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JUNE 1958

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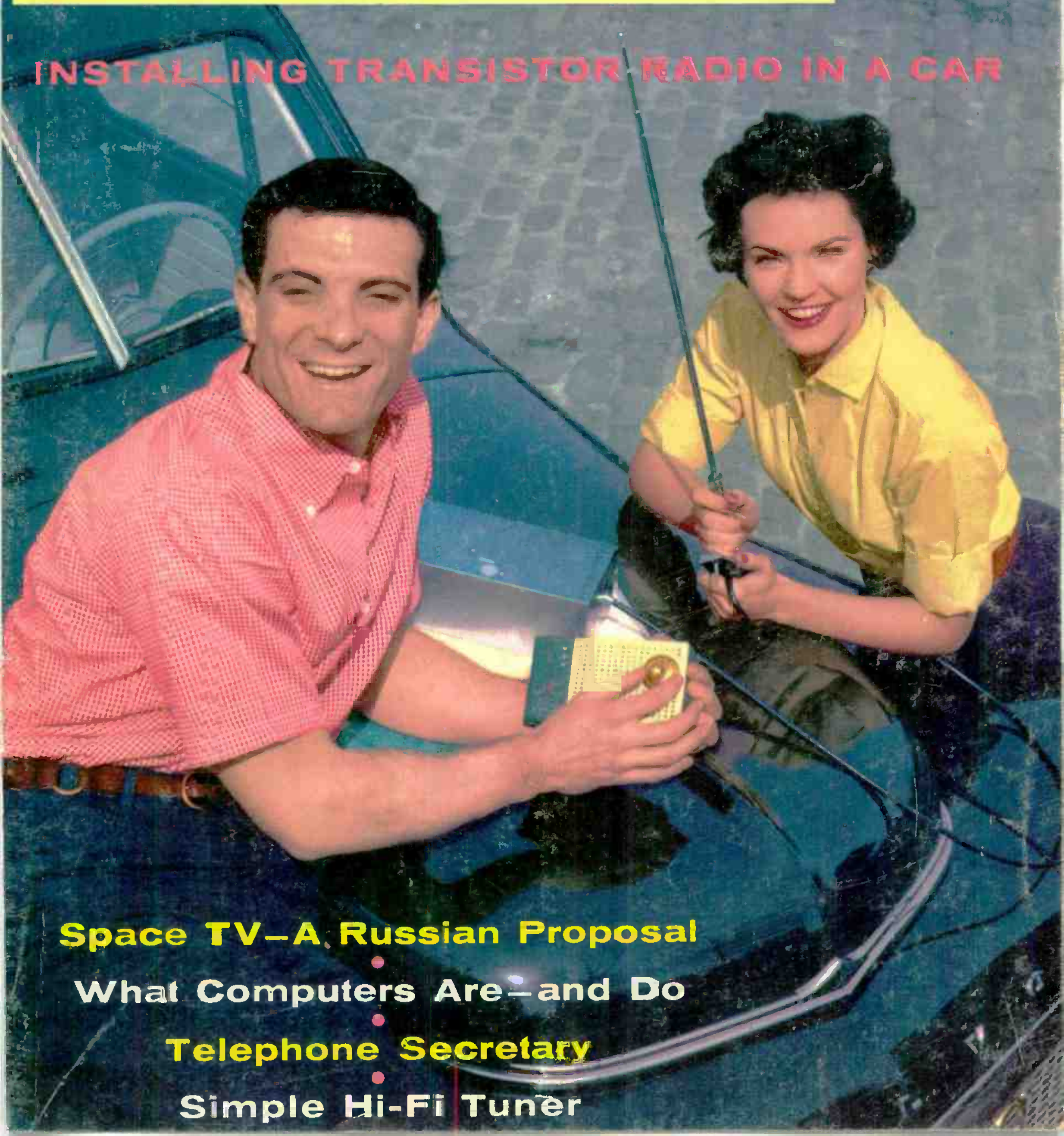

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POPULAR ELECTRONICS

VOLUME 8 NUMBER 6

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ELECTRONIC Build-It-Yourself Projects

AUDIO and Hi-Fi Features

Experimenter's Workshop

Miscellaneous Electronic News

(Also see page 6 for DEPARTMENTS)

Cover photo by Maynard Frank Wolfe
Volvo automobile (made in Sweden) courtesy of Volvo Distributing, Inc.
Portable receiver is Raytheon transistor radio.

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JUNE 1958

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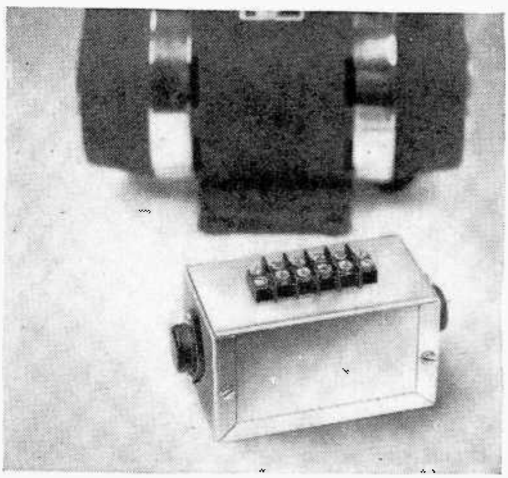

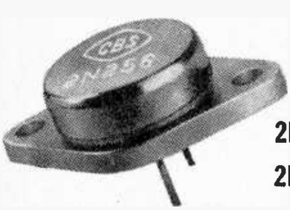

DEPARTMENTS

COMING NEXT MONTH (JULY)

(ON SALE JUNE 24)

Now that vacation time is here, you tape recording fans can get even more enjoyment from your recorder. Don't leave it home—take it with you on your travels. Our July cover shows how one happy couple relives a wonderful time abroad. We'll tell you how and what to record on your vacation and present hints on adapting your equipment to foreign power lines (50-cycle, 200-volt or other odd sources).

For electronicians there will be, among others, articles on how to use power transistors to convert battery power of car or boat to 117 volts a.c., build antennas for receiving signals from satellites, and, for the short-wave listener, how countries where there are no short-wave broadcast stations can be added to DX listening.

IN THIS MONTH'S

RADIO & TV NEWS

(JUNE)

A "High Power" Portable Paging System
Slave Flash Trigger
Electrostatic Loudspeakers—Questions and Answers
Electronics at Disneyland
The Gremlin Sentry—an Automatic Control Switch
Compact 35-Watt Standby Transmitter

By JOHN T. FRYE

The Tele-Tattletale

THE COOL INTERIOR of the basement laboratory was empty as Carl stepped in out of the June heat, but he noticed that the door leading into the other part of the basement was open, and he heard the voice of his chum, Jerry, calling: "Come on in here, Carl."

Jerry was kneeling on the floor in front of the deep-freeze. A couple of tiny wires coming from beneath the lid of the unit were connected to a pair of earphones lying on the floor. Another pair of phones led to a variable-frequency audio oscillator, and Jerry was adjusting this instrument until the tones from the two sets of phones were of the same frequency. When he was satisfied that the frequencies were zero beat with each other, he carefully noted the reading of the oscillator dial in a notebook. Carl said nothing, but his eyebrows arched above the horn rims of his glasses were shouting questions.

"I'm calibrating the temperature-reporting unit of our Tele-Tattletale," Jerry explained, with a teasing grin on his round face.

"Oh, fine! I didn't know we had one!" ejaculated Carl.

"Certainly we have," Jerry replied, opening the lid of the deep-freeze and lifting out a small wooden box with flat sides and rounded ends. The sides had large numbers painted on them, and one end was painted blue while the other was red. "This it is. I've been reading a lot about telemetering—or measuring at a distance—in connection with the satellites," he explained as he gathered up the equipment and started back into the laboratory; "so I decided we ought to get a little experience with that sort of thing—even though we have to do it in a pretty crude way.

"This little box," he continued, "can be placed anywhere so that its small, self-contained transmitter is within range of that transceiver on the bench. We can determine four things by listening to the signals from the Tele-Tattletale: (1) the temperature of the interior of the box; (2) the amount of light falling on both the red and blue ends; (3) if it is resting on

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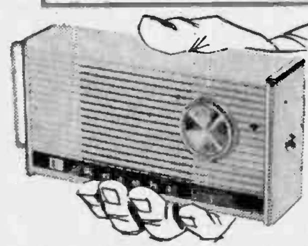

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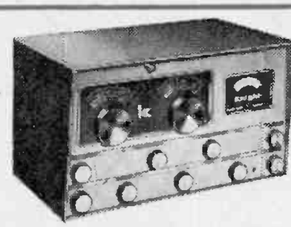

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Carl & Jerry (*Continued from page 8*)

side 1, 2, 3, or 4; and (4), what sounds are to be heard in its vicinity."

"Interesting, if true," Carl said doubtfully.

"It's true and really rather simple," Jerry insisted, as he removed some screws and took off one side of the box. "I use the spiral bi-metal unit out of an advertising thermometer to turn this easily working variable resistor. The resistor determines the frequency of a transistorized oscillator. I've calibrated the oscillator's frequency as a function of the surrounding temperature; so I know from the note it puts out how warm the box is. Photocells are mounted behind the openings in each end of the box. The resistance of each cell depends on the amount of light falling on it, and the cells are connected in twin oscillator circuits so that their varying resistances separately control the frequencies of the oscillators. By noting the frequencies of these oscillators, I can tell how much light is falling on either end of the box."

"You said you could tell on which side the box was resting. How do you do that?"

"That's easiest of all. I just fastened a sort of pendulum rod with a ball of lead on the end to the shaft of a variable resistor that can turn around and around. The weight always hangs down; so there

. . . "I'm calibrating the temperature-reporting unit of our Tele-Tattletale," Jerry explained, with a teasing grin on his round face . . .

Carl & Jerry (*Continued from page* 10)

is a different amount of frequency-determining resistance placed in still another oscillator circuit for every position of the box. And this little speaker here is used as a microphone driving a simple amplifier as the modulator so that the carrier of the transmitter is modulated by any sounds near the Tele-Tattletale."

"Surely you don't use a different transmitter on a different frequency for each of these information-reporting units."

"Oh, no; that would be wasteful and unscientific. There's just one transmitter whose output is modulated in sequence by each of the information sources. I use a tiny electric motor with a gear train to drive a cam at a speed of one revolution per minute. Here's the cam right here. As it goes around, it closes in order these five microswitches, each for a preset length of time. As switch #1 is closed, the temperature-indicating oscillator modulates the transmitter; switches #2 and #3 feed the light-indicating oscillators to the transmitter; #4 samples the position-indicating oscillator; and #5 connects the microphone. Each of the oscillators is on for five seconds out of every minute, with two-second separations between them; then the mike is on for thirty seconds before the whole thing starts over."

"She's a gabby little thing, but it's going to be a one-sided conversation," Carl observed with a grin.

"Not necessarily," Jerry remarked, pushing the transmit button on the transceiver. "How are you, Carl?" he asked with his lips close to the microphone, and his voice issued clearly from the speaker in the box. "The carrier from this transceiver operates a remote-control relay that connects the speaker-mike to the tail-end of the amplifier and feeds the output of the superregenerative receiver into the amplifier input. Since the two transmitters work on quite different frequencies, we can do this. Later, I intend to work it so that the Tele-Tattletale is silent until I command it to speak with a carrier from the transceiver."

"So what are going to do with the blabbermouth now?"

"Test it. I want you to take that box anywhere within a radius of three-quarters of a mile, leave it, and then come back here. We'll listen to the signals from it, and I'll try to tell you all I can about the surroundings in which you left the box. You can check me and see how close I come. Before you start back, just twist

Carl & Jerry (*Continued from page* 12)

these two wires together; and that will start the Tele-Tattletale to talking."

Carl clicked his heels together and gave an exaggerated salute. "Start the countdown," he said, tucking the box under his arm and heading for the stairs. "As soon as I get my bicycle, T-T and I are going into orbit!"

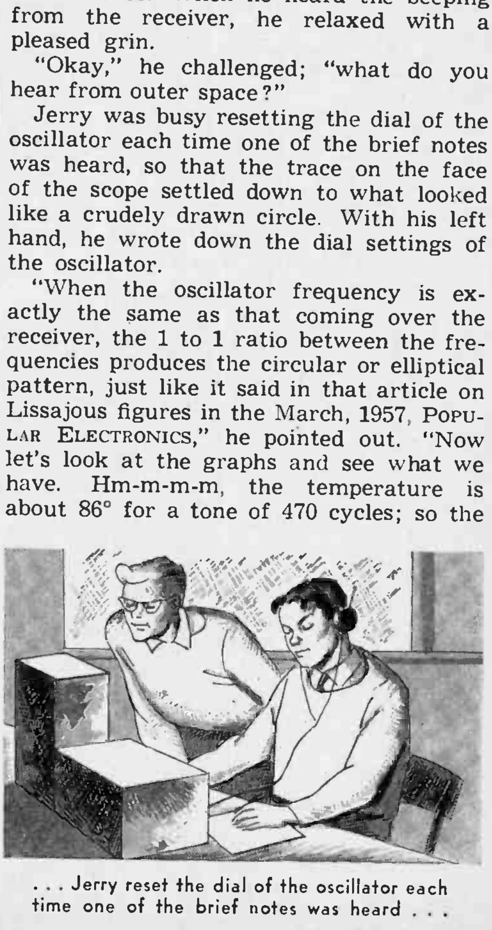
JERRY BUSIED HIMSELF cleaning up the littered workbench, and he had just finished when the little speaker of the transceiver began to emit a regular series of musical notes of different pitches. Jerry spread out on the bench some graphs of the calibration of the different oscillators, and he ran a couple of leads from the transceiver speaker to the vertical input terminals of his scope. Then he connected the variable-frequency audio oscillator to the horizontal input terminals.

As this was completed, Carl came clattering down the steps and burst into the laboratory, wiping the perspiration from his red face. When he heard the beeping from the receiver, he relaxed with a pleased grin.

"Okay," he challenged; "what do you hear from outer space?"

Jerry was busy resetting the dial of the oscillator each time one of the brief notes was heard, so that the trace on the face of the scope settled down to what looked like a crudely drawn circle. With his left hand, he wrote down the dial settings of the oscillator.

"When the oscillator frequency is exactly the same as that coming over the receiver, the 1 to 1 ratio between the frequencies produces the circular or elliptical pattern, just like it said in that article on Lissajous figures in the March, 1957, POPULAR ELECTRONICS," he pointed out. "Now let's look at the graphs and see what we have. Hm-m-m-m, the temperature is about 86° for a tone of 470 cycles; so the



. . . Jerry reset the dial of the oscillator each time one of the brief notes was heard . . .

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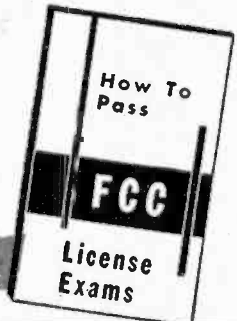

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PE-39

Carl & Jerry (*Continued from page* 14)

box must be in the shade. The red end is 'seeing' light of around 200 foot-candles per square foot, and that is what a light meter shows looking to the north in open shade; but the blue end only reads about 25 foot-candles. The box must be lying with one end out in the open and the other end back in some sort of enclosure."

Jerry paused in puzzled fashion for a moment and then demanded: "You dog, did you prop that box up edge?"

Carl chuckled an admission. "I used a couple of rocks to do it."

"Okay, but you have it lying on the edge separating sides #1 and #4. The tone is just halfway between the ones it would have if the box were lying on either of these sides. Be quiet now and let's see if we can hear any sounds picked up by the mike."

As the sequence of tones ceased, the steady hiss of the carrier was modulated by some faint tinkling sounds. Jerry listened carefully for the full thirty seconds and then exclaimed: "That's rippling water! Let's see; the box is in the shade, near water, and it's half in and half out of some sort of enclosure. I've got it. I'll bet you parked the Tele-Tattletale at the mouth of the culvert where the highway crosses Tick Creek!"

"You're just too good," Carl said, in pretended disgust. "That's exactly where it is. I hid it in a clump of grass growing at the north end of the culvert—"

HE WAS INTERRUPTED by the sudden sound of boyish voices echoing hollowly and coming from the speaker of the transceiver:

"This is a dandy place," one voice was saying. "No one can see us here. You got the fags? Here are the matches."

"Sure, I sneaked them out last night."

The conversation was cut off as the Tele-Tattletale started reporting on the temperature, etc.

"I'll bet anything that's the pair of little kids I met as I started back," Carl declared. "They were acting kind of sneaky."

The mike cut in again. ". . . green onions are to take the cigarette smell off our breath," a boyish voice said. "My old man uses an electric razor, but he's still got a razor strop, you know."

"He'll never know about this," the other voice replied. "Come on; give me a light."

As the mike cut off again, Carl suddenly reached for the transceiver. With a smile crinkling the corners of his blue eyes, he

1948—*Early "point contact" transistor.*

The remarkable transistor observes its 10th birthday

In 1948, Bell Telephone Laboratories announced the invention of the transistor. In 1958, the transistor provided the radio voice for the first United States satellite.

To advance the transistor to its high level of usefulness, Bell Labs solved problems which, in themselves, approached the invention of the transistor itself in scientific achievement.

First, there had to be germanium of flawless structure and unprecedented purity. This was obtained by growing large single crystals —and creating the "zone refining" technique which reduces impurities to one part in *ten billion.*

The junction transistor, another radical advance, spurred transistor use. Easier to design, lower in noise, higher in gain and efficiency, it became the heart of the new electronics.

An ingenious technique for diffusing a microscopically thin layer on semiconductors was created. The resulting "diffused base" transistor, a versatile broadband amplifier, made possible the wide use of transistorized circuits in telephony, FM, television, computers and missiles.

In telephony the transistor began its career in the Direct Distance Dialing system which sends called telephone numbers from one exchange to another. For Bell System communications, the transistor has made possible advances which would have been impossible or impractical a brief decade ago.

1958—Satellite transistor, incorporating 10 years of Bell Labs research and development.

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Carl & Jerry (*Continued from page* 16)

pitched his voice as low as he could and spoke in sepulchral tones directly into the mike of the transceiver:

"*That* is what *you* think. Someone always knows when you try something as foolish as you boys are doing now."

That was all he said. The transceiver was switched back to the receive position. The Tele-Tattletale turned on the microphone, but at first not a sound could be heard except the rippling of the stream; then, suddenly, just before the mike cut off, there was a scrambling, scuffling sound followed by rapidly retreating footsteps.

"Come on," Carl said, heading for the door. "We'd better go rescue that precious little electronic snitcher before someone finds it. I don't want to lose that thing. It's got too many possibilities."

THE CULVERT was less than a half-mile away, and Carl and Jerry were there on their bicycles in no time at all. The Tele-Tattletale was still purring quietly away where Carl had hidden it in the tall grass. The boys walked along the narrow bank near the huge culvert; and soon they found four freshly pulled green onions, several wooden matches, and the contents of a broken package of cigarettes strewn over the narrow walkway.

"I'll bet we really made believers out of those two," Carl said with a chuckle as he kicked the cigarettes into the stream with the toe of his shoe and carefully picked up the matches. "As long as they live, those little boys will probably always feel that somebody—or some*thing*—is watching every bad move they make."

"I guess somebody or something really is," Jerry said thoughtfully, looking down at the little box he held in his hands. "You can call it 'conscience' or 'electronic Tele-Tattletale' or whatever you like, but it adds up to the same thing. Someone knows."

—30—

. . . "Someone always knows when you try something as foolish as you boys are doing now" . . .

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FOR RESIDENT SCHOOL COURSES SEE AD ON OPPOSITE PAGE

LETTERS FROM OUR READERS

AM DX Clubs

■ I noted the letter from Jim Ernst in the April '58 issue regarding AM DX'ing, and thought your readers might be interested in knowing that there are two very fine clubs in our country specializing in this facet of the DX hobby. The National Radio Club and the Newark News Radio Club have both been active for about 25 years. The address of the National Radio Club is R. D. 1, Lake City, Pa., and yearly dues are $4.00.

SCOOTER SEAGRAVES
The Swamp Angel DX'er
Stuttgart, Ark.

Proximity Relay Parts

■ Pages 65 to 67 of the February 1958 issue of P.E. describe the construction of a battery-operated proximity relay. In the parts list, *C2* is given as a capacitor in the *L1* assembly, but there is no $\mu\mu$fd. rating for this trimmer. What is it? And do *RFC1* and *C2* come as one unit from the manufacturer, or are they separate units to be joined together?

L. L. AMOS
(No Address)

These parts, enclosed in dashed box in the diagram, come with the coil assembly specified in the parts list.

Tip for Soldering Gun

■ On page 30 of the January 1958 issue, you give the suggestion by D.L.S. that longer life for tips can be obtained by using foreign matter to slow oxidation. I have an even better method. Tin the area just behind the tip.

P. A. ROBERTSON
Rochester, N. Y.

Wartime Use of Infrared

■ While awaiting a gastrectomy, I read with interest the Infrared article in your January '58 issue. Your contributor implies that the infrared camera was developed five years ago.

In 1939 I led a research team which found that all green pigments photographed black on IR but natural foliage photographed white to dark-grey, according to whether it was deciduous or conifer foliage. It was obvious that a German recon aircraft, using IR for fog or haze penetration, could, by photographing the same objective on a panchromatic film, have our installations clearly outlined by direct contrast with the surroundings.

We built an IR camera and used this to test newly synthesized green pigments. Ultimately we were able to produce a lake pigment which photographed identically on IR and panchromatic film. Some 4½ million gallons of camouflage paint were produced, under bombardment in London, for the RAF and USAAF, who collected it in 3000-gallon tankers and sprayed it directly on concrete runways as they hardened.

I do not claim this to be the first IR camera, as we obtained much useful data from a textbook

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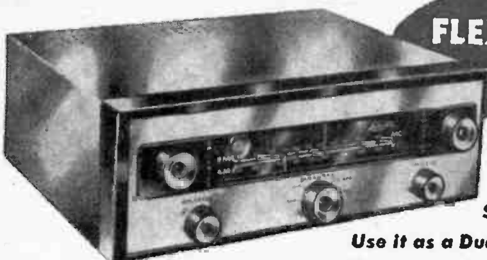
Lafayette STEREO TUNER KIT

THE MOST FLEXIBLE TUNER EVER DESIGNED



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

- Multiflex Output for New Stereo FM
- 11 Tubes (including 4 dual-purpose) + Tuning Eye + Selenium rectifier Provide 17 Tube Performance
- 10KC Whistle Filter
- Pre-aligned IF's
- Tuned Cascode FM
- Separately Tuned FM and AM Sections
- Armstrong Circuit with FM/AFC and AFC Defeat
- 12 Tuned Circuits
- Dual Cathode Follower Output
- Dual Double-Tuned Transformer Coupled Limiters.

KT-500 74.50 IN KIT FORM
ONLY 7.45 DOWN 7.00 MONTHLY

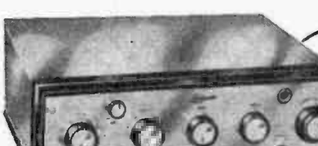
More than a year of research, planning and engineering went into the making of the Lafayette Stereo Tuner. Its unique flexibility permits the reception of binaural broadcasting (simultaneous transmission on both FM and AM), the independent operation of both the FM and AM sections at the same time, and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

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

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

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

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



KT-300 39.50 IN KIT FORM

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

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

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

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

DELUXE 70 WATT BASIC AMPLIFIER

KT-400 69.50 IN KIT FORM
ONLY 6.95 DOWN - 7.00 MONTHLY

- Conservatively Rated At 70 Watts
- Metered Balance And Bias Adjust Controls
- Inverse Feedback
- Variable Damping
- Available In Kit And Wired Form

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

KT-400—Lafayette 70 watt Deluxe Basic Amplifier Kit complete with cage and detailed assembly instructions. .... Net **69.50**

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

Lafayette Radio DEPT 1F **165-08 Liberty Ave. JAMAICA 33, N. Y.**

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BRONX 58, N.Y. 542 E. Fordham Rd. BOSTON 10, Mass. 110 Federal St.
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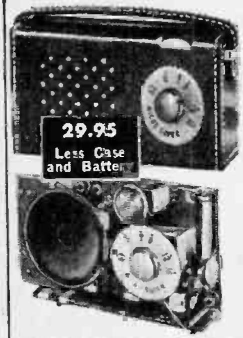
FEATURING THE BEST BUYS IN THE BUSINESS

The newest and largest assortment of Electronic, Radio and TV parts, Hi-Fi and Public Address Components and systems, Test Equipment, tubes, Transistor Kits and miniaturized components for transistor circuitry, Ham Equipment, Builders Kits, Tools, Books, Microscopes, Binoculars, Telescopes, Cameras, and Drafting Equipment.—*ALL AT LOWEST PRICES*—Catering to the economy minded dealer, serviceman, engineer, technician, experimenter and hobbyist. *CRAMMED FULL OF MONEY SAVING BUYS. SEND FOR YOUR FREE COPY TODAY.*

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

- GE 2N188A AUDIO OUTPUT TRANSISTORS • 100% SUBMINIATURE PARTS—NO COMPROMISES!
- CLASS B PUSH-PULL AMPLIFICATION-PLENTY OF POWER. • FOR GROUP AND PRIVATE LISTENING
- LABORATORY DESIGNED—SENSITIVE, SELECTIVE, STABLE!



