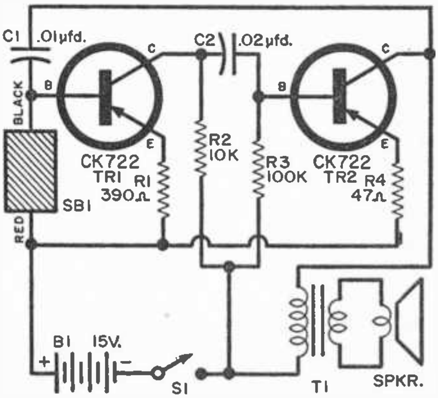
Interior view of photometer, with small parts and transistors wired directly to terminal strip. See the schematic diagram and parts list at right.

separate transistor sockets. Make the connections to the battery by soldering leads directly to its terminals. Avoid overheating the battery.

Using the Photometer. Hold the unit so that the light to be measured falls on the photocell. Close *S1*, and listen to the audio tone produced. The lower limit may be determined by operating the instrument in the dark. The upper limit may be determined by exposing the photocell to an extremely strong light . . . that is, by holding it close to a lamp bulb or by exposing it to full noon sunlight. Do *not* hold the unit close to a "spotlight" type bulb or other source of heat, however. Overheating the photocell, the transistors, or the battery would probably damage these components. —*Luis Vicens*

PARTS LIST

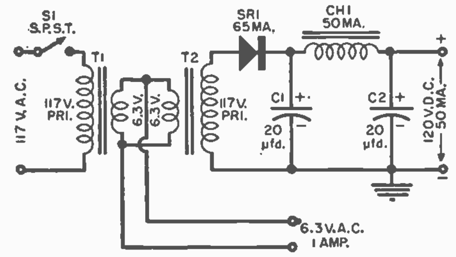
B1—15-volt miniature battery (Burgess Y10)
C1—0.01-µfd. disc ceramic capacitor
C2—0.02-µfd. disc ceramic capacitor
R1—390-ohm, ½-watt carbon resistor
R2—10,000-ohm, ½-watt carbon resistor
R3—100,000-ohm, ½-watt carbon resistor
R4—47-ohm, ½-watt carbon resistor
S1—S.p.s.t. slide switch
T1—Transistor output transformer, 2000 ohms to 10 ohms (Argonne No. AR-96)
Spkr—Subminiature PM loudspeaker, 10-ohm v.c. (Argonne No. AR-95)
Sun Battery—Selenium cell (International Rectifier Corp. No. B2M)
TR1, TR2—Type CK722 transistor (Raytheon)
2—Transistor sockets
1—Perforated Bakelite board
1—Small plastic case
1—8-position terminal strip
Misc. machine screws, nuts, soldering lugs, wire, solder, etc.



Power Supply Made from Filament Transformers

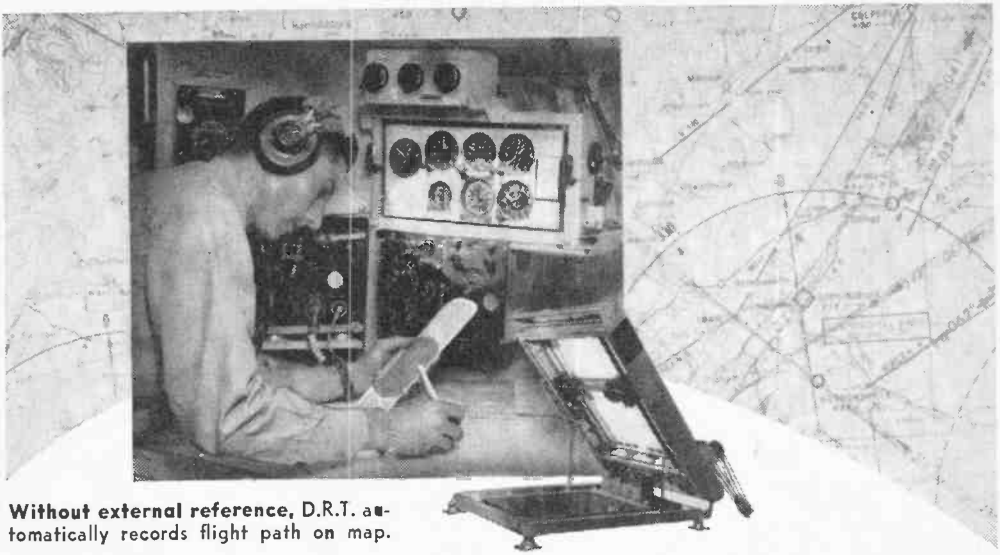
You can build a good power supply that will deliver 120 volts d.c. at up to 50 milliamperes—as well as 6.3 volts a.c. at a conservative 1 ampere—from a couple of ordinary 6.3-volt filament transformers. One of these should be rated at about 3 amperes, the other at about 1.2 amperes. No rewinding of the transformers is necessary and, with the setup shown in the diagram, both outputs are isolated from the power line.

A voltage of 117 volts a.c. is fed to the primary of *T1*, the transformer rated at 3 amperes. The voltage is stepped down to 6.3 volts in this transformer and then fed to *T2*, the transformer rated at 1.2 amperes. It is stepped up to 117 volts again in *T2*, rectified by selenium rectifier *SR1*, and filtered by capacitors *C1* and *C2* and filter choke *CH1*. Heater power is tapped off at the 6.3-volt link between the two transformers. —*Frank H. Tooker*



Schematic diagram of the power supply.

Where Are We?—Ask D.R.T.



Without external reference, D.R.T. automatically records flight path on map.

With no radio beacon to guide them, sun or stars hidden, and no landmarks below, the Navy patrols flying over vast ocean areas have often felt literally as if they were between the devil and the deep blue sea. The sea, of course, is Navy men's eternal companion. But the devil that beset them in this kind of flying has just been kicked overboard by Servo Corporation's new Dead Reckoning Tracer, called "D.R.T." for short.

This new computing device always has a fast answer to the vital question: "Where are we?" No longer does the navigator need to make his long, involved computations while perhaps the plane heads for nowhere and the fuel runs low. The D.R.T. marks the plane's course through the void as though it were letting out a string behind it.

Compass headings tilt, yaw and speed changes are sensed by gyroscopes, which respond to the plane's motion in all directions, and translate the motion into corresponding voltages. From these voltages, the D.R.T. draws a map of the plane's flight on an automatic plotting board.

Despite radio silence, clouded skies, and a criss-cross flight pattern, a single glance at the D.R.T. board will tell the navigator at any moment his present position and the quickest way to where he wants to go.

Doggone Electronics

Modern house planning, which allows for everything from the children's play space to the electric dryer, has neglected one important need—a place for Fido. What with the disappearance of basements, and the use of carports instead of garages, there's no place at home for delicate dogs these days.

Bob Elmore of Tulsa, Oklahoma, an electronic technician, found the answer to this problem by creating an electronic doghouse, the latest thing in dog living, for his two toy Manchesters who get the shivers at temperatures below 75°.

Built of plywood with aluminum roofing, the doghouse has electronically controlled heat. Two wall heating elements and floor pads are controlled by three thermostats. One thermostat regulates the first unit, keeping the temperature at 80°. The second thermostat and unit throw in extra heat in cold weather while the third thermostat serves as a fire alarm. Our picture shows Bob explaining this to one of the doghouse's inhabitants.—*Phyllis Braunlich*

Buttoned up and ready to go, the "21 Special" presents a clean and modern appearance. With it, you can work world-wide DX on the 21-, 27- and 28-mc. bands.

The 21 SPECIAL

By

WILLIAM I. ORR, W6SAI

Here's a 70-watt transmitter designed for today's Novice, tomorrow's General Class ham

"*WELL, Tommy, are you ready to start work on your 21-mc. rock-crusher tonight?*" I asked the young Novice who circled into my driveway on his bicycle. "*If you are, let's get to work!*"

"*Sure thing,*" replied Tommy, standing his bicycle against the fence and taking off his leg clips. "*It's pretty hard to work DX with my 20-watt peanut whistle, even with the beam.* Gee, I wonder how many of those watts actually reach the antenna. Not many, I'll bet.*"

"*Oh, I'd say about six or seven, at the most. That transmitter has a 6L6-G doubling to 15 meters, and the efficiency isn't much over 30% or so. You're just a pipsqueak in the background noise. You really need a serious, TVI-proof transmitter with some real power instead of that toy.*" We walked into the garage workshop and I handed Tommy the schematic of the proposed transmitter. "*Sit down on that stool, and I'll give you the story of the '21 Special'!*"

Intended for the Novice or the newly licensed General Class amateur, the "21 Special" is capable of 70 watts input on the 21-, 27- and 28-mc. amateur bands. World-wide DX can be worked on these interesting, long-distance bands, and the "21 Special" is designed particularly for those amateurs who have had some experience in building their own equipment. It is completely TVI-suppressed, and delivers over 50 watts to the antenna on each of the three bands.

A 6AG7 (*V1*) harmonic oscillator employing inexpensive 7-mc. crystals is capacity-coupled to a 6146 (*V2*) beam tetrode, working as a class C amplifier. The correct harmonic of the crystal is selected by the resonant circuit *C3-L2*. In the plate circuit of *V2* is a pi-network coupler capable of match-

No pictorial has been included with this article. We do not suggest that the Novice Ham construct this unit as his "first" transmitter. Before tackling such a project, the Novice should attempt to gain wiring experience and knowledge on how to tune up a transmitter. While the circuit is foolproof, a little extra know-how—principally gained through experience—should be sought first.

The Editors

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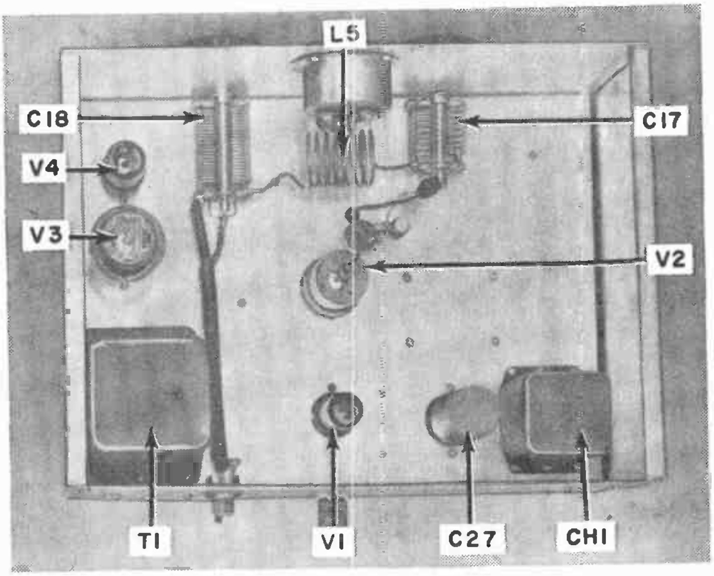
* See "A Beam and Tower for the 15-Meter Novice" which appeared in the November, 1956, issue, page 78.

ing the amplifier to either a 52-ohm or a 75-ohm coaxial transmission line. The pi-network tunes from 20 mc. through 32 mc., eliminating the necessity of coil switching. Amplifier tuning is done by capacitor *C17*, and antenna loading is controlled by capacitor *C18*. Stable operation of the amplifier is insured by complete parasitic suppression in the grid and plate circuits (*R4*, *L3* and *R9*, *L4*).

Plate power for both stages is provided by a dual-voltage supply utilizing a new Chicago-Standard transformer. The oscillator stage requires 300 plate volts, and the amplifier requires 600 volts. A 6AX5 (*V4*) is employed for the low-voltage rectifier, and a 5R4-GY (*V3*) is used for the high-voltage rectifier. For standby purposes, the two high-voltage circuits are broken by *S3*, permitting the transmitter to come on as soon as the switch is closed.

Grid and plate current of the 6146 amplifier tube are measured by a unique multiplier circuit, permitting both readings to be made on a single 0-1 d.c. milliammeter. Full-scale reading of the meter in the grid (*Ig*) position of *S2* is 3 ma., and full-scale reading in the plate (*Ip*) position is 200 ma. Normal grid current should read about 0.5 on the meter (1.5 ma.), and normal plate current should read about 0.6 on the meter (120 ma.).

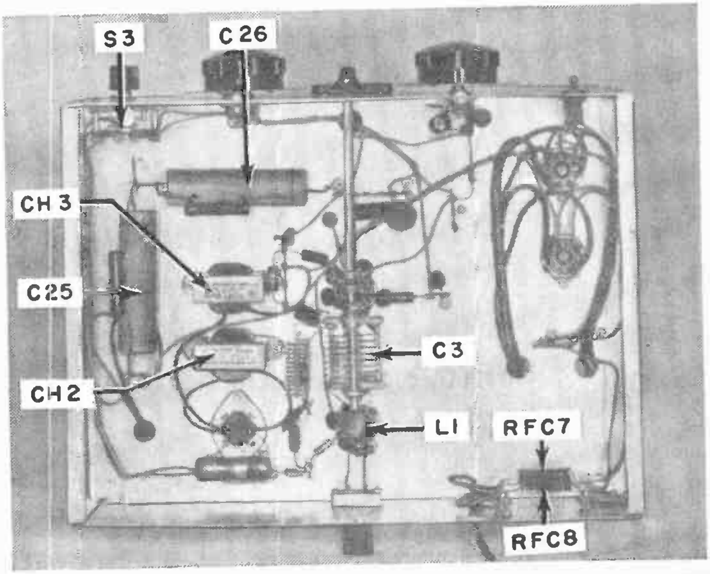
You can achieve maximum TVI-suppression by placing r.f. filters in the main power leads to the r.f. stages, in the keying circuit, and in the 117-volt a.c. power line. Housing the transmitter in the new LMB shielded cabinet will provide complete shielding.



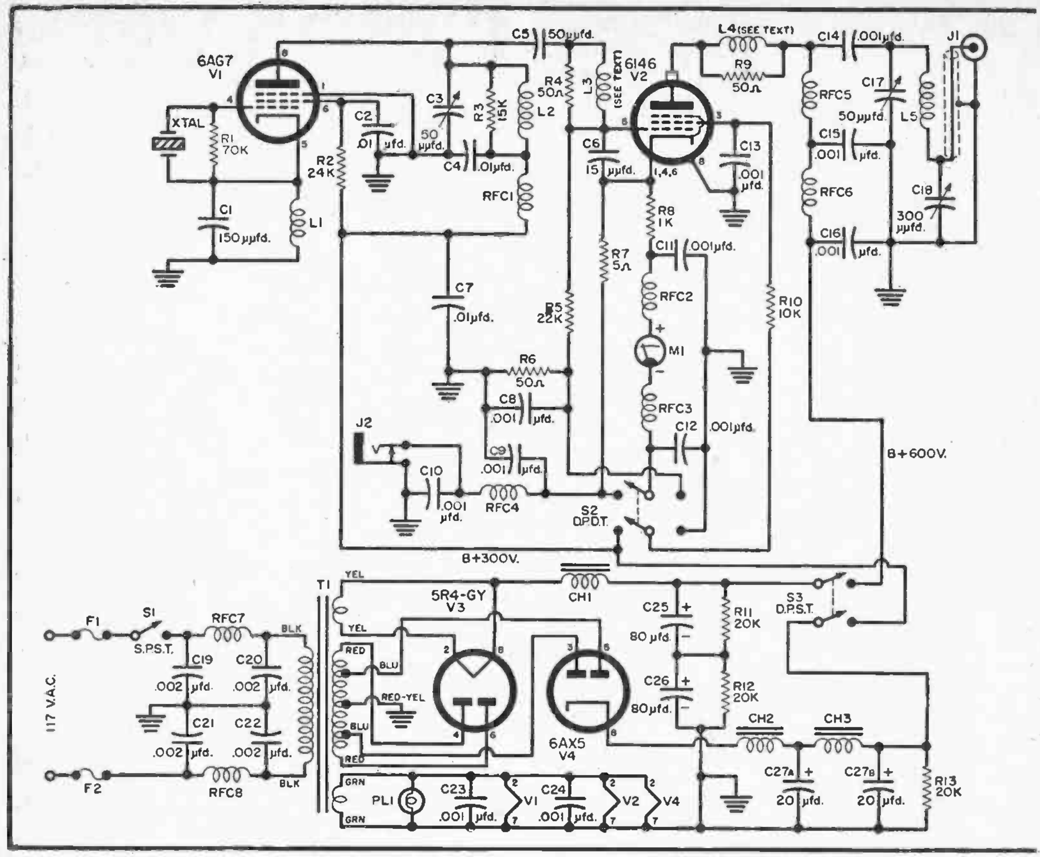
"No TVI, huh?" asked Tommy. *"My present rig makes Jackie Gleason look like he's playing behind bars!"*

"You may need a TVI filter in the coaxial antenna lead of the transmitter to prevent the harmonics from sneaking out that way; otherwise, the rig is as clean as a whistle. If you have a TV set that is near the transmitter, a high-pass filter in the antenna lead of the modulated milk bottle will keep your 21-mc. r.f. out of the innards of the set."

"Roger," said Tommy. *"Sounds swell. Now, just*



Top and bottom views of the chassis are shown in the photos above and at right, respectively. No effort has been made to economize on space nor is special shielding required to insure foolproof TVI-free operation. Principal components are identified to assist you in assembling the transmitter along the lines described in the text. The only really critical dimension is the spacing between the sockets of V1 and V2, as the oscillator tuning capacitor, C3, is mounted on spacers and long bolts through the socket mounting holes.



how do I go about putting the '21 Special' together?"

Placement of the major components may be seen in the above- and below-chassis photographs. The only really critical dimension is the spacing between the two r.f. tube sockets, as the oscillator tuning capacitor, *C3*, is mounted on spacers and long bolts that pass through the socket mounting holes.

The power supply should be wired first, up to standby switch *S3*. When this section of the transmitter is completed, check the wiring and test the supply. Without the r.f. tubes, the high-voltage supply should measure about 800 volts, and the low-voltage supply about 350 volts. When the transmitter is in operation, these voltages drop to normal values.

Wire the filament circuits of the r.f. tubes next, and make the circuit grounds at each tube socket. Oscillator cathode coil *L1* should be connected directly to pin 5 of the 6AG7 socket, and the 150-μμfd. capacitor, *C1*, wired across the leads of the coil. Wire the 15,000-ohm, 1-watt composition loading resistor, *R3*, directly across the oscillator plate coil, *L2*.

Then wire the 6146 stage. Note that capacitor *C6* is connected directly between pin 4 and pin 5 of the 6146 socket, using very short leads. Other wiring of the amplifier stage is straightforward. Coil *L5* is air-wound from a length of No. 10 tinned copper wire. The spacing between the turns may easily be adjusted, if necessary. Coil *L5* mounts directly between the stator of the plate tuning capacitor, *C17*, and the stator of the antenna loading capacitor, *C18*. Connect the antenna receptacle, *J1*, to *C18* by a short length of 52-ohm coaxial cable. Ground the cable's shield to the chassis at each end.

Finally, wire *S2* and the meter. Make a meter shield from the end of a tin can large enough to slip over the meter. Bend the edges of the can to fit flush against the panel of the transmitter. Then drill two holes in the end of the can to pass the meter studs, which are insulated from the can by a pair of rubber grommets. This simple but effective meter shield is held to the panel by three *4-40* machine screws. Mount chokes *RFC2* and *RFC3* on a two-terminal phenolic insulating strip soldered to the back of the can. Bypass capacitors *(C11* and *C12)* for the meter leads should also be soldered to the can.

"That will go together easily," exclaimed Tommy. *"A few evenings' work, and it should be ready to go on the air."*

"Not so fast, young feller," I replied. *"Let's take the tune-up process step by step before you go off half-cocked. You*

Schematic diagram of the "21 Special" is given at left; parts list appears below. Maximum TVI-suppression is achieved in this well-designed transmitter by placing r.f. filters in the main power leads to the r.f. stages, in the keying circuit, and in the 117-volt a.c. power line.

C1—150-μμfd. mica capacitor
C2, C4, C7—0.01-μfd. ceramic disc capacitor
C3, C17—50-μμfd. variable capacitor (Bud MC-1863)
C5—50-μμfd. mica capacitor
C6—15-μμfd. ceramic disc capacitor
C8, C9, C10, C11, C12, C13, C23, C24—0.001-μfd. ceramic disc capacitor
C14, C15, C16—0.001-μfd., 1-kv. capacitor
C18—300-μμfd. variable capacitor (Bud MC-1860)
C19, C20, C21, C22—0.002-μfd. ceramic disc capacitor
C25, C26—80-μfd., 450-volt electrolytic capacitor (Sprague TVA-1716)
C27—20-20 μfd., 450-volt electrolytic capacitor
CH1—10-hy. @ 150 ma. choke (Chicago-Standard C-2335)
CH2, CH3—7-hy. @ 50 ma. choke (Chicago-Standard C-1227)
F1, F2—2-amp. fuse in 117-volt line plug
J1—Coaxial receptacle (S0239)
J2—Closed-circuit jack
L1—8 turns of No. 16 wire, 1" diameter, ½" long (B&W 3015)
L2—12 turns of No. 16 wire, ⅝" diameter, 1½" long (B&W 3006)
L3—3 turns of No. 18 enameled wire wound on 50-ohm, ½-watt resistor (R4)
L4—3 turns of No. 18 enameled wire wound on 50-ohm, 1-watt resistor (R9)
L5—8 turns of No. 10 wire, 1⅜" inside diameter, 2" long
M1—0-1 d.c. milliammeter, 55-ohm resistance (Triplett 221, 2" square)
PL1—6.3-volt pilot light with holder (Johnson 147-300)
R1—70,000-ohm, 1-watt resistor
R2—24,000-ohm, 1-watt resistor
R3—15,000-ohm, 1-watt resistor
R4, R6—50-ohm, ½-watt resistor
R5—22,000-ohm, 2-watt resistor
R7—5-chm, ½-watt resistor
R8—1000-ohm, 1-watt resistor
R9—50-ohm, 1-watt resistor
R10—10,000-ohm, 2-watt resistor
R11, R12, R13—20,000-ohm, 10-watt resistor
RFC1—2.5-mhy. r.f. choke (National R-60)
RFC2, RFC3—20 turns of No. 28 enameled wire close-wound on 1-megohm, ½-watt resistor
RFC4, RFC6, RFC7, RFC8—20 turns of No. 18 enameled wire, close-wound, ½" diameter
RFC5—2.5-mhy. r.f. choke (National R-100U)
S1—S.p.s.t toggle switch
S2—D.p.d.t. slide type switch (Carling S-316)
S3—D.p.s.t. rotary switch (Centralab 1404)
T1—Transformer, to deliver 650 volts @ 150 ma., 315 volts @ 60 ma., 6.3 volts @ 3.5 amperes, and 5 volts @ 2 amperes; 117-volt primary (Chicago-Standard PC-8307)
V1—6AG7 tube
V2—6146 tube
V3—5R4-GY tube
V4—6AX5 tube
Xtal—7-mc. crystal
1—9" x 11" x 15" TVI-suppressed cabinet (LMB #159-11)
Misc. tube sockets, line cord, hardware, etc.

don't want to rush into this project and blow up the whole works, do you?"

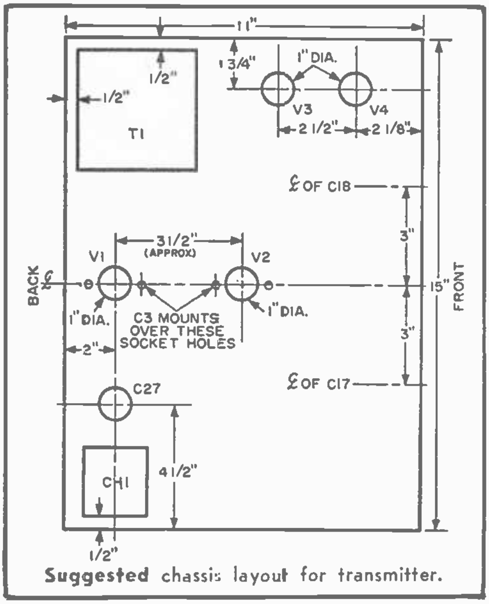
Plug all the tubes in their proper sockets, and place *S2* in the grid position. This removes screen voltage from the 6146 stage for tune-up purposes. Attach a 75-watt lamp bulb to the terminals of *J1* to act as a dummy antenna. Open *S3*, and place *C3*, *C17*, and *C18* at maximum capacity. Insert a 7-mc. crystal (frequency between 7031 kc. and 7082 kc. for the Novice 21-mc. region) in the crystal holder. Turn on *S1*. The pilot lamp should light, as well as all tubes.

Close *S3*, and note that a reading should be observed on the grid meter as *C3* is varied. Grid current should be observed at maximum and minimum settings of *C3*, corresponding to the third (21-mc.) and fourth (28-mc.) harmonics of the 7-mc. crystal. Set *C3* near maximum capacity, keeping the meter reading below 0.6 ma.

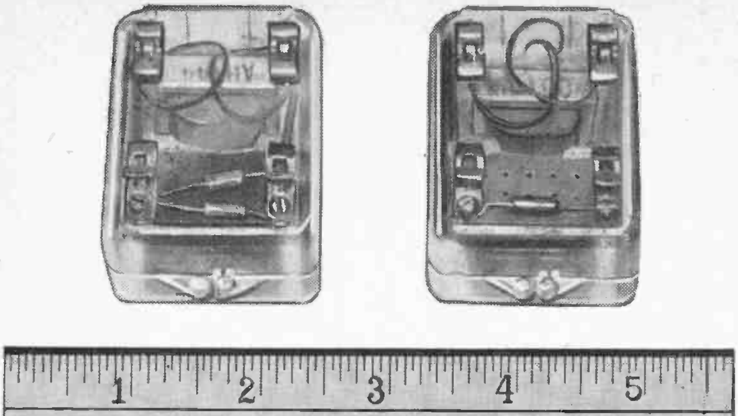
Next, open *S3* and switch *S2* to the plate current position. Close *S3*, and adjust the plate tuning capacitor, *C17*, for minimum current. Capacitor *C18* may be adjusted to bring the minimum plate current to 0.6 on the meter (120 ma.). Antenna loading and minimum plate current are both increased in value as the capacity of *C18* is decreased. Always re-resonate *C17* for minimum plate current after any adjustment is made to *C18*.

Now remove the lamp bulb, and attach the transmitting antenna to *J1*. The amplifier should be retuned for proper loading with this new load. Plug a key in *J2*, and the transmitter is ready for operation on 21 mc.

(*Continued on page* 118)



Suggested chassis layout for transmitter.



SUBMINIATURE A.C. Power Supplies

MOST experimental transistor circuits use batteries as the power source. Since rectified and filtered a.c. will do the job just as well, why should this be so? The reason is obviously the *size* of the average a.c. power supply. Certainly there is little sense in designing and constructing a tiny transistorized device and then tripling its size just to accommodate an a.c. power supply. What transistor experiments have needed very badly for a long time is a transformer that is more in keeping with the size and requirements of transistors.

A transformer is a transformer and, when it comes right down to facts, the transformer doesn't care whether it's handling audio or dropping the 117-volt line potential down to a value that's more easily digested by transistors.* Of the number of transistor audio transformers available, a few of those bearing the Argonne label meet the requirements nicely. Furthermore, they are miniature in size, and even in power supply applications they operate as cool as transistors themselves! The two power supply units to be described weigh only *two ounces* apiece.

Each of these power supplies is assembled in its own little plastic box. However, you can incorporate either in your own transistorized device. Just locate the power supply components right in your gadget wherever there is space for them. In most applications, the few miniature parts will take up no more space than the batteries they are replacing. The transformers and capacitors used in these truly miniature power supplies are available from any distributor of Argonne products.

Half-Wave Unit. The schematic of this supply is shown in Fig. 1. It measures only 2¼"x1¾"x1¼"; yet the inside of the box is far from crowded. (If a suitable enclosure were available, the supply could be assembled to much smaller dimensions.) Its performance is depicted in the graph. Open-circuit output voltage is 11.5 volts. When current is drawn, the output voltage becomes a function of the load. Thus, 6 volts is available at 6.5 ma., and 3 volts at 14 ma.

(*Continued on page* 122)

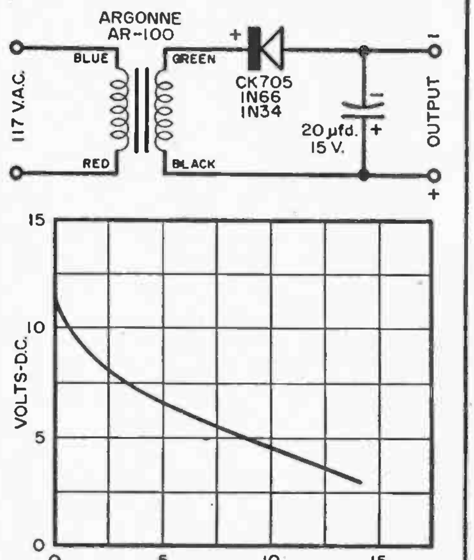


Fig. 1. Schematic diagram of half-wave supply and graph showing its performance.