29.95 Less Case and Battery

Superb Performance! Incomparable Value!

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

KT-119A — Complete Kit-Less Case and Battery .... Net **29.95**

BATTERY 9V BURGESS 2N6 .... Net **1.30**

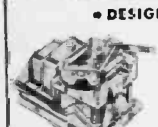
MS-339A — Sturdy attractive brown leather case with carrying strap for KT-119A. 6 x 3½ x 1½". Shpg. wt., 1 lb. .... Net **2.95**

MS-366 — Sensitive matching earphone .... Net **1.29**

Lafayette's Radio-Control Specialties

R/C ELECTRIC SERVO MECHANISM

• DESIGNED AND PRICED FOR HOBBYISTS



New, powerful, motor driven R/C actuator. Delivers positive, instantaneous action. Provides selective steering and electronic, automatic return to neutral: Extremely efficient when used with model boats and land vehicles. Only 2½" x 2" x 1¾". Includes instructions and linkage.

F-327 .... Net **4.95**

LITTLE "JEWEL" R/C RELAY

The Mighty Mite of the R/C field. Weighs less than ½ oz.! Only ¾"H x 17/32"W x 1-1/16"L. Highly sensitive—extremely rugged. Pulls at 1.4 Ma—drops out 1.2 Ma D.C. S.P.D.T. 5000 ohm coil.

F-260 .... Net **2.75**

LAFAYETTE SPECIAL R/C TRANSMITTER

New crystal controlled 27.255 MC R/C transmitter, completely assembled, tested and guaranteed. Includes tube, crystal and 6 section telescoping antenna. Approx. 1 mile range. Size 8½ x 2¾ x 1¾". Shpg. wt., 2½ lbs. Less batteries.

F-249 R/C TRANSMITTER (Less Batteries) .... Net **14.95**

LAFAYETTE SPECIAL R/C RECEIVER

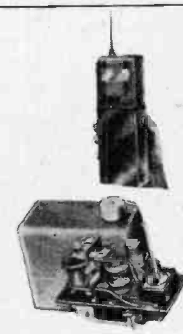
New factory wired and tested RC receiver. Completely enclosed — for use around water — case may be removed. Ready to operate on exam-free 27.255 MC band. Has fine tuning control, antenna lead, and connector plug. Requires one 1.5V and one 45V battery. Complete with 3S4 tube, less batteries. Size 3 x 2¾ x 1½". Ideal companion for F-249 Transmitter. Shpg. wt., 8 oz.

F-208 R/C RECEIVER (Less Batteries) .... Net **8.95**

SPECIAL COMBINATION OFFER

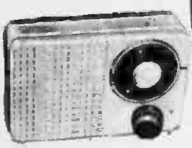
Consists of R/C Transmitter (F-249) and R/C Receiver (F-208)

F-259 Combination .... Net **22.90**



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" x 2⅝" x 1-1/16". Shpg. wt., 1 lb.

KT-116 —Complete Kit, less earphone .... Net **16.95**

MS-260—Super Power Dynamic Earphone .... Net **3.95**

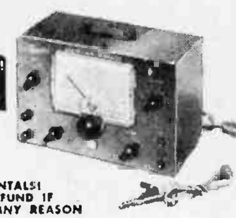
NEW! HIGH SENSITIVITY POCKET MULTITESTER

20,000 OHMS PER VOLT DC — 10,000 OHMS PER VOLT AC

A terrific buy in a convenient accurate, completely wired instrument. Has a 3" 36 μA meter. 1% precision resistors and efficient single selector switch. Scales: Volts DC and AC; 0-10-50-250-500-1000 Ohms; 0-50K-500K- 5 Meg; DC current; 0-50μA-1MA-25MA-500MA: Decibels; —20 to +22, +20 to 36. Attractive plastic front in rugged shielding metal case. Imported to save you money. Size: 3-5/8 x 5¼ x 1-5/8". Complete with batteries and test leads. Shpg. wt., 3½ lbs. **RW-50 Imported** .... Net **14.50**

LAFAYETTE SIGNAL GENERATOR

COMPLETELY WIRED AND TESTED! ACCURACY AND QUALITY GUARANTEED!



22.50

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

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

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

LSG-10 — Signal Generator **22.50**

Lafayette Radio DEPT IF

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Include postage with order

Letters (*Continued from page* 20)

which was published by Pitman, London, in 1936.

Incidentally, my German Kodak Retina I (1952) is calibrated and engraved for IR use, and I have used it with British Kodak IR film and filter with great success at home.

My congratulations on a very interesting magazine.

H. C. Devroome
London, England

True Experimenter Spirit

■ I have just completed my first unit which appeared in your magazine. I built the "Conversation Piece" transistor preamp in the March 1958 issue (p. 63), and had lots of fun doing it. I built it in an aluminum box (1½"x2"x3¼"), which makes it very compact and neat.

The only thing I could not figure out on the transistors was which lead was the emitter and which the collector. I knew the base was the middle one, though. So, after much puzzling, I just put them in anyway. The preamp works beautifully, but I still don't know if the transistors are in wrong or right.

Laura Butts
Solon, Ohio

Improved Capacitance Tester

■ Having accumulated a collection of mongrel capacitors in my wanderings through the field, I recalled Rufus Turner's article in the August 1957 issue and decided to build myself one of his capacitance bridges. He stated that you can measure very small values by putting a capacitor in parallel with the one to be measured, and measuring the sum.

I built this feature into my bridge, with an extra switch to cut in a 200-μμfd. mica capacitor. Instead of grounding the A terminal for the meter, as he shows, I grounded the B terminal (the one that goes to the slider) to the chassis, and have no trouble at all with false null. After trying out a few capacitors of known value and getting the "feel" of the gadget, I find I can come very close and have even come out right on a 22-μμfd. ceramic.

I'm a technical writer by trade, and have just started working for ——— Co. as an engineering assistant. Much of the knowledge I needed to get this job came from your magazine.

G. Stevenson
Watertown, Mass.

Don't Swamp This Reader

■ I just completed a course in TV and have diplomas in both radio and television. I will gladly help out anyone having trouble in wiring radio, TV, or instrument kits.

Pierre Langlois
5514 Verdun Ave.
Verdun, P. Q., Canada

Not As Easy As It Seems

■ You would be doing a great service to many readers who have very small, medium and large battery portable radios which have all the major

WE'RE MAKING IT EASIER THAN EVER TO BECOME A WELL PAID

RADIO-TELEVISION SERVICE TECHNICIAN

NOW—Just $6 Starts You Training in

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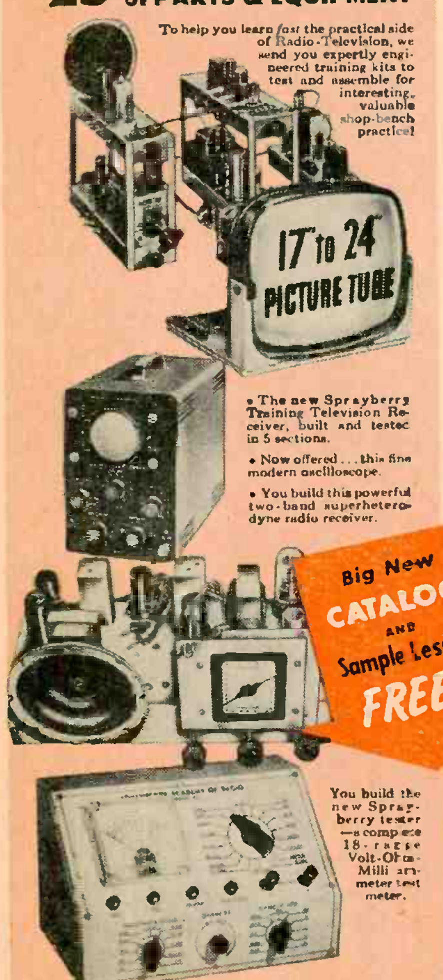
25 BIG, COMPLETE KITS of PARTS & EQUIPMENT

To help you learn *fast* the practical side of Radio-Television, we send you expertly engineered training kits to test and assemble for interesting, valuable shop-bench practice!



• The new Sprayberry Training Television Receiver, built and tested in 5 sections.

• Now offered . . . this fine modern oscilloscope.

• You build this powerful two-band superheterodyne radio receiver.

You build the new Sprayberry tester—a complete 18-range Volt-Ohm-Milliammeter test meter.

Big New CATALOG AND Sample Lesson FREE!

★ ★ ★ ★ This great industry is begging for trained men . . . to step into good paying jobs or a profitable business of their own! Our new plan opens the doors of Radio-Television wide to every ambitious man who is ready to act at once!

Men by the thousands . . . trained Radio-Television Service Technicians . . . are needed at once! Perhaps you've thought about entering this interesting, top paying field, but lack of ready money held you back. Now—*just $6 enrolls you* for America's finest, most up to date home study training in Radio-Television! Unbelievable? No, the explanation is simple! We believe Radio-Television *must* have the additional men it needs as quickly as possible. We are willing to do our part by making Sprayberry Training available for less money down and on easier terms than ever before. This is your big opportunity to get the training you need . . . to step into a fine job or your own Radio-Television Service Business.

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Only a limited number of students may be accepted on this liberal and unusual basis. We urge you to act at once . . . mail the coupon below and get complete details plus our big new catalog and an actual sample lesson—*all free.* No obligation . . . no salesman will bother you.

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Under world-famous 27-year old Sprayberry Plan, you learn entirely at home in spare time. You keep on with your present job and income. You train as fast or as slowly as you wish. You get valuable kits of parts and equipment for priceless shop-bench practice. And everything you receive, lessons and equipment alike, is all yours to keep.

LET US PROVE HOW EASILY YOU CAN LEARN!

Radio-Television needs YOU! And Sprayberry is ready to train you on better, easier terms, that any ambitious man can afford. *Just $6 starts you!* Mail coupon today . . . let the facts speak for themselves. You have everything to gain. Let us prove the kind of opportunity in store for you!

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Please rush all information on your ALL-NEW Radio-Television Training Plan. I understand this does not obligate me and that no salesman will call upon me. Include New Catalog and Sample Lesson FREE.

NAME .... Age ....

ADDRESS ....

CITY .... ZONE ..... STATE ....

Letters

(*Continued from page 24*)

essential parts already if you would give us some circuits for converting these battery portables to transistor operation, to save costs of constant expensive battery replacement.

HARRY MARCUSA
Paterson, N. J.

Need February '57?

■ I noticed in the *Letters from Readers* column that the February 1957 issue is out of circulation. I have a copy of that issue which I would like to trade for a copy of the September 1957 issue. This copy is unmarked with no subscriber name or newsstand stamp.

ROBERT A. VENSON
Galveston, Texas

Anyone Got a Mine Field?

■ I recently purchased an SCR625-4 Army Mine Detector from an advertiser in your October issue. No complaint. It's in good shape and works fine. My trouble is, I'm getting tired of digging up old beer cans, and nothing else, so I'm wondering if you can tell me how to make it more sensitive to smaller objects. If not, how about directing me to a good mine field somewhere?

EDWARD H. STEVENS
Imperial Beach, Calif.

More Coming

■ After reading several comments about the v.h.f. "T" ear in succeeding issues, I dug out my July '57 copy of your magazine and built the "de luxe" version. That it works very well will be no surprise to you.

Now that you have aroused a lot of interest and probably an unusual amount of reader response, I am sure that many people would like to have you follow it up with a more advanced receiver for the v.h.f. aircraft bands—transistorized if possible, with more sensitivity, loudspeaker and possible coil and antenna specs for extended range.

Your magazine is filling a real need for us beginners.

NORMAN A. CUCUEL
Bristol, Conn.

Tetrode Transistor Problem

■ In answer to Stanley Livingston (*Letters,* April, 1958) concerning his problem of a bad tetrode transistor, I offer the following comments.

The resistance between the two bases should be quite low. However, the current flow at base number two is generally limited to a small value, such as 300 microamps in the case of a 2N35, with which I am familiar. It is possible that either the circuit in which his transistor was originally used or the ohmmeter he used to check the base-two resistance passed sufficient current to cause the connection to the crystal to open (most ohmmeters pass a healthy slug of current on low ranges).

If this is a true tetrode transistor, the above is the most likely cause. Since he did not specify which type he had, there is a possibility of his unit having a fourth lead which is used as a ground for the transistor case. RCA manufactures transistors of this type, and possibly there

Letters *(Continued from page 26)*

are others. If his is an RCA unit, I suggest making an ohmmeter check between the extra lead and the case to see if it is of this type.

Bradford O. Van Ness
Phoenix, Ariz.

For more information on tetrode and triode transistors with four leads, see Transistor Topics in this issue.

Antique Lamps Needed

■ I am a charter subscriber to Popular Electronics. Please do not change anything about it, especially the picture diagrams of electronic hookups for various projects.

Do you know where I can obtain some of the old tungsten lamps with the "W" type filament? I would like to use these in old light fixtures that are more or less on the antique side.

L. E. Stauber
Rural Hall, N. C.

PLEASE!

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

POP'tronics BOOKSHELF

"COMMERCIAL RADIO OPERATOR'S LICENSE GUIDE—Element 3" by Martin Schwartz. Published by American Electronics Co., 1203 Bryant Ave., New York 59, N. Y. 122 pages. Soft cover. $1.75.

This is the second of a series covering the elements of the FCC Commercial Radio Operator's License Examinations. In addition to giving a complete answer for each one of the FCC study questions, the book also contains sample FCC practice examinations using multiple-choice type questions.

Recommended: To all "boning up" for Element 3 of the radiotelephone and radiotelegraph Commercial License exams.

"THE RADIO AMATEUR'S HANDBOOK" by the Headquarters Staff of the A.R.R.L. Published by the A.R.R.L., 38 La Salle Road, West Hartford 7, Conn. 584 pages, plus tube tables and catalog sections. $3.50 in the U.S.A., $4.00 in Canada, and $4.50 elsewhere.

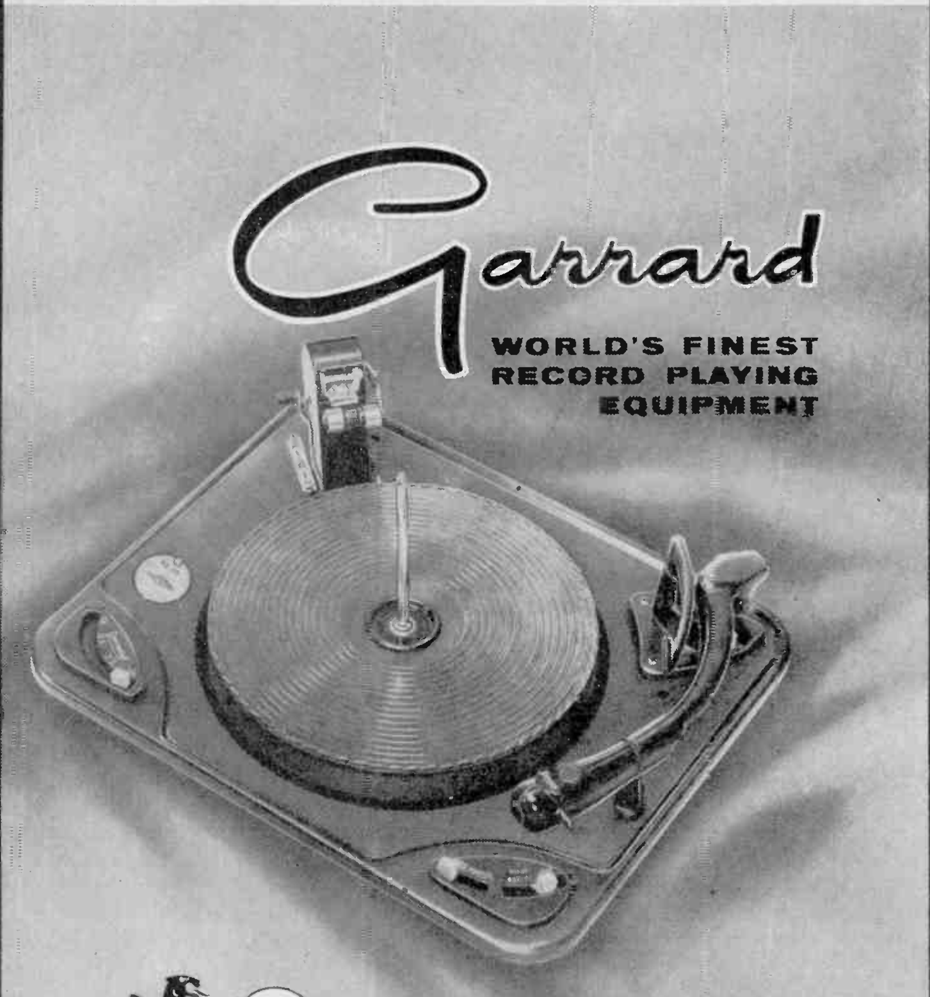
There is not a lot that can be said about the 35th edition of the *Handbook* that has not been said time and time again. It is complete, authoritative, and up-to-date. It has a place on the bookshelf of everyone interested in ham radio, and practically everyone else working in radio theory or circuit design. The ideas and presentations are the cream of the best articles from QST, and from the laboratories of the American Radio Relay League.

Recommended: To all POP'tronics readers as a gold-mine of information on *all* phases of electronics in radio.

"VAN NOSTRAND'S SCIENTIFIC ENCYCLOPEDIA—Third Edition," published by D. Van Nostrand Co., Inc., Princeton, N. J. 1839 pages. Hard cover. $30.00.

This is the standard one-volume scientific and engineering encyclopedia which is in effect a complete reference library of the major sciences and fields of technology. A thumb-indexed work, it has been pre-

Garrard models change. Garrard ideals do not. Meaningful new features are added. Time-proven features are carefully retained. Gadgets, for the sake of gadgetry, are sternly rejected. The all-important fact to remember is that thirty-five years of experience in designing, testing, and building fine record players, guide us in offering you the present Garrard models.



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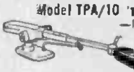
There's a Garrard for every high fidelity system

Model 301 PROFESSIONAL TRANSCRIPTION TURNTABLE
Each speed variable! Each unit with its own performance test report. $89.00

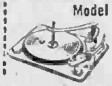
Model RC98 4-SPEED SUPER AUTO-MANUAL CHANGER
Continuous + or — variable control on all speeds. $67.50



Model TPA/10 TRANSCRIPTION TONE ARM
—Professional performance, jewel-like construction and exceptional versatility. $24.50

Model RC88 4-SPEED DELUXE AUTO-MANUAL CHANGER
Exclusive pusher platform protects your records. $54.50

Model T Mark II 4-SPEED MANUAL PLAYER
A superior unit for quality budget systems. $32.50



Model RC121/II 4-SPEED INTERMIX AUTO-MANUAL CHANGER
Fine performance with economy and compactness. $42.50

For Information Write: **GARRARD SALES CORPORATION, Dept. GF-358 PORT WASHINGTON, N. Y.**

Bookshelf (*Continued from page 30*)

eminent in the field since the first edition was published in 1938. Its 33 contributing editors stand high in the roster of eminent scientists, yet each of the 14,000 articles is simple enough for the layman to understand. An unusual feature is that most of the articles are cross-referenced in bold type, making it easy to follow through in a complete field of endeavor. The volume has about 11,000 illustrations in black-and-white and color.

Recommended: To the electronics beginner and advanced worker for a solid answer to any problem in the fields of science or technology.

"TV AND RADIO TUBE TROUBLES" by Sol Heller. Published by Gernsback Library, Inc., New York 11, N. Y. 224 pages. Soft cover. $2.90.

This latest addition to the Gernsback Library is devoted entirely to diagnosing and correcting electron tube troubles. Discussions of tube and component damage in radio and TV receivers with recommended trouble-shooting techniques fill the nine chapters with a large amount of handy test bench information.

Recommended: As a guide for the radio-TV serviceman and to the beginner for the theoretical discussions of possible tube troubles.

Free Literature Roundup

Standard Supply Company, 225 East 6th St., South, Salt Lake City, Utah, has issued a new 200-page electronic parts catalog listing components and equipment for service, industrial, communications, public address and amateur applications.

A 12-page P.E.C. (Packaged Electronic Circuit) Guide containing schematics and specifications on all 96 types of Centralab P.E.C.'s sold through electronic parts distributors is now available from Centralab, a division of Globe-Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wis. There is also a section on the proper test procedure for checking all listed packaged circuits.

A Stancor transformer Replacement Guide devoted exclusively to TV replacement transformers, including data on flybacks, yokes, powers, vertical outputs, etc., is now available from the Chicago Standard Transformer Corp., 3501 Addison St., Chicago 18, Ill. It contains many useful listings, charts and exact transformer replacement cross-reference tables. —30—

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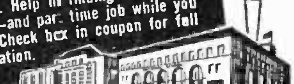

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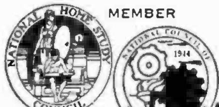

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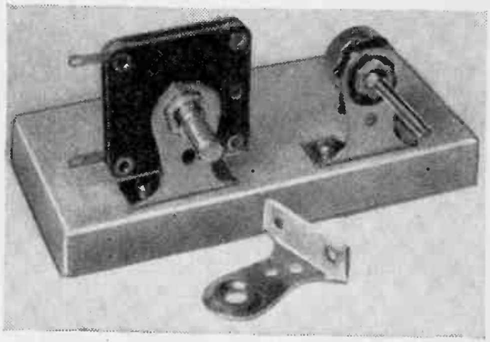
TIPS and TECHNIQUES

HANDY MOUNTING BRACKETS

Some types of angle-brackets, used for hanging roll-type window shades, come in handy for mounting such parts as volume controls, toggle switches, ferrite Loopsticks, single-hole-mounting variable capacitors, etc., on experimental breadboard setups. The photo shows a small variable capacitor and a midget volume control mounted on a wood base by means of



chrome-plated shade brackets purchased in a dime store for a few cents. Holes in the brackets can be enlarged with a rat-tail file or reamer to fit your requirements.—*A.T.*

REDUCE ANTENNA NOISE PICKUP

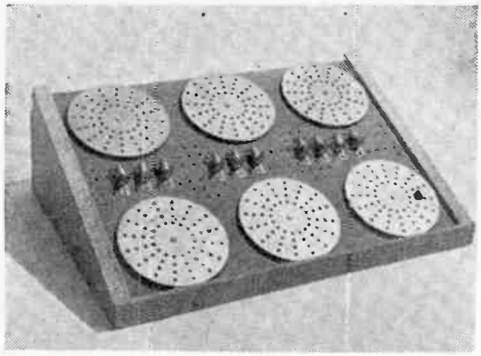
Power line and other electrical noise in the area near a radio antenna is picked up by metal objects which may reradiate it to the antenna. Reradiation is a very common cause of interference in many types of electronic gear, and a steel pole may reradiate noise to the antenna it supports. To reduce this effect, always locate the antenna insulator several feet from the pole.

Noise may also result from partial antenna grounding due to leakage permitted by wet or soot-coated insulators. The use of a second insulator reduces this possibility and is particularly applicable in areas of low signal strength where every effort must be made to maintain maximum possible signal-to-noise ratio. —*E.F.C.*

INSULATED HANDLE FOR HEX WRENCH

The plastic handle of a screwdriver can be used as an insulated handle for a hex

Can you think faster than this Machine?