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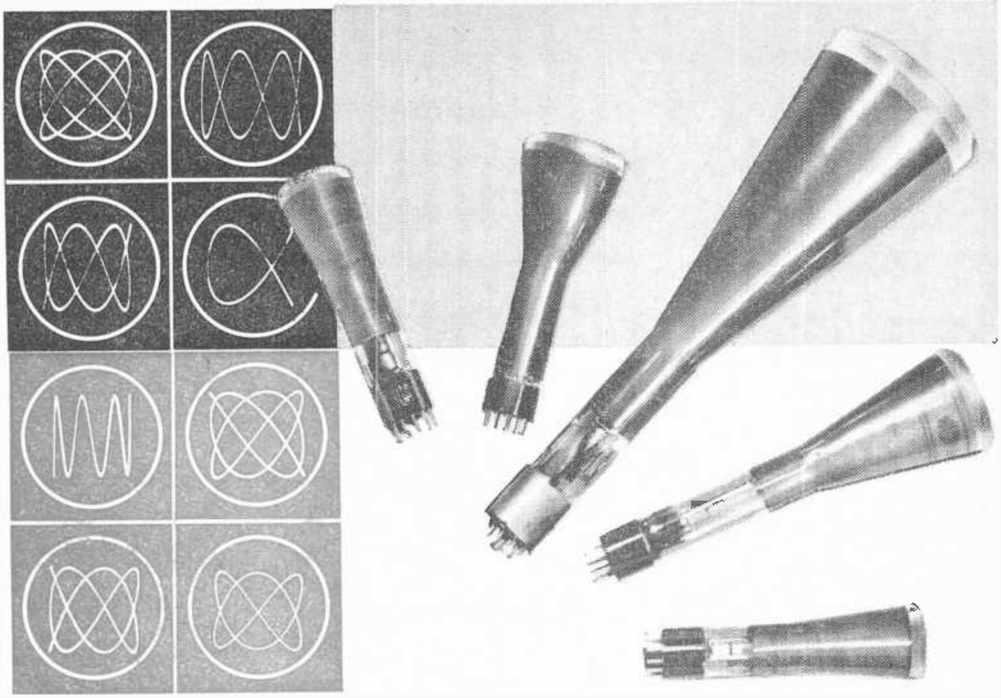
*Don't take just any audio transformer and slap 117 volts a.c. across it. There are a few catches involved: (1) the primary and secondary windings must be capable of handling their respective currents in the power application; (2) the primary impedance must be sufficiently high at 60 cycles to keep the no-load current at a minimum; (3) the iron core of the transformer must not run into saturation; and (4) the primary-to-secondary turns ratio must be such as to result in a secondary voltage which, after rectification and filtering, will be useful in transistor circuitry.



Lissajous Had a Figure For It

By HOWARD BURGESS

Century-old light pattern now serves as electronic yardstick

MEN ARE TRADITIONALLY attracted by figures with curves. A certain Frenchman named Lissajous, who lived around 1855, was no exception. He became an exception when he found that he could control these "figures with curves" in a dark room. He discovered that light reflected from two flat, rapidly rotating mirrors formed simple wave patterns when projected upon a screen.

This discovery set in motion a chain of developments culminating in the modern oscilloscope. Lissajous patterns on the oscilloscope screen measure sound frequencies or the rotary speed of a motor, tell whether a transmitter is multiplying frequency properly, check phase shift and distortion in hi-fi equipment, calibrate audio signal generators, and do many other jobs.

The light source for Lissajous' mirror-generated patterns was a simple candle. In place of a candle, the modern oscilloscope contains an electron gun in the narrow neck of the tube. This gun shoots about 6,000,000,000 electrons per second in a concentrated high-velocity beam toward the face of the tube. When the impact of this beam strikes the chemically coated face of the tube, it converts its energy into light, forming a small luminous dot.

Basic Traces. In its travel toward the tube screen, the electron beam must pass between two separate pairs of deflection plates capable of bending the path of travel. These correspond in their action to Lissajous' mirrors. An electrical signal or voltage applied to one set of the plates bends the beam up or down; a signal applied to the other set of plates bends the beam to the left or right, depending on the polarity of the signal. As the beam bends, the dot of light moves across the screen. Because it rapidly retraces its path and because the chemical used on the screen continues to glow for an instant after the dot has moved, the eye has the illusion of seeing a continuous and steady bright line rather than a fast-moving spot.

If different signals are placed simultaneously on each set of deflection plates, the beam makes a track like a Sunday driver. If the two signals have a fixed periodic re-

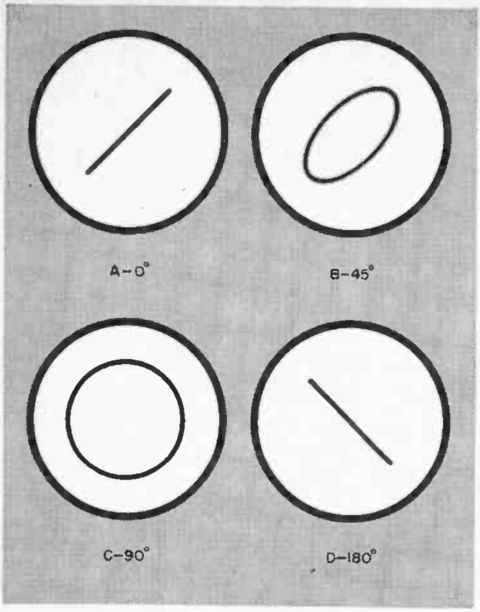
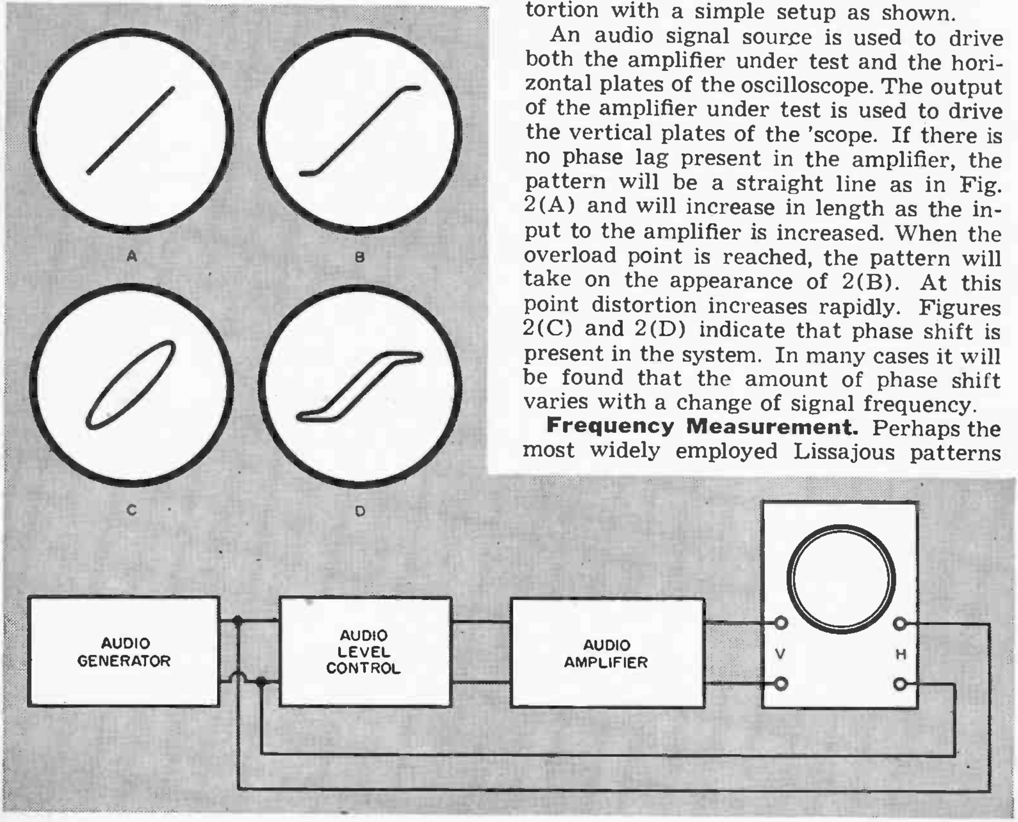


Fig. 1. Lissajous patterns representing phase relationships between two 60-cycle currents.

Fig. 2. Setup and test patterns for checking amplifier overload as described in the text.



lationship to each other, the pattern may seem like the "doodlings" of a lace designer, but to the experienced operator it will be a source of valuable information. These are still known as Lissajous figures.

Figure 1 is an example of the result obtained by putting a low value of line voltage on each set of deflection plates. In 1(A), the voltage on both sets of plates is in phase, that is, both are rising and falling at the same time and in the same direction. The result is a straight line. In 1(B), the rise and fall on one set of plates is lagging behind the rise and fall of the voltage on the other set, resulting in a curve. The trace and retrace curves together form an ellipse. The more one signal lags behind the other, the fatter grows the ellipse, until it turns into a perfectly round circle when the lag equals a quarter cycle. When one voltage lags behind the other in phase by 180°, a straight line results.

Distortion Checks. Closely related are the curves of Fig. 2. These represent simple tests for overloading in an audio amplifier. Most well-designed amplifiers, when fed increasing amounts of input signal, show little increase in distortion until a specific point is reached. Beyond this point, the distortion increases very rapidly. Any amplifier can be checked for this type of distortion with a simple setup as shown.

An audio signal source is used to drive both the amplifier under test and the horizontal plates of the oscilloscope. The output of the amplifier under test is used to drive the vertical plates of the 'scope. If there is no phase lag present in the amplifier, the pattern will be a straight line as in Fig. 2(A) and will increase in length as the input to the amplifier is increased. When the overload point is reached, the pattern will take on the appearance of 2(B). At this point distortion increases rapidly. Figures 2(C) and 2(D) indicate that phase shift is present in the system. In many cases it will be found that the amount of phase shift varies with a change of signal frequency.

Frequency Measurement. Perhaps the most widely employed Lissajous patterns

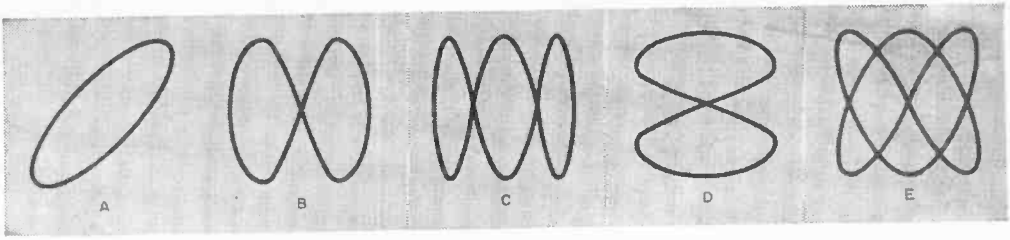


Fig. 3. The number of loops measures frequency by comparison with a known standard.

". . . the number is more important than the shape in frequency checking . . ."

are those for frequency comparison. If separate signals of the same frequency are on the vertical and horizontal inputs to the 'scope, a circle or ellipse (depending on their phase relation) will be formed, as in Fig. 3(A). For each cycle, the spot will make one trip sideways and one trip up and down. For frequency comparison, a perfect shape is not important.

If the frequency on the horizontal input is left unchanged and the frequency input to the vertical input is exactly doubled, the result will be a pattern like that in Fig. 3(B). In this case, the beam must make two trips up and down for each one across and back. If the frequency on the vertical deflection plates is made three times that on the horizontal plates, the pattern will be that of 3(C) because it must make three swings vertically for each one it travels horizontally.

Reversing the situation and reducing the frequency of the signal on the vertical plate to one-half of that on horizontal will give the pattern of Fig. 3(D). The spot now has time to make two trips across while traveling vertically once.

To get a usable pattern, the two frequencies being compared do not have to be exact multiples of one another. In Fig. 3(E), by counting the loops (or peaks), it is found that two horizontal excursions

(*Continued on page* 116)

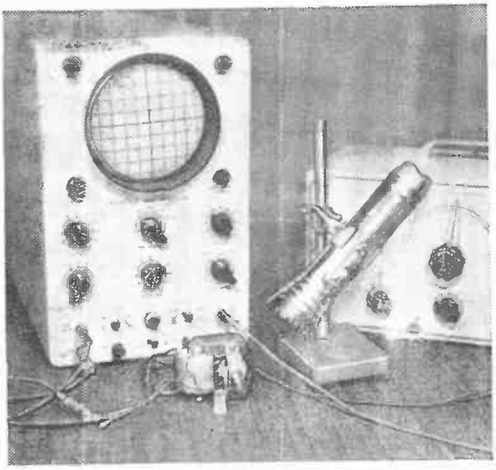
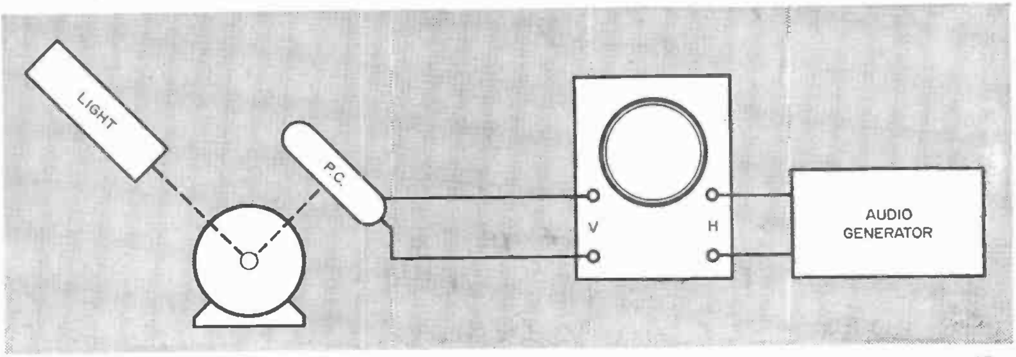


Fig. 4. For measuring the speed of a small motor, a self-generating type photocell is mounted on the white insulator (right), catching flashlight reflection from revolving shaft. This signal is then compared by the 'scope to audio generator frequency. Block diagram below shows setup for this test.



Lost Chords Found—Electronically

The strange instrument at left is no oriental oddity but a bit of electronic experimentation currently going on at the music department of the University of California in Los Angeles. Called "Harmona," the instrument uses tuned strings, struck with a piano hammer, as tone generators. The vibrations are picked up by electromagnetic coils and the resulting signal is run through a harmonic analyzer which picks out all the overtones. The overtones are then amplified to obtain a great variety of tonal blends. By re-combining the amplified overtones of a single note in different proportions, many unusual harmonies can be built up from the output of a single string. In this way, musical experimenters are now finding "lost chords" hidden in the complex overtone structures of a single note and are trying them out in new patterns of musical sound.

—Robert Franklin Ames

Watch That Radio!

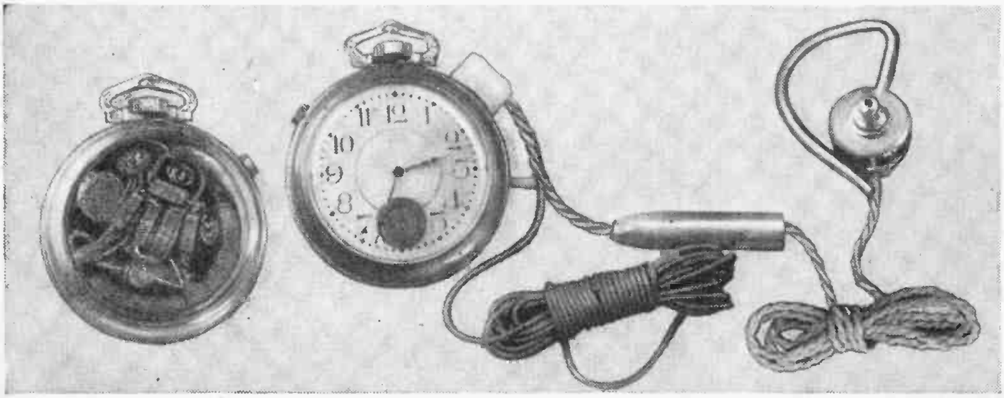
With miniaturization being the order of the day, it was inevitable that clock radios would eventually develop into watch radios. The one below uses three transistors and was made by Peter Dorsey, a watchmaker in Masontown, Pa., whose hobby is electronics. He designed a slug-tuned curved coil to conserve space. Most parts had to be hand-made and connected by a circular strip. Peter now plans to build an even smaller radio inside a wrist watch. In each case, the radio is to be listened to through the earpiece of a hearing aid.

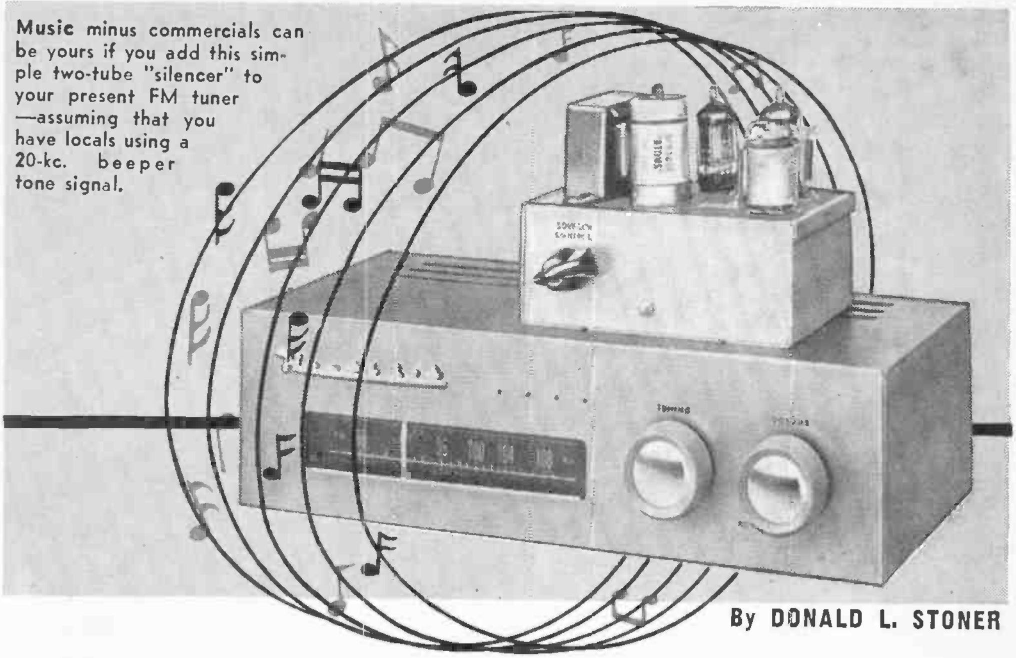
Atom Rays Poison Parts

Unseen and unfelt, atomic radiation brings slow peril not only to living organisms but also to inanimate electronic components.

Exposed to radioactivity, transistors rapidly go dead. Wire insulation loses resistance in proportion to the radiation intensity. Natural rubber deteriorates very rapidly. Insulating materials, such as Teflon, silicon rubbers, and polyvinyls, all suffer damage. Oil-filled capacitors develop gas from the oil, which creates internal pressure and bursts their containers. Some resistors change value and the operation of gas-filled tubes becomes erratic. In some tubes the glass envelope cracks around the base; or the glass itself darkens, impairing the transparency of camera and display tubes.

Yet in the atom-powered submarines, ships and aircraft of tomorrow, electronic control equipment may have to work in radioactive surroundings. The U. S. Air Force therefore urges extensive research on the still largely unknown effects of nuclear radiation on electronic devices. It is hoped that such research will eventually lead to the development of components unaffected by radioactive environments.





Music minus commercials can be yours if you add this simple two-tube "silencer" to your present FM tuner—assuming that you have locals using a 20-kc. beeper tone signal.

By DONALD L. STONER

How to Beep Out FM Commercials

HOW WOULD YOU LIKE to have 24 hours of continuous music in your home and never hear an announcer's voice insist that you use the sponsor's product? You've probably noticed that certain supermarkets, restaurants, etc., manage to play continuous music from an FM station. But did you know that you can have music minus commercials in your own home?

Many cities have FM stations that broadcast continuous music programs interspersed with short commercial announcements. Other stations broadcast music which is only interrupted by routine station call letter announcements. In many cities, such announcements can be easily removed by adding this "silencer" to your present FM tuner or receiver. The result is commercial-free music for those in your household.

Simply speaking, these 24-hour music stations broadcast a "beeper tone" to silence their receivers. Whenever an announcer turns on the microphone, the beeper tone automatically goes on. The commercial silencer amplifies this tone and uses it to trip a relay, which in turn shorts out the audio to the amplifier.

Construction. All components are mounted on an LMB 136 chassis box. Be sure to keep all leads as short as possible. Although the silencer handles no r.f. voltage, the audio voltage can sometimes be a bad actor and may result in feedback.

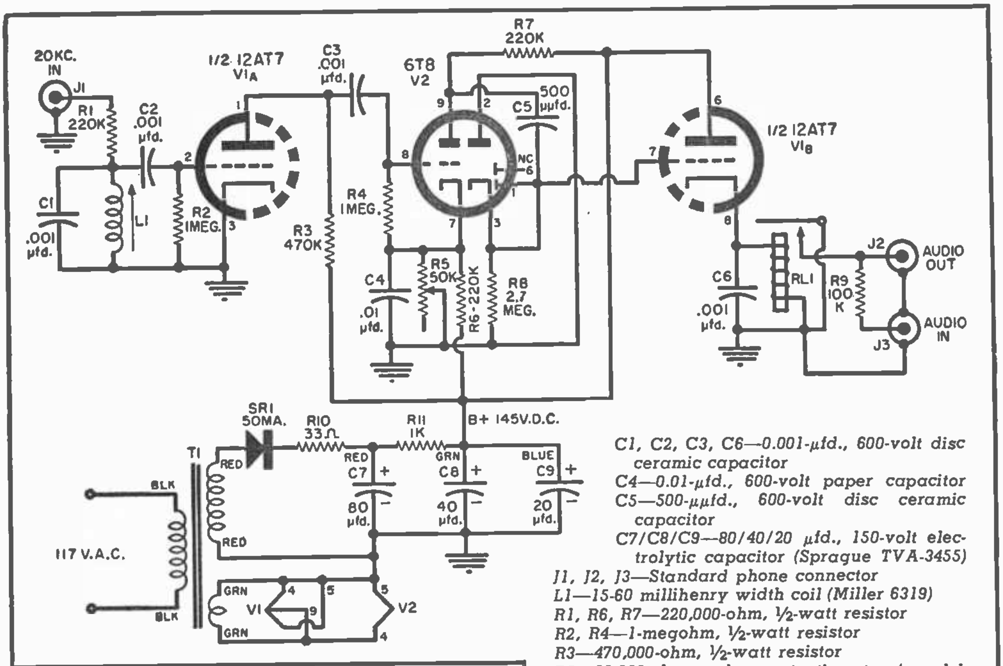
Drill out the chassis and mount all parts to check for proper clearance. The photos of the chassis should be used as a guide to mount components. Don't start wiring the unit until all components have been mounted. If you can locate a selenium rectifier *(SR1)* smaller than the author used, it

HOW IT WORKS

Technically speaking, the 24-hour music stations broadcast a "beeper tone" to silence their receivers. Whenever the announcer turns on the microphone to make an announcement, the beeper tone is automatically turned on. This tone, or 20-kc. oscillation (approximate), is above the range of hearing. It is amplified in the commercial killer and used to operate an electronic relay which shorts out the audio to the amplifier. In addition to keeping the tone above the range of hearing, the modulation percentage is kept low to prevent any unpleasant sound in the speaker.

The 20-kc. signal is removed at the detector of the FM receiver, passes through a 220,000-ohm resistor *R1*, and is developed across the tuned circuit composed of *C1* and *L1*. The voltage is amplified in half of the 12AT7 *(V1a)* and passed on to the 6T8 *(V2)* where it is further amplified. The greatly amplified 20-kc. signal is fed to a full-wave rectifier (diode section of the 6T8) and is converted to direct current of a positive polarity. This voltage decreases the bias on the other half of the 12AT7 *(V1b)* which causes the cathode current to rise sufficiently to trip the relay. It, in turn, is used to short out the audio so that the radio will be silent whenever the 20-kc. tone is present.

Resistor *R5* is made variable so that the sensitivity of the relay will be correct. It should only trip when the tone is present and not on audio. Resistor *R9* is necessary to prevent the relay from shorting out the beeper tone.



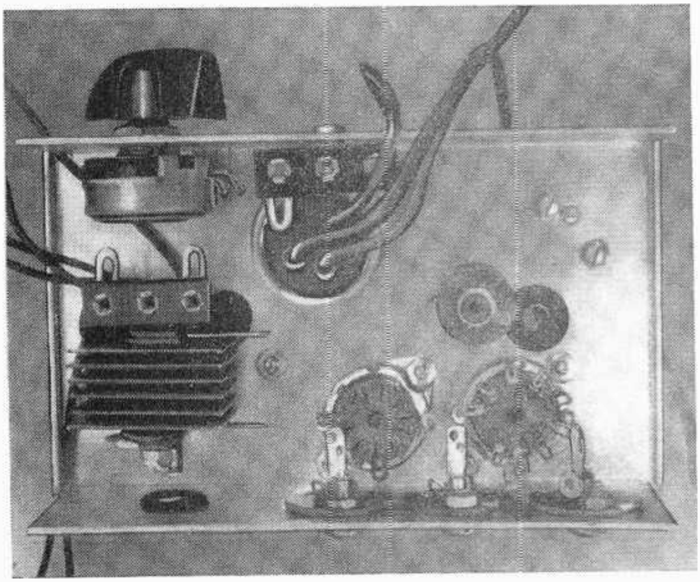
C1, C2, C3, C6—0.001-µfd., 600-volt disc ceramic capacitor
C4—0.01-µfd., 600-volt paper capacitor
C5—500-µµfd., 600-volt disc ceramic capacitor
C7/C8/C9—80/40/20 µfd., 150-volt electrolytic capacitor (Sprague TVA-3455)
J1, J2, J3—Standard phone connector
L1—15-60 millihenry width coil (Miller 6319)
R1, R6, R7—220,000-ohm, ½-watt resistor
R2, R4—1-megohm, ½-watt resistor
R3—470,000-ohm, ½-watt resistor
R5—50,000-ohm carbon potentiometer (squelch control)
R8—2.7-megohm, ½-watt resistor
R9—100,000-ohm, ½-watt resistor
R10—33-ohm, ½-watt resistor
R11—1000-ohm, 2-watt resistor
RL1—4000-ohm relay (Sigma 4F or equivalent)
SR1—25-50 ma., 150-volt selenium rectifier
T1—Power supply transformer, 117-volt primary, secondary 115 volts at 15 ma., 6.3 volts at 0.6 amp. (Triad R54-X)
V1—12AT7 tube
V2—6T8 tube
1—Chassis (LMB #136)
2—9-pin miniature sockets
Misc. shielded cable, line cord and plug, and hardware as required

Schematic diagram and parts list for the silencer are given above.

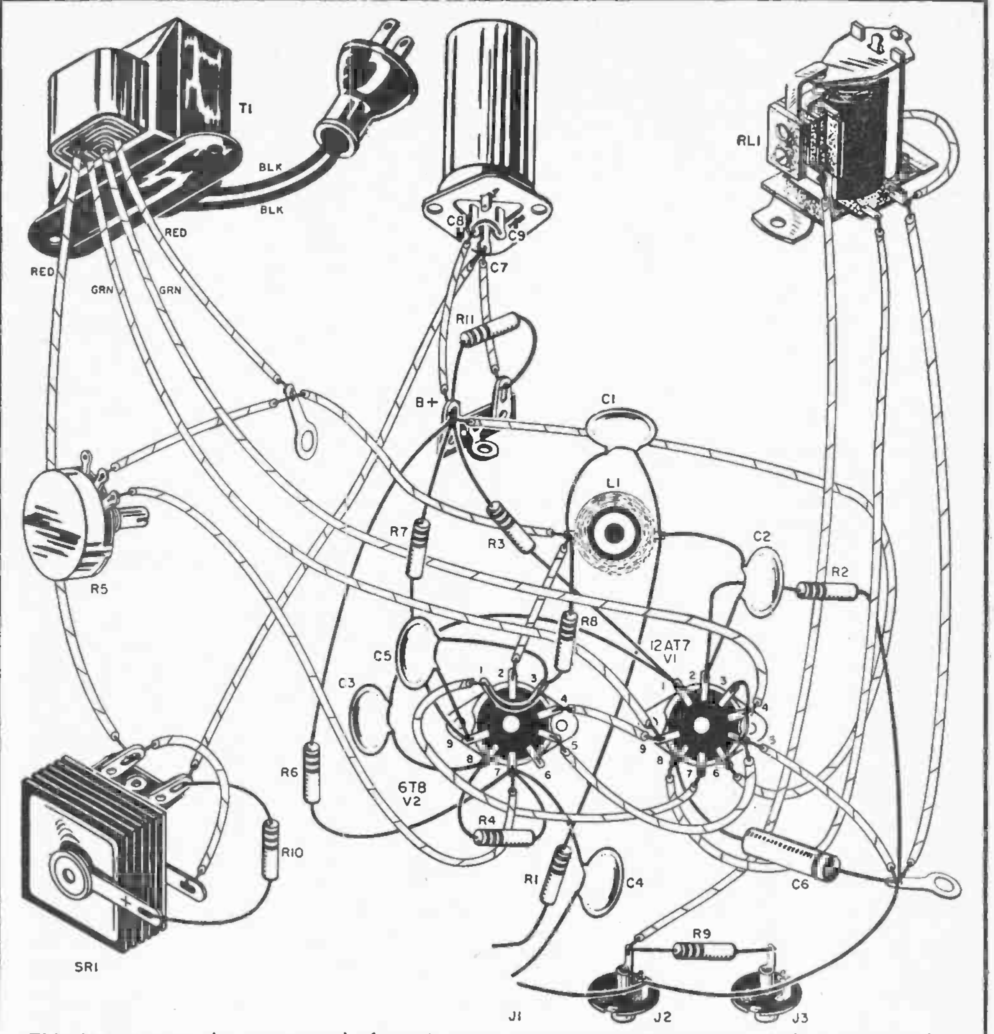
won't be necessary to make a mounting bracket like the one shown.