Control Panel of GENIAC set up to do a problem in space ship engineering

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- Bell Telephone Laboratories
- Walter V. Clarke Associates
- Barnard College
- Westinghouse Electric
- Phillips Laboratories
- General Insurance Co. of America
- Lafayette Radio
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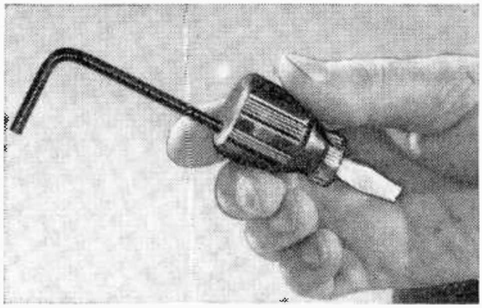
Tips *(Continued from page 34)*

wrench by merely drilling a hole to accept it snugly. Drill the hole halfway between



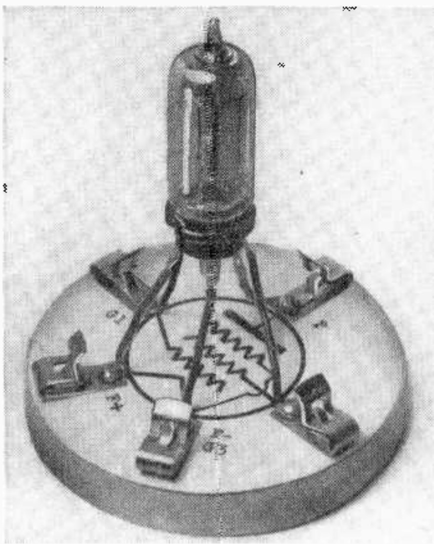
the outside and the center of the handle so that the wrench will be well separated from the embedded screwdriver shank. —*K. M.*

FLIP-TOP STORAGE

"Flip-top" type cigarette packages make fine containers for resistors, capacitors, r.f. chokes, nuts, bolts, and other small radio hardware. Simply remove the inner foil and use transparent tape to put a label on the top of the box to identify the contents. If the original cost of the cigarettes is discounted, such boxes are free. —*G.W.B.*

GRAPHIC VACUUM-TUBE MOUNT

Graphic terminal boards make it a pleasure to experiment with various vacuum tubes and circuits. Fahnestock clips allow quick connections; the picture shows just



where the connections go. Radio students and experimenters can make up a number of these graphic tube mounts, one for each of the most commonly used tubes, and save much time and trouble when trying various hookups. —*A. T.*

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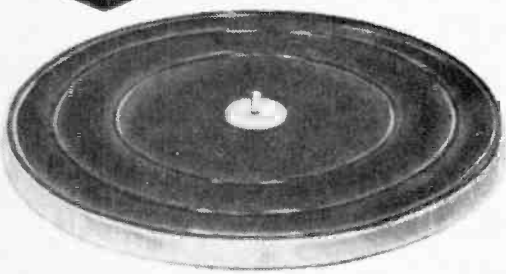
The Turntable Kit

. . . Another *Weathers* Original



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Analog computer-plotting board by Reeves as used at Bendix Aviation.

By ALLEN LYTEL

ELECTRONIC COMPUTERS

what they are and what they do

AUTOMATION has given new importance to electronic computers. From automatic factories to magazine subscriptions, they are becoming a part of our daily life. More applications are constantly being found for computers large and small.

There are two different types of computers: the *digital*, which uses numbers or digits, and the *analog*, which uses a measure, such as voltage, current, or angle of rotation.

While large-scale digital computers have captured the headlines, both types are important. Many more analog than digital computers are now in use although both analog and digital techniques are used in some computers. There are, however, striking differences between the two types. Each has applications where it is best suited; each has good features as well as disadvantages.

A comparison between them involves a measure of the exactness of computed results in terms of accuracy and precision. The *accuracy* is the measure of correctness or validity. *Precision* is something else again.

If, for example, you say *pi* is almost 3.15 and I say *pi* is between

3.1 and 3.2, both are accurate if *you* measure to hundredths and *I* measure to tenths. But 3.15 is more precise because it is a measure of greater refinement. If you say *pi* is 3.14159, this is even more precise than 3.15. Thus both accuracy (correctness) and precision (refinement) are important. Digital computers tend to be more precise but both types are accurate within their own limitations.

ANALOG COMPUTERS

There are many forms of analog computers. A bathroom scale is one. When you step on it, the pointer moves across the dial. If your weight increases, the pointer moves farther; if you lose weight, it doesn't move as far. The amount of rotation (angle) depends upon your weight or there is an analogy between the two.

In an analog system, quantities are measured (not counted) and fed as inputs to the computer. The computer acts on the inputs in such a way as to perform a number of mathematical operations or to solve an equation. Results are usually plotted on a graph as output data.

If you want to multiply two numbers using logarithms, you add the log of the first number to the log of the second, and their sum is the log of the result. On a slide rule, you do the same thing mechanically, for a slide rule is only a table of logarithms. The slide rule, then, is an analog computer.

Simpler and More Direct. Analog computers are, in a fundamental sense, more direct and simple than digital computers. An analog computer is not, ordinarily, a high-precision device. As an example, a circuit such as that in Fig. 1(A) will illustrate a simple operation.

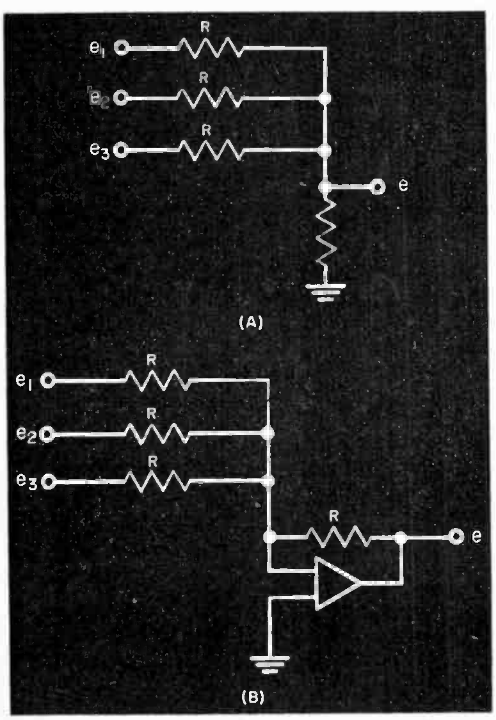


Fig. 1. Analog computer feeds value measurements into input (A), where e is analog of sum of voltages e_1, e_2, e_3. In (B), amplifier is shown in circuit.

The sum of the voltage drops in a series circuit is equal to the source voltage for a resistive circuit. Each input voltage is in series with the output.

With three input voltages (e_1, e_2, e_3) the output (e) will be the analog of the sum of the inputs.* This is an analog adder, and you can modify this circuit so that it will subtract by changing the polarity of any input voltage.

Amplifiers are used in many electronic analog computers, as shown in (B) of Fig. 1. Here the output voltage is the actual sum of the input voltages. These are high-gain stages suitable for many operations.

An example of a commercial amplifier is shown in Fig. 2. By the use of simple networks, a single stage (actually two tubes) can perform operations such as addition. Subtraction (negative addition), multipli-

* An interesting Ohm's law problem; actually, if all the resistors are equal, then: $4e = e_1 + e_2 + e_3$.

Digital computers tend to be large, but some have been put in small packages, as in this Hughes Aircraft model in the fighter plane above. At left, above, two forms of basic computers are shown being examined; the abacus is actually a digital computer, while the slide rule is an analog computer.

ANALOG	DIGITAL
Continuous quantity representation or measured values	Discrete quantity representation or counted values
Precise to 1 part in 10^3	Precise to one part in 10^{12} or better
Values may be in multi-dimensions	Values are ordered set of digits
Storage is localized, non-uniform, used *either* for data or instructions	Storage is centralized, uniform (in character), used for *both* data and instructions
Basic operations are usually sophisticated	Basic operations are quite simple
Limited and simple switching	Varied and complex switching
Programing tends to be fixed	Programing is quite flexible
System is (usually) simple, reliable, and expensive	System is (usually) complex, fallible, and expensive
For a given problem (usually) faster*	For a given problem (usually) slower*
Best suited to physical systems	Best suited for statistical (numerical) data

** A complete problem, as in equation-solving, not an operation alone.*

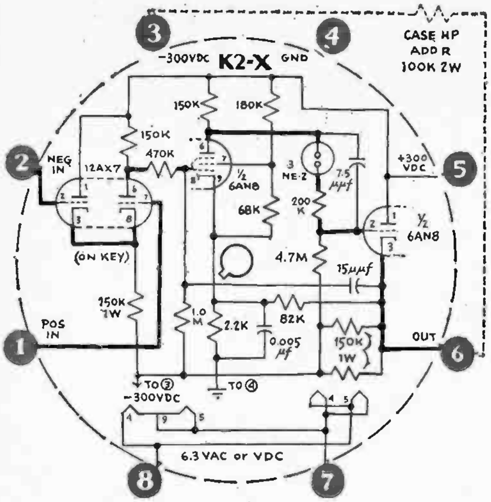


Fig. 2. Philbrick Research analog amplifier.

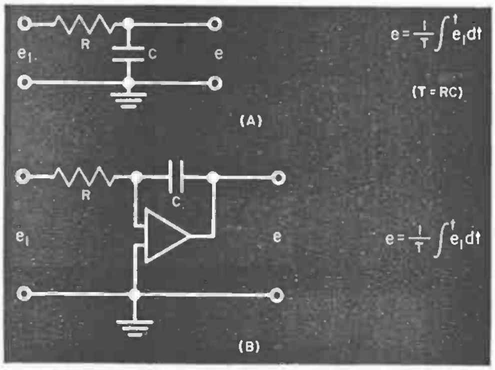
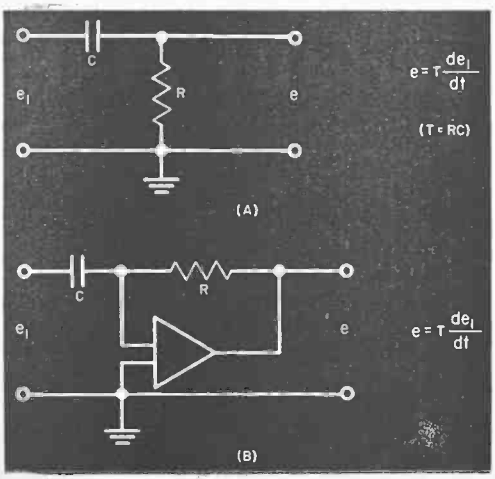


Fig. 3. In circuit (A), a capacitor stores the charge, and voltage across C is integral of charging rate. In (B), amplifier is added, to prevent removal of charge during integration.

Fig. 4. Circuit (A) will differentiate, but an amplifier is often used, as in circuit (B).



cation (the input multiplied by the gain of the amplifier), and division (multiplication with less than unity gain) can all be accomplished quite directly.

Other mathematical operations also can be done in a single stage, and this is the inherent value to the analog approach. Among the basic analog operations are integration and differentiation. Integral calculus deals, among other things, with the determination of a variable quantity when the law of its change is known.

Integration, as shown in Fig. 3(A), uses a capacitor C to store the charge received. The voltage across C is, at any instant, the integral of the charging rate. This circuit computes the time integral of the input. An amplifier is added, as in Fig. 3(B), to prevent the removal of the charge on C.

The inverse of integration is, of course, differentiation, or the determination of the rate of change of a quantity with respect to another quantity, usually time. A simple circuit, Fig. 4, will act to differentiate, but again an amplifier is often used. This amplifier has resistive feedback.

Parts of Analog Computer. A block diagram of an analog computer is shown in Fig. 5. A series of amplifiers and passive elements, such as resistors, inductors or capacitors, form an electrical system which represents (is an analog of) the problem to be solved. The computer has *control* (central signal component) for determining the operation and for introducing the input data, a *power supply,* a *display* or output (central response component and scope) which presents the final data, and the *operation* unit (component computing assemblage), the part which does the actual computing. Memory is distributed throughout the system.

An analog computer is at its best when a precision of three or four digits is sufficient, no program branches are required, and when there is one independent variable. Data which is available in analog form, such as varying voltage, can be directly fed to an analog computer.

The disadvantages of an analog computer are its lack of precision and its limited flexibility. Usually the computer has to be reconnected, by means of patch-cords, to run a different problem.

DIGITAL COMPUTERS

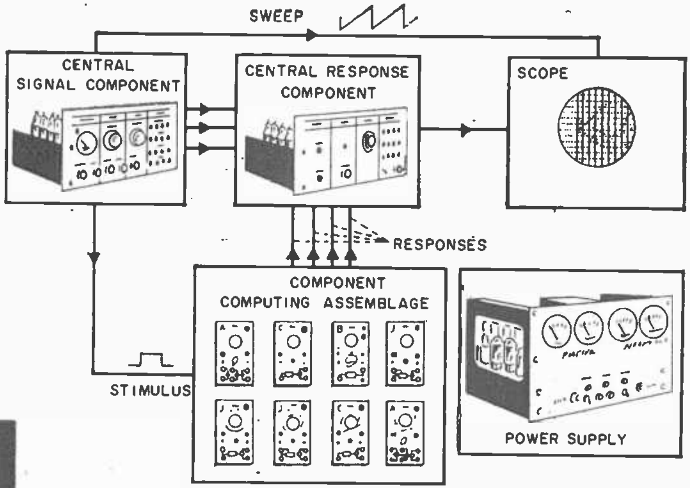
A digital computer *counts* rather than measures. Most large computers are digital in nature; they are versatile and, in structure, the electronic type has many small building blocks.

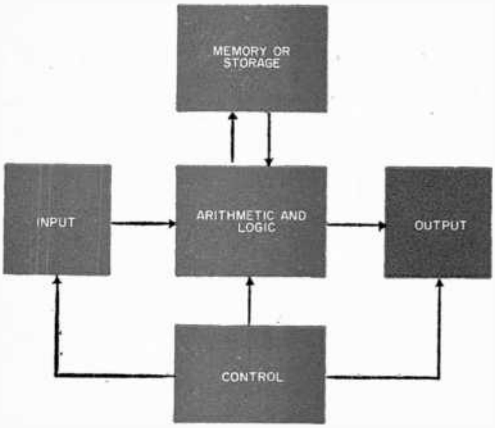
A cash register is a digital computer and so is an abacus. Because numbers are used, any required degree of precision may be ob-

Fig. 5. Major units (right) of an analog computer.

Fig. 6. Block diagram (below) of a digital computer.

Fig. 7. Diagram of a binary counter as used in a digital computer (bottom, right). See text on page 111.





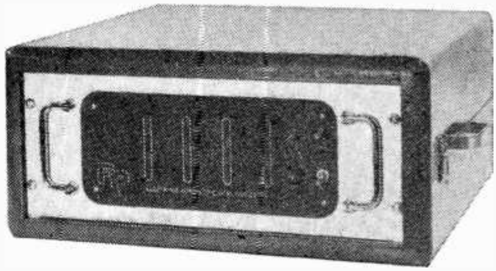
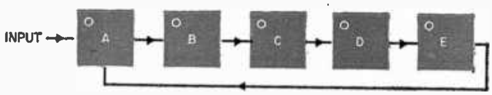


Photo at right (above) is of a Fischer & Porter analog-to-digital converter. It converts output of analog computer into data which is used by digital machine.



	A	B	C	D	E
DECIMAL	1	2	4	8	16
20	0	0	1	0	1
10	0	1	0	1	0
5	1	0	1	0	0

tained by carrying more digits. Since digits are used, the computer components (transistors, vacuum tubes) respond to *on* and *off* states like a switch which is either open or closed.

In many respects a digital computer is a kind of automatic calculating device which follows directions. Many digital computers can be represented by the block diagram in Fig. 6, and there are variations of this fundamental computer.

The basic units are: the *arithmetic and logic* section, which performs the actual arithmetic operations; the *memory* or storage which retains the program, the problem, and the results; the *control* unit which directs the computer operation; the *input* device for translating all input information to a form usable by the computer; and the *output* device which translates the computer output into a form which is most usable.

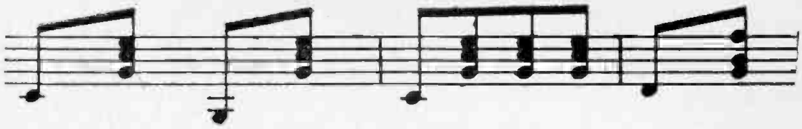
Operational Details. The *arithmetic* unit is an accumulator which can store information and, under proper control, act on this stored data which the accumulator obtains from the memory. A number from the memory can be placed in the accumulator. Upon receipt of an order such as "and," a number will be added to the number already present in the accumulator, which then contains the sum. This can be transferred to the memory or it can be retained by the accumulator for further operations.

For a "subtract" operation, the accumulator finds the difference and attaches the proper sign. To "multiply," a series of additions is made in the accumulator. To "divide," a series of subtractions is made.

The *memory* has a large number of locations or addresses, all of which can store information and retain it until needed.

(*Continued on page* 110)

ONE-Tube



By
LEON A. WORTMAN

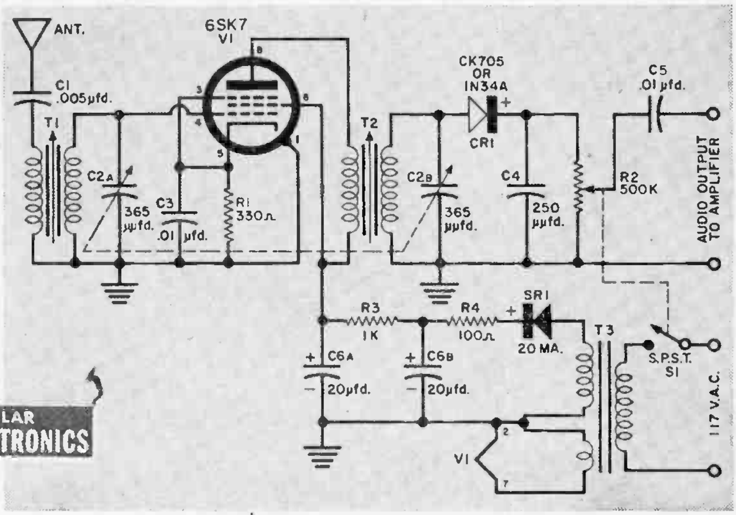
THIS UNUSUALLY COMPACT, inexpensive broadcast-band AM radio tuner is useful for the AM channel of AM/FM stereo listening.* As a solo performer, it will bring new life into AM broadcasts played through your hi-fi rig.

* Stereophonic AM/FM broadcasts are being programed in several areas throughout the country. The 1958 edition of "Hi-Fi Guide and Yearbook" (available at your newsstand or from Ziff-Davis Publishing Co., Circulation Dept., 434 S. Wabash Ave., Chicago 5, Ill., for $1) contains a section listing AM/FM stereo broadcast schedules and the hookup used to listen to them.

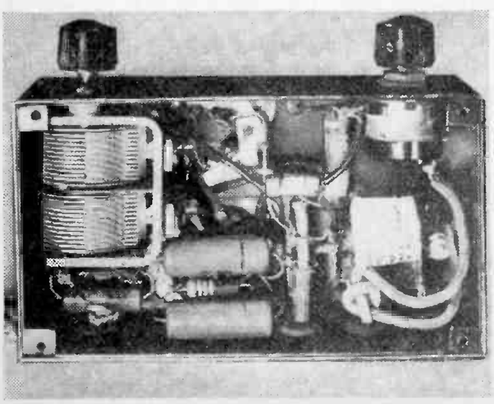
Completely self-contained, and with its own transformer-type a.c. power supply, the unit has as wide a frequency response as AM stations transmit. It introduces no distortion in its detector stage and uses so little power that you can expect operation for many years without trouble or breakdown. A stage of r.f. amplification and the two tuned stages of iron-core high-Q coils cover the whole broadcast band with sensitivity and selectivity.

The entire tuner is constructed on a 5¼" x 3" x 2⅛" chassis. Needless to say, the cost

In schematic at right, note the use of the power transformer to allow connection of the tuner to any amplifier. Underchassis view of the completed tuner is shown below.



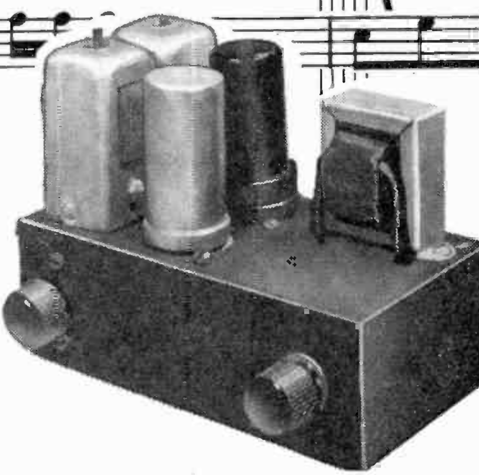
TESTED By POPULAR ELECTRONICS



PARTS LIST

C1—0.005-µfd., 600-volt capacitor
C2a/C2b—365-365 µµfd., 2-gang, TRF-type tuning capacitor
C3—0.01-µfd., 400-volt capacitor
C4—250-µµfd. mica or ceramic capacitor
C5—0.01-200-volt capacitor
C6a/C6b—20-20 µfd., 150-volt dual electrolytic capacitor
CR1—1N34A or CK705 germanium diode
R1—330-ohm, ½-watt resistor
R2—500,000-ohm potentiometer
R3—1000-ohm, 1-watt resistor
R4—100-ohm, ½-watt resistor
S1—S.p.s.t. switch (on R2)
SR1—20-ma., 130-volt selenium rectifier
T1—Antenna coil (Miller A-320-A)
T2—Detector coil (Miller A-320-RF)
T3—Power transformer, 117-volt primary, 125 volts @ 15 ma. secondary, and 6.3-volt, 0.6-amp. filament winding (Stancor PS8415)
V1—6SK7 tube

Hi-Fi AM Tuner

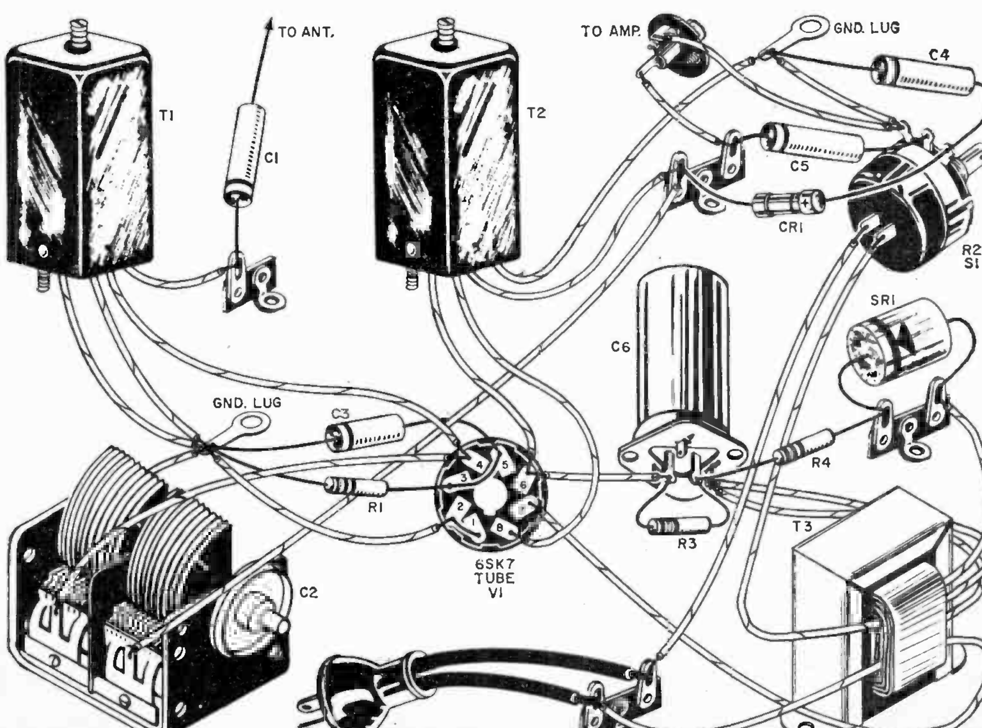


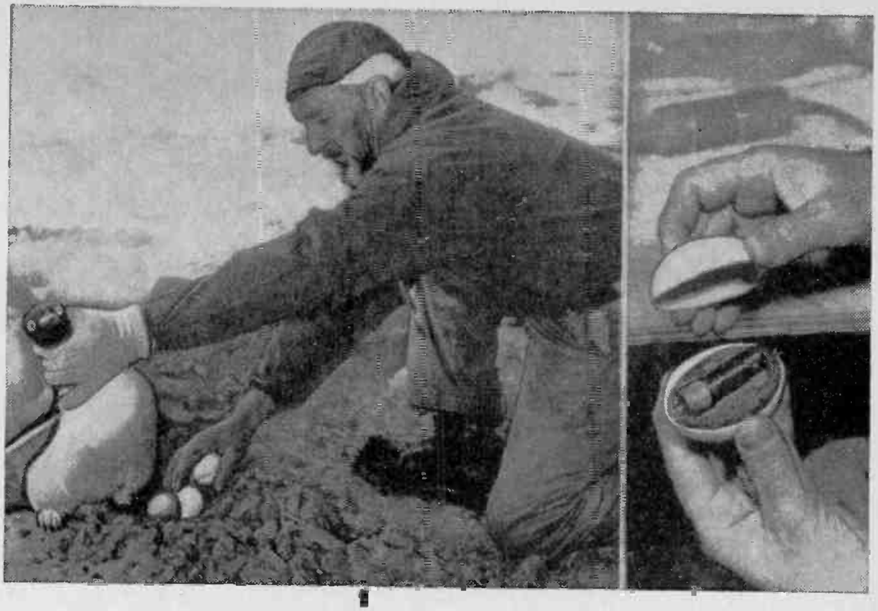
of this "one-evening project" is quite low.

An old standard, the 6SK7 tube, is used as an r.f. amplifier, and is paired with a 1N34A or CK705 as a tuned diode detector. A selenium rectifier eliminates the need for a tube in the power supply.

Antenna length is not critical—just use a long enough wire to give adequate audio signal output. A volume control with an on-off switch is shown in the photos and diagrams; this can be eliminated if the high-fidelity amplifier to which the tuner is connected already has one. —30—

The components are mounted away from the power transformer, as shown in the top view of the chassis above, to prevent possible pickup of hum. Follow the pictorial diagram below for best results in building the tuner.





RADIATING EGG!

Friend penguin above looks for all the world as if she expected to wind up in the dinner pot, but she needn't worry so. It's all in the name of science, for the bearded biologist is planting a doctored "egg" in the nest to determine how penguins hatch their eggs in frigid weather.

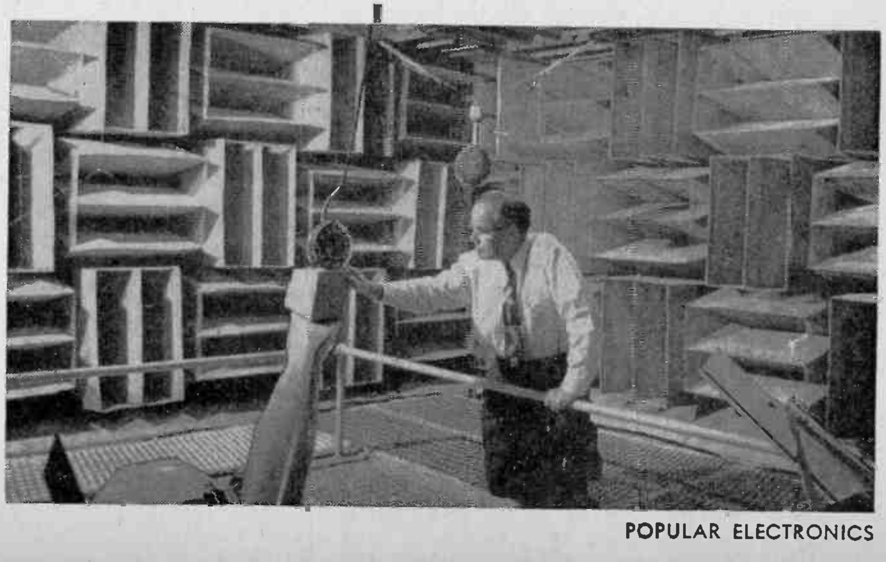
The "egg" contains telemetering equipment (as shown above, right), consisting of a tiny battery-powered transmitter which signals the temperatures within the nest during the hatching period. This experiment, sponsored by the U. S. Fish and Wildlife Service, is taking place in Antarctica.

ECHO-FREE SILENCE

Silence is not always golden. In RCA's anechoic (echo-free) chamber below, it can be maddening.

"Lock a man up in there overnight and you're apt to drive him crazy," says the head of the acoustic lab. "He'll hear sounds he's never heard before—like blood circulating in his head . . . his neck or knee joints emitting weird creaks."

It is in this echo-free chamber that RCA tests new designs and refinements of sound accessories. The walls and floor rest on hundreds of springs on rubber cushions. Fiberglas sheets over wire mesh are the sound-absorbent materials.



How to Convert Transistor Set For Car

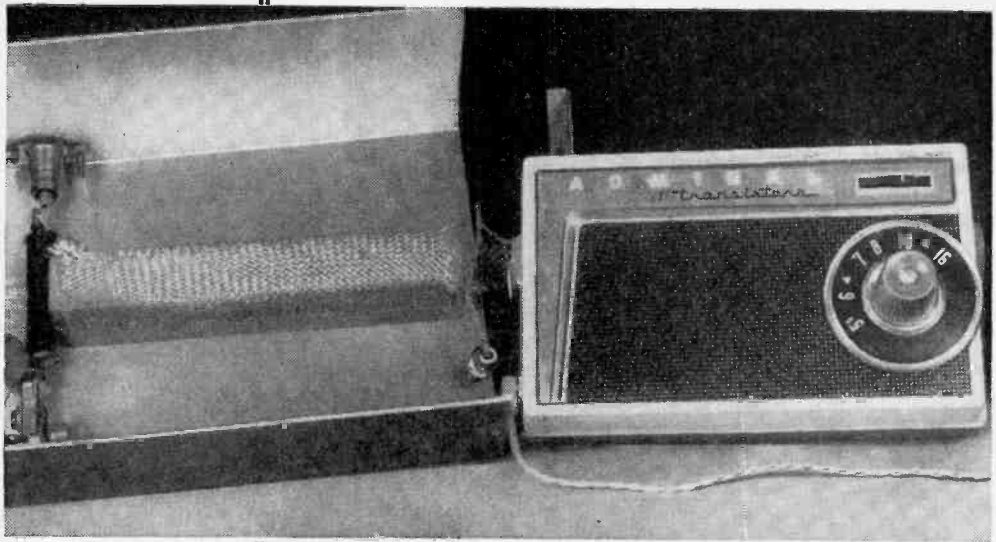
By HOMER L. DAVIDSON

Simple installation provides operation as auto radio which can be removed for regular portable use

MANY PEOPLE want to know if it is possible to purchase a portable radio and operate it in an automobile as well as take it on a picnic. It *is* possible. But the portable would have to be built in a metal case to shield it from the ignition system. And inasmuch as the metal car top and body would prevent the radio waves from reaching the built-in antenna of the set, an outside antenna must be installed.

At our service shop, one persistent questioner, a salesman, persuaded us to tackle the job of installing an Admiral seven-transistor radio in his car. He insisted that if it could bring in only one station he would be well pleased. He also wanted to be able to operate the set in a hotel room.

A small aluminum box was obtained, and holes for the dial and volume control were made to the dimensions shown in



Padded wooden blocks can be used to hold receiver securely inside metal box. On some cars, there might be enough space behind the dashboard for mounting both the set and the speaker.

Fig. 1. (For other receiver models, different layouts and hole sizes are required.) The screw that holds the dial plate to the radio was removed and a longer knob was placed on top of the regular dial with a longer screw holding the knob in place.

Pine blocks 1″-thick are fastened inside the metal box to hold the set securely in place. Felt glued over the blocks prevents the plastic cabinet from being scratched.

The antenna jack and a homemade r.f. filter coil are mounted on one side of the metal box. The filter coil consists of 50 turns of No. 24 enamel wire wound over a ¼″-thick, 1-megohm resistor. Bolted to one side of the chassis is a small padder capacitor. These components are connected as shown in Fig. 2.

A fixed capacitor is wired into place from the capacitor and coil to a small female socket, which connects the antenna connection from the transistor radio to the outside antenna. The coil and button capacitor form an r.f. filter coupling network. The padder capacitor tunes the outside antenna to the input of the radio receiver; it should be tuned for best performance when a station is being received around 1400 kc.

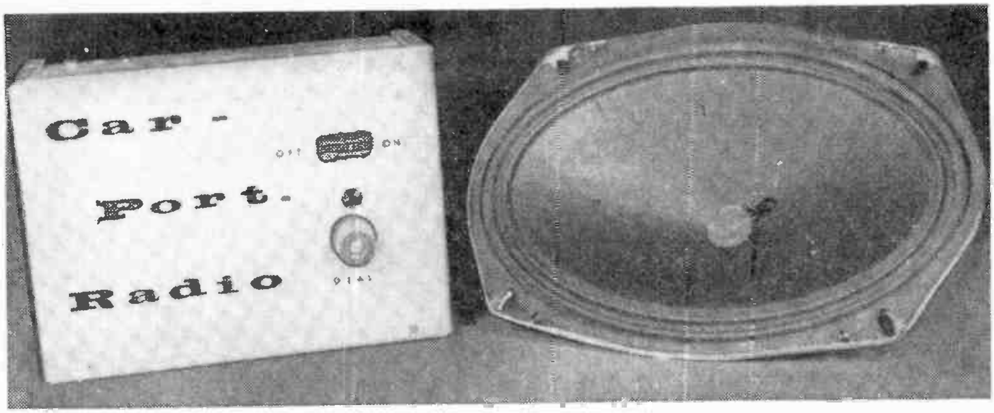
There is an output jack on the transistor radio for an earphone. The same type earphone plug can be connected to an external 6″ x 9″ loudspeaker. This is a permanent-magnet car type and it is mounted in the regular speaker grille work of the automobile dashboard.

The shielded side of the speaker cable is grounded to the car and also to the speaker frame, as shown in Fig. 3. This helps keep the auto ignition noise from entering the speaker cable and getting into the radio. If desired, small holes can be drilled in the aluminum case and the set's internal speaker used. With the larger speaker, both volume and tone are much better. On local stations the volume is surprisingly high.

After being wired up, the unit was tested on the bench before being mounted in the automobile.

Wing nuts are used so that the radio can be easily removed to serve as a separate portable. A small metal flange is bolted to the bottom of the metal box and in turn bolted to the bottom of the dash frame. The speaker is mounted into the grille and properly grounded.

When installing the outside car antenna, care must be taken to make sure that its metal washer bites into the metal of the



body. The shielded lead-in wire should be bonded to the car fender or top cowl mount. Sometimes it is best to scrape around the reamed hole so that undercoating and dirt will not make a poor connection resulting in excessive ignition noise.

This converted portable was mounted in a new car and there was no prominent motor noise. A distributor suppressor was added in case ignition noise should develop in the future. In some older cars, a distributor suppressor or generator capacitor may be needed to eliminate the unwanted noise.

Of course, this converted radio wasn't built as a commercial car radio, so it won't perform as well. But instead of getting one station for our salesman, there are at least six stations whose volume has to be turned down for pleasant reception. The author does not recommend using a portable that has less than seven transistors, however. —30—

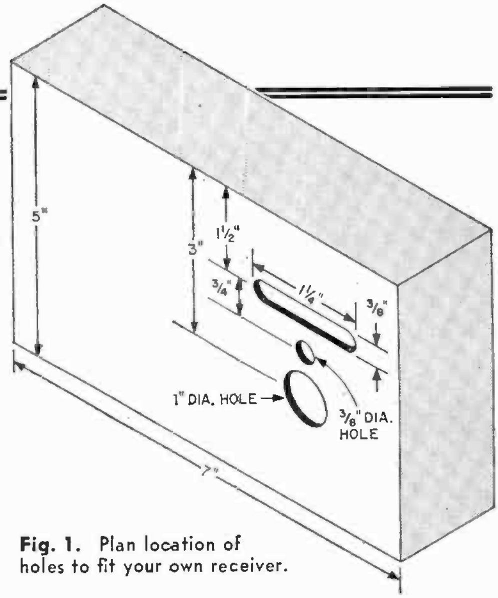


Fig. 1. Plan location of holes to fit your own receiver.

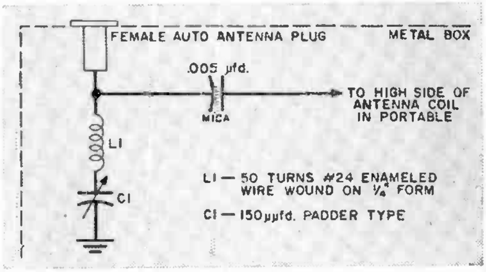


Fig. 2. Circuit for additional parts needed to feed set from conventional auto-radio antenna.

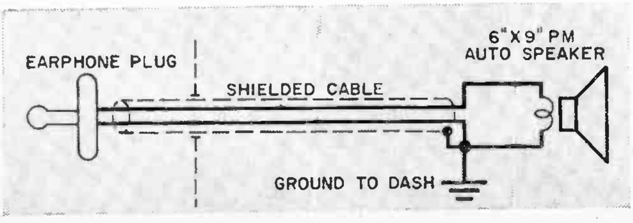


Fig. 3. Wiring of extra speaker to be permanently mounted in car. When the set is used away from the car, its built-in speaker operates.

Is Radio Earthbound?

By D. C. WILKERSON

Can Radio Waves conquer interstellar space and travel from planet to planet? That is the question the scientists hope to answer with Prof. Goddard's proposed Moon Rocket, which will contain a radio transmitter.

HOW IT LOOKED IN 1925

This article was originally published in RADIO NEWS, our sister publication, in March, 1925. It shows that even 33 years ago realistic individuals were thinking ahead on the subject of radio transmission. It is rather amazing that author Wilkerson predicted the future so well, as evidenced by the fact that we are receiving transmissions from space today. Note the similarity of the rocket conceived by Dr. Goddard back in 1925 (shown on page 52) to a modern rocket, the "Thor" (shown here).

—THE EDITORS

DURING the last year, more than any other year in history, men have been given the results of scientific radio achievements which stimulate the imagination, as a spur to lagging engineering and technical development.

We have experienced the near approach of Mars, the flurry of mysterious radio impulses apparently connected with the fiery planet in some way, but the findings of this investigation have not been thoroughly tabulated from all quarters.

Professor C. Francis Jenkins, the television and telephotographic expert, made signal graphs of the electrical disturbances for the whole time of Mars' approach period, and there are other results yet to be centralized for study from all over the world.

From scientific research and countless years of grinding labor, the human race has been able to grasp the immensity of the eternal universe to which the earth is an insignificant part. The average "man in the street" now knows that we on earth are flying at tremendous speed through the heavens, linked to the sun and the other planets, our solar system being in turn linked in some way to the greater system of tremendous stars.

Astronomers have yearned for centuries to bridge the gap beyond our own infinitesimal plane, and determine whether or not nature has peopled other worlds with living, thinking beings like ourselves. The physical limitations of space and the force of gravity chain us to the earth, but the eye, aided by giant telescopes, has pierced the heavens and found there much food for reflection.

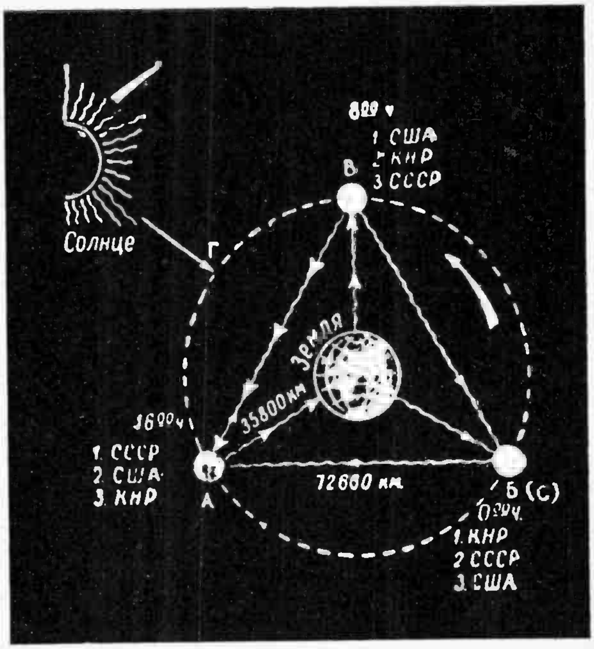
Even with the tremendous magnifying power of the mightiest of modern telescopes, we cannot discern on any other ce-

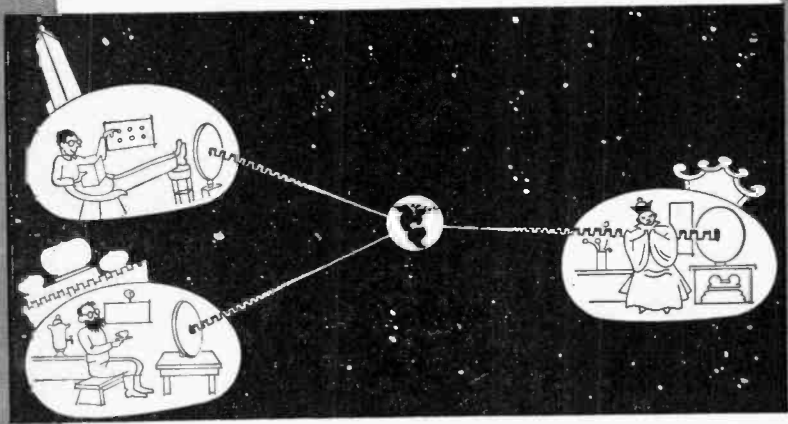
(Continued on page 52)

Whether or not radio waves are earthbound will be determined through the Moon-Rocket experiment.

Russian Proposes GLOBAL TV

THE RATHER LIMITED conception of radio transmission we had back in 1925, when we wondered whether radio waves could be propagated through space (see opposite page), has progressed to a stage where today we are near the point of transmitting television through space. With the launching of the first Sputnik last October, the dream of global TV received a tremendous shot in the arm and it has gathered momentum with each additional satellite thrown into the sky—both Russian and American.





How three satellites would bounce TV signals to each other and to ground stations is shown in diagram above, taken from Russian magazine "Radio." CWA is U.S., KHP is China, and CCCP is USSR. "A" would transmit Russian signals, "B" American signals, "C" Chinese signals. At left: how a U. S. cartoonist sees it.

The magazine which first published data on Sputnik I, the Soviet periodical *Radio,* has outlined a plan which would allow nearly every TV set anywhere on earth to pick up a program transmitted from any other point. Television today, of course, is pretty much limited by line of sight, except in those areas which have coaxial cables, and a few spots which are equipped with over-the-horizon scatter facilities. The system proposed by engineer V. Petrov would make use of satellites which would pick up signals from stations on earth and bounce them to other satellites for more distant relay.

"STATIONARY" SATELLITES

If a satellite is launched from the equator so that it follows an eastward track at the proper speed and height, it will remain over one spot on

(*Continued on page* 53)

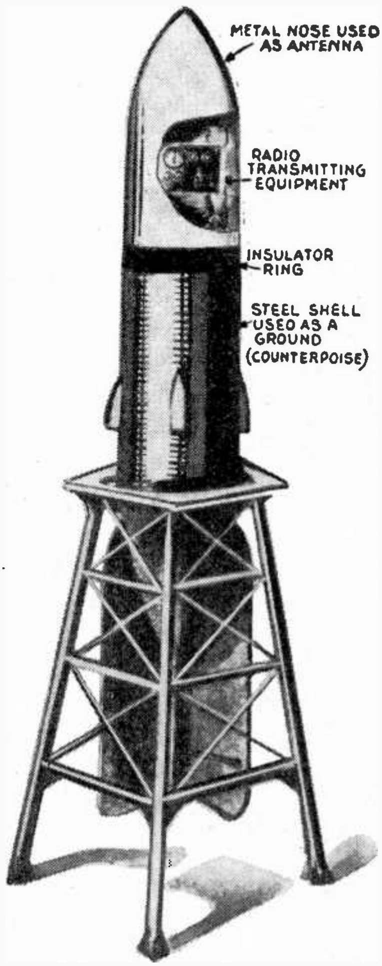
Is Radio Earthbound?

(*Continued from page* 50)

lestial body traces of life. The face of the moon, the nearest object in point of miles to our earth, discloses no vestige of animal or vegetable life. The greenish haze noted on the surface of Mars has not been satisfactorily observed generally.

HEAVISIDE'S RADIO WAVE THEORY

The sudden growth of radio has placed in our grasp a new force of most portentous possibilities. It is practically instantaneous. Its wave moves with the speed of light. A modern English physicist, Dr. Heaviside, has propounded the theory that radio waves are earthbound, being guided by the electrical properties of the surrounding gases.



Proposed design of the Moon Rocket. A radio transmitter, in the nose, will send out waves continually on its course.

This theory enjoys great vogue among men of high authority. More adventurous minds have hoped that by means of the radio wave we might communicate with other living beings on other planets. What a masterful conception to stimulate the hopes of man! To reach out beyond our own little sphere and find other civilizations will do more to advance human thought and development than all the works of religious founders for all time.

Communication from airplanes and airships between each other and with radio ground stations has given support to the thought that possibly the radio wave is not fettered to earth, and that it might penetrate to interstellar space.

Electromagnetic disturbances caused by mighty eruptions shown in spots on the face of the sun have been noted on the earth and records made from them in radio stations. If such disturbances can project a radio wave from the sun to the earth, then is it not proved that these impulses can carry on through space?

To obtain exact proof of this perplexing question has been a problem impossible of solution, since we had no way to set up radio waves beyond the earth's zone of influence, until Professor Goddard first brought out his projected Moon-Rocket.

THE MOON-ROCKET

The Moon-Rocket has been discussed in these columns before, and a lengthy discourse about it would be out of place here. Simply, the plan is to build a giant rocket which shall move through space by the ejection-reaction principle. It will carry a series of explosive charges sufficiently powerful to drive the body of the rocket beyond the gravitational pull of the earth, the successive charges to drive the rocket to the moon. As the mighty projectile progresses through the heavens, it will be watched by thousands of astronomers who will check on its flight, speed and the place where it lands on the moon. This latter item, of course, depends upon the accuracy of calculations made for the proper time, place and direction of initial flight.

TO INCLUDE RADIO TRANSMITTER

It is now proposed to include in the mechanism of the rocket a small but powerful radio transmitter which shall be set in operation at the moment the rocket is released. Coincident with the verifying of the flight of the rocket by astronomers, the vast army of radio listeners will stand by their receiving sets with watches in hand noting the strength of signals as long as they shall continue.

(*Continued on page* 109)

Russian Proposes Global TV

(*Continued from page* 51)

the equator. In other words, if it went into orbit over Belem in Brazil, or Stanleyville in the Belgian Congo, or Singapore in Malaya, it would remain fixed in the sky over that spot. This is because—if the velocity and height are correct—the speed of the satellite will exactly match the eastward rotation of the earth. It will be making an orbit of the earth once in 24 hours (compared to the 90 to 106 minutes or so for the present satellites. Since the earth rotates on its axis once in 24 hours, there will be no relative motion between the two spheres.

According to Mr. Petrov's article, the satellite would have to be orbited at a height of about 22,000 miles above the earth, launched at a speed of about 27,500 miles per hour. However, there is apparently some discrepancy in the latter figure, perhaps due to a typographical error in the magazine *Radio,* since at that speed a rocket would shoot out into space ("escape velocity," the speed at which a body will free itself from the pull of gravity, is slightly over 25,000 miles per hour). The speed estimated as needed to reach such an altitude to maintain a 24-hour orbit is somewhat under 25,000 miles per hour.

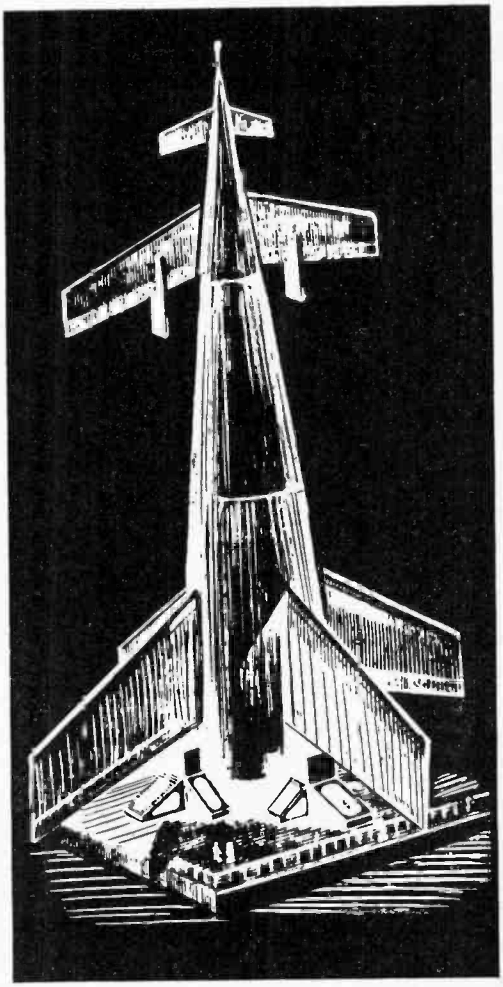
Mr. Petrov points out that due to the unequal distribution of the earth's mass near the equator, "the plane of the satellite orbit will slowly shift around the earth's axis with an angular velocity of 20 seconds an hour." In addition, there might be some deviation caused by the pull of the moon and sun. This is not considered a drawback, since the system would require three satellites set in orbit a fixed distance from each other. All three would be subject to the shift, so would remain in the same relative position.