The power supply uses a minimum of components. Total current drain is only 5 ma. and the smallest selenium rectifier you can find will be adequate. No switch is included in the power supply circuit, because the a.c. outlet on the amplifier or tuner into which the silencer is plugged is energized when the units are turned on.

Beeper Tone. It is necessary to make an internal connection in the tuner to remove the beeper tone. It is taken off



Mount the components as shown in the under-chassis view at left; wiring should not be started until they are all in place. Be sure to keep all leads as short as possible. You'll note the neat, uncluttered appearance of the chassis; the unit could be built right on the tuner chassis but it might not be possible to squeeze all the parts into the necessary space and not all tuners will have enough spare filament power to light up the tubes.

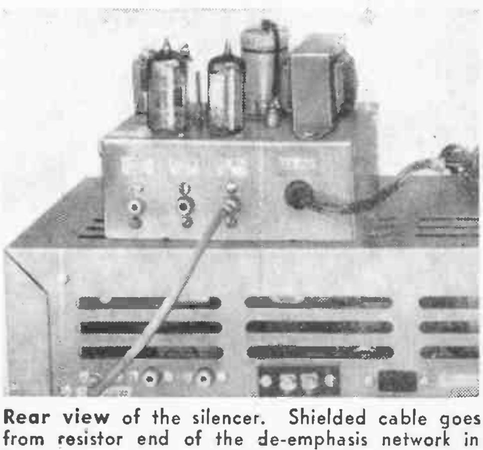


This is the way the commercial silencer's components are interconnected. Although the author employed a cardboard type capacitor for C7/C8/C9, a metal can type may be used as shown.

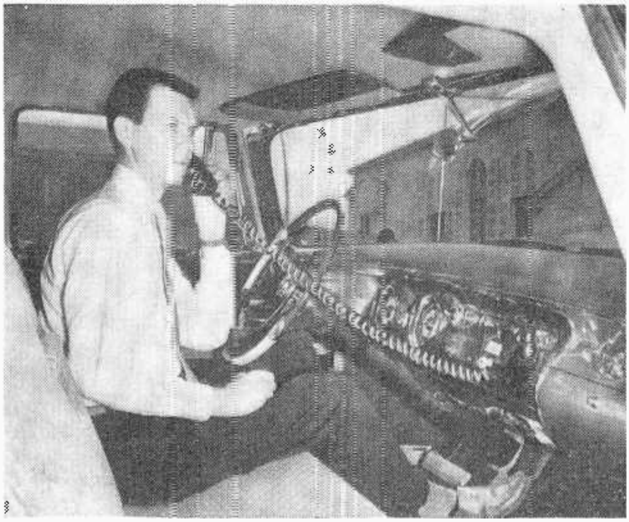
before the de-emphasis network. The de-emphasis network can be found by tracing back from the volume control to the detector. You will generally find a resistor with a value of 68,000 ohms for a discriminator circuit and 22,000 ohms for ratio detector circuits. The capacitor in both cases is usually 0.001 μfd. A shielded cable should be connected to the resistor end without a capacitor to ground. The other end of the cable is attached to a phono-type connector on the rear apron of the tuner.

Because the Heath FM-3 is undoubtedly one of the most popular FM tuners, it is used as an example of a typical installation. The phono connector was installed to the left of the high and low-level audio connectors. Connect the center wire of the

(*Continued on page* 119)

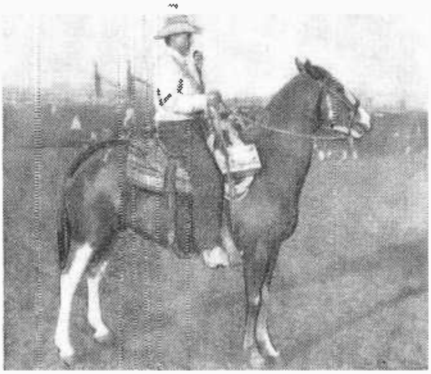


Rear view of the silencer. Shielded cable goes from resistor end of the de-emphasis network in tuner to 20-kc. input connector on silencer.

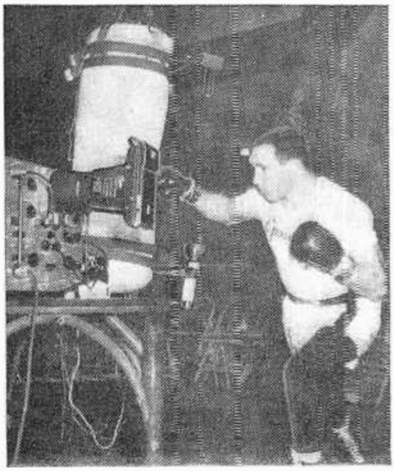


Calling All Cows!

Cowboys of the Old West might not recognize the rider shown below, but he's a genuine cattle foreman who rides herd for the huge Colt Ranch in California. Hanging from his saddle is a radio transceiver; in his hand is the microphone used for sending voice messages over the range. Radio aids ranch work. (Wide World Photo.)



How Hard Does Champ Punch?



Gene Fullmer hits heavy bag in training camp while the power of his punches is tested by special electronic and photographic device. Tests made with Fullmer wearing six-ounce gloves show that right-hand punch traveled at speed of 30.4 mph and carried force of 1260 pounds, left jab moved at 17 mph with force of 1035 pounds. (Wide World Photo.)

Mobile Selling

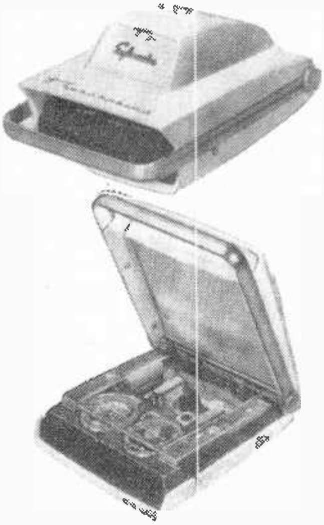
Car dealers who have taken to selling on wheels with the aid of mobile showrooms might profit from the example set by a Florida auto dealer who has installed a telephone in a demonstrator car (left).

Driving to the prospect's house, the salesman phones from the car and asks if anyone would care to see a new auto if it were parked just outside the front door. The reply is almost always "yes," the prospect thinking he now will have one less salesman to worry about. Then comes the startling statement: "Fine. I'm right outside."

The prospect's surprise generally turns to curiosity, and he comes out. Talk about "captive audiences!"

Tiny Portable

Radical in design is Sylvania's "Thunderbird," an all-transistor portable receiver. The set measures 3¾" high by 5⅝" wide by 6¼" deep. It weighs less than 2½ pounds with batteries. In "carrying position," its top folds down to form a compact unit. When opened, the plastic-covered chassis is revealed. It plays in either position.



hi-fi and the ELECTRONIC CROSSOVER

By Norman Eisenberg
Feature Editor

New type frequency divider uses separate power amplifiers for each speaker in multiple system

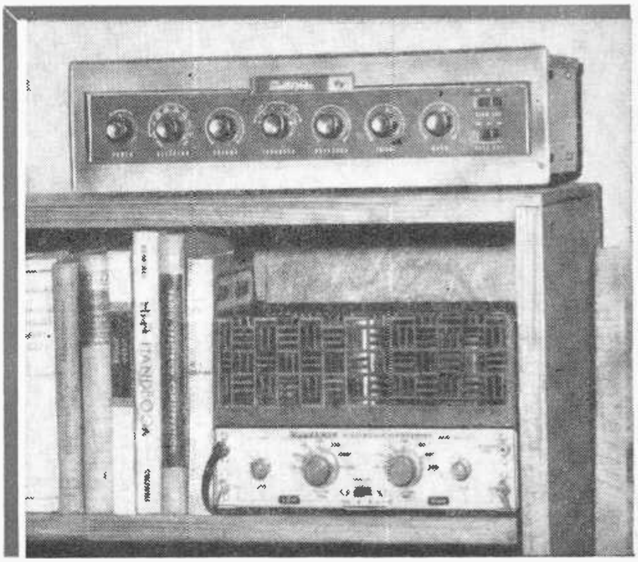
HI-FI SOUND—big, clean, smooth, and wide-range—is best reproduced by a multiple speaker system in which a woofer puts out the lows and a tweeter furnishes the highs. Going a step further, the mid-range frequencies can be sounded by another speaker or "squawker." In our January, 1957, issue (p. 70), we described how such speaker systems operate when audio frequencies are divided and channeled to correct speaker units. The device that does the job is a dividing—or crossover—network and is inserted between the power amplifier and the speaker system.

Crossover networks—if properly matched to carefully chosen speakers—can make for excellent response. Some of the finest-sounding speaker systems use them. But dividing networks have certain drawbacks.

First, there is the "noise" that may be introduced eventually by less-than-top-quality components. For instance, high-value capacitors of the paper variety are very expensive and not always used. Electrolytics can be substituted if selected with an eye toward possible deterioration and leakage. A defective electrolytic, however, may not only introduce noise but shift your crossover frequency from one that provides a correct balance to one that can throw off the speaker system.

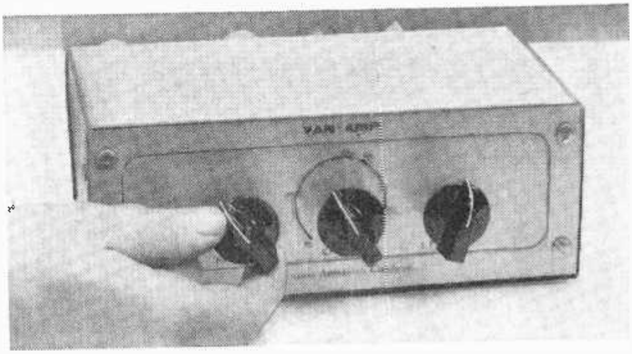
Secondly, networks made up of coils and capacitors must introduce some audio signal loss. Part of the total output of the amplifier is eaten up by the network as "payment" for the job it does. This is known as "insertion loss." Neither the amount of noise nor the degree of insertion loss may be, in itself, very serious. The setup may still sound good. But there is a third network bugaboo that *can* become a serious limitation on sound quality and impair your enjoyment of programs.

The Damping Problem. By "damping," we mean the ability of the amplifier to keep tight reins on the speaker. For sound faithful to the original, the cone must neither overshoot its mark nor keep jiggling after a sharp and sudden excursion. Good damping keeps the speaker motion strictly in step with the electric waveform arriving from the amplifier. Musically, this



Fixed crossover points at 100, 200, 400, 700, 1200, 2000, and 3500 cps are provided in Heathkit Model XO-1 crossover (lower right) shown in use in hi-fi system with an Electro-Voice PC-1 as preamp-control unit. Available in kit form, the XO-1 nets for $18.95 supplied direct from the Heath Company, Benton Harbor 15, Mich.

Compact electronic crossover is Brociner's "Van-Amp." Crossover points are continuously variable from 90 to 1100 cps. Each channel has adjustable voltage gain. This unit uses two tubes and is powered by a selenium rectifier. Completely assembled, it nets for $56.95. In kit form, its price is $39.95.



means clear definition of every sound—no blur, no crackling—and sharp, exciting transients.

Damping depends partly on the design of the speaker itself and partly on the interaction between speaker and amplifier. The amplifier effectively "puts on the brakes" whenever the speaker cone zooms out of control. With a crossover network inserted between amplifier and speaker, the insertion loss of the network hinders the action of this self-correcting "feedback brake." In other words, it lessens the damping. But, once again, this drawback may be more than offset by the advantage of the multiple loudspeakers made possible by the crossover network.

A more serious damping difficulty stems from the fact that the speaker itself changes impedance with changes in frequency. Air loading and springiness of the cone suspension differ at low and high notes. These variations reflect back into the voice coil circuit in the form of impedance variations. This affects the damping and thus changes the tone quality of the speaker. The impairment is most pronounced at bass frequencies which need greater surges of undistorted wattage in order for them to be faithfully reproduced.

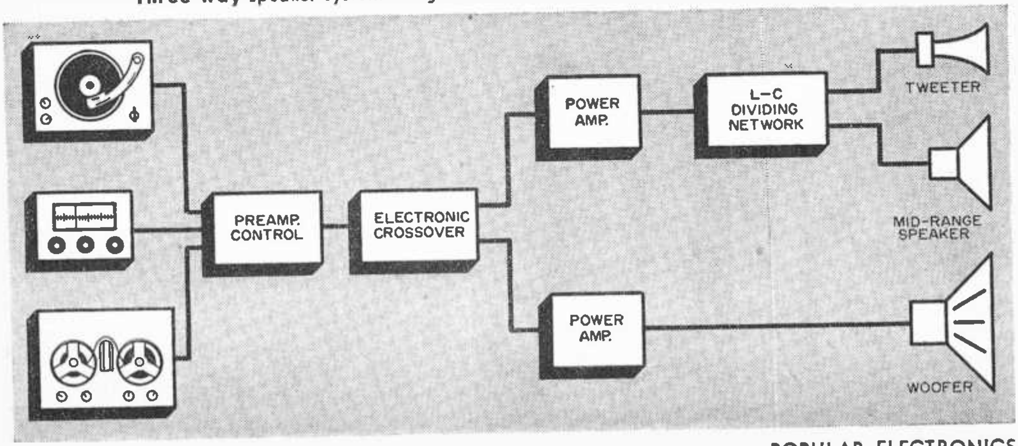
Introducing the ECU. For many listeners, the above considerations are not worth bothering about. But designers with ultra-critical listening tastes and an approach that puts no ceiling on hi-fi perfection have come up with a system that neatly sidesteps the damping problem.

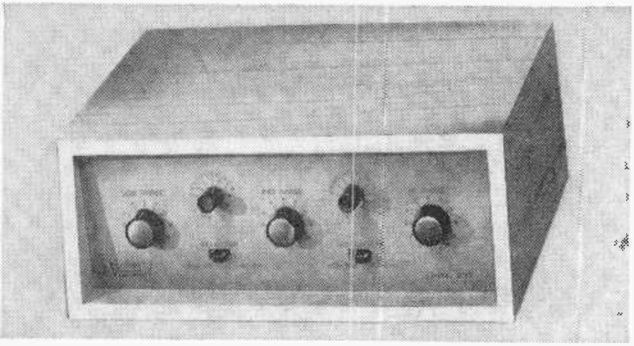
Instead of using one power amplifier to feed a network and thence the speaker system, the new approach uses *two separate power amplifiers*—one feeding a woofer, the other a tweeter. Frequency division is made *before* the sound enters either power amplifier. What's more, instead of using an *RLC* network, this system uses an electronic crossover unit (ECU) to separate highs from lows.

An ECU resembles an amplifier and has no signal insertion loss. Also, the ECU does not disturb the feedback setup between power amplifier and speaker. Thus, it permits optimum damping.

Typical Setup. In operation, the ECU is connected directly after the preamp-equalizer. The input signal is divided and fed to individual power amplifiers. Each power amplifier, in turn, drives its own speaker—one for lows, the other for highs.

Three-way speaker system using electronic crossover and LC dividing network.





Three-way electronic crossover is provided by Colbert Model 3-CFD. Included is 10-watt power amplifier for use on mid-range or treble channels, but two more power amplifiers are needed to complete setup. Device nets for $154.50, is made by Colbert Laboratory, Inc., 160-09 Hillside Ave., Jamaica 32, N. Y.

Such a setup permits great flexibility in adapting individual speakers to handle their correct frequency ranges. Highs and lows are amplified separately and reproduced separately. This means that intermodulation distortion is virtually licked. Unstable loading conditions and problems of impedance matching are solved. The variety of crossover points provided by the ECU permits experimenting with whatever speakers you have until the best possible combination is achieved.

Available ECU's. One of the first commercially produced electronic crossovers is the "Van-Amp" ("Van" standing for "variable audio network") made by General Apparatus, a subsidiary of Brociner Electronics Corp., 344 East 32nd St., New York 16, N. Y. The Van-Amp is illustrated and described on page 72.

Another electronic crossover is the Heathkit Model XO-1, shown in use and described on page 71.

Newest ECU is the two-channel divider made by the Marantz Co., 44-15 Vernon Blvd., Long Island City 1, N. Y. Twelve crossover points, from 100 to 7000 cps are provided. Each channel has adjustable gain. The unit uses three dual-triode tubes and is powered by a remote supply. It nets for $90.00.

Further Refinements. An ECU, such as one of those mentioned above, can be used as the basis for a three-way speaker system. One method would be to use two ECU's cascaded. A cheaper, but effective, method would be to combine the ECU with an *LC* network (see diagram on page 72). The ECU makes the first frequency division into bass and treble. The treble is then further split into two channels (mid-range and high) by the network.

To use the ECU in such a system, select a fairly low bass crossover point, say, 400 cycles. Everything below 400 cps is then fed to the woofer. Everything above 400 cps is fed to an external dividing network. The network then makes another division into mid-range and highs with a likely crossover at, say, 4000 cps, depending on the particular tweeter used.

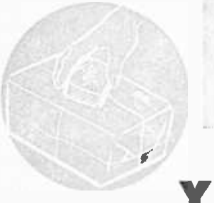
Such a system makes the best use of the natural advantages of both an electronic crossover and the *LC* network. By taking over the demanding job of bass crossover, the ECU delivers maximum undistorted power to the woofer for best bass reproduction. The network, designed to operate at about 4000 cps, can be built from relatively low-value and inexpensive capacitors. As a high-pass filter, it will not be called upon to handle excessively high wattages, but will deliver plenty of highs to a tweeter and help put a tonal sheen onto the sound you hear.

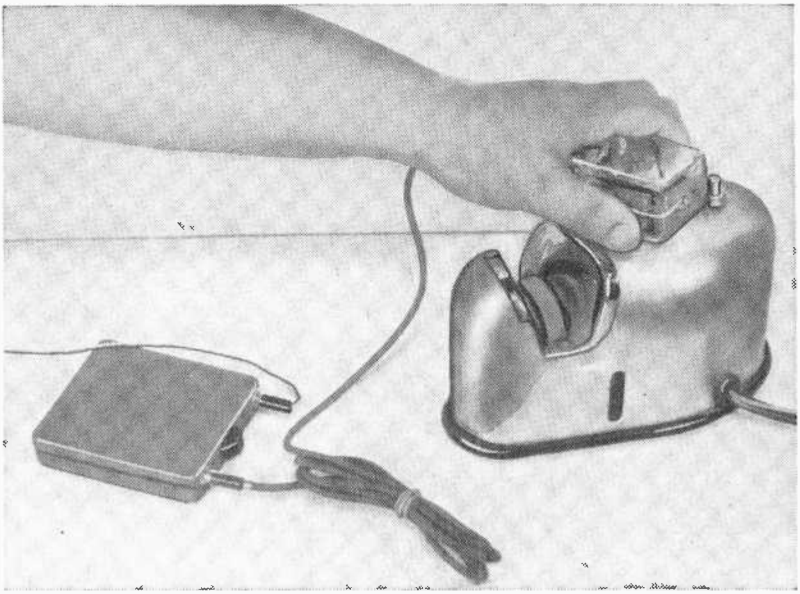
Three-Channel ECU's. At this point, someone will probably ask the inevitable question about an all-electronic crossover system for three channels—a unit that will furnish highs, mid-range, and lows for a three-way speaker system without any need to go through *LC* networks. Correctly designed and set up, it would provide unsurpassed frequency division for a three-way system.

Exactly such a unit is the Colbert "Three-Channel Electronic Frequency Divider," described and illustrated above.

Then there is the British-made "Tri-Channel Hi-Fi Sound System," marketed in the USA by the Ercona Corp., Electronics Div., 551 Fifth Ave., New York 17, N. Y. This sonic titan includes a three-channel preamp-mixer, three separate power amplifiers, and four speakers . . . in other words, three complete sound systems, minus program sources. This unit may not only be used as the ultimate of frequency division for multiple speakers, but can also serve as a bona fide, uncompromised stereophonic system. The sound it puts out can be heard to the tune of $795.00!

Whether your hi-fi needs lead you to the ultimate in sound systems or to one of the more modestly priced units described, you'll find that an electronic crossover can furnish you with a new measure of thrilling, realistic sound. —30—





You'll Amaze Your Friends with an Electronic "Detectoscope"

By LOUIS E. GARNER, JR.

Use of printed-circuit audio amplifier simplifies building of unusual listening device

IF YOU'RE the typical electronics hobbyist, chances are you get just as much enjoyment out of assembling an instrument or gadget as you do out of using it. But one of your greatest thrills is the admiration of friends, relatives and neighbors, and their compliments on your handiwork.

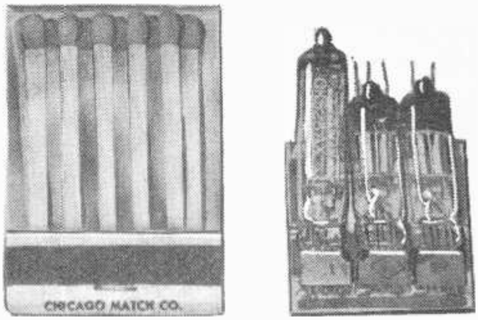
Here's an instrument which is sure to impress even the most sophisticated of your friends . . . an electronic "detectoscope." With it, you can make a ticking watch sound like heavy industrial machinery . . . you can open tumbler-type combination locks as easily *as if you knew the combination* . . . and, under the proper conditions, you can listen to conversations in closed rooms—right through walls, doors and windows!

The electronic "detectoscope" is a modern "sound microscope" designed primarily for non-medical applications. Almost everyone who works with machinery or mechanical devices will find it helpful in his work . . . and the experimenter will have lots of fun using it and demonstrating it. Locksmiths and watchmakers can employ it in their delicate work . . . refrigerator, washing machine and appliance repairmen can identify obscure troubles with it . . . auto mechanics can track down rattles and unusual noises with it . . . and even detectives and policemen will find it useful.

Three separate units make up the complete "detectoscope" assembly—an earphone, an amplifier, and a vibration pickup or transducer. If the word "transducer" is an unfamiliar one, simply remember that it is a device for changing energy from one form to another. Everyday examples of transducers are microphones and loudspeakers; these change sounds into electrical signals and vice versa. The transducer used here changes mechanical vibrations into electrical signals.

Construction Hints. Only standard, readily available components are used in the design of the "detectoscope." The schematic wiring diagram of the complete amplifier assembly is shown in Fig. 1. Heart of this assembly is a Centralab "Ampec" printed-circuit audio amplifier. This unit was chosen to simplify the construction and thus to make the project suitable for the advanced worker and the beginner alike.

The "detectoscope" is being used in the photo at left to listen to the vibration of an electric knife sharpener. At right, the "Ampec" printed-circuit plate is compared in size with a book of matches.



Although the "Ampec" unit is smaller than a pack of book matches, it includes all the essentials of a complete three-stage audio amplifier, excluding only the input and output circuits, the gain control and the power supply. Input, output, gain control and power connections are made through nine wire leads.

Cement the "Ampec" amplifier plate to a small piece of perforated Bakelite measuring approximately 2⅛" x 1¾", which previously has been cut out and drilled to accept the gain control and power switch (*R10* and *S1*) and a small bracket or "frame" which supports the input and output jacks (*J1* and *J2*). The small "frame" may be cut out and bent from a scrap piece of aluminum or brass. Install eyelets in the Bakelite mounting board for the output load resistor (*R8*) and for the A and B battery connections.

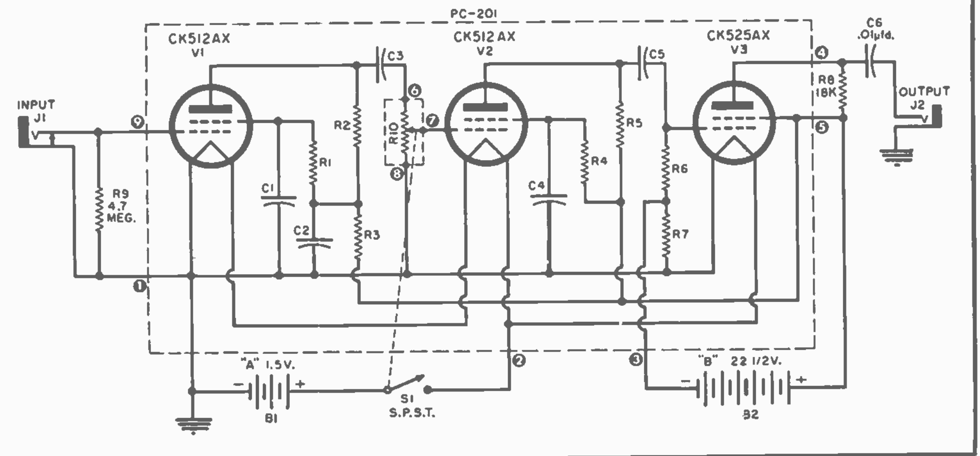
If desired, the case may be a small plastic box; but there will be less chance of noise and hum pickup if a metal box is employed. You can use either a commercial aluminum case or an empty metal cigarette box, cough lozenge or tobacco container. The model was assembled in an empty container which originally held English-made cigarettes. If you use an empty box of this nature, you can give the final instrument a "professional" appearance by covering the box with a coat of glossy enamel or wrinkle varnish.

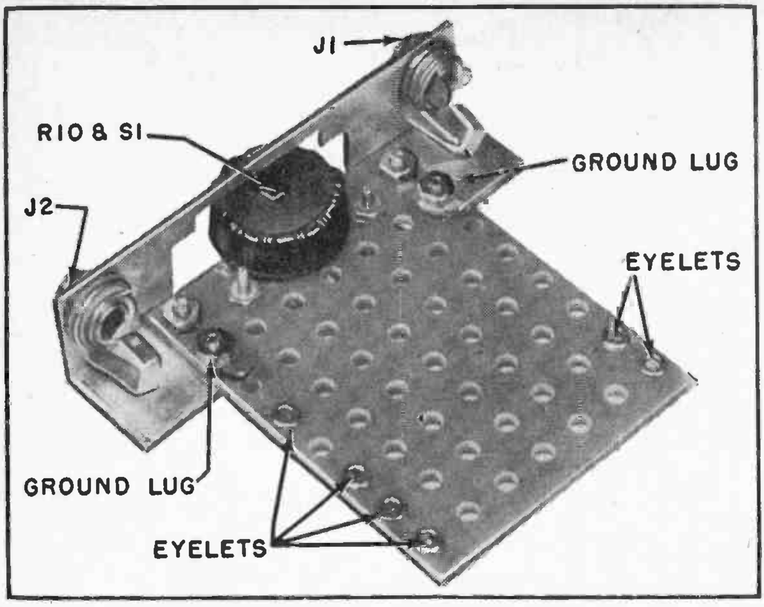
Transducer Assembly. The transducer consists of an inexpensive crystal or ceramic phonograph cartridge. Mount it in a plastic or metal case and connect it to the amplifier proper with a short length of shielded single conductor cable, terminated with one of the subminiature Telex plugs.

In most cases, you can obtain good results with the phono cartridge alone. Occasionally, however, somewhat greater

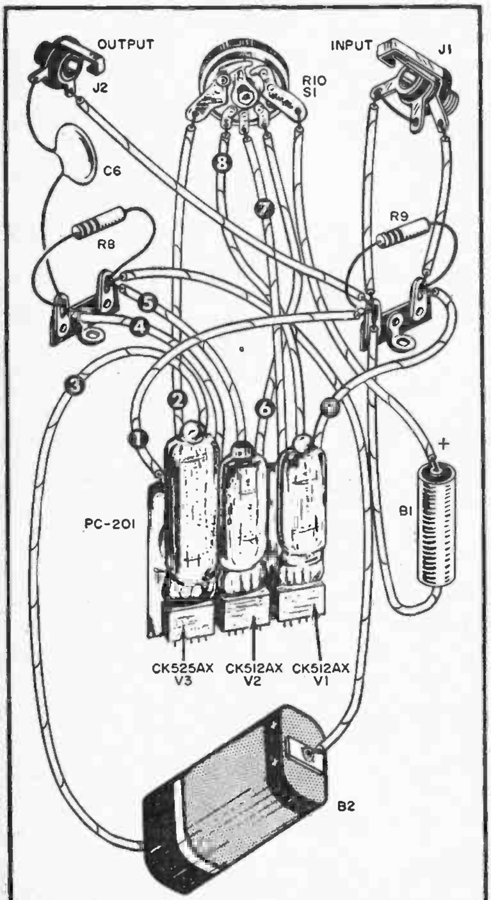
PC-201—Printed-circuit amplifier plate, with tubes (Centralab "Ampec" Model PC-201)
B1—1.5-volt penlite cell (Burgess Type Z)
B2—22½-volt hearing-aid battery (Burgess Type U15)
C6—0.01-µfd. ceramic disc capacitor
J1—Miniature closed-circuit jack (Telex No. 8570)
J2—Miniature open-circuit jack (Telex No. 9240)
R8—18,000-ohm, ½-watt carbon resistor
R9—4.7-megohm, ½-watt carbon resistor
R10—Miniature potentiometer, with knob and s.p.s.t. switch, 5 megohms, audio taper (Centralab No. B16-228)
S1—S.p.s.t. switch (on R10)
1—Small metal case
1—Bakelite mounting board
1—Standard crystal phonograph cartridge, high-output type (Shure No. W78, Astatic No. L-72A, Lafayette Type PK-11, etc.)
1—Small plastic box
1—30" flexible single-conductor shielded cable, and small plug (Telex No. 9231)
1—Sensitive earphone, and small plug (Telex No. 9231)—accessory

Fig. 1. Schematic diagram of complete amplifier assembly. The portion of the circuit within the dashed line (except R10) is part of printed-circuit plate PC-201. See parts list above.





Preliminary assembly of the Bakelite mounting board, "frame" for the input (J1) and output (J2) jacks, gain control (R10), and the power switch (S1). Small eyelets are installed in board as connection terminals. Use either or both of the ground lugs shown for grounding the circuit in accordance with Fig. 1. The ground tie point in the pictorial diagram below should be connected to one of these lugs.



Pictorial diagram shows how printed-circuit amplifier is hooked up to other components.

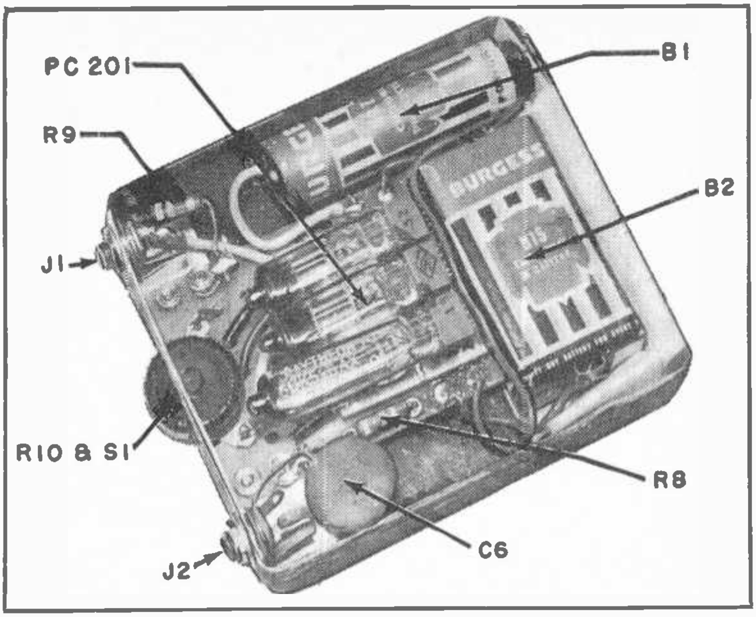
sensitivity may be had by mounting a small weight in the needle chuck. The weight serves to increase the effective inertia of the crystal system and to make it more sensitive to vibrational forces. The amount of weight needed will vary with the exact type of phono cartridge used and with the type and size of case. For best results, you'll have to determine this value experimentally. The simplest weight is a short length of heavy wire which just fits the needle chuck.

Another possible modification in the transducer design is the addition of a probe. This may be desirable where you need to reach into tight corners or through gratings. You can make a suitable probe from a 4" to 8" length of steel rod. Attach the rod to the case using any mounting method you prefer, but make sure that the back of the rod rests against the phono cartridge to insure the best transfer of vibrational energy.

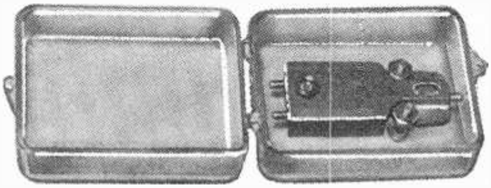
Using the "Detectoscope." Insert transducer plug into jack *J1* and the earphone plug into jack *J2*. With the 'phone to your ear, hold the transducer on the equipment to be checked, making sure that either the crystal mounting screws or the metal probe (if one is provided) makes good contact with the equipment.

Turn the amplifier on and continue to rotate the gain control, gradually increasing volume until a comfortable listening level is obtained. *Do not use excessive volume*—you may overload the amplifier, with resulting distortion and poor quality, giving difficult-to-interpret signals.

Get a lot of experience. Try the instrument out on different types of equipment.



Completed amplifier assembly with A and B batteries in place and components identified. Connections to the PC-201 are made through nine wire leads which are identified by number on an instruction sheet furnished with the PC-201. Best results will be obtained if a metal case is used to house the complete amplifier. Because of compactness of unit, batteries will stay put without clamps.



Vibration pickup or "transducer" assembly; crystal phono cartridge is mounted in small plastic case.

Listen to the vibration sounds produced by washing machines, refrigerators, mixers, and other household appliances; listen to the vibrations produced by your auto when it's idling; listen to watches and clocks. If you plan to use the "detectoscope" as an aid in servicing mechanical equipment, you'll have to practice with it quite a bit. Only experience will teach you how to correlate various sounds with defects or misadjustments in the equipment you are repairing.

Since the amplifier assembly proper is essentially a high-gain audio amplifier, you can use it for many other applications. By replacing the transducer with a crystal microphone cartridge, you can make an effective hearing aid out of the instrument. A telephone pickup coil connected to the input provides you with a useful telephone amplifier. A simple tuned circuit connected to the input changes the instrument into a radio receiver (for details, refer to "Radios Made from Hearing Aids" in the May, 1956, issue of POP'tronics, page 52).

As you gain experience with the electronic "detectoscope," you'll be able to dream up dozens of other practical applications on your own. -30-

HOW IT WORKS

Audio signals obtained from the transducer and appearing across input resistor *R9* are fed directly to the grid of the first amplifier tube, *V1*. An amplified signal appears across the plate load resistor, *R2*, and is coupled through capacitor *C3* to gain control *R10*. The setting of this control determines what portion of the available signal is passed on to the second stage, *V2*.

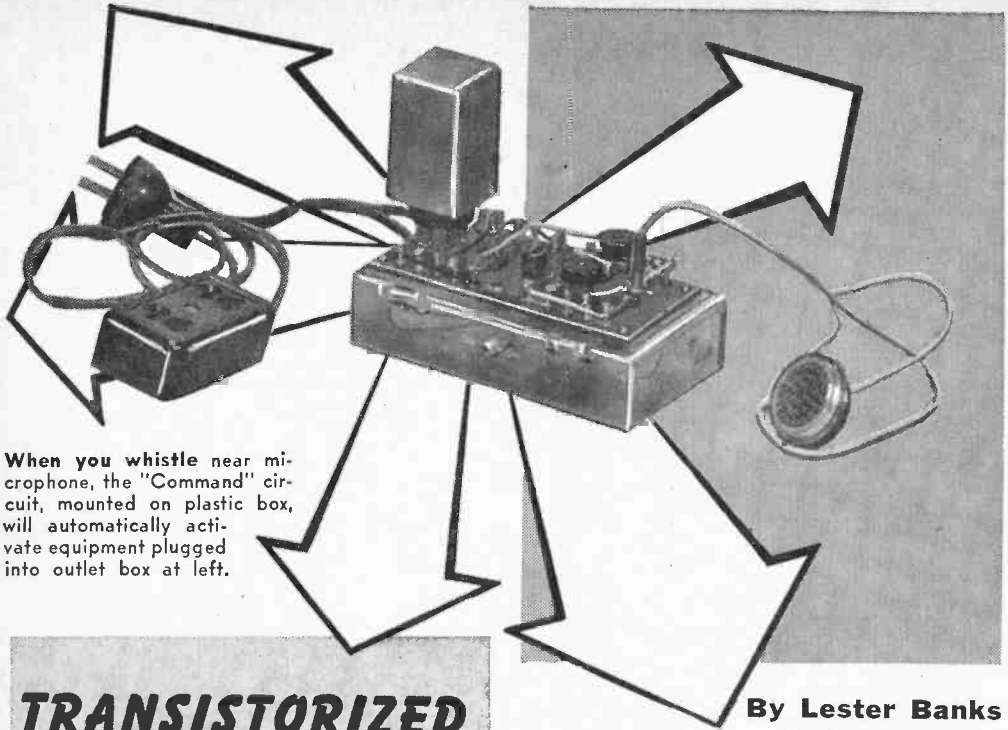
The first stage, *V1*, is decoupled from the rest of the amplifier through a "L" type filter network consisting of *R3* and *C2*. Screen voltage for this stage is provided by *R1*, bypassed by *C1*.

An amplified audio signal appears across load resistor *R5* of the second stage, *V2*, and is coupled through d.c. blocking capacitor *C5* to the grid of the output amplifier, *V3*, appearing across grid resistor *R6*. Screen grid voltage for *V2* is provided through screen resistor *R4*, bypassed by capacitor *C4*. Bias voltage for the output stage is provided by resistor *R7* in series with the B- lead. All the current used by the amplifier passes through this resistor, developing the necessary bias voltage for the output stage, *V3*.

The final output signal appears across the third stage's plate load resistor *R8*, where it is coupled through d.c. blocking capacitor *C6* to the earphone. Power to operate the amplifier is supplied by a single penlite cell serving as an A battery, and a 22½-volt hearing-aid battery serving as the B supply. The A battery is controlled by s.p.s.t. switch *S1*, mounted on the gain control.

Operation of the transducer involves a signal voltage developed by the piezoelectric crystal as the case vibrates around the crystal element, which resists this vibration by virtue of its own inertia. It is for this reason that adding weight to the crystal system through the needle chuck increases the sensitivity and output of the device . . . it simply increases the effective inertia of the crystal system.

Unfortunately, the weight that can be added is critical. If too much weight is used, the "damping" of the needle chuck will be insufficient, with the result that self-resonant vibrations will be set up in the crystal system every time it is excited externally—producing new sounds not present in the original signal. If too little weight is used, there will be little or no increase in sensitivity.



When you whistle near microphone, the "Command" circuit, mounted on plastic box, will automatically activate equipment plugged into outlet box at left.

TRANSISTORIZED "COMMAND" CIRCUIT

By Lester Banks

WANT TO PUT that loud whistle of yours to work? If so, then here's a good project that can be whipped together in a few hours. It has lots of uses around ham shacks, tape recording parties, model control events, magic demonstrations, etc.

Once you have it operating, you'll be surprised at the number and variety of places where you can use the "Command" circuit. Put it in a dark room, and when you come into the house, a whistle will turn on the lights. In a quiet residential area, you can hook it up to a garage door opener and the short toot on the horn will automatically turn on the motor to open the door.

The total cost of building this gadget is well under $10. Although I have pictured it here as being built into a plastic case, it can obviously be constructed on a metal chassis or any convenient blank chassis space you have available.

Construction. The "Command" circuit can be mounted on a single terminal board measuring 5¼"x2½". This size permits the device to be mounted in a radio ham transmitter or tape recorder.

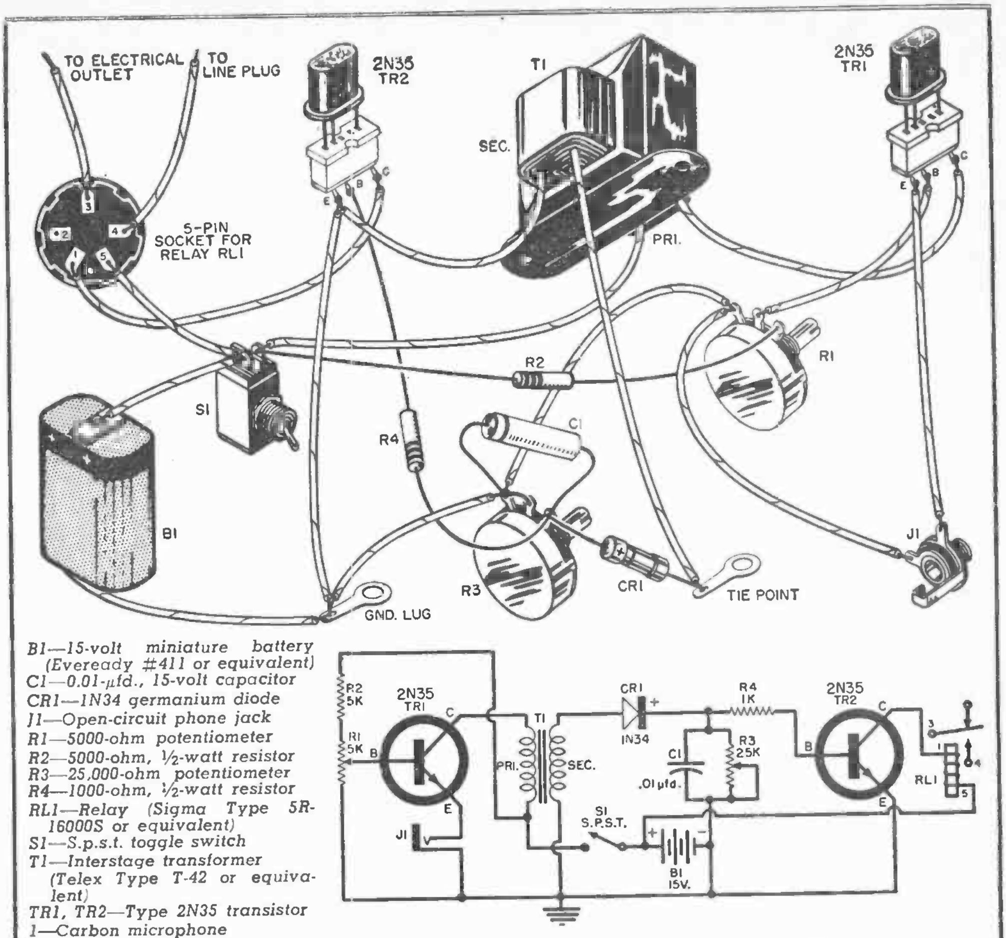
Begin construction by mounting the transistor sockets, relay socket and transformer on the terminal board. In the model, the Telex T-42 interstage transformer was held to the board with du Pont Duco cement. The Sigma relay uses a standard 5-pin tube socket. Mounting of this socket was accomplished by running stiff wires from two terminals on either side of the board to pins 3 and 4. These wires serve the dual purpose of providing support for the relay and electrical connections to the relay.

I mounted my terminal board on a plastic box (it once held cigars) using several *4-40* nuts and bolts. Extra holes

HOW IT WORKS

An audio signal picked up by the microphone and fed through *J1* causes more current to flow in the emitter circuit of *TR1*. This increase is also observed by the collector and its associated wiring, *T1* and *R2*. From *T1*, the audio signal goes to diode *CR1* where it is rectified into pulsating direct current. Capacitor *C1* is charged by this voltage according to the resistance value of *R3*.

Before a signal is applied to the microphone, the current flowing through the collector of the second stage does not pull in the armature of relay *RL1*. Raising the voltage on the base of *TR2* increases the emitter current, and hence the collector current, while closing the relay. Holding action is governed by the time constant of *C1* and *R3*, since this capacitor must discharge through the base of *TR2*. Adjustment of *R3* will vary this hold-in time.

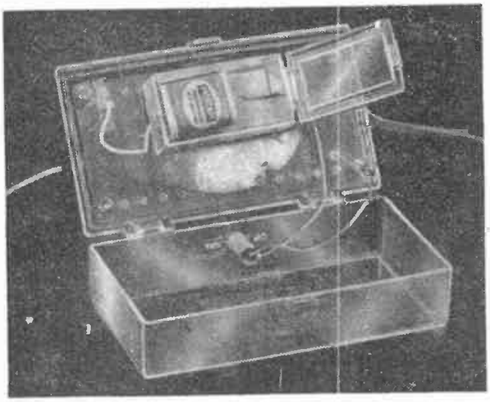


B1—15-volt miniature battery (Eveready #411 or equivalent)
C1—0.01-µfd., 15-volt capacitor
CR1—1N34 germanium diode
J1—Open-circuit phone jack
R1—5000-ohm potentiometer
R2—5000-ohm, ½-watt resistor
R3—25,000-ohm potentiometer
R4—1000-ohm, ½-watt resistor
RL1—Relay (Sigma Type 5R-16000S or equivalent)
S1—S.p.s.t. toggle switch
T1—Interstage transformer (Telex Type T-42 or equivalent)
TR1, TR2—Type 2N35 transistor
1—Carbon microphone

Pictorial, parts list and schematic diagram for the "Command" circuit. The output leads from the 5-pin socket break one side of the a.c. line to any "controlled" gadget.

were drilled in the box to permit entry of the positive and negative leads from the circuit to the battery inside the box. The switch, *S1,* was mounted on the face of the plastic box.

Wiring is straightforward and presents no unusual problems. Although the diagram calls for 2N35 transistors, it is possible to use others of the *n-p-n* variety, or even *p-n-p* transistors if the battery polarity is reversed. The only precaution that must be observed is not to exceed the rating of the Sigma relay. The contacts will easily handle about 200 watts, but will "freeze" at a higher current flow.



Battery is mounted inside another plastic box.

Adjustment. Putting the circuit into operation is also very simple; and once adjusted, it will remain so for a long time. Cover the microphone (do not disconnect it since that would disable the circuit) and adjust *R3* until relay *RL1* drops out of the "on" position.

Now uncover the microphone and set *R1* to the volume level of the voice or sharp sound that will activate the "Command" circuit. The relay should click in and out of operation depending on the setting of *R3*. After the volume level has been set, it is easy to go back and readjust *R3* to the desired holding time. —30—

THE TRANSMITTING TOWER

Herb S. Brier, W9EGQ

LEARNING THE CODE well enough to pass the 5-wpm Novice code test or the 13-wpm General code test is the problem facing all prospective amateurs. Doing so requires a certain amount of time and effort, but it should not be as difficult as some people make it. All it takes is the patient following of tried and true methods of study.

Obviously, the first step in learning the code is to memorize the alphabet. The quickest ways to do this are (1) to teach it to yourself with the aid of a code chart and a code-practice oscillator, or (2) for two beginners to teach each other. Unfortunately, these are not the best methods, because they make building up receiving speed a slow process. Having learned the characters by their individual *dits* and *dahs,* you naturally try to copy them in the same manner. Up to a speed of about 5 wpm, this works fairly well, but at higher speeds, there just is not enough time to count *dits* and *dahs.* As a result, your progress stops until, after many hours of practice, you learn to recognize the characters by their over-all sound.

THE RADIOTELEGRAPH CODE

A	·—	U	··—
B	—···	V	···—
C	—·—·	W	·——
D	—··	X	—··—
E	·	Y	—·——
F	··—·	Z	——··
G	——·	1	·————
H	····	2	··———
I	··	3	···——
J	·———	4	····—
K	—·—	5	·····
L	·—··	6	—····
M	——	7	——···
N	—·	8	———··
O	———	9	————·
P	·——·	0	—————
Q	——·—	.	·—·—·—
R	·—·	,	——··——
S	···	?	··——··
T	—	/	—··—·
DOUBLE DASH	—···—	END OF MESSAGE	·—·—·
ERROR	········	INVITATION TO TRANSMIT	—·—
WAIT	·—···	END OF WORK	···—·—

Thousands of hams now on the air have learned the code in the above manner, in spite of its disadvantages; nevertheless, you will save much time by not looking at a code chart or touching a radiotelegraph key until you can receive the code fairly well. To accomplish this seeming paradox, you will need the help of a good instructor or of a recorded code course.

Code Instruction. In teaching you the code, the instructor will first announce the letter he is going to send, and will send it several times at a speed equivalent to about 15 wpm. Then he will send it another dozen times or so without the prior announcement. You should write down the letter (not the *dit-dahs*) *every time it is sent.*

The instructor will then introduce another letter in the same manner. Next, he will send first one letter and then the other at the 15-wpm speed, but with long pauses between them, for you to copy. This entire routine is repeated over and over again until you have learned all the characters.

Because each character is sent at a fairly high speed, you are forced to learn them by their over-all sound. You will undoubtedly protest that you would recognize them faster at a slower speed. But at this stage you are laying the foundation for rapid future progress, rather than trying to memorize the characters in the shortest period of time. Therefore, the instructor will not send them slower. Instead, he will repeat each one as often as necessary to allow you to get its sound firmly impressed in your mind and to establish the habit of writing down the correct letter every time you hear that sound.

To avoid the possibility of memorizing the letters by association with other ones, the instructor will introduce them to you in a mixed-up order. Assuming an hour per lesson, you should be able to learn about five characters per lesson; therefore, it will

(*Continued on page* 105)

HELP US OBTAIN OUR HAM LICENSES

In this section of the Transmitting Tower, the names of prospective amateurs requesting help and encouragement in obtaining their licenses are listed. 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

Ricky Littlefield, Box 7, Raymond, Me. (Code)

Richard Danziger, 55 Woodlawn Ave., Northampton, Mass. (Code and theory)

George MacLauchlan (14), Addison, Maine. (Code and theory)

John L. Heaton, Jr. (13), 201 Mystic Valley Pkwy., Winchester, Mass. (Code and theory)

K2/W2 CALL AREA

George Laeske, 408 Center Ave., Bellmore, N. Y.

Emory Thompson III, 30 Esplanade, New Rochelle, N. Y.

Joseph Lofreddo, 79 Bregman Ave., New Hyde Park, N. Y. (Needs help in obtaining General Class license)

James Wendel, 28 Schuler Ave., Tonawanda, N. Y. (Code and theory)

Henry Weidman, 216 "C" Gibson St., Tonawanda, N. Y. (Code and theory)

Peter LaRoche, Thompsonville Rd., Monticello, N. Y.

Bill More (14), 333 Cedarwood Terrace, Rochester, N. Y.

Paul Markowitz, 389 17th Ave., Paterson, N. J. (Code and theory)

Allen Moult, 7 Brighton 4 Place, Brooklyn 35, N. Y.

K. Radziewicz, 846 Bergen St., Newark 12, N. J. Phone: BIgelow 3-4937. (Code and theory)

Robert Rogers, 24 Phillips St., Beacon, N. Y. (Code)

K3/W3 CALL AREA

George Healey, Jr., 1051 Grand View Blvd., Lancaster, Pa. (Code and theory)

Joel Ballon, 200 So. Atlantic Ave., Pittsburgh 24, Pa.

Martin Hartig, 825 Exeter Hall Ave., Baltimore 18, Md. (Code and theory)

Mike Wood, 371 Case Ave., Sharon, Pa. (Needs help in General Class theory)

Louis Grossman, 611 W. Norwegian St., Pottsville, Pa.

Olen S. Terry, 296—3rd St., Beaver, Pa. (Code and theory)

Donald Zupon, 59-H Boone Drive, Turtle Creek, Pa. Phone: VA 3-6820.

Gary P. Sweeney (14), Upper Black Eddy, Pa. Phone: FErndale 2-2714. (Code and theory)

Alan Cohen, 6605 Sylvester St., Philadelphia 49, Pa. Phone: PIlgrim 5-9319. (Code and theory)

Bill Goodman (14), 114 E. Wayne Ave., Easton, Pa. (Theory)

Walter Bohlman, 32 Bridge St., Doylestown, Pa.

Jerry Naditch (13), 3226 Sequoia Ave., Baltimore 15, Md. (Code and theory)

K4/W4 CALL AREA

John Cliburn, Rte. 2, Scottsville, Ky. (Code and theory)

D. W. Smith, 1024 Beecher St.. S.W., Atlanta 10, Ga.

George Hines, 3721 Catalpa Ave.. Knoxville, Tenn. Phone: 5-6224. (Code and theory)

Jacque White, 601 Highland Ave., High Point, N. C. (Code and theory)

Rhanor Gillette, 190 Little John Trail, Atlanta, Ga. (Code and theory)

James Green, 2124 E. 27th, Chattanooga, Tenn.

Terry Harmon (15), 301 DeRenne Dr., Savannah, Ga. (Code and theory)

Edgar Shrum (14), 210 Dixie Ave., Harrisonburg, Va. (Code)

K5/W5 CALL AREA

Stan Champion, 6 Glendenning, Houston 24, Tex. (Code and theory)

L. E. Jacob, c/o Band Director, Nixon, Tex.

Eddie Evans (15), 10017 Betts Dr., Albuquerque, N. M. (Code and theory)

K6/W6 CALL AREA

Kurt Kroeger, 406 N. Fourth Ave., Arcadia, Calif. (Code, theory and regulations)

Michael DeLauder, 7923 Melita Ave., North Hollywood, Calif. Phone: ST 5-3955. (Code and theory)

K7/W7 CALL AREA

E. W. Kangas, Box 165, San Jose Br., Bisbee, Ariz.

Laudio Doubrava (14), P.O. Box 7, Hubbard, Ore. (Code)

K8/W8 CALL AREA

Fred N. Olmstead, 11942 Belle River Rd., Memphis, Mich. (Code and theory)

Edward Wilush, 122 Princess St., Campbell, Ohio. (Code and theory)

Eliot Friedman, 12948 Victoria, Huntington Woods, Mich. (Code)

Thomas A. Root, 608 Copeman Blvd., Flint 3, Mich. (Code)

William Tiep, 18 Rockingham Dr., Toledo 8, Ohio. (Code and theory)

Ronald Noffsinger, R.R. #1, Frankfort, Mich. (Code and theory)

Bruce Hunt, Benzonia, Mich. (Code and theory)

Matthew Holm, 712 Grand Traverse, Flint, Mich. (Code)

K9/W9 CALL AREA

Jerry Janka, 1709 N. Moody, Chicago 39, Ill.

Larry Plummer, Box 244, Kewanna, Ind.

Dale T. Hollaway, P.O. Box 357, Byron, Ill. Phone: BYron 4703. (Theory and regulations)

K0/W0 CALL AREA

Thomas P. Gardner, 4144 Ettica Ave., St. Louis Park, Minn.

Jim Olmstead, 119 Third Ave., N.W., Hampton, Iowa.

Duane Nruechte, Caledonia, Minn. (Code)

Angelo Cossa, 7998 Raleigh Place, Westminster, Colo. Phone: HA 9-1470. (Code)

Bill Sokol, 4131 Lafeyette Ave., Omaha 3, Nebr.

VE AND OTHERS

Ross Duncan, 315 Kelvin Blvd., Winnipeg 9, Manitoba, Canada. (Code and theory)

Harold A. Benson, Rt. 1, Midland, Ont., Canada. (Code and theory)

Robert Moore, Chalet "San Ignacio," Carretera General, Cadiz, Spain.

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 33⅓ rpm) and a Novice Theory Course for $10.00, postpaid. The complete course or more information on it is available from RETMA, Suite 800, Wyatt Bldg., 777 Fourteenth St., N.W., Washington 5, D. C.

Transistor Topics

By **LOU GARNER**

OVER the past several months, a real "boom" in electronic construction has developed among home-builders, experimenters and electronics hobbyists. Last Christmas, electronic construction kits sold in unexpected numbers, with many of the kits going to individuals who had never before dabbled in electronics . . . newcomers to our ranks.

Contributing in a large part to the upsurgence of interest in home-built electronic equipment has been our favorite component . . . the *transistor*. Transistor receiver and experimental construction kits led most other kits in popularity during the Christmas season and are continuing to sell in good numbers. And with summer not too far away, we can expect an increasing interest in transistorized portable radios and phonographs.

Readers' Circuits. Ever since the first days of radio or "wireless" transmission, when the "standard" receiver was a crystal detector and the more powerful transmitters were Alexanderson alternators (giant high-frequency a.c. generators), receivers have been the most popular of construction projects with home builders and experimenters. This month we are featuring not one but *four* simple receiver projects, all submitted by our readers. Refer to Fig. 1 for circuit details.

High Selectivity. Sent in by Francis A. Ney of 22 Highland Ave., Flourtown, Pa., the circuit shown in Fig. 1(A) is basically a highly selective crystal receiver. With only moderate sensitivity, this circuit will give its best results when coupled to a long outside antenna (Francis uses a 100′ antenna) and a good earth ground. Because of its good selectivity, the receiver is excellent for use in areas with several stations operating near the same frequency.