SPACE RELAY OPERATION

"Let us imagine," writes Mr. Petrov, "that three artificial earth satellites are launched from one place situated on the equator. To accomplish the object of a global relay of TV broadcasts, the satellites must be launched with an interval of just eight hours apart. In addition, all three satellites placed in a 35,800-km. distant orbit must be spaced 120° from each other and will then be 72,660 km. (45,121 miles) apart in space. In this case, all three satellites will be motionless with respect to each other and the earth, since their angular velocities are identical and equal to the earth's angular velocity.

"Thus, each of the three satellites will be over one and the same terrestrial TV center (with a shift of 0.3 minute of arc per hour). At the same time all three satellites will, in relation to world space, be moving with a global velocity of 3076 km. hour or 1810 miles per hour." [It is believed in the U. S. that a more accurate figure would be about 6000 miles per hour.]

"Bearing in mind the annual rotation of the earth with its moon around the sun and the equatorial position of the earth's artificial satellites, each of them can con-



Three-stage monster rocket proposed by Mr. Petrov to hurl the TV satellites into their orbits around the equator.

duct reception of TV programs from the earth through the western satellite and transmit this program simultaneously to their central TV stations on earth. It must be borne in mind besides that the direction of radiation from the sun should never co-

(*Continued on page* 108)

By R. L. WINKLEPLECK

Wipe Out RECORD SCRATCH

Get new life from old records by subduing scratch frequencies

HERE'S a suggestion that will make the hi-fi*natics* scream with rage, but it's the answer to a problem in many homes—especially those with children.

Is your collection of records somewhat aged, somewhat dirty, and somewhat mishandled? Does the family phonograph give out with more scratches and scrapes than music? If so, you can solve your problem without throwing everything away and starting over. All you need is a simple scratch filter—a gadget which simply subdues the scratch frequencies.

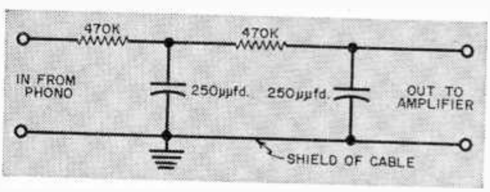
Designed to operate with a crystal pickup, this gadget is technically a tandem, low-pass *RC* network. The audio voltage "fights" its way through the first resistor and appears across the first capacitor. It then repeats the process in the next section with the voltage remaining across the last capacitor going on to be amplified and fed to the loudspeaker.

The low frequencies "change" slowly enough so that they appear across the two capacitors in turn, little diminished in amplitude. High frequencies (which include that dreadful scratching sound) "change" so fast that there's never much time for any significant amount to "fight" its way through a resistor and charge a capacitor before it changes potential and has to start all over again. As a result, the high scratch frequencies are greatly reduced in volume and are virtually unnoticeable.

As usual, there's a disadvantage, as suggested in the opening sentence. This filter can't distinguish between the scratch and music in the same frequency range. Thus, it cuts down (attenuates) the treble notes. Unless you have a music system approaching high fidelity, the effect is not too serious; and if you do, you probably take good care of your records and don't need a filter.

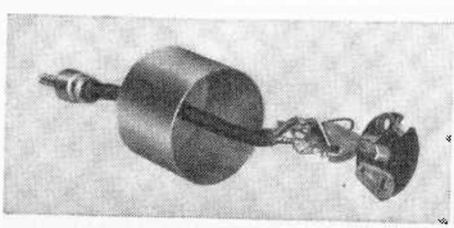
The complete filter network can be built into an old 35-mm. film can, as shown in the photographs, using a phono jack and plug with a short length of shielded cable. The can should be connected to the grounded side of the line. Put a soldering lug under one of the jack mounting bolts and solder the lug to the shield.

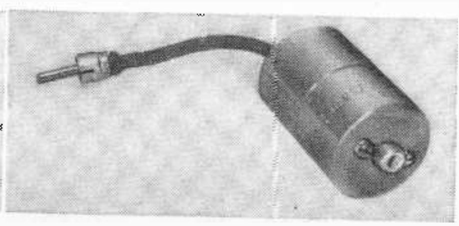
Plug the cable in-
(*Cont. on p.* 115)



The circuit (at left) consists of a tandem, low-pass RC network.

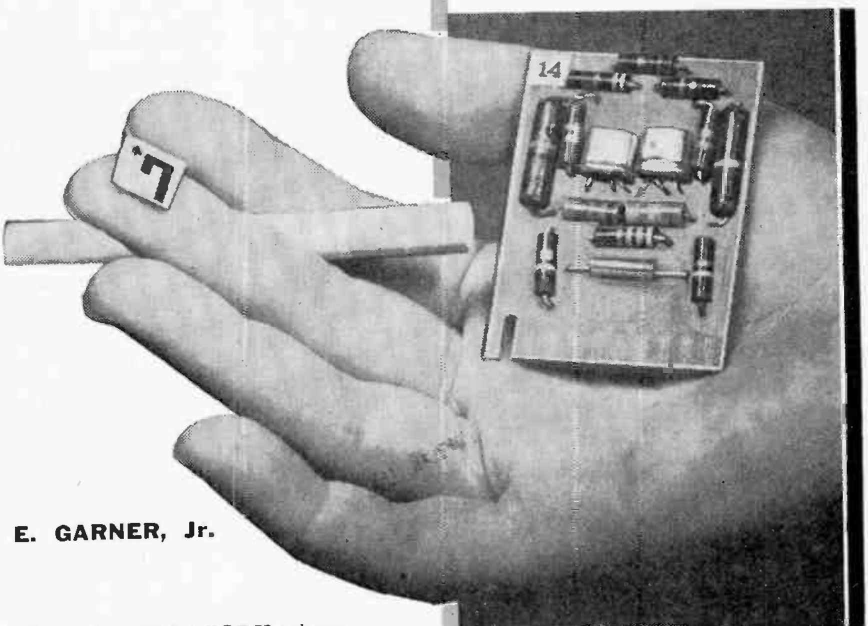
Filter assembly (below) is installed in film can (below, right).





New techniques make possible circuits so small that you can hold . . .

A RADIO ON YOUR THUMBNAIL



By LOUIS E. GARNER, Jr.

Note difference in size between the conventional flip-flop transistor circuit in palm of hand above and the new DOFL microminiature circuit on the end of the third finger.

WORKING IN A LABORATORY where one motto reads "If you can see it, it's too big," government scientists have developed an entirely new technique for manufacturing transistors. Using photolithographic methods, they have produced transistors so small that they can be fitted on the *head of a pin*. Research scientists Dr. J. W. Lathrop and James R. Nall at the Army's Diamond Ordnance Fuze Laboratory (DOFL) in Washington, D. C., are the individuals largely responsible.

For example, a standard flip-flop or binary counter circuit will require, say, two transistors, two diodes, and various resistors and capacitors. If subminiature construction techniques are used, such a circuit can be packed into a space of about one cubic inch. With the new microminiaturization techniques, and using photolithographic transistors, *two hundred such circuits* could be fitted into the same space!

And this is only the beginning! These scientists feel that further refinements may make it possible to reduce electronic circuitry to the point where *one thousand printed circuits* can be fitted into a volume of one cubic inch. Then it should become possible to assemble a complete electronic computer in a space the size of a small book. And you may be able to balance a complete radio on your thumbnail. If work on the development of a semiconductor picture-reproducing device is successful, we may also see the day when a television receiver can be assembled in a case the size of a wristwatch.

Transistor Construction. The photolithographic method for manufacturing transistors developed at DOFL begins with a tiny wafer of *p*-type germanium measuring only forty-five thousandths of an inch square by one one-hundredth of an inch thick. Arsenic is diffused into the germanium, giving the wafer an *n*-type "skin." The *p*-type material will become the collector of the final transistor, while the *n*-type skin will be the base.

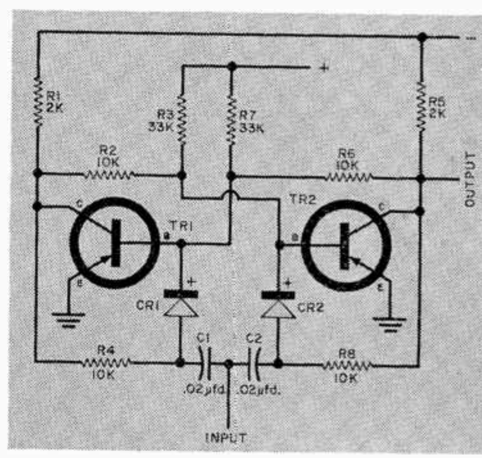
A photosensitive chemical resist is placed on the germanium's surface and exposed to ultraviolet light through a prepared film having a small rectangular pattern. Then the resist is developed, leaving a tiny rectangular area of bare germanium corresponding to the pattern of the photographic film.

Next, aluminum is evaporated and deposited over the layer of resist. When the underlying resist is stripped away chemically, the deposited aluminum remains only on the bare rectangular area. The aluminum forms the transistor's emitter and is alloyed to the germanium by heating.

A similar base contact pattern is formed next to the aluminum emitter, consisting of gold and a small amount of antimony. These are electrolytically deposited on the germanium's surface and heated to cause alloying.

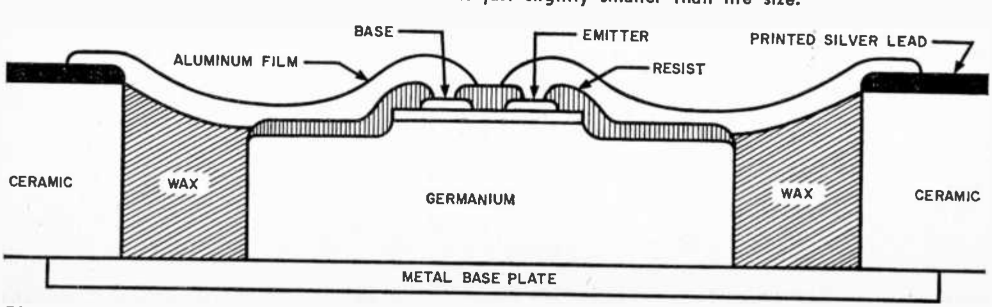
The outer *n*-type skin is now etched away except in the immediate vicinity of the base and emitter contacts, forming the final base-emitter junction. Then the finished transistor is covered with a coat of resist except in the areas directly over the base and emitter contacts and along the *p*-type germanium's lower or bottom surface. This surface is soldered to a thin metal base plate.

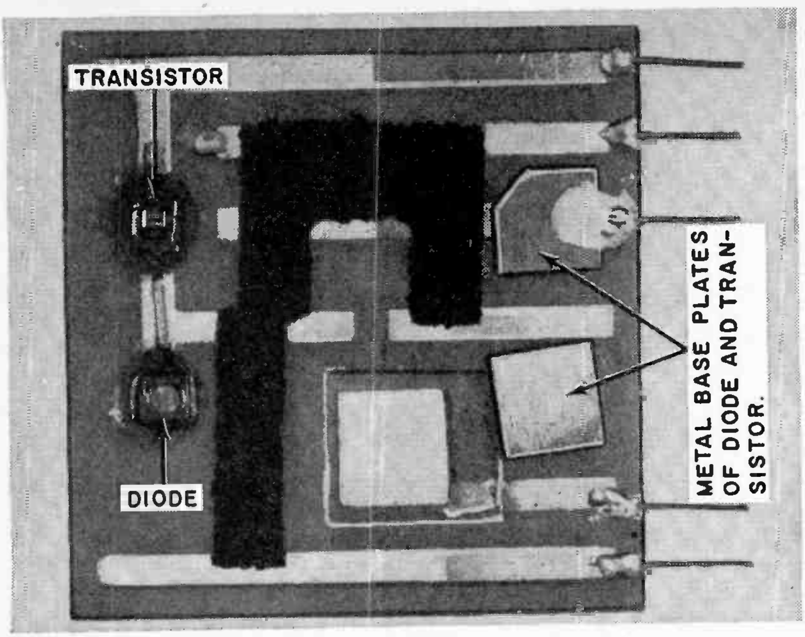
Final Assembly. The circuit is prepared on a separate ceramic board. Wiring is a deposited pattern of silver, while the resistors are made up of various ink compositions. Semiconductor diodes as well as transistors can be manufactured using the basic photolithographic method; they also are mounted on small metal base plates.



Schematic diagram of the microminiature flip-flop circuit shown on page 55. The entire circuit, including transistors and diodes, is reproduced using printed-circuit techniques.

Cross-section view showing the construction of the photolithographic transistor. The actual size of this component can be determined by studying the photo on page 57. Note the size of the transistor in the photo compared with the size of the entire circuit; then turn to the preceding page to see the actual size of the circuit on the finger. The hand illustrated is just slightly smaller than life size.





Greatly enlarged photo of thumbnail-size flip-flop circuit. The actual size is indicated on the first page of this article. As can be seen from the schematic diagram on the opposite page, the circuit is made up of two transistors, two diodes, eight resistors and two capacitors.

The transistors and diodes are put into small holes in the printed-circuit board. A mask is applied to the board and aluminum leads are deposited by a vacuum evaporation process, connecting the printed silver wiring on the board with the base and emitter contacts of the transistor. The metal base plate serves as the collector electrode connection.

These transistors have a power rating in the milliwatt range and an alpha cutoff of approximately 15 mc. However, there seems to be no reason why more powerful transistors can't be made using modified versions of the basic technique, and it is possible that transistors of this type may be manufactured with ratings up to one watt in the future. Also, it seems likely that units with an alpha cutoff as high as 100 mc., or higher, can be made.

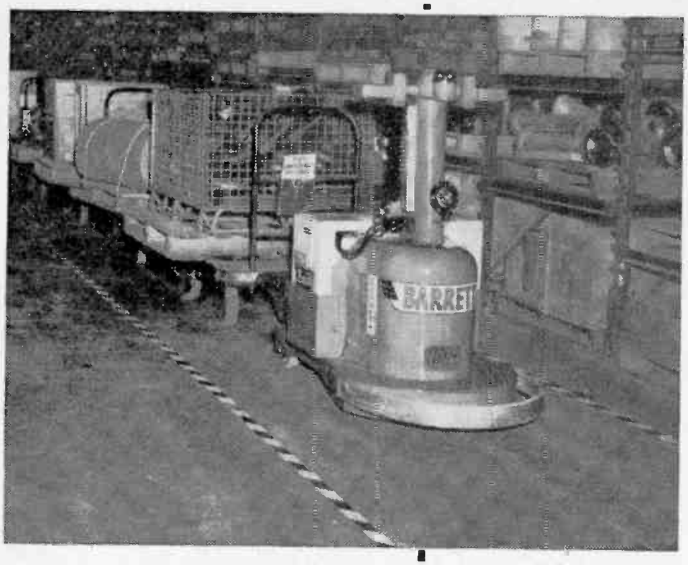
Circuits assembled using microminiaturization techniques are much more resistant to shock and vibration than are conventional circuits. A typical circuit may have the ability to withstand a shock on the order of 10,000 *g*, that is, an acceleration 10,000 times greater than that caused by earth's gravity.

Shown in the schematic diagram is a flip-flop circuit that has been assembled using microminiature techniques. This entire circuit, including two transistors, two diodes, eight resistors, and two capacitors, has been reproduced on a ceramic board *smaller than a postage stamp.* Diffused base diodes *CR1* and *CR2* have characteristics roughly comparable to those of the 1N90, while the photolithographic diffused base transistors *TR1* and *TR2* have characteristics roughly similar to those of a conventional type 2N207 transistor. Such flip-flop circuits are used extensively in the construction of computers and data-processing equipment.

Looking to the Future. To date, relatively little work has been done on reproducing inductance coils and transformers with microminiature printed-circuit techniques. As a result, a microminiaturized radio cannot be built at present. However, research and development is proceeding, and there is little doubt that techniques permitting the design and construction of microminiature receivers and transmitters will be developed soon.

The techniques discussed above are still in the laboratory stage. But just as the transistor, at first a laboratory curiosity, is used extensively today in receivers, amplifiers, hearing aids, clocks, and other consumer products, so will the DOFL-developed microminiaturization techniques find use in commercial products. —30—

"NO-HANDS" TRAIN



You don't need an engineer on this tractor-train, because the system at Esso's Baton Rouge refinery is electronically controlled. The train, which pulls five trailers at 2¾ miles at hour, follows the electromagnetic field of a wire laid in the floor.

Two gates in the building open automatically as the train approaches and shut when it passes. It makes 11 stops at service points called "beacons." Each "beacon" sends out a different signal to stop the train at the proper place.

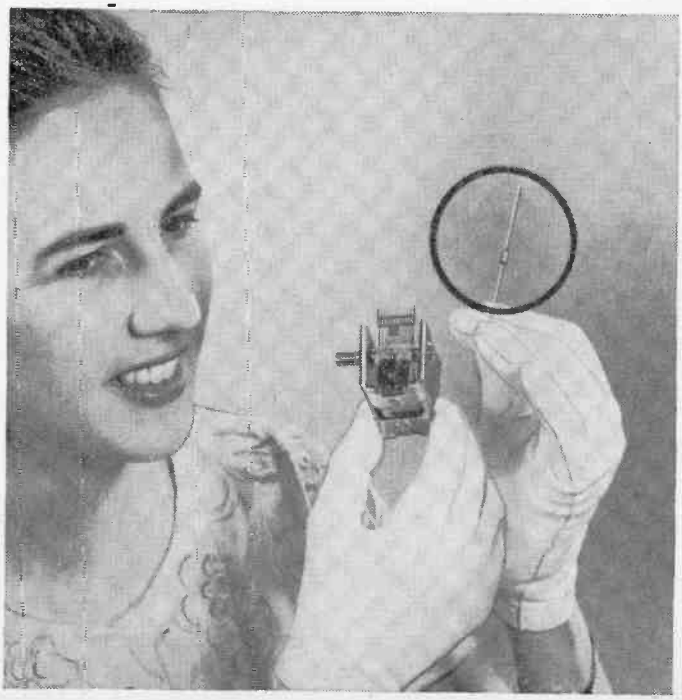
Known as "Guide-O-Matic," the train is made by the Barrett-Cravens Co., Northbrook, Ill.

THE "VARICAP"

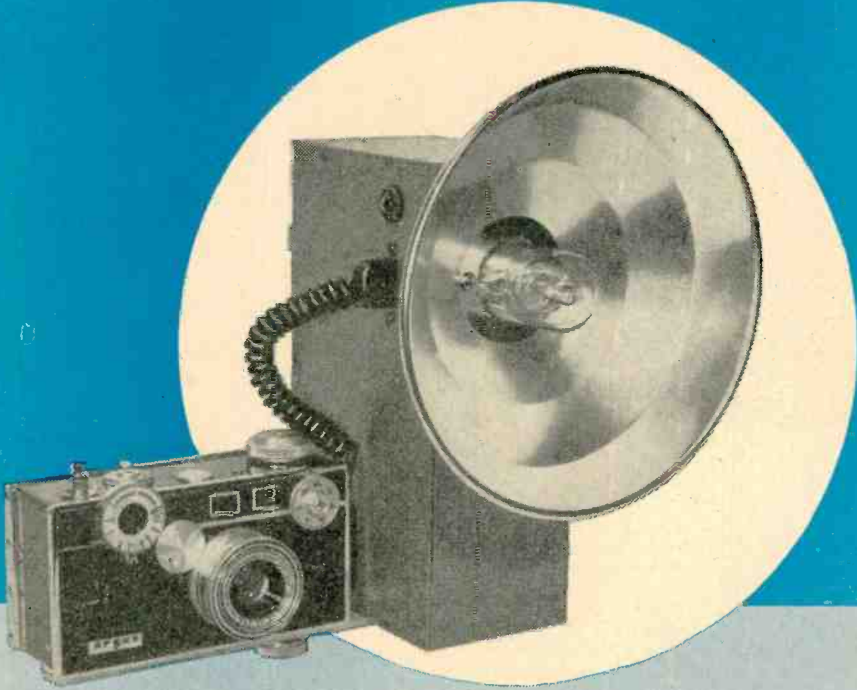
A tiny component, no larger than a teardrop, can do a job similar to that of one tuning capacitor used in AM and FM receivers. (Note the difference in size at right.)

In one application, the "Varicap," as it is called, together with a resistor and mica capacitor, performed the same function as 24 other parts. It is expected to have wide use in tuning and modulation of frequencies in FM receivers and transmitters, telemetering, missile control, and miniaturized communications systems.

The Varicap was introduced recently by Pacific Semiconductors, Inc., of Los Angeles, Calif.



Transistorized Photoflash



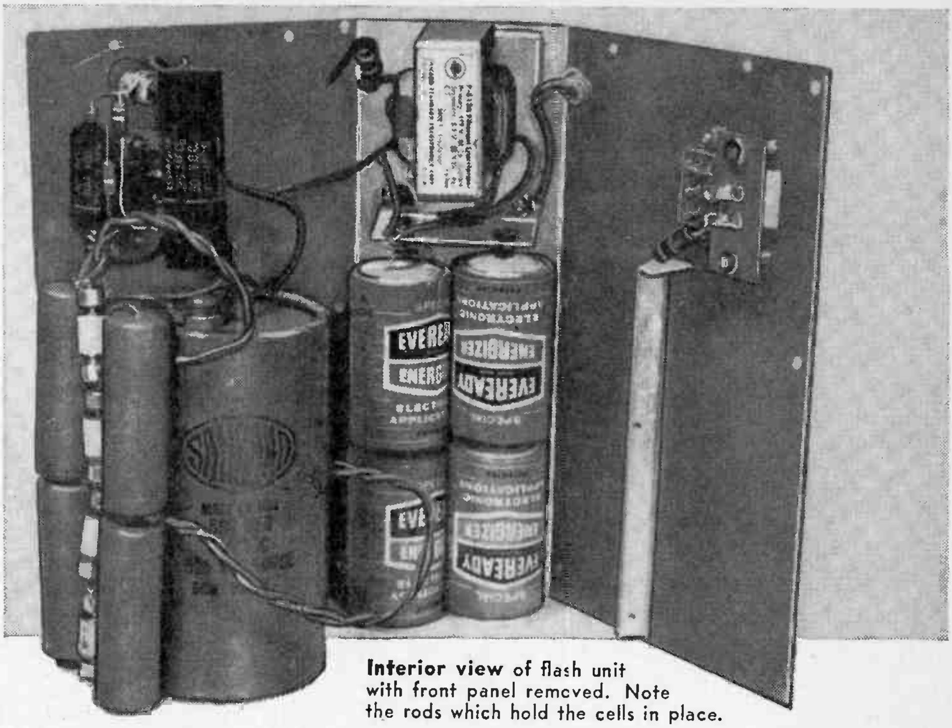
High-efficiency flash unit features power transistors

By R. L. WINKLEPLECK

ELECTRONIC PHOTOFLASH, or speed light as it is sometimes called, is surrounded by so much mystery, hocus-pocus and hocum that many photographers shy away from it without fully appreciating its advantages. Actually, electronic flash is quite simple. There are many variations but, basically, it consists of a power supply providing electrical energy which is stored in one or more large capacitors. A triggering circuit activated by the camera discharges the capacitors through a gas-filled flash tube.

Amount of effective light produced is affected by such factors as the amount of electrical energy consumed, reflector design and efficiency of the circuit and components, including the flash tube. Because the stored supply of electrical energy is about the only factor which can be simply stated and clearly understood, the "watt-second" ratings have been over-emphasized as a yardstick for measuring electronic flash performance. The watt-second rating shows only the amount of electrical energy held in storage. It indicates neither performance nor light output, since these considerations are also profoundly affected by a number of other factors apart from the efficiency of the circuit. Other points to be considered are the size and weight of the outfit, the frequency with which it can be flashed, whether it operates from batteries or an external power source, and whether it's a single unit or two separate units with the power supply carried by a shoulder strap and the flash head mounted on the camera.

No matter if we're building or buying, we can't usually have everything exactly



Interior view of flash unit with front panel removed. Note the rods which hold the cells in place.

as we'd like it. The electronic photoflash outfit described here is a good and comparatively inexpensive compromise. It operates from either house current or from four inexpensive size D flashlight cells, so battery cost is trifling. It's a single unit, easy to build, rugged and dependable in operation. The photoflash tube is mounted in neoprene under a glass dome to protect it from injury.