Capacitor *C1* is a 365-μμfd. variable unit used to "tune" the antenna circuit. *C2-C3* is a two-gang tuning capacitor; each section is rated at 365 μμfd. Coils *L2* and *L3* are

(*Continued on page* 98)

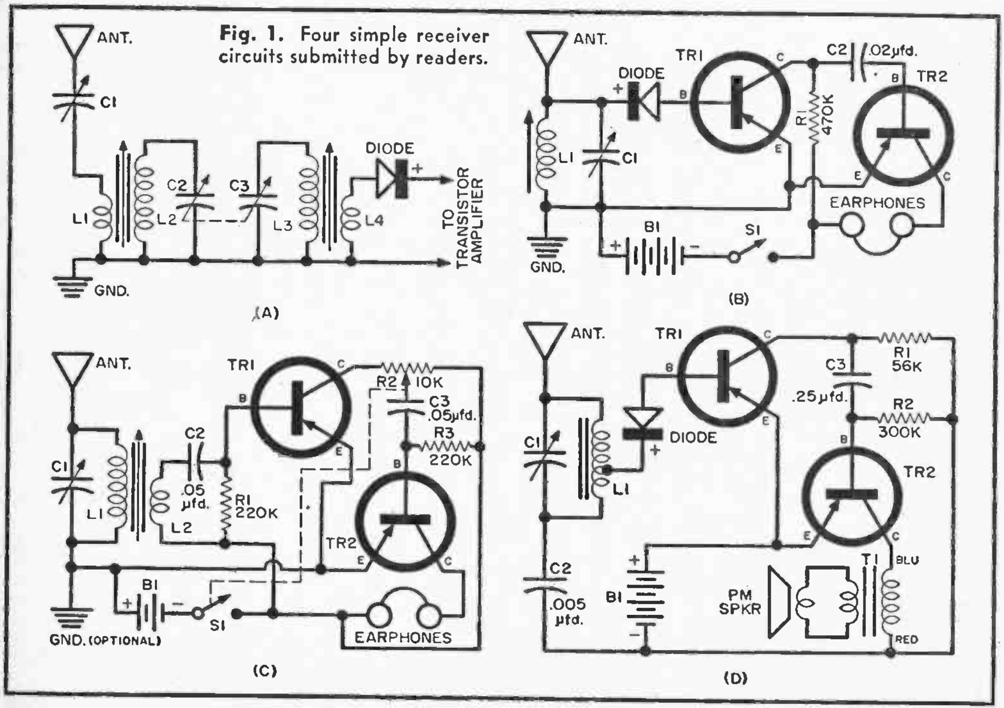
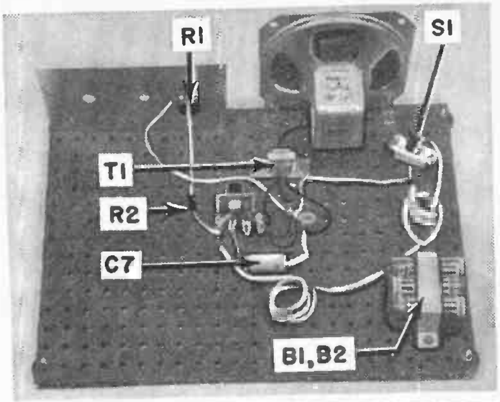
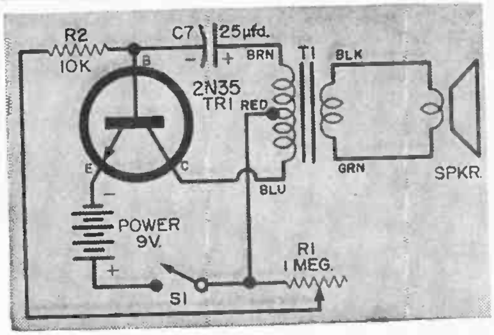


Fig. 1. Four simple receiver circuits submitted by readers.

Transtopic Experiment No. 16

Loudspeaker Metronomes





THIS is another experiment in the series that started in the March, 1956, issue. The last experiment, No. 15, appeared on page 85 of the February issue.

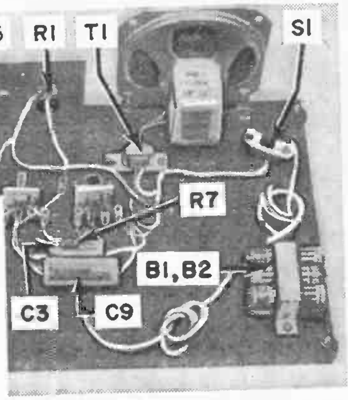
Assembling a loudspeaker-operated metronome is a simple operation. You have a choice of two circuits.

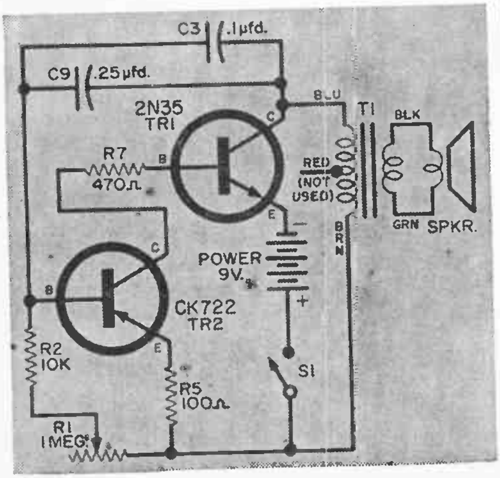
The first circuit (shown at right) is an adaptation of the code oscillator project (Experiment No. 15). The major change has been to substitute a 25-μfd. electrolytic capacitor (*C7*) for the 0.25-μfd. capacitor (*C9*). This increases the *RC* time constant in the transistor's base-emitter circuit. The "KEY" is eliminated as well as the protective resistor, *R5*.

When you have completed the wiring and checked it, adjust *R1* for the beat rate desired. You can change the range by changing *C7*—use a smaller capacitor for higher frequencies, a larger capacitor for lower rates.

If the one-transistor metronome is not complex enough, you can adapt it to a two-transistor circuit. This modified circuit uses the *p-n-p* and *n-p-n* direct-coupled circuit arrangement. Again, the setting of *R1* determines actual beat rate while the value of the feedback capacitors (*C3* and *C9*) determines range.

—*Louis E. Garner, Jr.*





Tuning the Short-Wave Bands

with Hank Bennett

WHAT *is* an SWL? What do you have to do to become an SWL? After you become one, then what? What advantages are there in being an SWL? Another important question aften asked by our younger readers is: "Do I need an expensive receiver?"

An SWL is a *Short-Wave Listener*, or one who tunes the short-wave bands. The only requirements necessary for becoming an SWL are an interest in radio, a receiver that is capable of tuning the s.w. bands, and a large quantity of patience and perseverance.

Well-designed listening post of Donald Larkworthy, Hales Corners, Wis. His equipment includes a S-40B, a BC-1066B, and an experimental receiver.

After you become a bit experienced, you may find it interesting to write to the stations that you hear, and, in turn, to receive their verification letters or cards. You may find it intriguing, as many SWL's do, to obtain your radio amateur operator's license, and to get on the air and talk to others via the radio waves.

Advantages of SWL'ing. What hobby could be more interesting than short-wave radio, with its magic and seemingly mysterious methods of being able to send human voices thousands of miles through space? In s.w. radio, the listener can learn about the peoples of other countries and continents, their customs and their policies. To high school students, it offers a chance for excellent workable lessons in languages as well as an opportunity to learn the music and habits of people in far-distant lands.

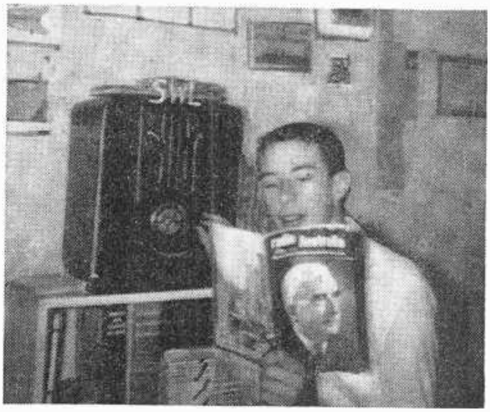
The DX'ing hobby enables some to further themselves in life. It supplies the means of meeting new friends, a few of which will prove to be life-long ones. And, if nothing else, it provides countless hours of pleasure and relaxation.

About Receivers. No license is required to operate a receiver, and you don't have to own one that costs a small fortune. There are many relatively low-priced receivers on the market between $60 and $150 that are ideal for one who is new in the hobby. Later on, of course, if you wish to continue SWL'ing and feel that you can afford a better receiver, you'll find them in all price ranges.

A number of our teen-age readers have written to tell us how they earned the money necessary to purchase a new receiver. With even younger DX'ers (and there are many of them), obtaining a good receiver presents a problem. Before you talk your parents into investing a lot of money in a communications-type receiver, try DX'ing on an old radio that you have in your house. I'll bet that you can find one in your attic or storage room that your folks put there when TV came into being.

You youthful DX'ers will be surprised at

(*Continued on page* 110)



Stuart Fidler, who operates from Jordan, N. Y., is a regular contributor to our short-wave column.

AFTER CLASS

Special Information on Radio, TV, Radar and Nucleonics

SOME NOVEL GLOW LAMP CIRCUITS

VIRTUALLY EVERYONE has seen miniature glow lamps used as pilot lights . . . you may even have experimented with small neon lamps as relaxation oscillators in simple electronic metronomes and stroboscopes. But few people know that these startling little tubes can outperform vacuum tubes in certain specialized applications. Many huge computers rely on them.

The unique behavior of gas-filled glow lamps may be traced to the process of ionization. An inert gas like helium or argon is ordinarily non-conductive and emits no light. Even when a low voltage is applied across a pair of electrodes enveloped in an atmosphere of one of these gases, nothing seems to happen. But when the applied potential rises above a certain critical value, the gas *ionizes* suddenly, becoming a relatively good conductor.

Characteristics. Typical glow lamp characteristics are as follows:

(a) A glow lamp does not carry a substantial current until the voltage applied across its terminals reaches an ionization potential. This critical voltage depends upon the nature and pressure of the gas with which the bulb is filled. Most miniature bulbs utilize neon.

(b) After ionization, the gas becomes a good conductor and a large current can flow, unless limited by a series resistor.

(c) To extinguish the lamp, the voltage must be dropped well below the ionization potential.

(d) During normal conduction, the glow lamp maintains a fairly constant voltage across its terminals even though the source voltage changes appreciably.

(e) Ionization potential for a given glow lamp depends on the presence or absence of light, gamma rays and other types of radiation, electrostatic or electromagnetic fields.

(f) Glow lamps have a tendency to "run away." Once ionization has taken place, the current through the lamp attempts to increase without limit—unless a limiting resistor is connected in series with the lamp. This runaway characteristic results in an arc across the electrodes.

Blown Fuse Indicator. One of the most useful applications of the miniature glow lamp type NE-2 or NE-51 appears in Fig. 1. It is shown connected across a fuse, protected from the runaway condition by a series-limiting resistor (*R*). As long as the fuse is good, the lamp is extinguished. Should the fuse melt and open the circuit, the full potential across the neon bulb will cause it to glow.

To calculate the approximate resistance required for an NE-2 or NE-51 bulb in this circuit, use the following equation:

$$R = V_{fo}/0.0025$$

where R is the resistance in ohms and V_{fo} is the voltage across NE-2 with the fuse open.

Dual Voltage Indicator. Two miniature glow lamps may be connected as shown in Fig. 2 to serve as dual voltage indicators. Such an arrangement is especially useful in audio circuits to establish

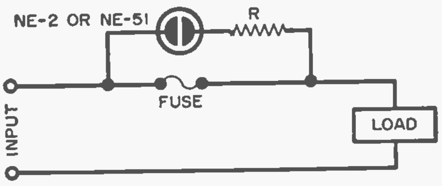


Fig. 1. Blown fuse indicator circuit.

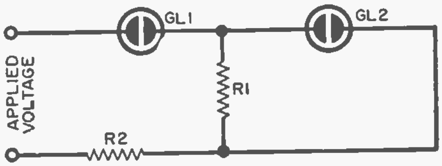


Fig. 2. Dual voltage indicator circuit using two NE-2 or NE-51 tubes.

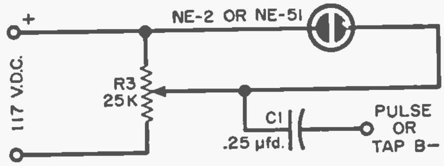


Fig. 3. Glow tube memory circuit.

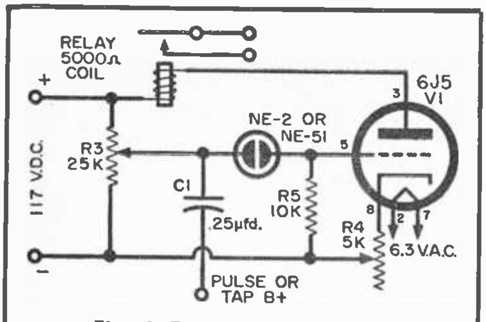


Fig. 4. Trigger latch-in circuit.

minimum and maximum voltages necessary for recording, monitoring, and playback.

GL1 glows each time the applied voltage reaches or exceeds about 70 volts, the rated ionization potential for these small lamps; resistors *R1* and *R2* comprise a voltage divider which is adjusted so that *GL2* glows only when the applied voltage exceeds a higher value by some predetermined amount. The glow voltage for *GL2* is set by choosing values for *R1* and *R2*. Choose the voltage at which *GL2* is to ignite and call this *E*. Then *R1* and *R2* may be approximately determined from the following equations:

$$R1 = E/0.0025$$

$$R2 = 50{,}000 - R1$$

For example, suppose that you want *GL2* to glow when the applied voltage reaches 100 volts. *GL1* will ignite at 70 volts as previously stated. So the approximate values for the resistors required are:

$$R1 = 100/0.0025 = 40{,}000 \text{ ohms}$$

$$R2 = 50{,}000 - 40{,}000 = 10{,}000 \text{ ohms.}$$

Memory Circuit. If *R3* in Fig. 3 is adjusted to the point where the NE-2 just fails to ignite, i.e., at about 65 to 68 volts, a short negative pulse applied through the 0.25-µfd capacitor (*C1*) will cause the tube to ionize. Even when the pulse disappears, the tube will continue to conduct the current as indicated by its sustained glow.

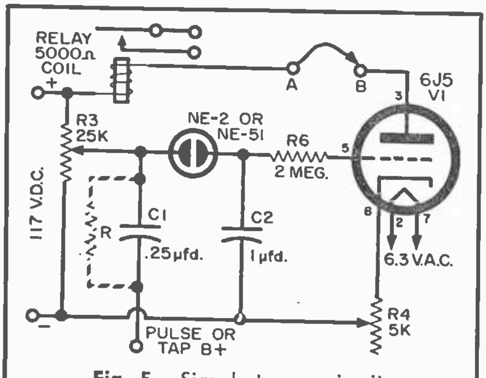


Fig. 5. Signal storage circuit.

This phenomenon is explained by referring to characteristic (c) as given previously. The pulse raises the voltage applied to the glow lamp enough to trigger the ionization process; then, upon removal of the pulse, the voltage drops back to its former value of 65 to 68 volts. But the lamp is already ionized so that it does not extinguish since the applied voltage is now well over the *de-ionization potential.*

Thus, the glow lamp "remembers" that a pulse has been received and can impart this information to other circuits of a computer or data processor.

Trigger Latch-In Circuit. It is often desirable to have a short-lived pulse operate and latch in an ordinary relay. This is accomplished in the circuit of Fig. 4.

The 5000-ohm potentiometer (*R4*) is adjusted so that the plate current of the 6J5 is well below the point needed to pull in the relay with the glow lamp extinguished. It is assumed that *R3* has been set as in the previous example (to about 65 volts or just below ionization potential for an NE-2 or NE-51). Now a pulse applied through *C1* will ignite the glow lamp.

Current thus flows through *R5* in such a direction as to make the grid more positive. Hence, the plate current increases and the relay pulls in. It remains that way until the neon lamp is extinguished, and is ready for the next pulse which again causes the latch-in operation.

Signal Storage Circuit. If the circuit in Fig. 4 is altered to include two more components (*C2* and *R6*), the system becomes a signal storage circuit (see Fig. 5). Now an incoming pulse triggers the glow lamp for an instant, causing a stored charge to appear on the 1.0-µfd grid capacitor (*C2*). The polarity of the stored charge is such as to permit a relatively high plate current to flow in the 6J5 if point *A* is jumped or otherwise connected to point *B* within a few hours after the pulse is originally received.

This is a storage circuit which provides relay operation any reasonable length of time after acceptance of a pulse; the capacitor remembers the arrival of the pulse and transfers the information to the relay when the latter's circuit is closed. If the leakage across *C2* is high, the pulse will be "remembered" only as long as the charge remains on the capacitor. This feature of eventual "forgetting" is also used in certain types of computers.

The reader's attention is called to resistor *R* in Fig. 5. If *R* is omitted, the storage circuit will react to pulses of slow repetition rate but not to rapidly recurring ones. This effect is due to the charge

(*Continued on page* 94)

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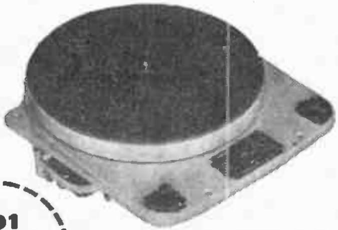

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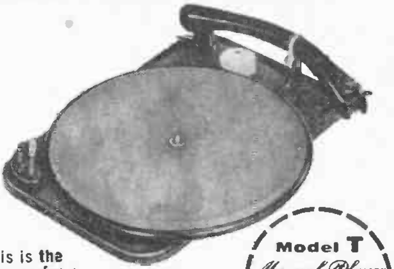

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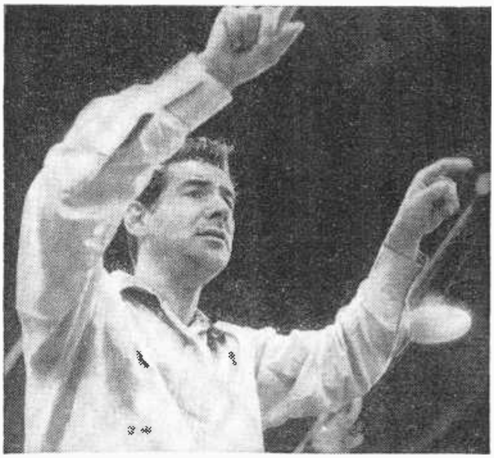
Sound Impressions

THE DISCOVERY of new musical personalities is one of the most exciting rewards for the hi-fi hobbyist and record collector. London Records' new International Label now brings us several outstanding discs of its French affiliate, Ducretet-Thomson. These releases frequently feature Desiré Inghelbrecht, an outstanding conductor of the Paris radio, and are recorded by M. Charlin, a French audio engineer with a distinctly personal touch.

Inghelbrecht's version of Debussy's *La Mer* (Ducretet DTL 93017) is a convincing evocation of the sea in its varying moods—alternating between dreamy mist, whipping storm, and sunlit brilliance. *Iberia,* on the flip side, is an orchestral reminiscence of Debussy's trip to Spain, pervaded by hints of fervid rhythm and flashes of sensuous melody, culminating in a finale of festive joy. M. Charlin, the recording engineer, achieved a true replica of the Paris orchestra's softly luminous sound.

A profound musical experience awaits you with Gabriel Faure's *Requiem* as recorded on Ducretet DTL-93083. Inghelbrecht brings forth this supremely beautiful music of quiet consolation with a tender reverence rarely heard in today's music making. The engineer's musical understanding prevented him from letting the vocal soloists obtrude into the acoustic foreground and thus mar the subdued atmosphere of this music. Instead, their voices seemingly float in from some distant nowhere, weightless, hovering in the orchestral blend. Here we have a fine example of the engineer's entering into the spirit of the music. With his microphones and dials, M. Charlin leads us to the heart of the musical matter as surely as M. Inghelbrecht's baton.



Leonard Bernstein has recorded two of his Omnibus television programs for Columbia Records.

Triple-Threat Man. Here at home, Leonard Bernstein does triple duty as composer, conductor and commentator in a venturesome series for Columbia.

The first saucy blare of his *Fancy Free* (Columbia CL-920) brashly announces his dramatic bite as a composer in the American idiom, as he leads the orchestra with assurance and verve through tricky rhythmic paces depicting three sailors on a spree.

In addition to conducting his own work, Bernstein leads the players on a snappy jaunt to Aaron Copland's *El Salon Mexico,* and into the imaginative realm of Darius Milhaud's *La Creation du Monde*. Copland picked up Mexican folk themes, weaving them into orchestral impressions of a big lively barroom in Mexico City. Milhaud uses the idiom of early jazz to suggest the languid "blues" of the yet undivided waters as well as the feeling of primeval force implicit in the title "The World's Creation."

The term "commentator" is hopelessly inadequate to describe what Bernstein does on *What Is Jazz* (Columbia CL-919). He explains, demonstrates, plays, sings, and cues performances by some of jazz's top personalities, including blues singer Bessie Smith and trumpeter Louis Armstrong. By the time he's through, you are amazed, delighted, and a lot wiser regarding the music and lyrics of jazz music in all its styles and variations. Originally performed for television's "Omnibus" show, *What Is Jazz* combines intelligent and brilliantly executed program material with the many mixings, dubbings, and other audio tricks at the command of the studio technician. The result is enlightening as a lecture and entertaining as a good show.

A somewhat similar production is Bernstein's musical explanation of Beethoven's *Fifth Symphony* (COL CL-918). On this record, he traces the numerous revisions made by Beethoven in his score until the master achieved the final themes, orches-

(*Continued on page* 94)

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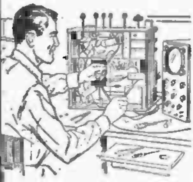

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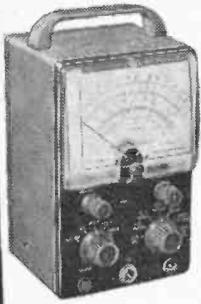

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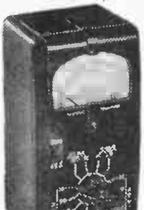

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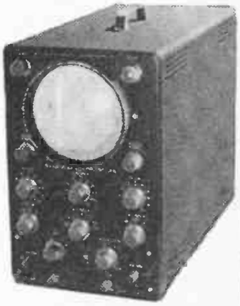

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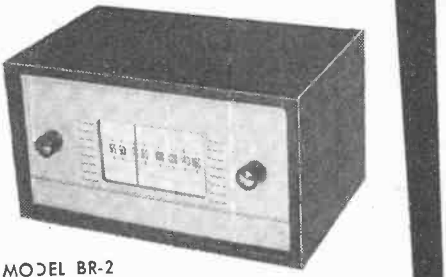

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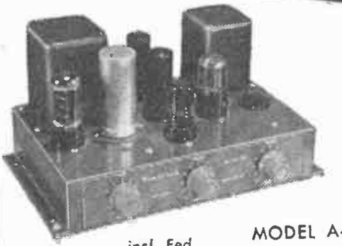

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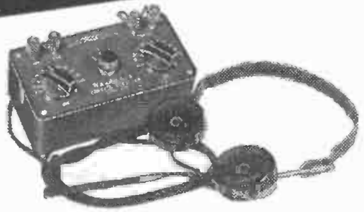

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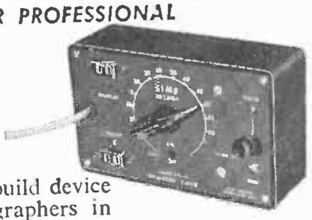

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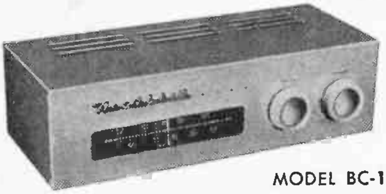

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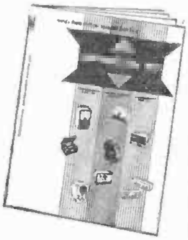

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Sound Impressions

(*Continued from page* 88)

trations, and rhythms that combine to give the listener a sense that his final version is as "right as rain." The reverse side of the disc contains a dramatic performance of the symphony—complete and uninterrupted—by the New York Philharmonic conducted by Bruno Walter.

Balkan Surprise. Hunting new talent for our turntables, Vanguard Records made a prize catch. Invading the far reaches of Yugoslavia with their sound truck, they discovered the Solisti di Zagreb, a chamber orchestra with an incomparable blend of sweetness and precision, zest and flexibility. Playing Mozart *Divertimenti* (Vanguard VRS-482), they can round off a pointed phrase without losing a feeling of sharpness. This sprightly music lends itself rewardingly to either casual listening for relaxation or concentrated listening for musical value. The size of the string orchestra—halfway between chamber music and symphony—is ideal for the average living room at moderate volume level, especially in this clear and vibrant recording.

Southern Style Choirs. Folk songs and other music of a regional character have lately been much worked over. Performance styles range from the natural, untrained voice of a young soloist accompanying himself on a guitar to the polished arrangements of professional choral groups.

A recent example of the latter style is *Songs of the South* (Columbia CL-860) done by the Norman Luboff Choir. The selections cover a scattered variety, designed to appeal to as many listeners as possible. Several of the renditions have a somewhat breathy, husky quality which, combined with the slow tempo, emphasizes the solid bass foundation of the Luboff group. -30-

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After Class

(*Continued from page* 86)

which appears across *C1*, a charge which dissipates itself through the capacitor leakage. To make the circuit responsive to fast pulses, *R* may be added. The speed of reaction will then be governed by the size of *R;* the higher the resistance, the slower the action.

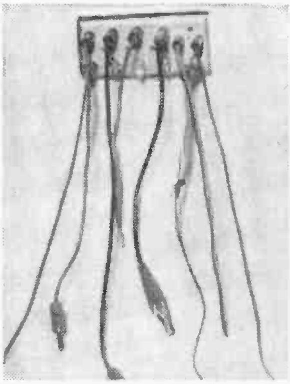
For the reader who wants to set up these circuits experimentally, it is suggested that the pulse be obtained directly from the power supply. By tapping the "pulse" end of *C1* on the B+ terminal, a sufficiently large surge current passes through the capacitor for the desired effect. -30-

Tips (*Continued from page 32*)

when either wire is touched to the binding post. (Be sure to use the same binding post.) If the picture and sound appear weaker for any single wire, the antenna is not pointed directly at the station, or there is either a broken or poor connection.

Still a third method of checking an antenna with folded dipole type elements is to use a continuity checker. With the lead disconnected from the set, check for continuity across the antenna leads. If no continuity shows, either a broken wire or connection is indicated. —*C. A. P.*

STOWING TEST LEADS

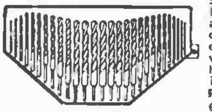


A good solution to the problem of stowing test leads out of the way without damage and still having them readily available is shown in photo. Short leads may be plugged into a vertical board mounted in a suitable location on the wall, but long leads should be hung from the ceiling straight down to prevent damage to the wire at the plug end, due to the weight of the wire. Use a No. 21 or 5/32" drill for banana plugs, and a No. 46 or 5/64" drill for pin type plugs. If fractional drills are used, the holes may have to be enlarged slightly, depending on the hardness of the block used. Either wood, plastic, or aluminum will make a good base. —*C. R. E.*

RADIO INTERFERENCE IN TAPE RECORDERS

Audio hobbyists and hi-fi fans sometimes find that their tape recorders and audio amplifiers pick up FM broadcast stations which interfere with the intended audio material to be recorded or amplified. In such instances, the equipment acts as though it had a built-in radio tuner, which is sometimes the case when the circuit constants are just right for radio reception. One remedy is to add a resistor of perhaps 10,000 ohms in series with the grid of the first stage. The resistor should be wired directly to the tube socket grid terminal or to the grid cap. Adding the resistor reduces the *Q* of the resonant circuit formed by the grid-to-cathode capacitance and the grid lead inductance. —*E. F. C.*

Chrome Vanadium 29 Pc. DRILL SET



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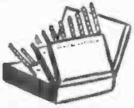

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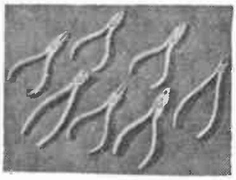

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Transistor Topics

(*Continued from page 82*)

standard ferrite broadcast-band antenna coils. *L1* consists of 27 turns of No. 28 enamel wire scramble-wound on *L2*'s form. *L4* is made up of 31 turns of No. 28 enamel wire scramble-wound on *L3*.

The receiver may be assembled on an old cigar box, in a plastic case, or on a standard metal chassis. Any standard crystal diode may be used for the diode detector . . . types 1N34, 1N34A, 1N66, or 1N295 are suitable. When assembling the receiver, make sure that *L2* and *L3* are loosely coupled; this is accomplished by mounting the two coils in parallel, with approximately ¾″ separation, center to center.

With the construction finished, the *ANT.* and *GND.* may be connected. Although you can obtain satisfactory reception of stronger local stations simply by connecting a pair of high-impedance magnetic headphones to the receiver's "output" terminals, best results are obtained if you couple the set to a standard one- or two-stage transistorized audio amplifier. Coils *L2* and *L3* are adjusted at both the "high" and "low" frequency ends of the broadcast band (use local stations near these frequencies) to obtain proper tracking across the dial. After tuning in a station, adjust *C1* for best reception . . . its principal effect will be to reduce the volume of stronger stations . . . on weaker stations it will be set to near full capacity.

Wide Reception. Basically a crystal detector followed by a two-stage common-emitter transistor amplifier, the circuit given in Fig. 1(B) was submitted by Kurt Metzer, Jr., of 880 Granger Road, Orton-

New V.H.F. Listing

In line with our article on listening to police calls (see December, 1956, issue, page 58), we note publication of a new listing of v.h.f. industrial radio systems. Entitled "Official Registry of Radio Systems in the Industrial Services," this volume features one listing by companies, and another by operating frequencies.

Stations include fixed and mobile units in such categories as power utility, petroleum and gas pipeline, low-power industrial, special industrial, forest products, relay press and motion picture, and v.h.f. maritime. The book lists for $5.00 and is available from Communication Engineering Book Co., Radio Hill, Monterey, Mass.

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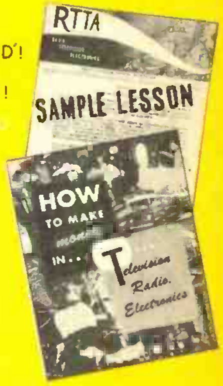

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ville, Mich. With less selectivity than the first circuit, this receiver is suitable for use in areas with widely separated stations. According to Kurt, he has received local stations up to 50 miles away using only a 15'-long antenna.

All the components are standard and readily available through most suppliers. *L1* is a ferrite core Vari-Loopstick, *C1* a standard 365-μμfd. variable capacitor. Kurt used a 1N34 diode, but other standard diodes should work as well. Transistors *TR1* and *TR2* are Raytheon *p-n-p* Type CK722. *S1* is a simple s.p.s.t. toggle or slide switch; *B1* is a 22½-volt hearing aid B battery. Best results are obtained if high-impedance magnetic earphones (2000 ohms or more) are used.

Refinements. The circuit given in Fig. 1(C), while basically similar to Kurt's circuit, has several interesting refinements. Sent in by Thomas Finnell of 382 East 199th St., Bronx 58, N. Y., this circuit employs one transistor as a combination detector-amplifier and a second as a resistance-capacity coupled audio amplifier; the common-emitter circuit configuration is used in both stages. A step-down r.f. transformer (*L1-L2*) on the input provides a better impedance match to the transistor, thus improving selectivity, while a potentiometer (*R2*) is used between stages as a volume control.

You can assemble this receiver on a small chassis, on a Masonite "breadboard," or in a wooden or plastic case. *C1* is a 365-μμfd. tuning capacitor, *L1* is a ferrite-core "loopstick" antenna coil. *L2* consists of 16 turns of litz wire, close-wound on top of *L1*. *TR1* is a Raytheon CK768 r.f. transistor, while *TR2* may be either a CK722 or CK721 unit (the latter will provide higher gain). The battery (*B1*) consists of two Burgess No. 7 penlite cells in series to supply 3 volts. S.p.s.t. switch *S1* is ganged to the volume control (*R2*). Base bias resistor *R3* should be chosen experimentally for maximum gain . . . while its nominal value is 220,000 ohms, you should try values from 100,000 to 500,000 ohms here. Use high-impedance magnetic headphones with this circuit.

While an antenna is required, a ground (*GND.*) is optional, depending on your location. According to Thomas, he picked up nine local (N. Y.) stations with good volume using the "finger stop" of a telephone dial as his antenna . . . and without a ground!

Loudspeaker Output. If you'd like to experiment with loudspeaker output, you might want to try the circuit shown in Fig. 1(D), sent in by Addison Nicholas, of

(*Continued on page* 104)

Gear Reduction MOTORS

DELCO 5069370 (Pictured at left.) 27 VDC Reversible PM Motor and Gear Assembly, in an aluminum case. Output speed is 80 RPM through a friction clutch to a double shaft—¼" x ¾" on one side, ¼" x 1½" on the other side. Complete Assembly Size: 3⅝" x 2" x 4¼" excluding shaft. Has built-in noise filter system. Weight: 1 lb. 5 ozs. Price.................. **$5.95**

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General Electric 5BA10AJ370
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As pictured at left—High Gain—May be used on desk, in car, in hand, or strapped to chest. Complete with on-off momentary switch. New: **$1.95**
RS-38 Carbon Mic.—With PL-68 Plug. Used: **$2.50**
Sound Powered Mic. No cord—Used, checked **$1.00**
HS-30 Headset—Hearing Aid type. Used: **$1.50**
HS-18 Headset—4000 ohm ....Used: **$1.95**
Sound Powered—One Headpiece only. Used: **$1.00**
TS-10 Sound Powered Handset—Used, checked **$5.95**
TS-9 Handset—Push to talk switch—No Plugs. Used: **$3.95**—New: **$5.95**
TS-13 Handset—Push to talk switch. With PL-68 and PL-55 Plugs......Used: **$5.95**

Address Dept. PE • 25% Deposit on C.O.D. Orders $5.00 and over. • All prices are F.O.B., Lima, Ohio

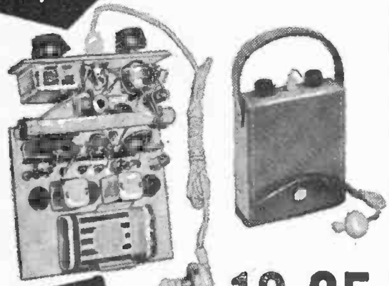
FAIR RADIO SALES
132 SOUTH MAIN ST. LIMA, OHIO

Lafayette's

4 AND 6 TRANSISTOR SUPERHET KITS POCKET AND HOME RADIOS FOR SPEAKER AND EARPHONE OPERATION

FIRST BUILD THIS

KT-94



19.95

POCKET SIZE: 4"L x 3-5/16"W x 1"D BUILT-IN ANTENNA! REQUIRES NO EXTERNAL ANTENNA OR GROUND!

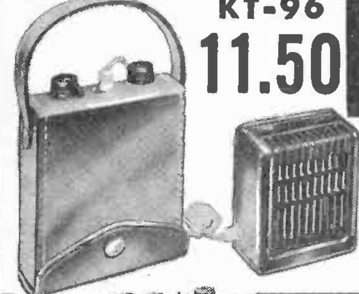
Lafayette engineers have designed this fascinating 4-transistor superhet receiver kit in a unique and interesting form. It is, by itself, a completely self-contained, pocket sized personal portable set which operates a miniature earpiece so only you can hear; by plugging into the KT-96 kit listed below, it is instantly converted to a full 6-transistor home radio, complete with speaker for the entire family to enjoy. The set is completely subminiaturized and utilizes the new, radically different Argonne "Poly-Vari-Con" ultra miniature 2-gang variable condenser. You will be delighted with the truly subminiature parts, from the variable which measures only 1-1/16" square x ⅝" deep, to the tiny I.F.'s and electrolytics. The chassis measures only 4" L x 3-5/16" W x 1" D. You'll be amazed at its performance. Circuit features use of 4 transistors (2 high frequency and 2 audio type) plus a germanium diode, 2 I.F. stages and built-in high gain ferrite core and antenna. The result is a sensitive, stable and selective set covering the entire broadcast band. Requires no outside antenna or ground connection. The kit is furnished complete with transistors and all parts, including battery and chassis already drilled and punched. The earpiece and carrying case are accessory items, not supplied. All necessary pictorial and circuit diagrams are furnished with simple, easy-to-follow instructions. Shpg. wt., 2 lbs.

KT-94 Kit .... Net **19.95**
MS-311 LEATHER CARRYING CASE .... Net **1.95**
MS-260 Super power dynamic earpiece .... Net **3.95**
MS-278 Economy earpiece .... Net **1.95**

THEN BUILD THIS

KT-96

11.50

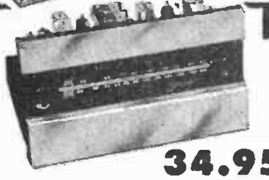


2-TRANSISTOR CLASS B PUSH PULL OUTPUT STAGE KIT WITH SPEAKER SELF-CONTAINED IN BEAUTIFUL PLASTIC CASE.

- **CONVERTS 4-TRANSISTOR KIT INTO A 6-TRANSISTOR HOME RADIO WITH SPEAKER**

Add a completely transistorized push-pull audio stage to your 4 transistor receiver. Complete stage including speaker and case measures only 3" H x 2⅜" W x 1⅜" D. Plugs right into 4 transistor kit above. Converts your 4 transistor set to a 6 transistor plus diodes superhet receiver. Performance equal or superior to commercially wired sets selling at more than twice the price. Kit includes 2 transistors, 2 transformers, 2½" PM speaker, pre-punched chassis, speaker case to hold entire stage, battery, hardware, instructions and diagrams. Shpg. wt., 1 lb.

KT-96 .... Net **11.50**



FM-AM TUNER KIT

Basic FM-AM Tuner having outstanding specifications and delivering astonishing performance — all at a budget price in easily assembled kit form.

34.95

- **AFC DEFEAT CIRCUIT WITH FRONT PANEL CONTROL**
- **FOSTER-SEELEY DISCRIMINATOR CIRCUIT**
- **GROUNDED GRID TRIODE AMPLIFIER**
- **20-20,000 CPS RESPONSE**

Choose this 7 tube compact high-fidelity FM-AM tuner whose characteristic features are found in units costing many times as much, and whose performance is unheard of at this low price. There are two front panel controls, a function control for AM, FM, PHONO, TV and a tuning/AFC defeat control. Features Armstronf FM circuit with limiter and Foster-Seeley discriminator. Simplified tuning with slide-rule dial and flywheel counterweighted mechanism, high impedance phono input and high impedance audio output.

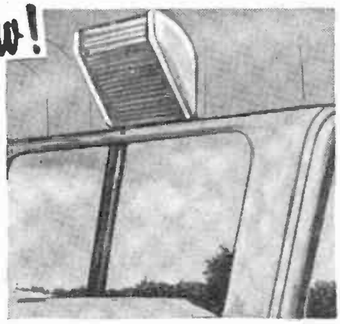
SPECIFICATIONS

FREQUENCY RANGE: FM 88-108MC, AM, 530-1650 KC. **ANTENNA INPUT:** FM, 300 ohms, AM Ferrite loopstick and high impedance external antenna. **DISTORTION:** Less than 1% at rated output. **FREQUENCY RESPONSE:** FM, + .5 db 20 to 20,000 cps, AM ± 3 db 20 to 5000 cps. **SENSITIVITY:** FM, 5 UV for 30 db quieting, AM, Loop sensitivity 80 UV/meter. **SELECTIVITY:** FM, 200 KC bandwidth, 6 db down; 375 KC FM discriminator peak to peak separation, AM, 8 KC bandwith, 6 db down. **IMAGE REJECTION:** 30 db minimum. **HUM LEVEL:** 60 db below 100% modulation: **TUBE COMPLEMENT:** 2-12AT7, 1-6BE6, 1-BA6, 2-6AU6, 1-6AL5 plus selenium rectifier. **SIZE:** 5¼" high x 9⅝" wide x 9½" deep (excluding knobs). **CONSUMPTION:** 30 watts. For 110-120V 60 cycles AC. Attractive etched copper-plated and lacquered finish. Less metal case. Shpg. wt., 9 lbs.

KT-100 A .... NET **34.95**
ML-100...Metal cage for above, Shpg. wt., 3 lbs. **5.00**

STATION WAGON REAR SEAT SPEAKER

New!



Now, rear seat passengers in your station wagon can enjoy car radio programs with equal pleasure. Good quality 6"x9" oval speaker mounted in luxurious ivory and gold housing, provides listening enjoyment of both music and voice. Rear seat speaker is quickly and easily installed. NO HOLES TO CUT. All wires, brackets and screws are hidden from view after installation. Installation kit includes mounting brackets, screws, switch, switch plate, nut and spacer, knob and wire leads.

CAR	YEAR	MODEL	Any Model Net, Each
Ford	52 thru 56	SB-41	**8.08**
Chevrolet	57	SB-42	
Plymouth	56	SB-44	
Pontiac	55 thru 57	SB-45	

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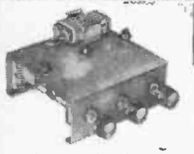
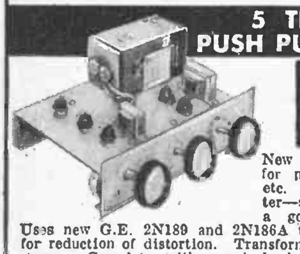


3 TRANSISTOR HI-FI PREAMPLIFIER KIT

New Lafayette Hi-Fi Pream Kit using new GE 2N190 quality audio transistors. Separate Volume, Bass and Treble controls. Frequency response 20-20,000 cps. Three phono and microphone. Provides low-noice, stable preamplification without hum and microphonics. Complete with all parts transistors, pre-punched chassis, battery and detailed step-by-step instructions. Size 4⅛" x 3¾" x 1½". Shpg. wt., 2 lbs.

KT-117—Complete Kit..........................Net **18.45**

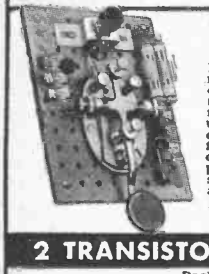
5 TRANSISTOR PUSH PULL AMPLIFIER KIT



- ¼ WATT, CLASS B, PUSH-PULL OUTPUT
- CRYSTAL AND MAGNETIC INPUT
- SEPARATE BASS AND TREBLE CONTROLS

New 5 transistor audio amplifier for phonos—microphones—tuners—etc. Excellent for the experimenter—student—or any one desiring a good transistorized amplifier. Uses new G.E. 2N189 and 2N186A transistor. Inverse feed back for reduction of distortion. Transformer coupled driver and output stages. Complete with punched chassis, knobs, transistors, all parts and detailed instructions and diagrams.

KT-104—3.2 ohm output..........................Net **22.95**
KT-105—8 ohm output..........................Net **22.95**



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**

2 TRANSISTOR POCKET RADIO KIT

Packed into a 2½"x3½"x1¼" plastic case This Two Transistor plus crystal diode radio kit offers many surprises, utilizing a regenerative detector circuit with transformer coupled audio stage, gives you high gain and excellent selectivity. Pulls in distant stations with ease with more than ample earphone volume. Kit comes complete with two transistors, crystal diode, loopstick, Argonne transistor audio transformer, resistors, condensers, plastic case, etc. Including schematic and instructions.

KT-68A Complete Kit less earphones. Net **10,95**
MS-260 New Super Power Dynamic Earphone, ideal for Transistor Circuit imp. 8000 ohm, D.C. 2000 ohm **3.95**

NEW POCKET AC-DC VOM MULTITESTER 2,000 ohm per Volt on AC & DC

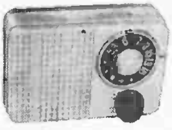
• Completely wired — Not a kit

Accurate VOM with a sensitivity of 2000 ohms per volt on both AC and DC. Single selector switch. 3" 160 amp. meter. Scales: DC Volts: 0-10-50-500-1000; AC Volts: 0-10-50-500-1000; Ohms: 0-10K, 0-1 Meg; DC Current: 500 ua and 500 ma; Decibel: —20 to +22, +20 to 36; Capacity: 250 mmf to .2 mfd and .005 to 1 mfd. Heavy plastic panel, metal bottom. 4¼" x 3½" x 1⅝". With batteries and test leads. Shpg. wt. 4 lbs.

RW-27A **8.95**

***NEW!* Mail Order Center ------▶**

3 TRANSISTOR SUPERHET POCKET RADIO KIT



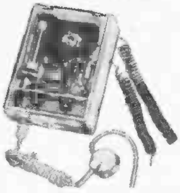
- A TRUE POCKET SUPERHET RECEIVER-NO EXTERNAL ANTENNA!
- NO EXTERNAL GROUND!

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

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

1 AND 2 TRANSISTOR POCKET RADIO KITS

ONE TRANSISTOR POCKET RADIO KIT—KT-97



- IDEAL FOR STUDENTS, HOBBYISTS AND EXPERIMENTERS
- PRE-PUNCHED CHASSIS FOR ADVANCEMENT TO 2 TRANSISTOR KIT

Ideal, low-cost translstor pocket radio kit. Super-selective ferrite loop antenna permits good reception up to 50 mile radius with approx. 50 ft. antenna and good ground. Provisions for advancement to 2 transistor receiver. Complete Kit with simple detailed instructions. 3⅝" x 2⅝" x 1". Shpg. wt., 1 lb.

KT-97—Complete, less earphones..Net 4.50

TWO TRANSISTOR POCKET RADIO KIT—KT-98

Contains all KT-97 components plus additional R-C coupled transistor stage for increased sensitivity and output. Complete with instructions. Shpg. wt., 1 lb.

KT-98 —Complete 2 Transistor Kit, less earphono......Net 5,95
MS-111—Crystal earphone for KT-97 and KT-98........Net 1.49
MS-260—Super power dynamic earphone..................Net 3.95

20,000 OHM PER VOLT MULTITESTER SEMI KIT

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 3⅜" x 4⅜" x 1⅝". Shpg. wt., 3 lbs.

KT-20—Kit ....Net 11.95

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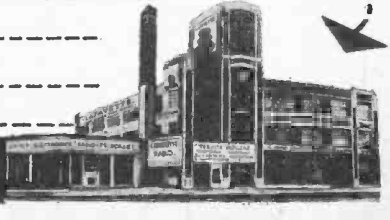


CUT OUT AND MAIL TODAY!

Transistor Topics

(*from page* 101)

38 Peace Ave., Dalton, Mass. Essentially a simple diode detector followed by a two-stage capacity-coupled common-emitter transistor amplifier, this circuit features a tapped antenna coil (*L1*) and loudspeaker output.

Assembly and wiring are straightforward and non-critical. *L1* is a tapped "transistor" antenna coil, such as a Miller No. 2000 or Lafayette No. MS-166; *C1* is a 365-μμfd. variable capacitor. A 1N34, 1N66, CK705, 1N295, or similar general-purpose diode can be employed as a detector, while *TR1* and *TR2* may be any standard *p-n-p* audio transistors . . . suitable types are Raytheon CK722 or CK721, G.E. Type 2N107, General Transistor Types GT-34 or GT-222. Output transformer *T1* is an Argonne Type AR-138 to match to a 3.2-ohm speaker voice coil (use Type AR-137 if your loudspeaker has an 8-ohm voice coil). Almost any size PM loudspeaker may be utilized, but you'll find that the larger speakers (six inches and up in diameter) are more efficient. *B1* is a standard 6-volt battery (Burgess No. Z4); although no "on-off" switch is shown, one may be connected in series with either the positive or the negative lead of the battery.

Note that *no ground (GND.) connection is employed,* although an external antenna is desirable. Addison says that *C2* is somewhat critical . . . he found that a 0.005-μfd. capacitor worked best here, but you may wish to experiment with other values.

In all four of the circuits shown, all resistors may be ½-watt units while capacitors (other than the variables) may be either mica, ceramic, or paper units, with rated working voltages of 25 volts *or more.* The transistors can be soldered permanently in position or installed in standard sockets.

New Booklets. Lafayette Radio (165-08 Liberty Ave., Jamaica 33, N. Y.) has issued its second annual *Transistor Brochure.* Featuring most available transistors, all types of transistor components, many transistor kits, and considerable useful information, this is the most complete "transistor catalog" currently available . . . and it's FREE on request!

Raytheon Manufacturing Company (55 Chapel St., Newton 58, Mass.) now has two new booklets available. The *Transistor Guide* gives much general information about transistor selection and installation, plus a number of practical circuits, while a newly issued booklet for the Raytheon *Transistor Experimenter's Kit* features many circuits designed around the popular 2N295 diode, the CK768 r.f. and CK722 audio transistors. For information on these booklets, write directly to Raytheon.

Product News. Coming soon . . . a "Radio for your Ear." Called the "EARADIO," it is a self-contained transistorized superheterodyne radio . . . a complete unit which can be attached to the ear . . . and makes for easy listening while traveling or at home.

Over *four times* as many transistors were sold in 1956 as in 1955. At the present rate of increase, transistor sales will equal (or exceed) vacuum tube sales in just a few more years. According to the experts in design and production of transistors, we can expect a 25-cent transistor by 1962!

The Jackson Electrical Instrument Company, Dayton 2, Ohio, has announced a new transistor code practice oscillator. Intended for code practice by amateurs, the unit includes special jacks for interconnecting two units to simulate station-to-station operation. With a few minor circuit changes, the instrument may also be used as a *monitor* for a c.w. transmitter.

A transistorized electronic megaphone is available from the Pye Corporation of America, 270 Park Ave., New York 17, N. Y. Called the "Transhailer," the unit has a maximum power output of 3½ watts, and an over-all weight of only five pounds. With an operating range of ¼-mile, the instrument is manufactured in England.

That's it for now, fellows . . . see you next month.

Lou

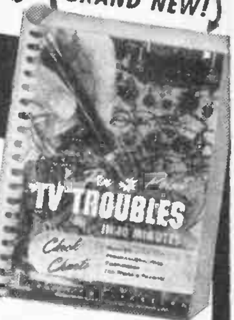
The Transmitting Tower

(*Continued from page* 80)

take about eight lessons to learn them all. In the process, you will have heard and written down each character 50 to 100 times, and, by the time you have learned the last one, you will probably be able to copy at a speed of about 8 wpm.

Next to having a private code instructor, undoubtedly the best way to learn the code is with the aid of a recorded code course. Such courses are available on 33⅓- and 78-rpm phonograph records, on magnetic tapes for reproduction on a standard tape recorder, and in the form of punched paper tapes for use on a special tape machine. The exact method of teaching the code varies from course to course, but it is similar to that described above.

Speed Your Receiving. Once you have memorized the code by any method, the only way to increase your copying ability



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"Pinpoint TV Troubles in 10 Minutes" is one of the most valuable "tools" you can carry on a servicing call. Amazingly practical. Over 300 spiral bound fast reference pages with 50 time-saving Check Charts; dozens of important diagrams and tests; explanations of circuits and designs. Fits easily into your tool kit for handy on-the-job reference. Prepared and backed by the famous Coyne Electrical School.

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TWICE AS FAST!

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IN HALF on
2 jobs out of 3

TV TROUBLE-FINDER GUIDES

Now! Handle television receiver troubles by easy picture analysis. Let these famous PIX-O-FIX Guides tell you what is wrong . . . then show exactly how to fix it.

Just turn the PIX-O-FIX dial until the picture in its window shows the same trouble symptoms (wavy lines, snow, no raster, "squeezing" distortion, etc.,) as the picture on the TV set you're repairing. PIX-O-FIX then tells the possible trouble causes and gives step-by-step repair instructions. It's as easy as that!

The two PIX-O-FIX units No. 1 and No. 2 cover 47 different television troubles . . . just about anything you're likely to be called on to fix. No. 1 identifies 24 of the most common troubles and gives 192 causes and 253 remedies. No. 2 covers 23 more advanced troubles not included in No. 1. Together, they are a comprehensive guide to quick "picture analysis" servicing of any TV set . . . AND THE PRICE IS ONLY $2.00 FOR THE TWO. Use coupon.

DON'T THROW OLD
RADIOS AWAY!

This giant book shows exactly how to fix old sets in a jiffy . . . without useless testing

There's a "secret" to repairing old radios fast and profitably . . . and this big RADIO TROUBLESHOOTER'S HANDBOOK is it!

Just look up the old make and model you want to fix. This 3½ pound 744-page Ghirardi handbook tells what the trouble is likely to be . . . AND SHOWS YOU EXACTLY HOW TO FIX IT. No useless testing! No wasted time! Even beginners can handle jobs "slick as a whistle." *The only guide of its kind* . . . cuts repair time in half!

Included are common trouble symptoms and remedies for over 4,800 old models of home and auto radios and record changers. Actual case histories cover practically every model made by 202 manufacturers between 1925 and 1942—Airline, Apex, Arvin, Atwater Kent, Belmont, Bosch, Brunswick, Clarion, Crosley, Emerson, Fada, G-E, Kolster, Majestic, Motorola, Philco, Pilot, RCA, Silvertone, Sparton, Stromberg AND DOZENS MORE. Gives how-to-do-it data on SPECIFIC jobs—NOT general theory. Includes hundreds of pages of individual tube and component data, service short cuts, etc. Price $6.95. 10-day free trial.

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232 Madison Ave., New York 16, N. Y.

☐ Enclosed is $2.00 for PIX-O-FIX Nos. 1 and 2. You guarantee to refund my money if I return them in 10 days.

☐ Send book RADIO TROUBLESHOOTERS' HANDBOOK for 10 days FREE EXAMINATION. If I like book, I will promptly send $6.95 (plus postage) in full payment. Otherwise I will return book and owe you nothing. (SAVE! Send cash with order and we pay postage. Same 10-day Money-back Guarantee.)

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is by regular practice, copying sending slightly faster than you can copy solidly. You can get this practice from an instructor or from a recorded code course, but you will probably obtain most of it from your short-wave receiver.

At almost any time of the day or night, you will find stations in the ham bands sending at speeds from 5 wpm and up. Also, W1AW, the ARRL headquarters station, transmits code practice every evening at 9:30 p.m., Eastern Time.* On Sunday, Tuesday, Thursday, and Saturday evenings, transmissions start at 5 wpm and conclude at 13 wpm. On Monday, Wednesday, and Friday, they start at 15 wpm and conclude at 35 wpm.

W1AW transmits simultaneously on 1885, 3555, 7080, 14,100, and 21,010 kc. In general, the farther you are from Connecticut, the higher the frequency on which you will receive W1AW the best. You can identify it by "QST QST QST DE W1AW W1AW W1AW," repeated in code for five minutes before the start of the code-practice session.

When you get your Novice license, every contact you make will give you code practice for your General class license. However, do not depend on that entirely. Not all Novices send perfectly; therefore, still copy W1AW or other good sending regularly, in order not to forget how it is supposed to sound.

News and Views

Garin, KN2UML, uses an AT1 transmitter and an "Ocean Hopper" receiver in conjunction with an antenna 40′ high. In three months of operation, this combination has accounted for 100 contacts in 10 states. He uses no antenna coupler on the transmitter, but does find that an "Antenna Peaker" helps drag in the DX on the receiver . . . **Butch, WN3JJO,** has been on the air only two weeks, but has made 26 contacts in 14 states on 80 and 40 meters. He uses a borrowed B & W 5100 transmitter running a full pint (75 watts) feeding a 147′ antenna. He will be on with his own converted ARC-5 transmitter as soon as he figures out how to hook it up . . . **Mike, WN7FKF,** thinks he has antenna problems, because he has worked only three states in three months. He uses an S-38D receiver and a 25-watt transmitter, but has a Globe Chief 90 on the way.

Roger, KN2VJN, has a gripe against hams who send: "R R R. Sorry OM, I missed your name, my report, etc. Please repeat." He asks: "Why don't they just say, 'Sorry I missed everything'?" I hope he lets us know, if he gets an answer. (Probably, however, operators who send "R" when they actually did not copy everything sent to them do not remember that "R" means "I copied 100%.") Rog has worked

---

*See "W1AW Will Help YOU Become a Ham," in the January, 1957, issue of POPULAR ELECTRONICS, page 47.

"ONE DOLLAR" buys

100 – ASSORTED ½ WATT RESISTORS some in 5%	$1
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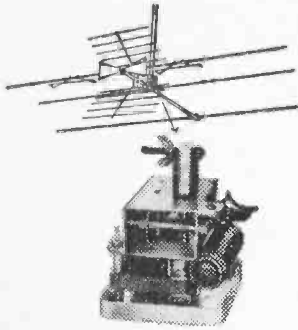

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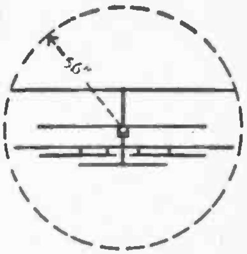

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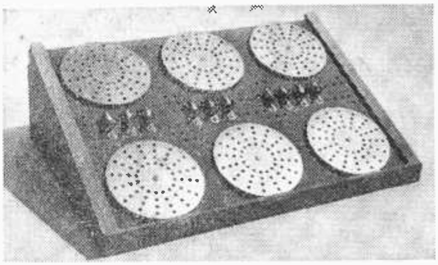
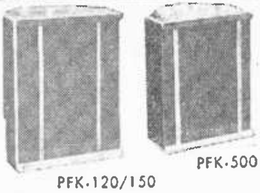


14 states in a month on the air with his 6146 and BC-454 and BC-455 receivers . . . **Tort, KN0HQW,** operates on 3725 kc., running approximately 15 watts to a 6J5-6V6 transmitter, feeding a long-wire antenna about 7' high. His receiver is a 3-tube Ocean Hopper. He has made 200 contacts in 16 states and has QSL cards from 14 of them . . . **Don, KN8CCO,** has worked 16 states, too, in three months of operation, mostly on 40 meters. Don's equipment includes an Adventurer transmitter at 50 watts and an NC-98 receiver. He will probably have his new 15-meter beam finished and in operation by the time he sees this in print.

Earl, KN8CFJ, who thought getting a Novice license at the age of 51 was unusual, inspired **Ed, K6OJQ,** to report that he was 71 when he obtained his General license. Who can beat that? K6OJQ has three ham grandsons, W6JEA, W6MLV, and K6SNN, and a son-in-law—about 52—who took his General examination in December. He operates on 75, 40, and 10 meters, using converted ARC-5 equipment . . . Earl's comments also stirred up **John, ex-8JX,** who operated "spark and c.w." in 1920 and 1921, to a renewed interest in ham radio at the "advanced" age of 52 . . . **Fred, KN9DGE,** runs 60 watts to a TR-75-TV transmitter feeding a long-wire antenna on 80 and 40 meters, and has two receivers—an HQ-100 and a BC-455. In about seven months of operation, he has made over 350 contacts in 21 states.