Construction. To design in all of these features, it was necessary to accept a bit more size and weight than is considered ideal—2¾" x 4½" x 7¾", and 4½ pounds with batteries. The housing can be constructed of .064" aluminum sheet with heavier gauge (.125") in the base plate to which the mounting bracket is attached. It is assembled by using self-tapping sheet metal screws to hold aluminum rods or angles as cleats.

Components are mounted on each of the side panels and prewired before assembly of the cabinet. Power transformer, transistors (mounted externally) and resistors of the oscillator, and the battery terminals are on the back panel. The batteries are a snug fit between the back panel and the main storage capacitor.

A removable section in the bottom of the case offers access to the batteries. The lower battery contact, an aluminum strip, is glued to a strip of plastic to insulate it from the case and this is glued to the inside surface of the battery access door plate.

PARTS LIST

B1—Four 1.5-volt standard size "D" dry cells
C1, C2, C3, C4—1.0-µfd., 400-volt tubular capacitor
C5—500-µfd., 450-volt electrolytic capacitor (Sangamo DCM or equivalent)
C6—0.05-µfd., 200-volt tubular capacitor
C7—0.25-µfd., 400-volt tubular capacitor
FT1—Flash tube and reflector combination (Amglo HD-2AR; available from Amglo Corp., 2037 W. Division St., Chicago, Ill.)
J1—TV-type a.c. input receptacle
J2—Rectangular a.c. outlet (for camera sync connection)
NE1—NE-51 neon lamp
R1, R2—68-ohm, 1-watt resistor
R3—27-ohm, 1-watt resistor
R4—1.5-megohm, ½-watt resistor
R5, R6—3.3-megohm, ½-watt resistor
S1—S.p.d.t. slide switch
SR1, SR2, SR3, SR4—Silicon rectifier (Sarkes Tarzian M150)
T1—Modified 6.3-volt filament transformer (Stancor P6134—see text)
T2—Ignition coil (Amglo ST-25)
TR1, TR2—2N256 power transistor (CBS)

The transistors must be mounted on 3/16" composition with the mounting screws insulated from the case with composition shoulder washers. A rather thick plastic should be used between transistors and case since with thinner material an electrostatic voltage may develop in the case.

No part of the circuit is electrically connected to the case since most camera flash synchronization contacts have one side grounded to the camera body. By keeping the case isolated, there is no need for a polarized flash cord connection.

Wiring. The left panel of the case has mounted on it the s.p.d.t. switch (*S1*) and a recessed TV-type a.c. connection (*J1*). An ordinary TV cheater cord is used when the flash is operated on house current and the switch is wired so that the a.c. input is in the circuit only when the batteries are off.

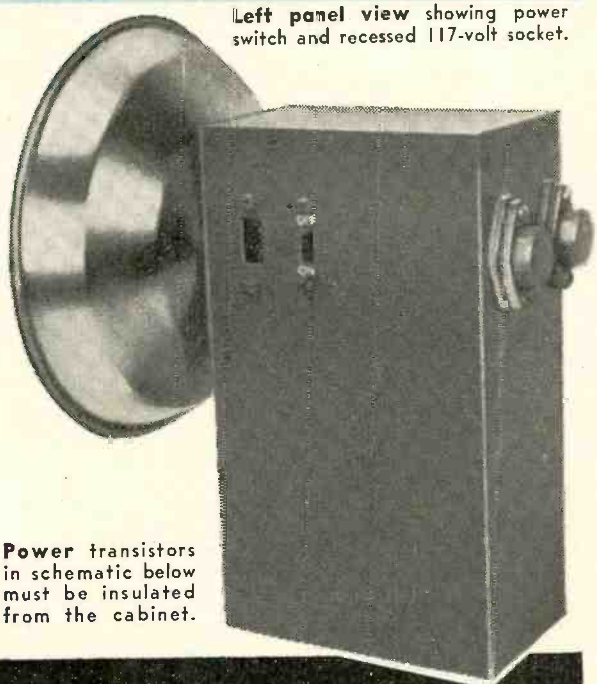
On the right-hand panel is an ordinary a.c. outlet (*J2*) into which the flash cord from the camera is plugged, the neon charge-indicating lamp (*NE1*) mounted in a ⅝" rubber grommet, and a 4-point tie strip. Tape the tiny trigger transformer (*T2*) to the tie strip. All of the components shown in the schematic between the storage capacitor (*C5*) and the flash tube (*FT1*) can be mounted on this panel and wired before it is attached to the case.

The flash tube and its reflector are mounted on the front panel, using the two bolts provided. Note that the red lead goes to the positive terminal of *C5*, the black lead to negative, and the white lead to *T2*. This leaves only the four silicon rectifiers and the four capacitors (*C1, C2, C3* and *C4*) of the voltage quadrupler. They also are prewired, using a physical layout which corresponds with the placement shown in the schematic. Considerable space is saved by using pigtails on the rectifiers instead of mountings clips.

The quadrupler is wrapped in plastic and the unit placed against the front panel when the case is assembled. It's held in place with the storage capacitor which is kept in position with two shaped aluminum rods fastened to the side panels.

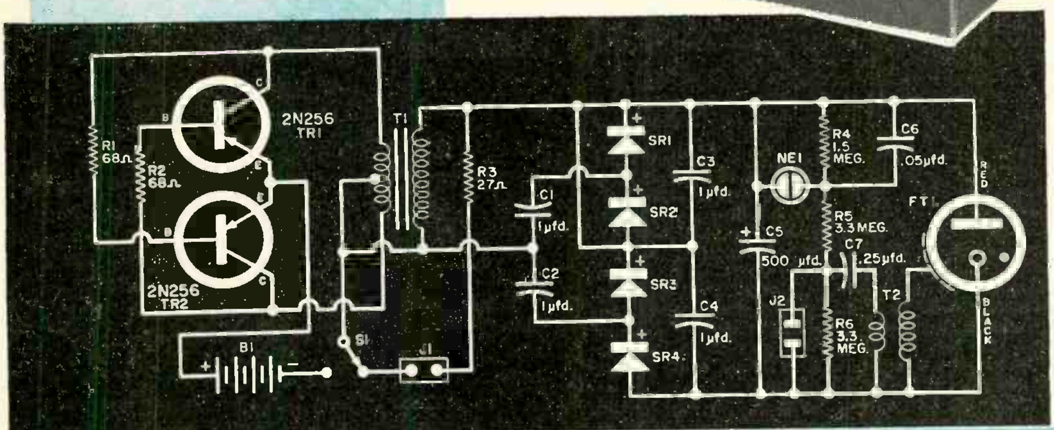
Assemble the front, rear and right side panels of the case, put the voltage quadrupler and storage capacitor in position, and complete most of the interconnecting wiring. Fasten the left panel in place and wire the switch and a.c. input from above. The top and bottom of the case are then fastened in place to complete the assembly.

A ¼" tapped hole in the heavy bottom plate is used to attach the camera mounting bracket. The battery access panel is held in place with one screw. Mark the



Left panel view showing power switch and recessed 117-volt socket.

Power transistors in schematic below must be insulated from the cabinet.



HOW IT WORKS

The four D cells operate a 120-cycle, square-wave, transistor oscillator using a pair of the new, low-priced power transistors. This method of producing a.c. or interrupted d.c. is several times more efficient than the use of a vibrator.

This a.c. voltage from the oscillator is fed into the modified low-voltage winding of a filament transformer and is boosted to approximately a.c. line voltage. (At this point line voltage is applied when the unit is powered from the line.) A voltage quadrupler using silicon rectifiers boosts the 120 volts up to about 500 volts, which is then supplied to the special storage capacitor (*C5*).

The flash tube is connected directly to *C5* but it will not fire spontaneously. The "trigger" circuit which fires the flash tube consists of three resistors *R4*, *R5*, *R6*, in a voltage-divider network. Resistor *R4*, shunted by capacitor *C6*, operates neon lamp *NE1* as a relaxation oscillator when the charge on *C5* reaches approximately 375 volts. *R6* is shunted by capacitor *C7* and the primary of the trigger or ignition coil *T2* in series.

While *C5* is charged, *C7* is also charged by the amount of the voltage drop across *R6*. When the flash contacts on the camera close, they short *R6*, and *C7* is discharged through the trigger transformer primary. This induces pulses of several thousand volts in the secondary which ionize the gas in the flash tube.

The "breakdown" of the tube permits capacitor *C5* to discharge through it. This produces a brilliant flash of light having a duration of less than one-thousandth of a second and intensity of nearly thirty million lumens.

EXPOSURE GUIDE

Correct exposure can be determined best by experiment with the camera and film you customarily use. Set up your equipment for average conditions and take a series of pictures varying *only* the lens aperture. The aperture which gives the best film exposure, multiplied by the flash gun-to-subject distance, gives the correct flash guide number.

The peak light output far exceeds that of most flash bulbs, but it is of such short duration that somewhat longer development will be necessary.

No color correction is usually considered necessary with daylight color film. However, if the results are just a bit blue by your standards, a Wratten 81 or 81-A filter will warm the pictures nicely.

For black-and-white film having a daylight speed of 200, you might start your testing with a flash guide number of 200. Greater speed is possible with over-development, but this practice is falling out of favor.

Film ratings are not necessarily an accurate indication of electronic flash speed. Because of what is known as "reciprocity failure," some of the fastest films are less sensitive to the brief burst of light from electronic flash than some of the slower rated films. Remember that shutter speed has no effect on exposure since the light duration is less than one millisecond. However, if a slow shutter speed is used, other lighting in the room will upset the results.

When the flash contacts are closed, the flash of light takes place almost instantaneously. Thus, the camera shutter must be synchronized at "X" or "zero" delay. Accuracy of synchronization can be checked by firing at a light-colored wall and looking through the back of the camera with the lens aperture wide open.

With perfect synchronization, the shutter will be wide open; and with partial synchronization, the leaves of the shutter will be visible and frozen to immobility by the short duration of the flash. If the shutter needs adjustment, this is best left to a specialist.

Compared to conventional flash bulbs, the electronic flash produces softer effects with better modeling in the shadows and less burning out of highlights.

battery polarity on the side of the opening to reduce the possibility of inserting the batteries incorrectly. The photo below shows details of the construction. If desired, the battery trap door can be hinged. The plate that is mounted on the door and which contacts the positive and negative terminals of the batteries *must* be insulated from the door itself. It may be glued to a piece of plastic which, in turn, is glued to the door panel.

Modifications. The only component which requires modification is the power

Battery installation; note the polarity markings and insulated contact plate.

supply transformer (*T1*). Its frame and laminations are taken apart and the entire center-tapped 6.3-volt winding removed. Using only 20 feet of this wire, rewind the secondary, taking off a tap at its mid-point, and re-assemble. This rather simple operation is necessary to provide sufficient voltage for satisfactory operation as the battery output drops with use.

The layout shown is not offered as the final answer. The unit could probably be made smaller and with a different shape. Some builders might like to have a two-unit flash outfit with the power and storage components carried in an over-the-shoulder

Further data on the use of flash, including speed light, is available in the November 1957 issue of POPULAR PHOTOGRAPHY, 434 S. Wabash Ave., Chicago, Ill., for 35 cents.

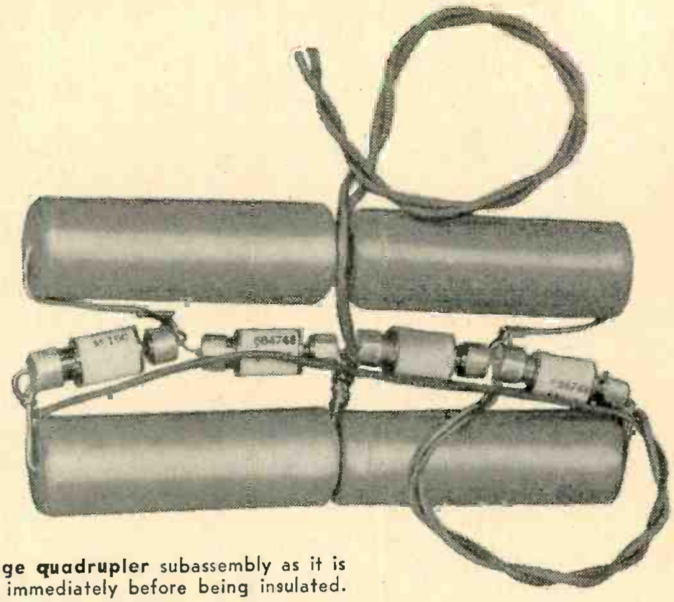
case and the rest of the components mounted with the flash tube and reflector on the camera. Amglo offers a back cover for the reflector for such an installation.

If such an arrangement is followed, the builder may wish to use six 1.5-volt cells. This would eliminate the need to rewind the transformer.

In any event, please keep in mind at all times that *the fully charged storage capacitor can give you a powerful and dangerous shock.* Treat it with the respect it deserves. Even partially charged, it offers a nasty

charge in the storage capacitor reaches approximately 375 volts. From this point on, *C5* charges very slowly and will require several minutes to reach 450 volts on a.c. or with fresh batteries. The difference in light output between a 357-volt and 450-volt charge would require only a one-half stop exposure correction.

In operation, the external a.c. power source will require 15 to 25 seconds recycling time between flashes to charge the capacitor. Fresh batteries will require about 45 seconds.



Voltage quadrupler subassembly as it is wired immediately before being insulated.

surprise for the unwary. During trials of the unit, discharge the capacitor before working on any part of the circuit by shorting it with a 25-watt resistor of several hundred ohms. Don't use a screwdriver. If this is your first high-voltage project, follow the rule the old-timers use; keep one hand in your pocket when working on it.

Operation. When the unit is assembled and the wiring completed and double-checked, it is best to try it out the first time with external a.c. power. This is suggested since an electrolytic capacitor, when new or unused for a time, is "unformed"

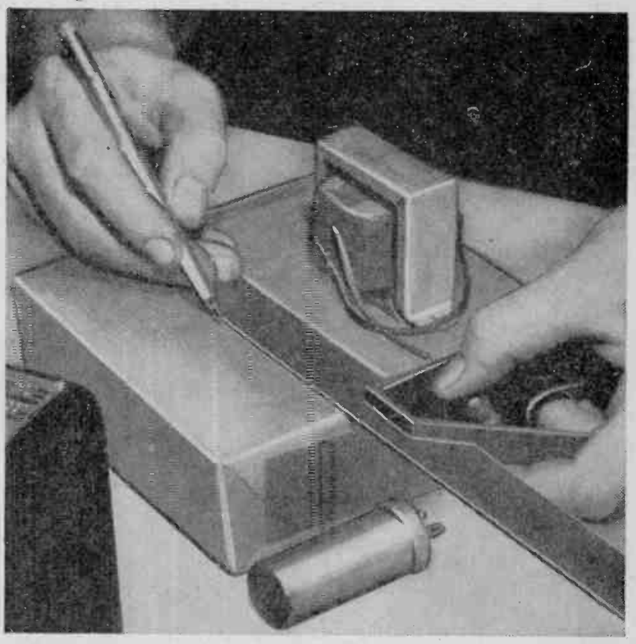
When the unit is first turned on, the huge storage capacitor (*C*5) will have a high current leakage. The batteries can "reform" it, but only by nearly exhausting themselves.

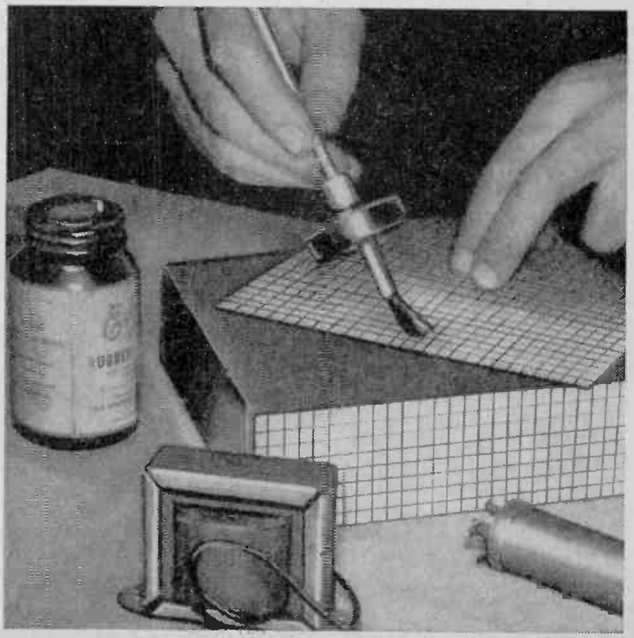
Neon lamp *NE1* starts flashing when the

Naturally, the number of flashes possible from a set of batteries is variable; but it should be possible, under reasonable use, to get at least 50—probably many more—flashes from one set. Since this outfit draws approximately one ampere (more at beginning of charge and less at full charge), it's a good idea to turn it off if you expect to wait a while between pictures.

Slight errors in exposure are not as serious as with regular flash bulbs and the depth of lighting is somewhat greater. This may be an important reason for the strong preference many photographers have for electronic flash. You'll undoubtedly find yourself taking many more flash shots than ever before; but your picture quality will probably be better and, at one or two cents a shot, who really cares about the cost of flash? —30—

Simplifying Chassis Layout





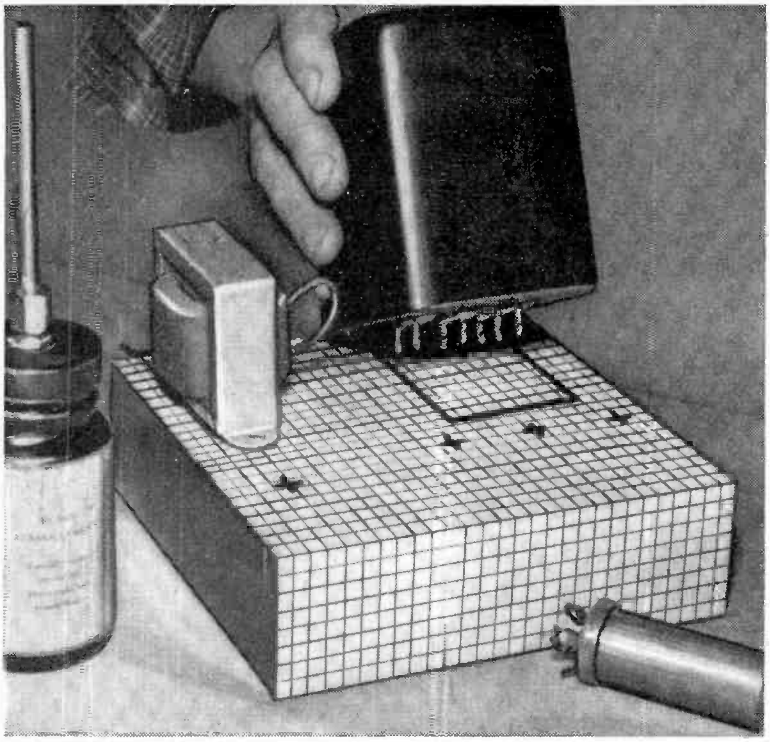
THE TIME-HONORED WAY to lay out a chassis is shown in the photo at right. Parts are placed in approximate position on the brown paper wrapper, and a square is used to establish center lines, mounting lines, location of mounting holes, etc. This system produces satisfactory results, it's true, but there is a much easier way to do this kind of job.

Strip the brown paper wrapping from the chassis and cover it as shown in the photo at right, below, with what is known as "math paper" or "Quadrille." This is a type of graph paper ruled in quarter-inch squares which is available in most stationery stores and bookshops in 8½" x 11" sheets. The paper is held to the chassis with ordinary rubber cement.

If you align the lines on the ruled paper with the edges of the chassis, the surface (and sides, if the paper is applied there) will be neatly ruled with a grid of parallel lines ¼" apart. Using the grid lines as reference lines, it's an easy matter to push the parts around on the chassis to get an electrically desirable and eye-pleasing layout.

The photo at the top of the next page shows how the location of the mounting holes can be marked on the paper with respect to the cross rulings. (In the photo, the choke has been moved back to show one of its mounting holes more clearly.) After the holes are marked, the chassis is drilled in the usual manner. Of course, the ruled paper should be peeled off before the individual parts are mounted on the chassis.

To cover large chassis, the 8½"

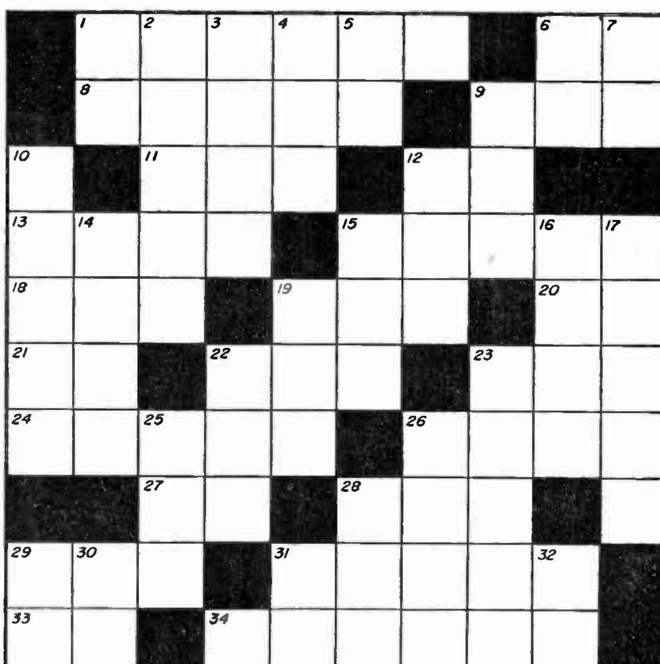


By
BOB
WATSON

x 11" sheets can be joined carefully to obtain the desired size. The little time required to cut and apply the paper to a chassis is more than saved in layout time. This method really *does* simplify chassis layout. —30—

CROSSWORD PUZZLE

By Arthur L. Branch



ACROSS

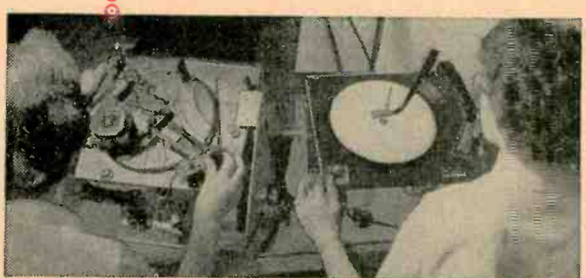
1 Resistance unit.
6 Type of frequency: Abbr.
8 A combination of antennas.
9 A tramp.
11 Gaseous insulator.
12 That man.
13 A trial.
15 Type of modulation.
18 Cool drink.
19 Vigor.
20 Able-bodied seaman: Abbr.
21 American soldier: Slang.
22 Cooking utensil.
23 Past.
24 Anesthetic.
26 Kind of bird.
27 Either.
28 To be of the right size.
29 Tub.
31 Type of frequency amplifier.
33 We.
34 Part of a pentode.

DOWN

1 Current: Abbr.
2 Eradicate.
3 Sand-like particles.
4 Paddle.
5 Inductance unit: Abbr.
6 Chemical symbol for ruthenium.
7 Type of modulation: Abbr.
9 Relative power unit.
10 A part of the amplifier giving one level of gain.
12 60-cycle interference.
14 To revise and prepare for publication.
15 Part of an electron tube.
16 Wise.
17 Heavy black wood.
19 Changeable: Abbr.
22 For each.
23 Man's nickname.
25 Live: Elec.
26 Broad.
28 Animal hair.
29 Volume unit: Abbr.
30 Like.
31 Input current to rectifier.
32 Condition of electronic device with power applied.

(See page 110 for solution)

TESTING YOUR CHANGER ELECTRONICALLY



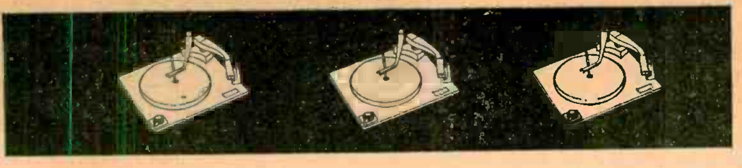
Mechanical and operational test involves simulation of in-use conditions. The tester checks the underside for wiring, clearances, welds and solder joints. Flipping it, she checks for freedom of all moving parts. Then she runs through intermixed 7", 10" and 12" records in several orders to check size and speed selection. "Speedminder" control is tested as well.

Start of test procedure consists of a visual check and final settings of parts fits and clearances. Changer is mounted on special "flip-over" test stand. The tester sets height of tone arm, checks smooth operation of pivots, and adjusts velocity trip friction so that change cycle actuates only after the last groove of the record. Also, stylus pressure is set for all changers.