John, KN5GXR, puts the fairly rare state of Arkansas on 7175 kc. with 10 watts input to the "Sandwich Box" transmitter (described in POPULAR ELECTRONICS, March, 1956), and a BC-455 receiver. His states-worked total is nine, with eight confirmed. John has added bandspread tuning to the BC-455 receiver by the method described in POPULAR ELECTRONICS, December, 1955, by W1FSN for use with the SW-54. He mounted a 15-μμfd., midget variable capacitor to the right side of the receiver and connected it in parallel with the oscillator section of the ganged tuning capacitor. To adjust it, the added capacitor is set to half capacity and the receiver dial tuned to the center of the Novice band. Then the antenna trimmer and the mixer trimmer (screwdriver adjustment on top of center section of ganged capacitor) are peaked for maximum receiver output. After this is done, the Novice band will occupy a good portion of the bandspread dial. Also, by judiciously removing plates from the capacitor, the band can be spread over the entire dial.

John, K5ERJ, has not wasted any time with his amateur license. In 3½ months on the air, he has made 732 contacts in 36 states and four countries. Equipment used in his station includes a DX-35 transmitter at 45 watts, an "all-band trap" antenna, such as described in the January, 1957, *Transmitting Tower,* and an SX-99 receiver. John also reports that his mother has just passed the Novice examination. I'll try to have details on that next month . . . **Dick, KN6TVC,** is another of the many Novices using the "Sandwich Box" transmitter with excellent reports. He thinks running flea power makes it more interesting when competing with the 50- and 75-watters. As he puts it: "I'm as proud of that little ras-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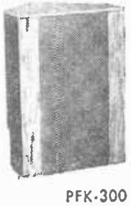
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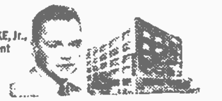
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I hope to receive a report from you before the next deadline rolls around.

Herb, W9EGQ

▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲

Tuning the Short-Wave Bands

(*Continued from page* 84)

what you can hear on old consoles and table model a.c.-d.c. sets. Try your hand with these receivers first. Build up a log of what you hear; send for a couple of verifications. After a while, your folks will begin to notice and appreciate your efforts and results; and before long you, too, may be the proud owner of a glistening new receiver that will literally open up a whole new world of DX'ing for you.

Current Station Reports

The following is a resume of the latest reports. All times shown are Eastern Standard Time, and the 24-hour clock is used.

Aden—ZNR, Aden, can be heard with an Arabic xmsn opening at 1030 on 7170 kc. The program is mainly chanting. Signals are good but there is QRM from a dictation-speed Chinese station. (*29*)

British Honduras—The British Honduras Broadcasting Service, Belize, 3300 kc., opens daily at 1830 with "Greensleeves" signature tune and program preview. Programs noted are: light music, 1900; English news, 1930; commentary, 1940; Spanish news and talk, 1945; a play at 2000; light music from 2030; an interview session at 2045; BBC concert of classical music at 2100-2200. After a brief news bulletin and the program preview for the next day, s/off is at 2210. (*61, 65*)

Canada—One of the lesser heard Home Service stations is CJCA, Edmonton, 9540 kc. All-English, it is scheduled at 0800-0200. Other regional stations include: CFVP, *Voice of the Prairie*, Calgary, on 6030 kc. with 100 watts (this relay of CFCN operates at 1400-0200); and CKFX, 6080 kc., Vancouver, which is noted relaying CKWX at 0115 with a musical program. *Radio New Zealand*, 6080 kc., provides QRM on the latter station. (*61, 70, 120*)

China—*Radio Peking* currently carries English schedules as follows: at 2200-2230 on 17,745, 17,720, 15,350, and 15,115 kc.; at 0400-0430 on 17,835, 17,720, 15,350, 15,060, and 11,650 kc.; at 0930-1000 on 17,720 and 15,350 kc.; at 1100-1130 on 11,805 and 9700 kc.; at 1400-1430 on 11,650, 9765, and 7295 kc.; and at 1430-1500 on 9680 and 7080 kc. (*4*)

El Salvador—YSS, San Salvador, 9552 kc., can be heard at times at 1930-2300 with popular and classical music and all-Spanish language. News is noted at 2120. They often have "Panorama International" at 2040. (*31, 44, 116*)

French Guiana—*Radio Cayenne,* 6231V kc., normally signs off at 1830 but on Saturdays and Sundays can be heard at 1915-1930V with music and French announcements. (*29, 59*)

French West Africa—*Radio Dakar,* Federal Network, 4893 kc., is using a new IS of eight notes played rapidly on a piano. This one opens in a Home Service xmsn at 0130 with recorded music, talk, religious program, and more recorded music. French language is used throughout this period. (*61*)

Germany—DDR, *Deutscher Demokratischer Rundfunk,* Berlin, 9730 kc., has English sessions daily except Sundays, parallel to 7150 and 6115 kc., at 1500-1530, 1630-1700, and 1730-1800. (*44*)

The Voice of Germany, Cologne, has replaced 11,795 kc. with 5980 kc. at 2030-2330 to N.A. with English news at 2130-2140. Both 5980 and 9640 kc. are heard very well. (*4*)

Gold Coast—Accra relays the BBC General Overseas Service until 1300 on 4915 kc., and at 1400-1715 on 3067 kc. (*GK*)

The Gold Coast B/C Service has recently been noted several times on 9615 kc. around 1500. The BBC news is relayed at 1500. QRM from VOA-Tangier on the same channel usually makes this one difficult to receive. (*4*)

Haiti—4VWI, 15,390 kc., Cape Haitien, is now heard with English broadcasts from 0800. The "Mailbag" at 0930 on Saturdays has been extended to 45 minutes. This is repeated on Monday at 2130 and on the following Saturday at 0500. 4VEH, Cape Haitien, is on a new frequency of 9630 kc. afternoons and can be heard at 1630 with "Listener's Post." Dual channels were announced as 17,845, 6106, and 1200 kc. (*4, 82, 116*)

Indonesia—*The Voice of Indonesia,* Djakarta, presents three English periods daily at 0600-0700 and 0930-1030 on YDB2, 4910 kc., and YDF6, 9710 kc., and at 1400-1500 on YDE, 11,770 kc., and YDF8, 9865 kc. (*44*)

Iran—EPB, Teheran, 15,100 kc., is often noted from 1500 to 1530 s/off with an English xmsn and good music programs. (*25*)

Israel—*The Voice of ZION,* 4XB31, Tel Aviv, 9008 kc., signs on at 1630 with English news; commentary to 1705; music to 1710; news summary to 1715 s/off. (*127, AG, RS*)

Jamaica—One of the few usually reliable English-speaking stations in the Tropical Band is *Radio Jamaica,* Kingston, on 4950 kc. This one can be heard often evenings with local broadcasts and BBC news relays. (*RP*)

Japan—*Radio Japan,* Tokyo, is noted at 1800-1830 on 17,825 and 15,235 kc. with English session to Eastern N.A. (*HC*)

The xmsn to Western N.A. is now heard one hour later, at 2330-0030, on 11,705 and 9525 kc. The 15,235-kc. outlet has been dropped for this xmsn. (*JA*)

Luxembourg—*Radio Luxembourg,* Junglinster, 6090 kc., is noted with music at 1700-1755, s/off at 1903, popular and light music with French announcements at 0100-0215. They identify every 15 minutes. (*31, 59, 61, 65, 70*)

Lebanon—The Lebanese B/C Station, Beirut, 8036 kc., opens at 1000 with IS, Arabic announcement, anthem, and English ID, and follows with English news. (*29*)

Monaco—*Radio Monte Carlo* is being heard

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on 3AM3, 7140 kc., in parallel with 3AM2, 6035 kc., at 0100/opening and at 0600 in French. The Billy Graham program is aired at 1705-1735. A German program follows to 1750; ID and s/off are at 1755 (sometimes runs to 1805). *(29, 40, 44, 71)*

Mozambique—*Radio Clube de Mozambique*, CR7BG, 15080 kc., has an excellent signal at 0000 s/on. Popular, L.A., and light music are featured at 0030-0100 with frequent identifications and a 4-note gong IS. The station left the air at 0100. It was also noted in another xmsn at 1300-1515. All-Portuguese language is used on both xmsns. *(25, 61)*

North Vietnam — *The Voice of Vietnam*, Hanoi, broadcasts an English session at 0945-1015 on 7410 kc. This program consists of news, music, and commentaries; good signal strength but some c.w.QRM. *(TC)*

Norway—LKW, Tromso, is operating on a new channel of 17,755 kc. at 0045-0300, 0515-0800 (Sundays at 0215-0945, 1030-1700) relaying the Norwegian Home Service. "Norway This Week" is noted Sundays at 1200-1230. *(82, 100)*

LKJ2, 9540 kc., Tromso, carries a program to N.A. daily at 2000-2100 in dual with LKQ, 11,735 kc. On Sundays, this xmsn is extended to 2120 for the only English program on these outlets. *(112)*

Pakistan — *Radio Pakistan*, Karachi, 15,335 kc., dual with 17,750 kc., beams a program to S.E. Asia daily from 1930 s/on. "Pakistan Calling," in English, is noted at 2000. Native music is heard at 1930-2000 and to 2016 s/off. *(44)*

Another outlet from Karachi is 15,270 kc., heard with English news at 1415. *(CC)*

Saudi-Arabia — This country now uses Standard Time (EST plus eight hours) instead of sun time, so their broadcasts are now at fixed times instead of shifting a few minutes each day. The current Jidda schedule reads: Arabic at 2330-0045 on 3990, 5975, 9650, 9750, and 9875 kc., at 0630-0900 on 3990, 5975, 11,750, 11,850, and 11,950 kc., and at 1230-1445 on 3990, 5975, 9650, 9750, and 9875 kc.; Indonesian at 0930-1010 on 11,950 kc.; and Urdu for Pakistan at 1030-1110 on 11,950 kc. *(100)*

Other xmsns are noted on 17,787 and 15,129 kc. in Arabic from 0900 to 1045/close and again from 1230 to 1245/close in Arabic on 17,787 and 15,160 kc. *(29, 31)*

South Africa—SABC, Roberts Heights, 25,820 kc., is often heard at 1000-1015 with classical music, at 1015-1045 with talks, at 1100-1105 with news, and at 1105-1130 with music. The

SHORT-WAVE ABBREVIATIONS

A—Approximate frequency
BBC—British Broadcasting Corporation
c.w.—Code
ID—Identification; identity
IS—Interval signal
kw.—Kilowatts
L.A.—Latin America (n)
N.A.—North America (n)
QRM—Station interference
s/on—Sign-on
s/off—Sign-off
V—Varies
VOA—Voice of America
xmsn—Transmission from station
xmtr—Transmitter used by station


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9680-kc. outlet is noted with cricket games at 0930. *(26, 31, 90, AF)*

South Korea—HLKA, 11,925 kc., Seoul, is still heard with test program to Hawaii at 0130-0145 in English and Korean. HLKB, 7935 kc., Pusan, is noted at 0530-0550 with an English session. HLKA, 3911 kc., is tuned at 0700 in Korean and probably replaces the 2510-kc. outlet. AFKN, Homesteader, 6895 kc., relays the Armed Forces programs in English around 0700. *(29, RB)*

Surinam — PZC, Paramaribo, 15,406 kc., is noted with good signal and English news at 2030-2040, and in Spanish from 2045 to 2100 s/off. *(25)*

Switzerland—HER4, Berne, was noted with good signal in xmsn to Western South America from 2330 to 0000/close. A DX program is broadcast on the first Thursday of each month at 2045-2100 on HER3, 6165 kc., HER4, 9535 kc., and HER5, 11,865 kc. *(112, BT)*

SHORT-WAVE CONTRIBUTORS

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Ha Chung-kwan *(HC)*, Kowloon, Hong Kong
Tom Conner *(TC)*, Ashland, Oregon
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Howard Kass *(127)*, Brooklyn, N. Y.
Tibor Gasparik *(128)*, Cleveland, Ohio

Tangier—*IBRA-Radio*, Tangier, is now on a new channel of 8935 kc., replacing 15,020 kc.; and is noted in English at 1615-1645. The 11,515-kc. outlet runs in parallel. *(4, 59, 82)*

Turkey — This country can be heard well from TAU, 15,160 kc., in beam to British Isles and Europe at 1600-1645 in English. In parallel are TAS, 7285 kc., and TAP, 9465 kc. TAT, 9515 kc., has a N. A. program daily from 1815 s/on to 1900 s/off with news and music in English. *(44 and many others)*

Vatican City—*Vatican Radio* can be noted in English on 15,120 and 11,685 kc. at 1315-1330. The 9646-kc. outlet has a Slovak religious program at 1615-1650. The 15,120-kc. outlet does not carry French at 1345-1400. *(25, 128)*

Windward Islands — Windward Island B/C Service, Grenada, has moved from 17,800 to 17,805 kc. to avoid QRM from the VOA and is heard at 1700-2115 with 3390 kc. They have a request program Thursdays and Saturdays at 2030-2100. *(23, 25, 26, 100)*

-30-

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1J6GT	.46	5Y3	.38	6CB6	.50	7B6	.41	12SQ7	.39
1L4	.45	5Y4G	.42	6CD6G	1.17	7B7	.42	12V6GT	.44
1L6	.54	5Z3	.44	6CU6	.79	7B8	.46	12W6	.59
1LA4	.55	6A7	.56	6D6	.47	7C4	.40	12X4	.36
1LA6	.46	6A8	.46	6E5	.43	7C5	.41	14A7	.44
1LB4	.58	6AB4	.44	6F5	.36	7C6	.42	14B6	.44
1LC5	.48	6AC7	.66	6F6	.37	7C7	.44	14Q7	.44
1LC6	.46	6AF4	.75	6H6	.37	7E5	.44	19T8	.69
1LD5	.56	6AG5	.49	6J4	1.59	7E6	.44	19BG6G	1.17
1LE3	.56	6AG7	.68	6J5	.38	7E7	.48	25BQ6GT	.84
1LH4	.63	6AH4GT	.69	6J6	.48	7F7	.58	25CA5	.79
1LN5	.46	6AH6	.70	6K6GT	.38	7F8	.65	25CD6	1.29
1N5GT	.49	6AK5	.53	6K7	.38	7G7	.74	25CU6	.99
1R5	.50	6AL5	.41	6L6	.67	7N7	.57	25L6GT	.46
1S5	.45	6AM8	.79	6N7	.59	7Q7	.58	25W4GT	.42
1T4	.50	6AN8	.79	6Q7	.39	7X7	.64	25Z6	.36
1U4	.46	6AQ5	.45	GS4	.39	7Y4	.34	27	.24
1U5	.45	6AS5	.47	6S8GT	.70	7Z4	.39	35B5	.47
1V2	.70	6AS7G	2.25	6SA7	.47	12A4	.59	35C5	.47
1X2	.66	6AT6	.38	6SB7Y	.75	12A6	.40	35L6GT	.46
2A3	.49	GAT8	.79	6SC7	.47	12AB5	.59	35W4	.38
2A7	.54	6AU4GT	.64	6SG7	.40	12AQ5	.49	35Y4	.38
2D21	.95	6AU5GT	.60	6SH7	.42	12AT6	.40	35Z3	.40
3A4	.50	6AU6	.42	6SJ7	.42	12AT7	.65	35Z5GT	.38
3A5	.50	6AU8	.79	6SK7	.49	12AU6	.42	39/44	.25
3AL5	.52	6AV5GT	.64	6SL7GT	.56	12AU7	.58	50A5	.47
3AU6	.52	6AV6	.38	6SN7GT	.56	12AV6	.41	50B5	.47
3BZ6	.57	6AW8	.89	6SQ7	.40	12AV7	.66	50C5	.47
3BC5	.57	6AX4GT	.65	6SS7	.40	12AX4GT	.64	50L6GT	.44
3BN6	.57	6AX5GT	.56	6T4	.85	12AX7	.62	80	.39
3CB6	.57	6BA6	.46	6T8	.67	12AZ7	.62	84/6Z4	.45
3Q4	.55	6BC5	.49	6U5	.54	12B4	.67	117L7GT	1.25
3Q5GT	.56	6BC8	.89	6U8	.79	12BA6	.45	117N7GT	1.25
3S4	.46	6BD5GT	.52	6V3	.79	12BA7	.59	117P7GT	1.25
3V4	.55	6BE6	.45	GV6GT	.45	12BE6	.45	117Z3	.36
4BQ7	.75	6BF5	.39	6W4GT	.39	12BH7	.59	117Z6GT	.61
4BZ7	.75	6BG6G	1.17	6W6GT	.52	12BY7	.63		
5AM8	.79	6BH6	.50	6X4	.38	12CA5	.59		
5AN8	.79	6BJ6	.46	6X5	.38	12CU6	.79		
5A95	.49	6BK5	.67	6X8	.74	12DQ6	.79		

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Lissajous Had a Figure For It

(*Continued from page* 65)

were made for each three that were made vertically. The frequency on the horizontal plates is then two-thirds of that on the vertical.

Using this sort of frequency comparison, a home-built or commercial audio generator can be calibrated at a large number of points by using only the 60-cycle line current as a standard or one of the audio tones broadcast by the National Bureau of Standards on Station WWV. The table below shows a few of the cardinal points that can be calibrated by using 60 cycles as a standard. If the 600-cycle tone from WWV is used, all figures are multiplied by 10.

This same method serves the "ham" in checking the multiplying stages in shortwave transmitters. A signal picked up from the input of the stage to be checked is compared with a signal taken from the output of the same stage. The number of loops in the pattern indicates the number of times the stage is multiplying the frequency. Almost all of the common makes of oscilloscopes will operate in this manner up to 30 megacycles if the signal is applied directly to the deflection plates.

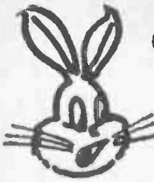
Mechanical Tests. The value of an oscilloscope is not limited to those interested in sound or electronics. For the hobbyist who would like to know the speed of small motors, perhaps one too weak to drive a mechanical tachometer, the scheme in Fig. 4 (page 65) is the answer.

The shaft has been given a light coat of dull black paint or ink and a white spot of paint is dabbed on one side. When a flashlight or some other source of light

Horizontal Frequency (cps)	Vertical Frequency (cps)	Horizontal Peaks	Vertical Peaks
60	10	6	1
"	20	3	1
"	30	2	1
"	40	3	2
"	50	6	5
"	60	1	1
"	80	3	4
"	90	2	3
"	100	3	5
"	120	1	2
"	140	3	7
"	160	3	8
"	180	1	3
"	240	1	4
"	300	1	5
"	360	1	6
"	420	1	7

A few examples of calibrating audio frequencies (listed in "vertical" column) against the 60-cycle standard obtainable from the a.c. power line.

CHECK THESE "MARCH-MAD" VALUES!



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4 CRYSTAL DIODES. Most commonly used—1N34, 1N56, 1N58, 1N69 in poly bag. Reg. $5. K-303 **$1**

100 COIL FORMS. 15 types. Assorted sizes, insulation. Reg. $15. K-136 **$1**

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70 RESISTORS. Insulated IRC, A-B, etc. 5 ohms to 10 megs: ½, 1 & 2 W. 1% & 5%. Wt. ½ lb. Reg. $10.95. K-141 **$1**

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30 POPULAR BULBS. 1.1 to 6V, screw and bayonet types, miniature. Wt. ½ lb. Reg. $2.40. K-113 **$1**

15 AC/DC LINE CORDS, for clocks, motors, etc. 2-cond. w/ molded plugs. Wt. 1 lb. Reg. $5. K-149 **$1**

10 "POLY" BOXES. Asstd. sizes, clear plastic hinged boxes w/ snap locks. Reg. $2.50. K-170 **$1**

40 MINIATURE CONDENSERS. Asstd. miniature, subminiature, printed circuit types; Centralab, Sprague. K-200 **$1**

30 POWER RESISTORS. WW, candohm, sandcoated vitreous. 15 values, 5 to 50W; 35 to 11000 ohms. Wt. 2 lbs. Reg. $8. K-309 **$1**

30 PRECISION RESISTORS. WW & carbofilm. 30 values, 56 ohms to 1 meg; ½, 1 & 2W. 1% tol. Wt. ½ lb. Reg. $21. K-150 **$1**

25 TUBE SOCKETS, 4 to 11-prong miniatures, subminiatures, octals, zip-ins. Tube shields, too. Wt. 2 lbs. Reg. $6.50. K-154 **$1**

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8-PC. NUTDRIVER SET. Plastic handle, 3/16, 7/32, ¼, 5/16, 11/32, ⅜, 7/16" steel socket wrenches in plastic case. Wt. 1 lb. $3 value. K-102 **$1**

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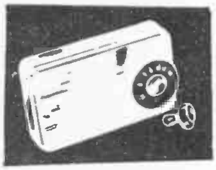

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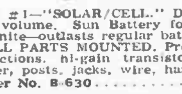

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(operated on direct current) is directed on the shaft, the light reflected from the white dot as the shaft revolves induces a voltage in a photocell. This signal, which consists of one pulse for each revolution of the motor, is placed on one set of 'scope plates. If a signal from a calibrated signal source is placed on the other set of plates and adjusted until a single loop pattern is formed, the revolutions per second of the motor tested can be read from the oscillator.

Almost any type of rotating machinery can be checked with this method by using the proper variation. The speed of a model airplane engine can be checked by shining the light through the rotating propeller to the photocell. Of course, the result must be divided by two, because the double blade of the propeller is generating two pulses for each revolution.

Another variation of this same method is the use of a microphone to pick up sounds. The sustained note of a musical instrument can be picked up and the resulting impulses used to energize one set of 'scope plates. If the second set of deflection plates is fed from a calibrated audio signal source, the frequency of tone picked up by the microphone can be determined with precision.

In using the Lissajous form of oscilloscope display, several things should be remembered. The general shape of the pattern is not important for frequency comparison. Ignore odd ripples and bumps. The number of line-crossings or loops is what counts. —30—

The 21 Special

(*Continued from page* 61)

Never switch *S2* to the grid current position when the key is open. The key should be closed during all tuning operations.

"Simple enough," admitted Tommy. *"Now, what do I do when I want to operate the transmitter on 10 meters—assuming I pass my General Class license one of these days?"*

"Don't worry about the General exam! You'll do okay when the time comes. Then you'll be ready for 28-mc. DX'ing! Here are the tuning steps for ten and eleven meters . . ."

Both the oscillator and amplifier tuned circuits cover the range of 20 mc. to 32 mc., inclusive. It is possible, therefore, to tune to any frequency in that portion of the spectrum. For 10-meter operation, resonate *C3* to 28 mc., which is near minimum capacity. At this point, grid current may be observed on the meter when *S2* is in the grid position. Adjust *C3* for about 0.5-ma. current reading. Set *C17* near minimum capacity and

C18 at maximum capacity. Attach the 10-meter antenna, and place *S2* in the plate position. Close *S3* and resonate *C17* for minimum plate current. Adjust antenna loading by means of *C18* until the plate meter reads 0.6 ma., corresponding to a plate current of 120 ma.

"Gee, that's swell," said Tommy, *"but what if I want to get on 11 meters?"*

"No problem there if you use a crystal between 6750 and 6800 kilocycles. Your plate tuning capacitors may need a little touching up since this is a lower frequency."

"Well, I'm off to the junkbox," announced Tommy, heading for the door.

"Slow down a minute," I yelled after him. *"You may have to check that big jobber downtown for the power transformer and LMB cabinet. But don't worry; they're in stock. Good luck!"* —30—

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FM Commercial Silencer

(*Continued from page* 69)

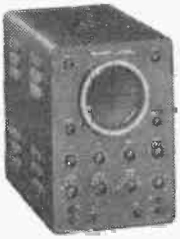
shielded cable to the end of the 68,000-ohm resistor that is nearest the side of the cabinet. This is the output for the beeper tone. Conversion to another type of tuner or FM radio is just as simple.*

Testing and Adjusting. Once the unit is connected to your tuner or radio, the adjustment is extremely simple, though it will take some time to catch enough announcements to tune it properly. Connect a voltmeter across the relay coil and adjust the squelch control *R5* so that the relay drops out and the audio comes through. During an announcement that has a beeper tone, adjust the filter coil, *L1*, for maximum voltage across the relay coil. When the beeper tone is absent, the voltage across the coil should be about 8 volts. When the beeper tone is present, the voltage should rise to about 20 volts.

These voltages are approximate and will vary with the type of relay used. Any sensitive relay will work satisfactorily. The resistance of the relay coil acts as bias for the output tube *V1b;* and if a relay of more than 8000 ohms is used, the relay will probably not trip. In general, any coil resistance between 4000 and 8000 ohms will be satisfactory. Make sure the squelch control is not set up too high, or the relay

---

* If you are connecting the silencer to a radio, it will be necessary to install two more connectors. Select the wire that is connected to the end of the volume control opposite the ground connection and remove it. Then connect the shielded wire to one of the connectors. This is the audio input. The wire that was removed from the volume control should be connected to the other connector. This is the audio output. Both of these connections are wired to the silencer through fairly short pieces of shielded wire.



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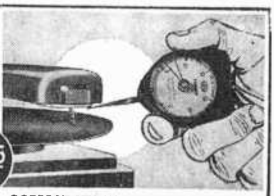

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* * *

Infrared Photocell System

(*Continued from page* 49)

approximately 3⅝" from the center of the lens. The distance of the filament from the lens is easily changed by sliding the socket backward or forward between the jaws of the battery clip.

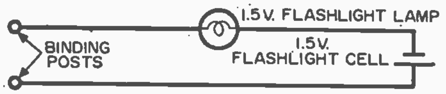
Putting the infrared lens assembly together is a simple matter. Using a pair of diagonal pliers, cut through the plastic frame of the lens in two or three places so that it may be peeled off. Set the lens in the wide portion of the infrared filter holder and lay a piece of thick spaghetti tubing around its edge. Carefully bend the flanges downward to exert pressure all around the circumference. This holds the lens firmly in place without a metal-to-glass contact.

Cut a hole in the front panel of the light-source case the same distance up from the bottom as in the photo-relay. The hole size should be carefully chosen so that the smaller flange of the infrared filter holder fits into it snugly without light leaks. Finally, bend the inside serrations against the sides of the hole to prevent the assembly from falling out.

If there are objectionable light leaks due to improper fit anywhere on the case, these may be sealed with black vinyl insulating tape.

INSTALLATION

Line up the light source and photocell relay with the infrared beam sharply focused. Although the beam itself is invisible, a dull red glow may be seen in a slightly darkened room by looking into the lens of the light source. Slide the 32-candlepower lamp back and forth between the jaws of the battery clip until a projected



Connections of test lamp setup that may be connected to the relay binding posts during adjustment of photo-relay. These help determine the position of the Sigma 4F relay contacts while the setup is being adjusted.

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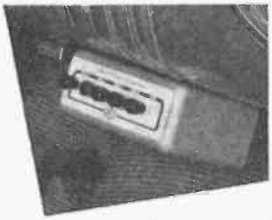

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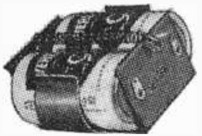

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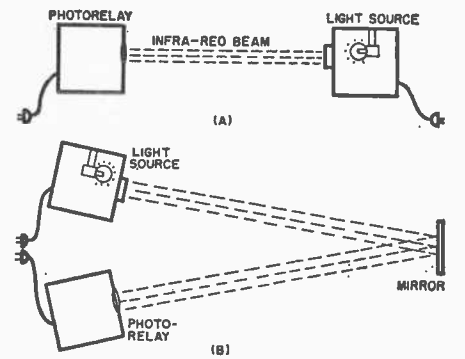

If light source and photo-relay are set up at opposite ends of site, as in (A), you will need two different outlets. They may be set up side by side, however, both a.c. plugs then going to the same duplex outlet, as in (B); a small mirror reflects beam back to relay and the total throw distance is doubled.

spot is focused on the lens of the photocell.

It is absolutely essential that the infrared beam be focused sharply on the solar cell. It may be necessary to shift the box slightly laterally or up or down to get proper alignment. Experiment with the setup until you become familiar with the best orientation of the two cases. After that, you can increase the distance between the units up to 30 feet and still obtain positive relay action. —30—

Subminiature Power Supplies

(*Continued from page* 62)

All parts can be mounted in the little plastic box in which the AR-100 transformer is purchased. Make the holes for the screws to hold the Fahnestock clips to the top of the box. Then mount the transformer in the hinge end of the lower half of the box.

Scrape the two mounting ears of the transformer, and scrub these areas thoroughly with fingernail lacquer remover. Then run a generous bead of household plastic cement along the underside of the transformer and immediately clamp it in place. Red and blue leads should be toward the hinges of the box. With the transformer clamped securely, run a generous blob of cement over each mounting ear. When it has hardened, apply a second blob of cement to each ear in exactly the same manner. Allow all of this to harden for at least 12 hours, and then remove the clamp.

In the meantime, make a little panel to hold the crystal rectifier and filter capacitor. Any 1/16"-thick insulating material will do. The panel should be a

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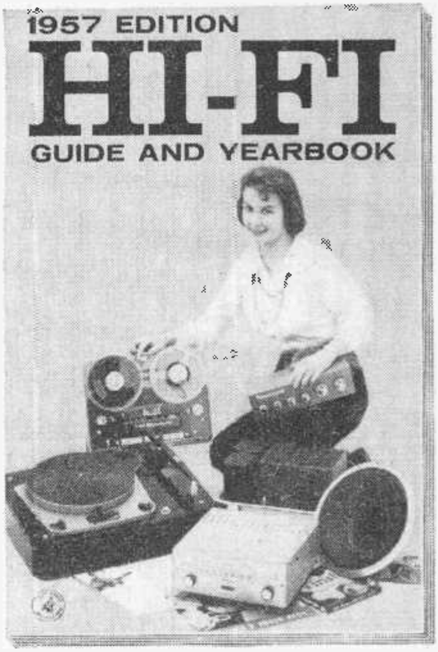

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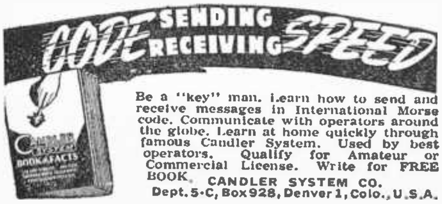
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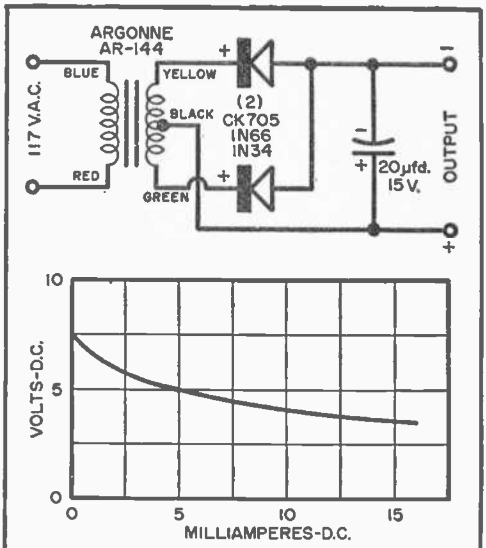

Fig. 2. Schematic diagram of full-wave power supply, and its performance curve.

snug fit in the space between the transformer and the front of the box. Drill three *4-40* x ¼" holes for the screws which act as terminals. Make the connections between the transformer, panel and Fahnestock clips; then cement the panel in place. Connect a light power cord to the two Fahnestock clips associated with the transformer primary (red and blue leads).*

D.c. output is available across the two remaining clips. Marking the positive (+) clip with a dab of red fingernail lacquer will help you to observe correct polarity when you're connecting the supply to a transistor circuit.

Full-Wave Supply. Figure 2 is the schematic of a full-wave supply. Its size and weight are identical to those of the half-wave unit, but the regulation of this supply is considerably improved. The open-circuit voltage of the full-wave unit is about 7 volts. This tapers down to 3.5 volts when 16 ma. are drawn. Close to 25 ma. may be drawn at 2.5 volts.

Construction of the full-wave supply is identical to that of the half-wave supply, except that an additional crystal rectifier is used and four terminal screws are needed instead of three. —*Frank H. Tooker*

---

*A word of caution. Neither of the transistor transformers discussed on these pages were originally constructed to be operated from a 117-volt power line. The author's transformers checked out in a 300-volt insulation test, so they would seem to be quite safe. To insure still greater safety, some constructors may prefer to wire a small fuse in series with the 117-volt side of the transformer. Also, it is advisable to cover the Fahnestock clips (117-volt side) with tape to prevent accidentally touching them or shorting out the house wiring line. Possibly a better method would be to drill through the plastic case and run the line cord directly to the transformer.

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1H5GT	.47	6AQ6	.42	6SA7	.48	12AV6	.42
1LA4	.57	6AQ7GT	.70	6SC7	.48	12AV7	.67
1LA6	.47	6AM8	.80	6SD7GT	.57	12AX7	.63
1LB4	.59	6AN8	.80	6SG7	.41	12AY7	.90
1LC5	.49	6AS5	.48	6SH7GT	.43	12BA6	.46
1LN5	.47	6AT6	.39	6SJ7	.43	12BA7	.60
1N5GT	.50	6AU4	.85	6SK7	.50	12B4	.68
1R4	.66	6AU5GT	.60	6SL7GT	.57	12BE6	.46
1R5	.51	6AU6	.43	6SN7GT	.57	12BH7	.60
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1U6	.53	6BD5GT	.53	6V6GT	.46	12SH7	.47
1X2A	.68	6BE6	.46	6W4GT	.40	12SJ7GT	.45
2A3	.50	6BF5	.40	6W6GT	.53	12SK7	.48
3A4	.51	6BG6G	1.18	6X4	.39	12SK7GT	.50
3ALS	.57	6BH6	.51	6X5GT	.39	12SL7GT	.60
3AU6	.57	6BJ6	.47	6X8	.75	12SN7GT	.57
3AV6	.57	6BK5	.68	6Y6G	.60	12SQ7GT	.40
3BA6	.60	6BK7A	.76	7A4-XXL	.47	14A7	.45
3BE6	.60	6BL7GT	.75	7A5	.53	19BG6G	1.18
3Q5GT	.57	6BN6	.58	7A6	.45	19T8	.70
3S4	.47	6BQ6GT	.80	7A7	.45	25BQ6GT	.85
3V4	.58	6BQ7A	.80	7A8	.45	25L6GT	.47
5AQ5	.60	6BY5G	.58	7B4	.44	25Z6GT	.37
5AT8	.80	6BZ7	.88	7B5	.41	35A5	.46
5J6	.60	6C4	.37	7B6	.42	35B5	.48
5T4	.69	6C5GT	.35	7B7	.43	35C5	.48
5U8	.80	6CF6	.80	7B8	.47	35L6GT	.47
5U4G	.49	6C6	.47	7C4	.39	35W4	.39
5V4G	.58	6CB6	.51	7C5	.42	35Y4	.40
5X4G ●	.44	6CL6	.71	7C6	.43	35Z3	.41
5Y3G	.39	6CD6G	1.18	7C7	.45	35Z5GT	.39
5Y3GT	.39	6CS6	.51	7E5	.25	4875GT	.40
5Y4G	.43	6D6	.48	7E6	.30	50A5	.48
5Z3	.45	6E5	.44	7E7	.49	50B5	.48
5Z4	.54	6F5GT	.37	7F7	.59	50C5	.48
6A7	.57	6H6GT	.38	7F8	.70	50L6GT	.45
6AB4	.45	6J5	.39	7G7	.75	70L7GT	.45
6AB7	.80	6J6	.49	7H7	.50	117Z3	.37
6AC5GT	.59	6J7	.43	7J7	.75	117Z6GT	.62
6AC7	.67	6J7GT	.45	7K7	.75		

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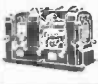

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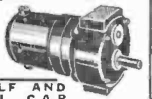

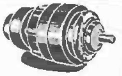

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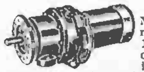

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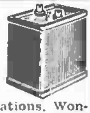

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A "WAVE" in Naval Electronics

(*Continued from page* 40)

Electronic Technicians, where physics, mathematics, and basic electronic theory are ladled out in heavy doses. On the practical side, she learned the circuitry of various types of electronic gear, from simple radio receivers to complete radar systems. The biggest thrill of her electronics training was operating navigation equipment and airborne radar in actual flight, directing a plane from target to target.

Later, on the job, the thorough schooling ripened into a sure knack for troubleshooting equipment. With the great variety of electronic devices passing under her hands, Dee has had hardly a dull moment at her workbench.

Sailors Ashore. Service life in this technical age is a far cry from our traditional ideas about soldiering. Looking back at her Navy career, Dee tallies up pluses and minuses and feels that she comes out well ahead in the balance. Nowhere else could she have got such a good technical education—not just for free, but actually being paid for it. Nowhere else would she have been able to learn so much so fast. No civilian job open to beginners fresh out of school would have given her the variety of electronic experience she obtained from her Navy assignment.

There are off-duty gains also: meeting and making friends with people from all parts of the country and many different backgrounds has enhanced Dee's personality, giving her a wider range of human experience and understanding. "I have formed many rewarding friendships and I've learned tolerance and self-control," she says. "Many people feel that when you go into the service you lose your individuality and have to conform to a group. This is certainly true to a point. My individual desires became secondary when they conflicted with those of 40 other people. You do very little without thinking how it will reflect on the uniform you wear."

Yet the dulling of the individual's outer edge is compensated for by strengthening of the core. "I feel that I am more of a person now than I was the day I joined," says Dee, "more capable of making my own decisions and standing up for what I believe in."

Dee has formed a very realistic attitude about the military atmosphere pervading her work: "If you talk back to your boss in civilian life, you get fired. In the Navy, your punishment is different. That's all."

Steady Ahead. After discharge, Navy electronic technicians, male or female, find the doors of the fast-growing electronics industry wide open to them. Or, using the educational provisions of the G.I. Bill, they may continue their schooling toward a formal engineering degree.

Dee is steering a steady course toward her own goal: a combination of electronics and marriage. The shipmate whom she plans to sign on permanently also works in Naval electronics. When they are both back in civilian life, she wants to work in industry while he completes his engineering studies.

Perhaps it seems paradoxical that the net result of Dee's Navy training is a firm foundation for civilian life. But we must remember that, after all, the purpose of the military in a democracy is not a war-like quest for "glory," but to assure the safety of the private citizen and help this troubled world gain enough peace to sustain the good of ordinary living. -30-

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Civil Air Patrol

(*Continued from page* 44)

ble without the formality of using a state "control" station; but once such a mission is definitely established, a "redcap" is declared and all transmissions are handled through the control station. During the duration of a "redcap," all stations located in nearby states which might cause interference with the communications either secure or go to different channels.

Many CAP units, either Cadet or Senior squadrons, conduct courses in radio communications under supervision of competent licensed personnel. Membership is open to all persons 14 years of age or over. There is nothing compulsory about the organization. While it is an auxiliary of the Air Force, there is no obligation or arrangement for any Civil Air Patrol member or unit ever to be taken into the armed forces as a result of his or her participation in the CAP program.

Although Civil Air Patrol radio communications is not connected with amateur radio, many hams become CAP members and many CAP members develop an interest in radio and become hams. . . . Neither activity conflicts with the other.

Many varied adventures reward the CAP volunteer. All too often, search and rescue missions become necessary—several hundred a year. There are also practice missions, Cadet encampments at Air Force bases, state and national meetings. Any man or woman interested in radio Civil Air Patrol has a definite place to go to learn theory and actual operating practice on the world's largest network of two-way radio stations. -30-

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SONGPOEMS and Lyrics Wanted! Mail to: Tin Pan Alley, Inc., 1650 Broadway, New York 19, N. Y.

Kit Builder's Korner

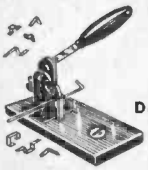
(Continued from page 52)

Wonder of wonders, the FM-3A kit contains enough spaghetti to cover all bare leads, which is not a practice followed by most radio equipment kit manufacturers. In fact, all you will need (and this applies to most kits) is the usual assortment of tools and some rosin-core solder.

Heath seems to have pre-alignment down to fine tolerance. When we turned our kit on, it immediately pulled in a local station that was three miles away. Touching up the ratio detector and some other minor adjustments will give you an FM tuner to be proud of.

Comment. Obviously the FM-3A is built in a case that matches the Heathkit preamp. However, it still makes a fine-looking unit on its own behalf. Although there are a lot of stories around about how difficult it is to assemble an FM tuner, we didn't think this was tough at all. —30—

POPULAR ELECTRONICS BARGAIN BASEMENT
SAVE ON THESE SPECIAL BUYS OF THE MONTH



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Made-in-England. Bends, shears & punches strip metal. Makes all kinds of complex brackets. Holes & slots too. Includes supply of steel strip. Deluxe Model also has rod material & threading die.

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Makes a one man band out of every harmonica player.

A fine quality, sensitive, crystal microphone with a high output especially designed to fit harmonicas. May be connected to any P. A. system, or the audio section of a phonograph or radio. Installation is simple. Sturdily built and measures only 1⅝" L x ⅝" W x ¾" D. Complete with 7 ft. shielded cable. Dept. PE-L...Net 2.95

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RADIO CONTROL Headquarters

For model airplanes, boats, cars, etc. FREE CATALOG "P."
No operator's license required. FREE—SEND FOR FCC FORM 505
Garage Door Radio Control Transmitter & Receiver Kits Available.

R/C TRANSMITTER & RECEIVER KIT—27¼ Mc. 5 Watt 2-Tube Simple Transmitter & Supersens. 2-Tube Simple Receiver—Parts incl. Drilled Bases Wound Coil, Res., Cond., SIGMA Relay, Instruc. $9.95

SIGMA 4F RELAY: 8,000 ohm, $3.85; 6 Reed Relay 14.95
2-6V Battery Charger Kit $4.95; wired 6.95
R/C BOOKS: Model Control $1; Radio Control $1; Handbook 2.25
CRYSTALS: 27,255 Mc. Petersen Z9A . . $3.95; HOLDER . . .15
2" METERS, 150 MicroA, $3.95; 500 MicroA, $3.95; 3 Ma 2.95
RELAY CONTROL UNIT incl. Sensitive 10,000 ohm Sigma Relay (1½ Ma) Thermal Bimetal Strip, Heating Element, Hi Z Audio Choke, Mini Alnico V Magnet, Neon Lamp, Resistors, Capacitors....only .99
TUBES: XFG1, RK61, 3A4, 3A5, 1AG4, 6K4—Transistors .99
Storage Batteries: Mini, 6V NT6 $2.45; 2V 27A/Hour... 2.75
RELAYS, 10K ohm 2 Ma DC or 110V AC SPDT 95c; SPST .85
Flash STROBOSCOPE 110 V AC, Range 900-14000 per min. 29.95

GYRO ELECTRONICS 325-P CANAL ST.
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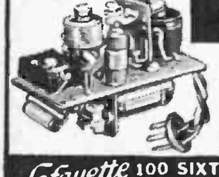

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Completely wired and assembled, with tube, ready to operate on exam free 27.255 MC remote control band. Size: 1⅜" x 1-15/16" x 3". Weight 3.3 oz. Uses one 1.5 volt and one 45 volt battery. Less batteries. Shpg. wt., 6 oz.
F-208 .... Net 7.95

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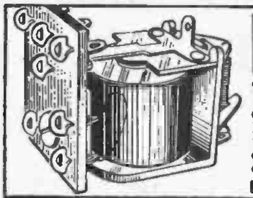
Include postage with order



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Desk Stand Style
Slightly used but in excellent condition
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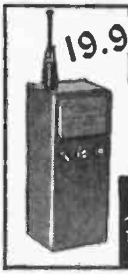
Come complete, ready to use with wiring diagrams included. Two complete for only $5.00. $2.75 Postpaid in U.S.A.
TELEPHONE LAMP KIT—with illustrated instructions for making Desk Telephone Lamp including all parts (harp, nipples, push switch, cord, plug, etc.) . . . $6.50 Ppd. (Shade is not included.)

MICROPHONE, Dept. C-707, 1760 W. Lunt Ave., Chicago 26, Ill.



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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.
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please print your name and address clearly, be specific in your order, enclose proper amount, allow ample time for delivery.

ADVERTISERS INDEX

ADVERTISER	PAGE
Allied Radio Corp.	8, 9, 119
Altec Lansing Corporation	10
American Radio Relay League, Inc.	95
American Technical Society	127
Arnhold Ceramics, Inc.	26
Argonne Electronic Manufacturing Company	33
Atlas, Charles	124
Audak Company	97
Audel Publishers	104
Austin Craft	122
B & K Manufacturing Co.	22
Bailey Technical Schools	34
Barjay Co., The	26
Beckman Instruments, Inc.	122
British Industries Corp.	87
Brooks Radio & TV Corp.	107
Burstein-Applebee Co.	107
Cabinart	109
Canadian Institute of Science and Technology Limited	121
Candler System Co.	124
Capitol Radio Engineering Institute	15
Centralab	18
Central Technical Institute	31
Cisin, H. G.	97, 109
Civin, L.	26
Cleveland Institute of Radio Electronics	17
Coyne Electrical School	5, 23, 105, 109
DeVry Technical Institute	11
Duotone Company, Inc.	95
Electro-Voice, Inc.	19
Electronic Instrument Co., Inc. (EICO)	38
Electronic Measurements Corp.	12
Embry-Riddle School of Aviation	28
Emig School of Electronics	122
Fair Radio Sales	101
Garfield Co., Oliver	35, 108, 116
General Electric	16
Gonset	121
Grantham Schools	120
Greenlee Tool Co.	114
Gyro Electronics	130
Hallicrafters	37
Hawkins Co., P. E.	126
Heath Company	89, 90, 91, 92, 93
Hershel Radio Co.	32
Hi-Fi Guide and Yearbook	123
Indiana Technical College	26
Indianapolis Electronic School	127
Instructograph Company	126
International Correspondence Schools	13
Interstate Training Service	126
Kester Solder Company	26
Lafayette Radio	7, 102, 103, 130
LaPointe Industries, Inc.	107
Lektron Specialties	117
Merit International	104
Midway Company	127
Miller, Gustave	122
Milwaukee School of Engineering	129
Modernophone, Inc.	108
Moss Electronics Distributing Co., Inc.	132, 3rd & 4th Cover
MusiCraft	27
Nantais Antenna Systems	122
National Radio Institute	8
National Schools	21, 26
North American Phillips Co., Inc.	14
Nortronics, Inc.	116
Olson Radio Warehouse	130
Orradio Industries, Inc.	30
Pacific States University	96
Philadelphia Wireless Technical Institute	124
Popular Photography	98
Port Arthur College	120
Precise Development Corp.	Second Cover
Precision Electronics, Inc.	20
Prentice-Hall, Inc.	113
Progressive "Edu-Kits," Inc.	29, 114
Quality Electronics	122
RCA Institutes, Inc.	25, 126
Radio & Television News	96
Radio-Television Training Association	99, 100
Raytheon Manufacturing Co.	6
Rek-O-Kut Company, Inc.	112
Rider, Publisher, John F.	111
Rinehart & Co., Inc.	106
Sams, Howard W.	94
Scherr Company, George	120
Scott-Mitchell House, Inc.	97
Shure Brothers, Inc.	24
Springfield Enterprises	113
Standard Line Electric Mfg.	115
Stanley Electronics	125
Surplus Center	125
"TAB"	131
Telephone Repair & Supply Co.	130
Tri-State College	118
Tube Mart	110
Uncle Sam's Recording Corp.	116
University Loudspeakers, Inc.	113
V.S.I. Television School	122
Valparaiso Technical Institute	126
Van Nostrand Company, Inc., D.	118
Video Electronics Company	121
Western Radio	124, 126
Whitehall Pharmacal Co.	118
World Radio Labs.	36
YMCA Trade Schools	124

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Millen 1007 Chrome 1⅝" Knob..........39¢ @, 3/$1
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$59 SHAWLITE 400!! SPECIAL $20

Assembled & ready to work! Not a Kit. Latest features SUPER CIRCUIT—Low cost flash less than ¾¢, inbilt AC & Batteries* all in one case, powerful, compact. Guide ± Color 60+, B&W 200+. Recycles 2 secds. Limited Qty. Special $20
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FULL WAVE BRIDGE—*One Year Guarantee*

18VAC/14DC—1 Amp $1.60; 2A $2.40; 3A $3.45; 4A $4.25; 6A $5.10; 10A $7.50; 12A $9.20.
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NEW VARIABLE 0 to 6 & 12 VOLT/12 AMP

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Battery Eliminator, Charger, Model RR, Plates Aircraft, Marine or any DC requirement. Extra Hvy. duty Selenium Rectifier, 2 meters volt & ammeter (insert for V & A). Designed for cont. service & up to 20 amps intermittent overload.
MODEL T612..........$29.95

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OUR 12th YEAR IN BUSINESS

0A2	.70	6AQ5	.45	6S4	.45	12AX7	.55
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5Y3G	.65	2D21	.75	7C5	.55	50B5	.55
6AB4	.40	6C4	.35	7F7	.55	50C5	.45
6AC7	.64	2D21	.75	7N7	.55	50L6	.40
6AQ5	.75	6CB6	.48	12AT6	.40	1626	7/$1
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6AL5	.38	6K7	.35	12AX4	.70		

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"TAB" FINEST HI-FI RECORDING TAPE

7" Reel—1200 Ft. Per Reel
Sold on Money Back Guarantee..**$1.45** Lots of 12

FERRO-SHEEN processed, quality controlled, constant output, Noise FREE, Splice FREE Plastic Tape. Freq. 7½ IPS. 40-15KC Oxide Wnd In..........."TAB" @ $1.50 ea; 3/$1.50 ea.

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1,000's OF SATISFIED CUSTOMERS

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5 Crystal Diodes
250 ft. Hook Up Wire, Asst'd
100 Fuses
35 Ceramic Condensers
10 Rotary Switches
6 Crystals
60 Inductors & Coils
5 Microswitches
10 Wheat Lamps
*In Plastic Box

EACH KIT ONLY........**99¢**

"TAB"

TERMS: Money Back Gtd. (cost of mdse. only). $5 min. order F.O.B. N.Y.C. Add shpg. charges or for C.O.D. 25% Dep. Tubes Gtd. via R-Exp. only. Prices shown are subject to change.

111P Liberty St., N. Y. 6M, N. Y., Rector 2-6245

Superior's New Model 670-A

SUPER-METER

A Combination VOLT-OHM MILLIAMMETER PLUS Capacity, Reactance, Inductance and Decibel Measurements.

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts

A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts

OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts

D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes

RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms

CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of electroylic 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

ADDED FEATURE:
Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

The Model 670-A comes housed in a rugged crackle-finished steel cabinet complete with test leads and operating instructions.

28^{40}

Superior's New Model TV-60

20,000 OHMS PER VOLT

ALLMETER

FEATURES

- Giant recessed 6½ inch 40 Microampere meter with mirrored scale.
- Built-in Isolation Transformer.
- Use of the latest type printed circuit and 1% multipliers assure unchanging accurate readings.

Includes services never before provided by an instrument of this type. Read and compare features and specifications below!

8 D.C. VOLTAGE RANGES: (At a sensitivity of 20,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500/30,000 Volts.

7 A.C. VOLTAGE RANGES: (At a sensitivity of 5,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500 Volts.

3 RESISTANCE RANGES: 0 to 2,000/200,000 Ohms, 0-20 Megohms.

2 CAPACITY RANGES: .00025 Mfd. to 30 Mfd.

5 D.C. CURRENT RANGES: 0-75 Microamperes, 0 to 7.5/75/750/Milliamperes, 0 to 15 Amperes.

3 DECIBEL RANGES: —6 db to + 58 db.

R.F. SIGNAL TRACER SERVICE: Enables following the R.F. signal from the antenna to speaker of any radio or TV receiver and using that signal as a basis of measurement to first isolate the faulty stage and finally the component or circuit condition causing the trouble.

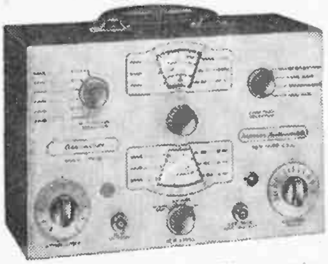
AUDIO SIGNAL TRACER SERVICE: Functions in the same manner as the R.F. Signal Tracing service specified above except that it is used for the location of cause of trouble in all audio and amplifier systems.

Model TV-60 comes complete with book of instructions; pair of standard test leads; high-voltage probe; detachable line cord; R.F. Signal Tracer Probe and Audio Signal Tracer Probe. Pliofilm bag for all above accessories is also included. Price complete. Nothing else to buy. ONLY

52^{50}

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 • Bar Generator • Cross Hatch Generator • Color Dot Pattern Generator • Marker Generator

R. F. SIGNAL GENERATOR: Provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics. • **VARIABLE AUDIO FREQUENCY GENERATOR:** In addition to a fixed 400 cycle sine-wave audio, the Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal. • **BAR GENERATOR:** Projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars. • **CROSS HATCH GENERATOR:** Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect. • **DOT PATTERN GENERATOR (FOR COLOR TV):** The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence. • **MARKER GENERATOR:** The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

MODEL TV-50 comes absolutely complete with shielded leads and operating instructions. Only

47^{50}

SHIPPED ON APPROVAL

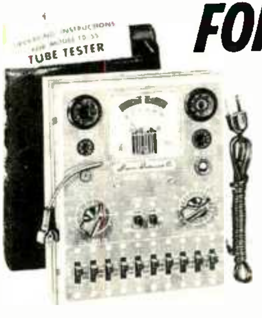
NO MONEY WITH ORDER — NO C.O.D.

SEE FOLLOWING PAGE FOR COMPLETE DETAILS

PRINTED IN U.S.A.

rior's New Streamlined Model TD-55

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 Tube Testers for its field men.

Speedy, yet efficient operation is accomplished by: 1. Simplification of all switching and controls. 2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

HECKS FOR SHORTS AND LEAKAGES BETWEEN ALL ELEMENTS— Iodel TD-55 provides a super sensitive method of checking for shorts and eakages up to 5 Megohms between any and all of the terminals. Con-inuity between various sections is individually indicated. **"FREE-POINT" LEMENT SWITCHING SYSTEM**—Model TD-55 incorporates a newly lesigned element selector switch system which reduces the possibility of bsolescence to an absolute minimum. Any pin may be used as a filament oin and the voltage applied between that pin and any other pin, or even he "top-cap." **ELEMENTAL SWITCHES ARE NUMBERED IN STRICT ACCORDANCE WITH R.M.A. SPECIFICATION**—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.

Model TD-55 comes complete with operating instructions and charts. Housed in rugged steel cabinet. Use it on the bench—use it for field calls. A streamlined carrying case, included at no extra charge, accommodates the tester and book of instructions.

$26.95

Superior's New Model TV-12

TRANS-CONDUCTANCE TUBE TESTER

TESTING TUBES

• Employs improved **TRANS-CONDUCTANCE** circuit. An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading. • **NEW LINE VOLTAGE ADJUSTING SYSTEM.** A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%. • **SAFETY BUTTON**—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching • **NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY.** Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

ALSO TESTS TRANSISTORS!

TESTING TRANSISTORS

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale. The Model TV-12 will accommodate all transistors including NPN's. PNP's, Photo and Tetrodes, whether made of Germanium or Silicon, either point contact or junction contact types

Model TV-12 housed in handsome rugged portable cabinet sells for only

$72.50

Superior's New Model TW-11

STANDARD PROFESSIONAL TUBE TESTER

• Tests all tubes, including 4, 5, 6, 7, Octal, Lockin, Hearing Aid, Thyraton, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc. • Uses the new self-cleaning Lever Action Switches for individual element testing. **Because all elements are numbered according to pin-number in the RMA base numbering system,** the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary. • The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus **it is impossible to damage a tube by inserting it in the wrong socket** • Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE

SEPARATE SCALE FOR LOW-CURRENT TUBES—Previously, on standard 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 standard scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

$47.50

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

We invite you to try before you buy any of the models described on this page, the preceding page and the following pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

SEE OTHER SIDE

CUT OUT AND MAIL TODAY!

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. D-327 3849 Tenth Avenue, New York 34, N. Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance or interest charges added. It is further understood that should I fail to make payments when due, the full unpaid balance shall become immediately due and payable.

☐ Model TW-11...Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ Model TV-12...Total Price $72.50 $22.50 within 10 days. Balance $10.00 monthly for 5 months.

☐ Model 670-A...Total Price $28.40 $7.40 within 10 days. Balance $3.50 monthly for 6 months.

☐ Model TV-50...Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months

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Superior's New Model **76**

IT'S A

CONDENSER BRIDGE

with a range of .00001 Microfarad to 1000 Microfarads (Measures power factor and leakage too.)

IT'S A

RESISTANCE BRIDGE

with a range of 100 ohms to 5 megohms.

IT'S A

SIGNAL TRACER

which will enable you to trace the signal from antenna to speaker of all receivers and to finally pinpoint the exact cause of trouble whether it be a part or circuit defect.

IT'S A

TV ANTENNA TESTER

The TV Antenna Tester section is used first to determine if a "break" exists in the TV antenna and if a break does exist the specific point (in feet from set) where it is.

Specifications

✓CAPACITY BRIDGE SECTION

4 Ranges: .00001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad; .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. This section will also locate shorts, and leakages up to 20 megohms. And finally, this section will measure the power factor of all condensers from .1 to 1000 Microfarads. (Power factor is the ability of a condenser to retain a charge and thereby filter efficiently.)

✓RESISTANCE BRIDGE SECTION

2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms. Resistance can be measured without disconnecting capacitor connected across it. (Except, of course, when the R C combination is part of an R C bank.)

> As Design Engineers, we the undersigned would like to say that the Model 76 is in our opinion the best combination unit of its kind we have been privileged to design. Although it is comparatively a low-priced tester, it will, after you become acquainted with its multiple services, be your most frequently used instrument.
>
> S. LITT
> L. MELENKEVITZ

✓SIGNAL TRACER SECTION

A built-in high gain pentode voltage amplifier, plus a diode rectifier, plus a direct coupled triode amplifier are combined to provide this highly sensitive signal tracing service. With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc. Provision has been made for use of phones and meter if desired.

✓TV ANTENNA TESTER SECTION

Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? The Model 76 will enable you to locate a break in any TV antenna and if a break does exist, the Model 76 will measure the location of the break in feet from the set terminals. 2 Ranges: 2' to 200' for 72 ohm coax and 2' to 250' for 300 ohm ribbon

Model 76 comes complete with all accessories including R.F. and A.F. Probes; Test Leads and operating instructions. Nothing else to buy ....Only

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We invite you to try before you buy any of the models described on this and the preceding pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate. (See other side for time-payment schedule details.)

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

SEE OTHER SIDE

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