PUTTING THE HIGH into high fidelity requires components built to exacting standards. Otherwise, somewhere along the line from pickup to speaker, some form of distortion will creep in. In this picture story, we take you behind the scenes to show how a turntable is tested to make sure it conforms to the rigorous standards set by the National Association of Radio-Television Broadcasters.

These photos were taken in the plant of Glaser-Steers Corp., Belleville, N. J., manufacturer of the GS-77 record changer. They present the step-by-step process of testing through which every changer goes before it is approved, packed and shipped. And they reveal some of the research and development work that goes into maintaining quality. —30—

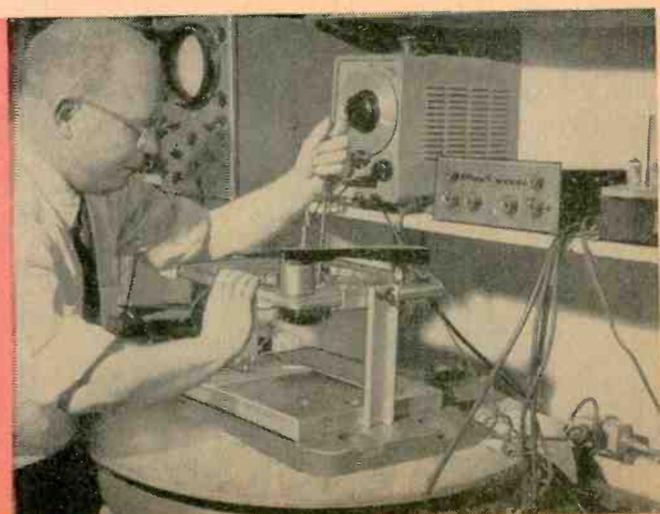
A permanent record of test figures of wow, flutter and rumble is kept on all changers. Meter at left measures wow directly in percentages. Flutter is checked on same equipment. Meter at right measures rumble, rated below audibility on the changer. Operator monitors test record tone with earphones. Finally, dielectric safety test of motor and wiring is made with center meter.



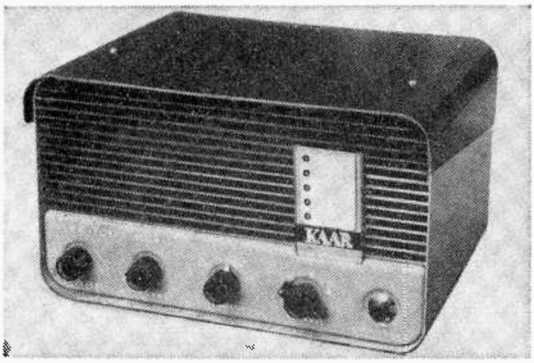
Several changers on rack are checked by quality control operator. If one fails, all get a complete test re-run. Test involves mechanical run-through of all operations, thorough listening with records, amplifier and speaker, and checking for malfunctions or spurious sounds. A rack of tested changers moves on to final packing and the shipping room.

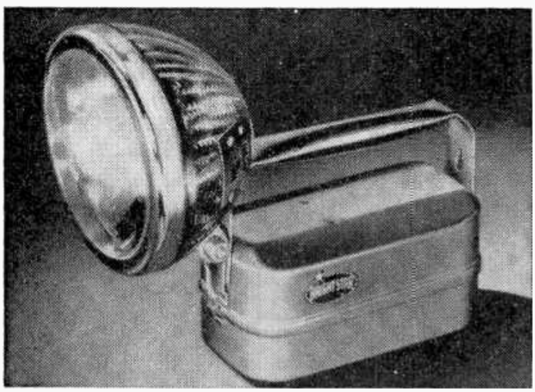
Quality control lab is "conscience" of plant, constantly testing parts quality and maintaining performance of changers up to specs. Here speed accuracy is checked with a "Strobotac" stroboscopic light and strobe disc.

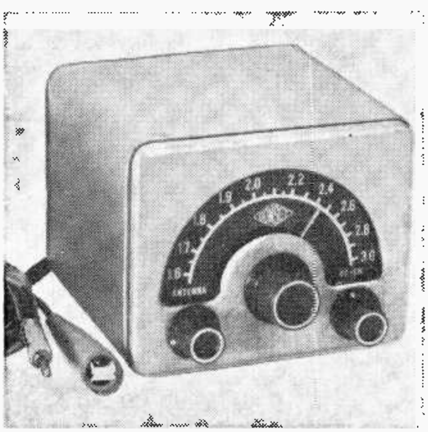
Development lab prepares stripped-down model for resonance and vibration tests. Pickup arm output is fed to vertical deflection plates of oscilloscope. Audio oscillator output fed to horizontal plates simultaneously will produce Lissajous pattern to determine frequency of any resonances. Later a vibration analyzer will be used to detect gross resonance. Results of such experimental work are compiled for future developmental use by the firm.



Ship Ahoy!







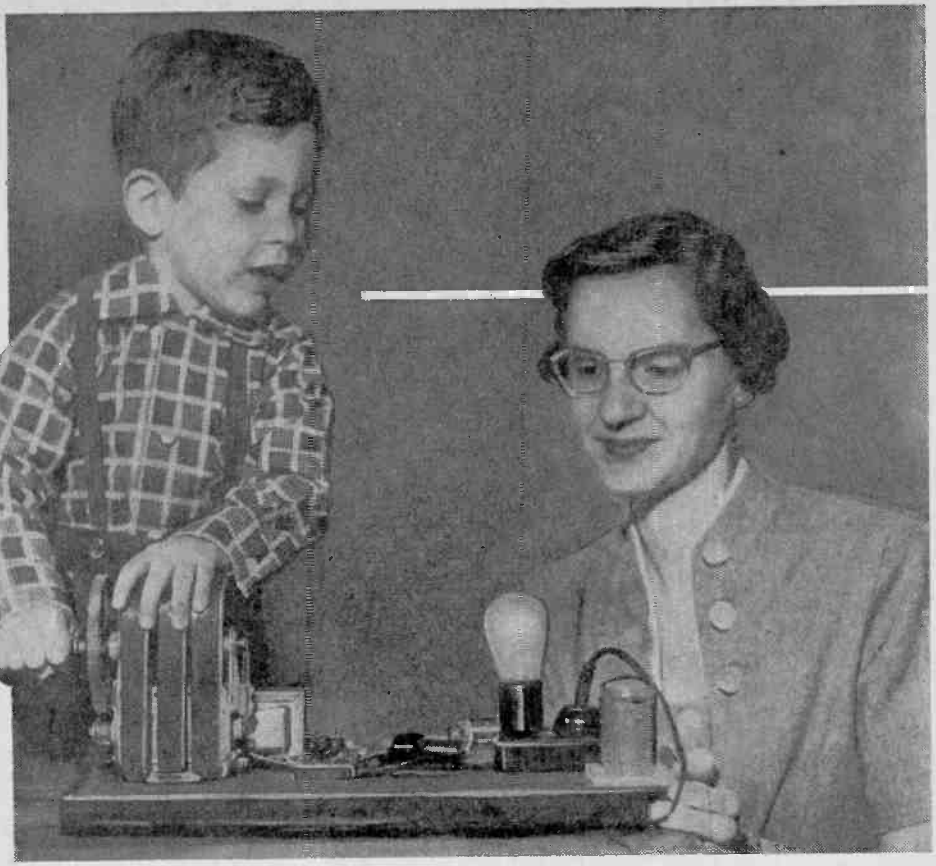
What's new on the horizon for boat owners

THE CALL of the wild waves is upon us again with the season, so after you've scraped and painted the hull and put your craft in shipshape order, perhaps you'd better cast an eye on the accessories for easier boating shown at left.

At the top is the new Kaar 5-channel radiotelephone which meets FCC regulations for commercial craft carrying more than six people. It features a flexible built-in 6-12-32-volt d.c. or 117-volt a.c. power supply, automatic noise limiting, *pi* output network and a new speech clipper and filter. It generates 28 watts r.f. output, and includes the broadcast band. Cabinet and chassis are protected with corrosion-resistant materials.

In the center is a new Bright Star sealed beam flasher lantern which is ideal for boating use. It has a 100-hour sealed beam bulb in a specially designed searchlight head that provides a red rear light for both steady glow and red flashing warning. Power source is a 6-volt lantern battery, which clips in quickly.

At the bottom is the new Gonset marine converter for reception of maritime and police bands in the 1.6 to 3 mc. range. While this is primarily used for auto radios powered by a 12-volt ignition system, it could also be used on craft supplied with 12-volt storage batteries. Operating voltage is obtained by clipping the lead to the battery. On a boat it would be necessary to connect the chassis to the ground of the boat's wiring system. The output plug fits into the antenna jack of the auto radio with which the converter is used. A switch permits marine or broadcast reception. —30—



By John Hoke

TEACH KIDS ELECTRICITY

Easily assembled "power plant" shows electrical facts of life

"DADDY, what makes the light bulb light? . . ."

Thus begins an era for many a young father, for this sentence is but the first trickle of what will later become a waterfall of questions, as a small boy learns that there is more involved than just flicking on the switch. When dealing with an elusive entity such as electricity, the most effective means of describing what it *is* consists of a simple way of showing what it *does*.

Seeing Is Believing. Here, on a short length of planking, are the ingredients of a small power plant capable of doing amazing things. It will *make* electricity—at the turn of the crank. It will provide high or low voltages at the flip of a switch. It will *store* electricity. It will light a 117-volt, 10-watt light bulb or run a small, 6-volt motor. It will operate a transistor radio or an electric clock. And it will yield current in small enough doses to permit *feeling* it —without discomfort.

For a small boy, next to putting a coin in a gum machine, there is no greater urge than to turn a crank. It won't take long to get the idea across that *he* is making the bulb light—or the motor run—when he turns the crank. And when he first feels the current generated, he will realize that his crank-turning makes "something," and that this "something" in turn flows through the circuit to the motor and makes it run.

From here on, step by step, his understanding of this invisible force will increase. A useful by-product of the child's self-education is a healthy respect for the power of electricity. He soon becomes aware of the shocking potential of wall outlets when a few turns on his little generator make its current uncomfortable to touch.

On the Board. Assembly is not overly complicated. Most of the components which are mounted on the plank should be locally available and only the generator need be obtained by mail.

The generator is actually the same type of bell-ringing mechanism used in rural telephone systems years ago. Having a maximum output of about 100 volts, a.c., such generators are currently available from firms like Johnson Smith Co., Detroit 7, Mich., for approximately four dollars. No modifications are necessary; they are ready to operate as is.

The output of the generator is fed to the center posts of a double-pole, double-throw knife switch (*S1*). One side of the switch is connected to a conventional socket. This will permit connecting a number of devices, including a 10-watt light bulb.

You'll need a step-down transformer—line voltage to about 6 volts is the proper size. A bell transformer will do fine.

Primary leads of the transformer go to the remaining terminals of the knife switch, and hence to the output of the generator, when switched in. The secondary feeds through the rectifier and then to the binding posts that will serve as an outlet for devices. The rectifier can be any low-voltage type with adequate current rating, such as International Rectifier M1H.

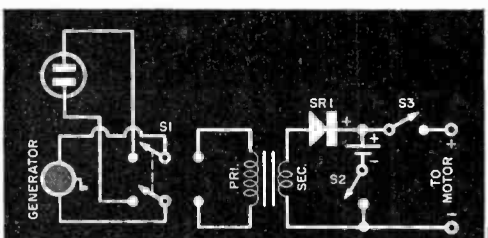
Current on Tap. To store current, you will need a small storage cell. The Willard 2-volt types are useful in this application.

When hooking up a circuit to utilize one of these cells, it is a good idea to incorporate an s.p.s.t. knife switch (*S2*), so that the cell can be switched in and out of the circuit whenever circumstances dictate. You can then run the motor directly from the output, or you can switch in the battery *with* the motor to charge the cell and run the motor simultaneously. The motor's continued running when the generator is stopped will illustrate the fact that power was stored in the battery—and is yielded when the supply from the generator and transformer ceases.

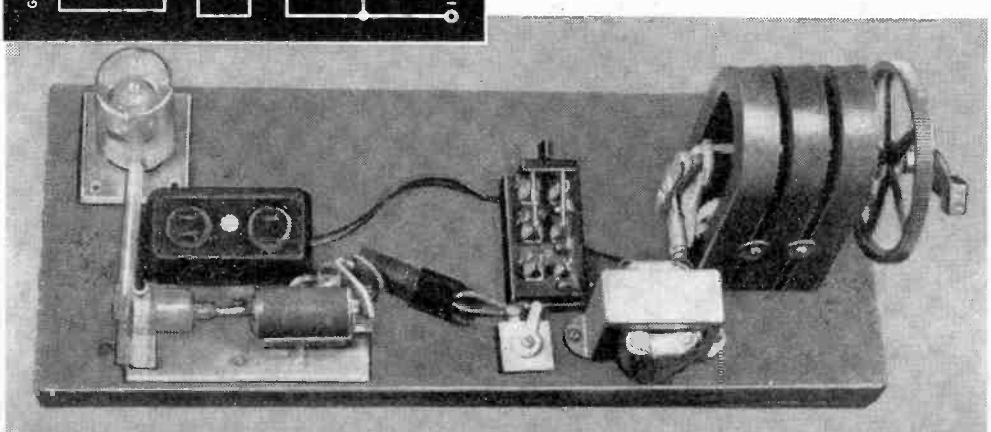
If you wish, you can charge the battery alone, with the generator, and run the motor on the stored current by opening and then closing another s.p.s.t. switch (*S3*). Other variations are also possible.

As an example, the small motor shown mounted on the board is hooked up to a miniature water fountain. Motors such as the Mighty Midget (Lafayette F253) can be used in innumerable mechanical hookups.

With the complete setup, you have an impressive transference of power. The chain goes from initial mechanical origin to generation, transformation, rectification, storage and consumption by motor . . . all at the turn of a crank, with a one boy-power source of energy! This is the foundation for a course in electricity and its applications, tailor-made and contained on a short pine board. —30—



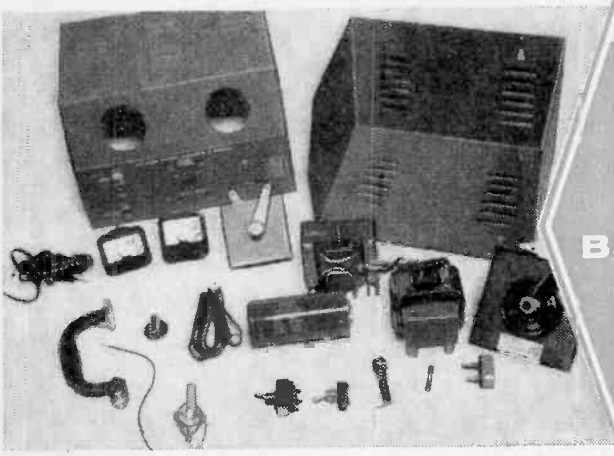
Hand generator mounted on plank (below) with one of the gadgets that can be powered by it. Schematic shows one possible hookup described in text.



KIT BUILDER'S KORNER

THE NEW all-transistor automobile radios, "hybrid" car radios comprised of both vacuum tubes and transistor stages, and similar transistor equipment can tolerate very little a.c. ripple in the d.c. that powers them. The EICO Model 1060 battery eliminator (Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City 1, N. Y.) is expressly designed as a workbench d.c. power source for this type of equipment.

This instrument can also power any conventional 6-volt and 12-volt battery-operated equipment—such as transmitters, receivers, amplifiers, marine and aviation equipment. For marine use, it can operate boat lights, radiophone, bilge pump and other electric utility units at dockside.



EICO Model 1060 Battery Eliminator & Charger

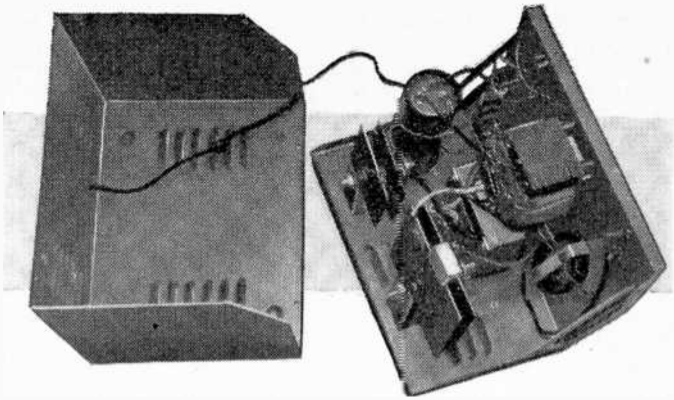
The high filtering action of the Model 1060, resulting in a.c. ripple as low as 0.3%, is accomplished by a special filter circuit comprised of an iron-core 6-millihenry choke and a dual 5000-μfd., 20-volt electrolytic capacitor. The filter is designed to take the *full continuous* as well as the *higher intermittent* current output of the rectifier circuit, thus enabling full filtering on high currents.

Putting It Together. Assembly is as simple and straightforward as possible; there are only 14 electrical parts, 15 mounting steps, and 20 wiring steps. The entire job, from start to finish, can be accomplished in three to four hours without hurrying. The following tips should be of help to you.

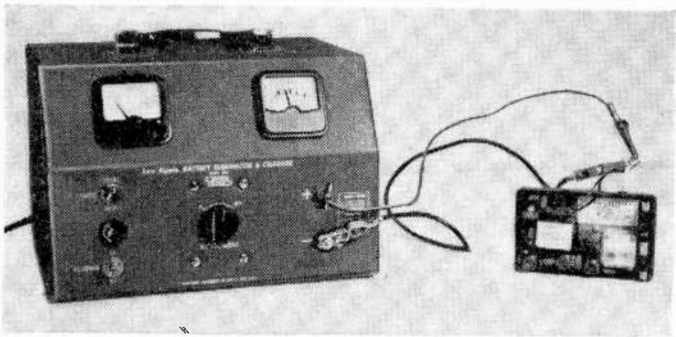
Your reviewer found that the wiring could be facilitated by *not* first mounting the electrolytic capacitor in its holder, but rather by wiring to it and then pushing it aside so that its bulk would not impede making connections to the ammeter and d.p.d.t. toggle switch nearby. Don't move it too much, or you are liable to break the lugs.

EICO supplies #14 hookup wire for making the electrical connections because of its current-carrying capacity. Being thicker than the usual hookup wire, it requires a bit more care in "looping" for the mechanical connections to the solder lugs. Stick closely to the exact lengths of wire asked for and start a loop at the end of the wire *before* connecting to the lug.

You will have to connect two or three wires to a single lug or point although there is not enough room to insert the wire through the lug itself. It is perfectly good practice either to loop the second or third wire neatly and tightly over the existing



Completed chassis before installation in cabinet is shown at right. Large cylinder at top is filter capacitor. Note variable transformer at right, center, and the two rectifiers at rear of chassis.



The 1060 is ideal for powering a transistor radio, as shown at left.

mechanical connection or to make a good connection to one of the wires which are already there (as close to the lug or point connection as possible). Solder the whole business together at one stroke.

Use a good-size iron; thick wire conducts heat away rapidly and it takes longer to reach solder-melting temperature unless your iron is 100 watts or more.

Special Features. The parts are oversize and rated for higher currents, voltages and wattages than are called for in the specifications. And there is double protection against damage due to overloading: an overload relay opens the transformer secondary circuit if the current exceeds 20 amperes and automatically resets itself when the overload is removed; the primary of the stepdown transformer is protected by a 5-ampere fuse which is easily replaceable.

The Model 1060 has two ranges (0-8 volts, 0-16 volts). Both the voltage and current outputs of each range are simultaneously monitored by a separate voltmeter and dual-range ammeter, so that you can see at a glance how much voltage is being applied and how many amperes are being drawn. The appropriate range of the dual-range ammeter is automatically switched as you select either of the two voltage ranges. For wide-angle vision, the meters are mounted on a sloping front panel.

Made of heavy-gauge steel, the cabinet is louvered for safety ventilation, and can be placed on the service bench or mounted on a wall by means of two keyhole slots in the rear.

Comment. In the 0-8 volt range, the Model 1060 can deliver 10 amperes continuously and 20 amperes on an intermittent basis; in the 0-16 volt range, it can provide 6 amperes continuously and 10 amperes intermittently. The basic circuit consists of a variable stepdown transformer and full-wave selenium rectifier.

Ventilation should be provided to assure long life and dependable performance. The Model 1060 should not be placed in any *enclosed* test panel or rack, nor should the louvers in the cabinet be blocked or covered. All rectifiers must have constant air circulation to prevent overheating. Inadequate ventilation might also cause the automatic reset overload relay to operate prematurely. (It is perfectly normal for the housing of any battery eliminator to become warm during operation.)

The instruction book describes the proper ways in which to use the instrument for workbench power supply and battery charging. It also describes simple ways to test your 6-volt or 12-volt storage battery.

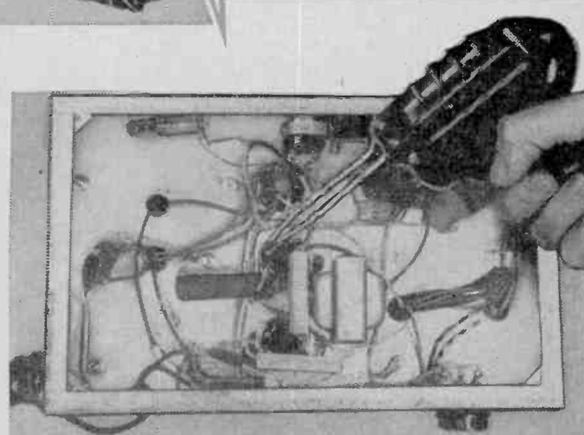
WRL Universal Modulator UM-1

HOW WOULD YOU LIKE to have a modulator which can supply up to 45 audio watts capable of fully modulating the r.f. input of your c.w. rig to 94.5 watts output? Or would you like to use the same modulator at anywhere from 5 to 45 watts output with low-power transmitters? Available from WRL Electronics, Inc., of Council Bluffs, Iowa, the compact UM-1 can be used at the home QTH or in a mobile installation.

Shown in action, the UM-1 feeds a Model 90-A transmitter.

The power output rating of this modulator is only half the story. You have a choice of output impedances from 500 to 20,000 ohms, adequate to match almost any requirement of your final r.f. amplifier. In addition, the 500-ohm tap enables this universal modulator to double in brass as a p.a. amplifier for parties and hamfests. Of course, the speakers used in this application have to be fed from 500-ohm line to voice-coil transformers.

Putting It Together. The construction book accompanying the modulator kit was a pleasant surprise. One would think that a kit meant for a Novice or more advanced ham would consist of a box of components, a blueprint type schematic and nothing more. But such is not the case. The WRL construction manual is fully the equal, in clarity and detail, of any we've seen. Between the wall-size assembly and wiring pictorials and the exceptionally detailed step-by-step instructions, nothing is left to chance or accident.



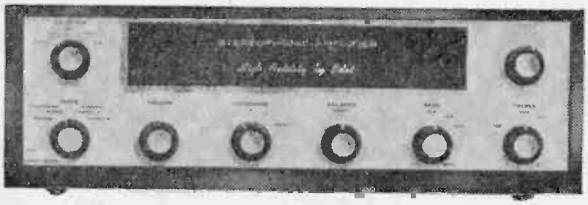
Under-chassis view of the modulator as it nears completion.

The only difficulty experienced in putting the kit together was a minor one. WRL is careful to supply grommets for all chassis holes through which leads pass (a good safety precaution) but there isn't quite

(*Continued on page* 114)

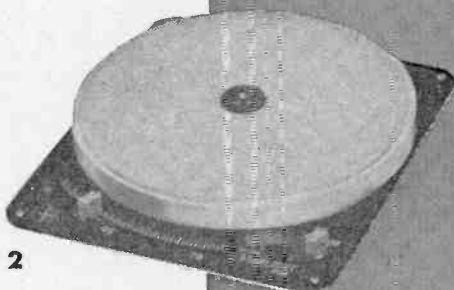
Hi-Fi Highlights

MANY READERS have been writing in to inquire about new and novel developments in high-fidelity equipment that they have heard about. To help supply such information quickly, POPULAR ELECTRONICS presents a roundup of the most interesting high-fidelity accessories crossing our desks in recent weeks. Each brief description is numbered and a box appears on page 107 along with additional items. Just circle the numbers in the box pertaining to the items that interest you and send the box in to the address given. You'll receive complete information on those items. —30—



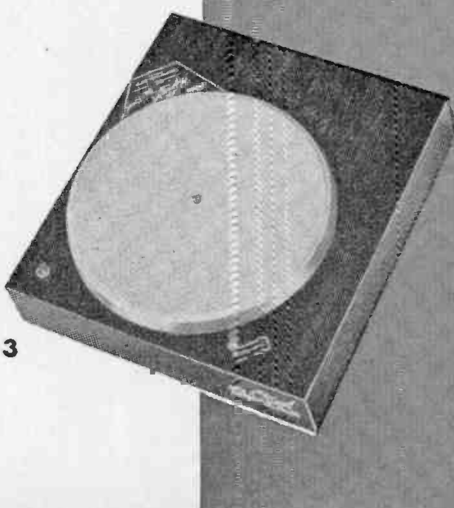
1

1 Complete stereo amplifier, with bi-channel preamp with bass and treble controls, loudness and volume controls for each channel and two 14-watt power amplifiers. Inputs for stereo AM-FM broadcasts, stereo tape, stereo discs, microphones and separate output for making stereo tape recordings. Balance control is provided for relative level of channels. Pilot SM-244.



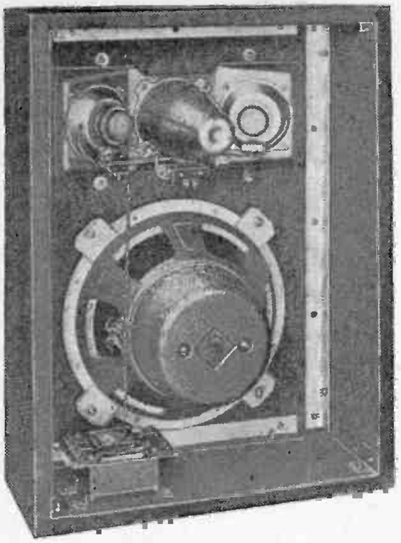
2

2 Continuously variable (between 16 and 84 rpm) turntable with settings at the four standard speeds. Illuminated stroboscope, automatically retractable 45-rpm spindle, built-in "on-off" click filter are featured. Starlight 60A.



3

3 Two-speed belt-drive turntable. Heavy non-metallic disc under aluminum turntable shell adds to mass, while belt-drive allows for lighter over-all construction. Available for 33⅓ - 45 and 33⅓ - 78 rpm. Cork turntable mat eases record wear. Components Corp. Professional 45.



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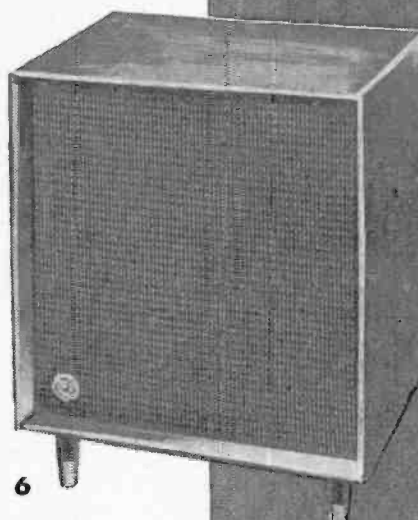
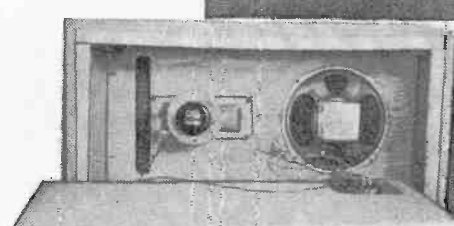
5



6



7

4 Four-speaker high-fidelity system, consisting of 12" woofer, two cone-type tweeters, one horn-type midrange speaker, comes with crossover and matching transformer. System is mounted on baffle board designed to be installed in an enclosure. Range of the system is 30 to 16,000 cps. Isophon G-3037.

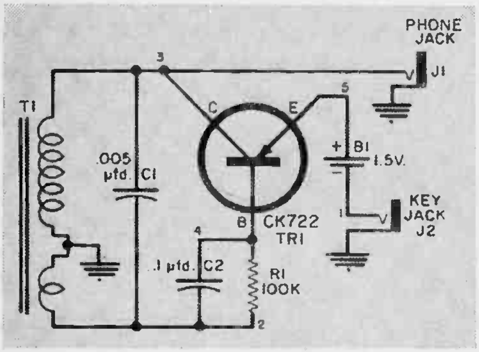
5 Stereo cartridge reproduces 45-45 discs, fits all standard arms. It contains a pair of ESL moving-coil assemblies similar to the single unit in the ESL C-60 cartridge. Range is 20 to 18,000 cps; output, 2 mv. Electro-Sonic.

6 Floor enclosure for 12" speaker. Unfinished or in mahogany, walnut or blond. It utilizes special front and back loading on the speaker to improve response with a triple laminate board to eliminate spurious cabinet resonance and vibrations. British Industries R-J 12-F.

7 Bookshelf-type speaker cabinet available as kit contains compression horn-type tweeter and 8" woofer with high-pass crossover. Cabinet is preassembled and may be finished as builder wishes. Assembly time, minutes. EICO HFS-1.

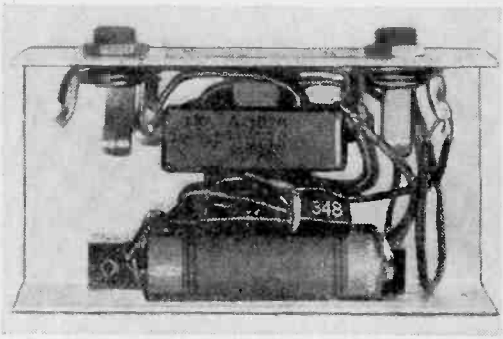
TRANSISTORIZED CPO FITS IN YOUR POCKET

Everyone interested in electronics has use for a code practice oscillator at one time or another. Learning the Morse code, teaching others, or getting the feel of an automatic key are some of the areas in which it can be helpful. With the inexpensive transistors now available, it is easy to build a battery-operated oscillator tiny enough to fit in your pocket and have a battery life of a year or more.



Placement of parts is shown in detail in the photo. All parts are mounted on the inner half of a 4" x 2⅜" x 1⅝" Minibox. For oscillation to occur, transformer *T1* must be connected with the correct polarity (see diagram). If the circuit fails to oscillate when first wired, with a high-impedance headset in jack *J1* and the *J2* circuit closed, reverse the blue and red wires from the transformer.

The oscillator circuit is of the Hartley type, with feedback produced by a tapped inductance. Output is approximately one volt r.m.s., at a frequency of one-thousand cycles. The output waveform is a half sine wave, which is rich in harmonics. Some radio operators have found that such harmonics relieve listening fatigue.

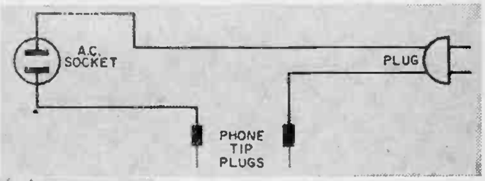


Battery current drain is approximately 120 microamperes, and maximum output is about 1/20 milliwatt. This is sufficient output for most headsets, but an amplifier is necessary if a loudspeaker is going to be used, or if more than a few headsets are to be plugged in at the same time.

—*W. H. Caldwell*

ADAPTER FOR MEASURING A.C. AMPERAGE

Some volt-ohmmeters have an a.c. ampere range that can be used for measuring current drawn by 117-volt appliances. An extension cord can be adapted for convenient use of this meter range. First cut one side of the line cord and rip each end back about three inches from the other side. Strip the free ends of insulation and install phone tip plugs. Circuitwise, you should end up with the hookup shown in the diagram. To use, set the meter to the appropriate range and function, insert the phone tips in the meter jacks, plug the extension cord into an outlet, and plug the device whose current is to be measured into the socket on the cord.



—*Louis Golden*

Transistor Topics

By LOU GARNER

THIS MONTH marks the tenth anniversary of the "birth of the transistor." The point-contact transistor made its first public appearance at the West Street headquarters of the Bell Telephone Laboratories in New York in June of 1948. Invented by Drs. Shockley, Bardeen, and Brattain, it was a noisy, hard-to-make, low-frequency laboratory curiosity capable of handling about 25 milliwatts. While its principle of operation was revolutionary, the crude, hand-made device shown to the press hardly seemed to offer a challenge to the reigning "king" of electronic devices, the vacuum tube.

But the "king" no longer rules supreme. Today, with over 600 different types in production, the transistor has replaced the vacuum tube in hearing aid design, is rapidly replacing it in portable radio receivers, and is seriously challenging its use in computers, military gear, and other types of electronic control and communications equipment. Modern transistor types range from low-noise subminiature audio units, which are superior in some respects to comparable vacuum tubes as high-gain audio amplifiers, to the high-frequency units in the transmitter and instrumentation circuits of our earth satellites . . . from tiny units handling microwatts to large types capable of switching powers up to a kilowatt or more.

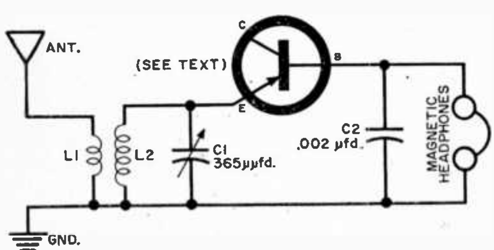
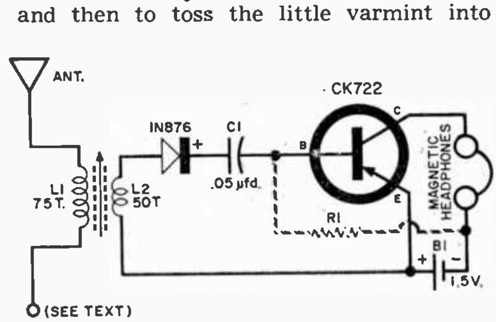


Fig. 1. Frank Schrader's diode receiver (above) uses damaged transistor.

Fig. 2. Tom Keifer's short-wave set (right) is basically a diode detector.



Last year more than *28 million* transistors were sold, at an average price of $2.40 each . . . a price, incidentally, 20% lower than in the previous year. One of the transistor's co-inventors, Dr. William Shockley, believes that the average cost will drop to about 25 cents in another five years. If production continues to expand, and if applications continue to increase at past rates, the day will come when more transistors than vacuum tubes will be used in electronic equipment.

Readers' Circuits. Simple receiver circuits continue to rank high in popularity among experimenters, gadgeteers, and home builders of electronic equipment. This month we are featuring *three* such circuits, submitted by as many readers.

Diode Receiver. Often, when one lead of a transistor is broken off too short to serve as a satisfactory connection, the first reaction is to say a few choice cuss words and then to toss the little varmint into the nearest trash can. However, reader Frank W. Schrader suggests that you can *save that broken transistor,* pointing out that a transistor with one lead missing still may be an excellent semiconductor diode and, as such, can be used as a low-power rectifier or detector.

A simple circuit using a damaged *p-n-p* junction transistor is shown in Fig. 1. Here, we assume that the collector lead has been broken off short, with the emitter and base leads serving as connection terminals for the diode. Of course, the collector and base leads could be used if the emitter lead were the broken one. Both *p-n-p* and *n-p-n* types may be employed in this application.

The resulting receiver is essentially a

crystal set. Since the transistor serves as a detector rather than an amplifier, no gain is obtained and a good antenna-ground system and high-impedance magnetic headphones are required for best performance.

Almost any standard AM broadcast-band r.f. antenna coil (*L1* and *L2*) can be used when assembling such a receiver, but Frank indicates that he obtained good results by employing a Miller Type 20A coil assembly. *C1* is, of course, a standard 365-μμfd. tuning capacitor, while *C2* is a small ceramic or mica r.f. bypass capacitor. The capacitors' d.c. working voltages are not critical.

Short-Wave Set. Tom Keifer, of 101 Long Lake Blvd., Akron 19, Ohio, reports that he has picked up airport stations, amateurs, and short-wave transmitters using a receiver based on the circuit in Fig. 2. He tells us that he has logged stations in Moscow, Quito, and other foreign cities with it.

Tom's receiver is basically a diode detector followed by a one-stage capacitance-coupled amplifier using a *p-n-p* transistor in the common-emitter arrangement. Operating power is supplied by a 1.5-volt flashlight cell (*B1*).

Coils *L1* and *L2* are hand-wound on a standard slug-tuned antenna coil form. *L2* consists of 50 turns of #24 to #30 enameled copper wire, scramble-wound close together on the ¼"-diameter form. *L1* consists of 75 turns of the same type of wire, wound directly on top of *L2*. Either end of *L1* may be connected to a good outdoor antenna. Although Tom did not use an external ground, you may want to experiment with a ground connection to *L1*'s "free" lead. The receiver is tuned by adjusting the coil's powdered iron core.

Here's a tip for you, Tom. You may be able to increase sensitivity by connecting a small bias resistor between the transistor's base electrode and *B1*'s negative terminal. This resistor is shown dotted in Fig. 2 as *R1*. Its value will depend on the characteristics of your transistor and on the impedance of the headphones. Try values from 100,000 ohms to 2.2 megohms, finally installing the resistor which gives highest gain. A half-watt carbon unit can be employed here.

Direct-Coupled Receiver. Four direct-coupled *p-n-p* and *n-p-n* transistors are used in the receiver circuit shown in Fig. 3, which was submitted by reader Billy Tegarden, of 805 E. College St., Pulaski, Tenn. According to Billy, this receiver is capable of giving satisfactory loudspeaker reception on local stations with a moderate-sized antenna. As you can see, relatively few components are needed.

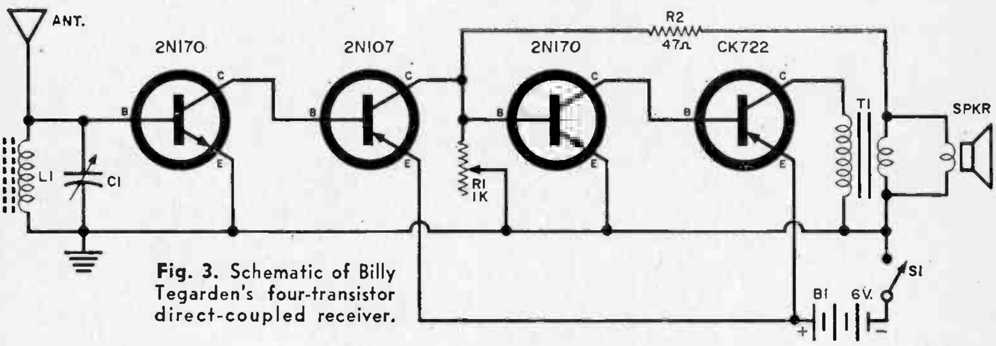


Fig. 3. Schematic of Billy Tegarden's four-transistor direct-coupled receiver.

L1 is a standard AM broadcast-band ferrite antenna coil. *C1* is a 365-μμfd. variable capacitor to match *L1*. *R1* is a 1000-ohm carbon potentiometer, while *R2* is a ½-watt resistor. Although Billy suggests a nominal value of 47 ohms for *R2*, you may find it worthwhile to experiment and pick the value which gives best operation. Billy used a 3V4 output transformer for *T1*. You may prefer a standard transistor transformer—an Argonne Type AR-138 should give satisfactory results.

(*Continued on page* 114)

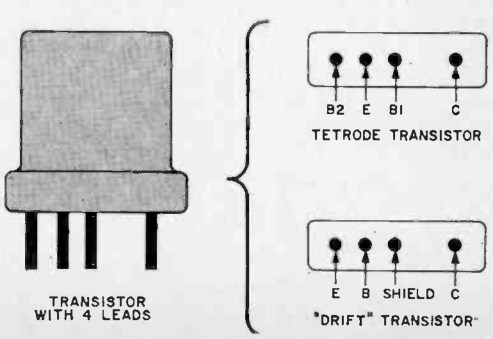


Fig. 4. Lead connections for standard tetrode and r.f. "drift" transistors. See page 115 for details.

Make the POP'tronics Secretary

Tell your friends that their telephone messages to you will be recorded by electronics

By TRACY DIERS

HOW WOULD YOU LIKE to have a secretary who will answer your phone and take messages at any hour of the day or night but who will demand no pay and no coffee breaks? Impossible, you say? The miracle of electronics has all but removed the word "impossible" from the dictionary.

There are two types of systems you can build which will do this job for you. The deluxe system requires two tape machines or one tape machine and one disc machine—when a call comes in, it plays a recording of instructions and then switches over to record the message. The simpler type, to be described here, requires only one recorder and anyone who can put together a small amplifier can build it.

Before you put it in service, tell all prospective callers to let the bell ring for 45 seconds (about 10 times). When the phone is picked up by your "secretary," the caller will then have 30 seconds to record his message to you.

The Amplifier. A 3" x 5" phenolic or perforated composition board may be used as a subchassis. Parts placement is non-critical, but be sure you connect the 1N34A (*CR1*) diode in the correct polarity. Relay *RL1* should also be mounted on this subchassis. The wiring procedure is straightforward and uncomplicated.

After the amplifier wiring is completed, certain checks should be made. Connect the battery pack (watch the polarity) with a

PARTS LIST

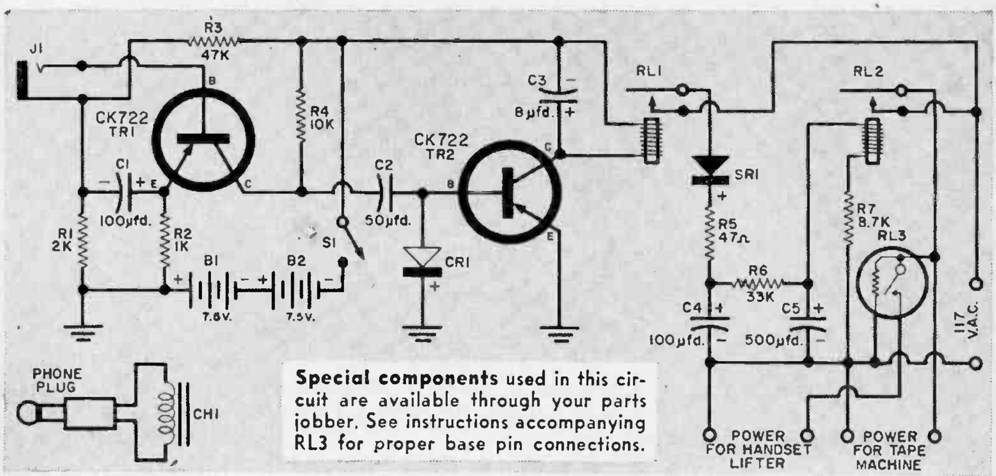
B1, B2—7½-volt battery (Burgess D5)
C1—100-µfd., 150-volt electrolytic capacitor
C2—500-µfd., 150-volt electrolytic capacitor
C3—100-µfd., 15-volt electrolytic capacitor
C4—50-µfd., 15-volt electrolytic capacitor
C5—8-µfd., 15-volt electrolytic capacitor
CH1—Modified 16-henry choke (Stancor C-1003)
CR1—1N34A crystal diode
J1—Open-circuit phone jack
R1—2000-ohm, ½-watt resistor
R2—1000-ohm, ½-watt resistor
R3—10,000-ohm, ½-watt resistor
R4—47-ohm, ½-watt resistor
R5—33,000-ohm, ½-watt resistor
R6—8700-ohm, ½-watt resistor
RL1—5000-ohm relay (Potter & Brumfield RS5D)
RL2—9000-ohm relay (Sigma 11F-9000-G/sil)
RL3—30-second thermal time delay relay (Amperite 115N030)
S1—S.p.s.t. toggle switch
SR1—130-volt, 50-ma. selenium rectifier
TR1, TR2—CK722 transistor
1—Telephone pickup coil
1—Solenoid (Guardian Type #12)

HOW IT WORKS

The telephone bell pickup coil (*CH1*), a modified 16-henry choke, is placed close to the phone and picks up the "ring" voltage by induction. The induced voltage is sent to the two-stage transistor amplifier and causes relay *RL1* to close momentarily at each ring. Each time *RL1* closes, it feeds the line current through selenium rectifier *SR1*, which charges *C1* and *C2* to a higher and higher voltage.

When the voltage across *C2* is high enough, it will close *RL2* and keep it closed. *RL2's* closing connects the line voltage to the tape or wire recorder and to *RL3*, which is a special 30-second thermal delay relay. The tape machine is running from the time *RL2* closes. After 30-seconds time delay, *RL3* closes, putting 117 volts a.c. on the handset lifter, and the bell stops ringing.

When the caller hears the receiver lifted, he starts to record his message. (The tape machine audio pickup is one of the inductive pickup types designed for placement under the telephone.) In about 30 seconds, the voltage on *C1* and *C2* has fallen too low to hold *RL2* closed. When *RL2* opens, it shuts off the entire mechanism, except for the transistor amplifier—which is ready for the next caller.



Special components used in this circuit are available through your parts jobber. See instructions accompanying RL3 for proper base pin connections.

milliammeter in series with the negative lead.

The instant the connection is made, *RL1* should close for two to three seconds. The current at that time should be about 5 or 6 ma. When *RL1* opens, the meter will read about 0.75 ma.

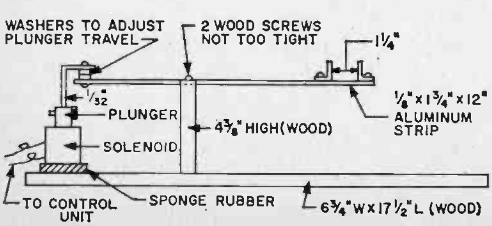
Bell Pickup Coil. Almost any choke coil will work, but the greater its inductance the more sensitive it will be. To adapt it for pickup service, you must realign the laminations so that they all point in the same direction—forming an "E" with the coil on the center pole.

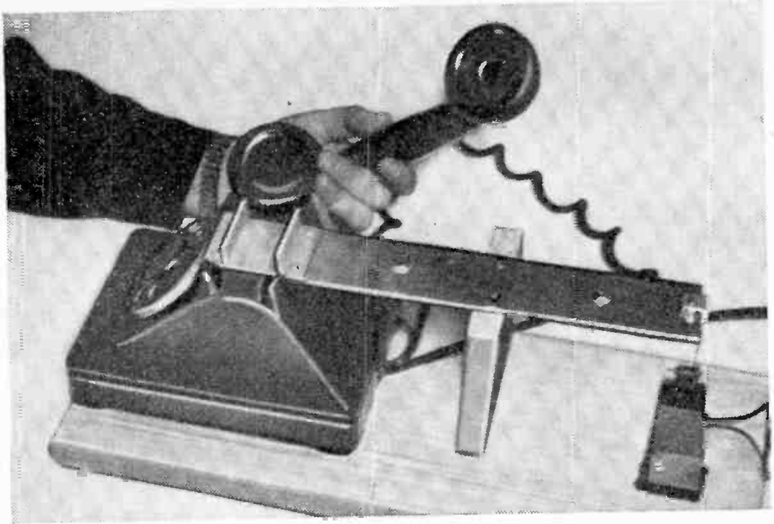
Connect the pickup coil (*CH1*) to the amplifier with a 3′ to 4′ length of lamp cord wire. When you turn on the battery power to the amplifier, *RL1* should close momentarily as before.

Have someone call your telephone number and, while the bell is ringing, move *CH1* around the sides of the plastic telephone case until you find a spot where *RL1* closes instantly each time the bell rings. Plastic tape will hold it in position.

Main Chassis. A good chassis size is 10″ x 5″ x 3″, with the transistor subchassis mounted as shown. Four machine screws with ½″ sleeves or standoffs will keep the subchassis from making electrical contact to the main chassis. Bring all subchassis

Assembly details of handset lifter. See photo on next page for setup.





Handset lifter mechanism in place. Voice pickup coil is beneath the base, bell pickup is on the far side.

connections into the main chassis. The on-off switch (*S1*) can be mounted in any convenient spot.

Mount a standard phone jack (*J1*) on the main chassis for plugging in the telephone bell pickup coil. Insulate *J1* from the chassis with insulating shoulder washers. Chassis must *not* be used as a ground for either the transistor amplifier or timing circuit—use insulated terminal lugs as common points and keep the ground of the amplifier separate from the ground of the main control unit.

The thermal delay relay tube (*RL3*) plugs into a standard octal tube socket, and the two 7.5-volt batteries are held in place with a small metal strap as shown. Mount two standard a.c. female receptacles in one side of the chassis for the recorder and the handset lifter—both of these operate on 117 volts a.c.

Timing capacitors *C1* and *C2* must be mounted on low-loss standoffs. If you can't obtain the capacitance needed in a single unit, parallel several low-leakage types.

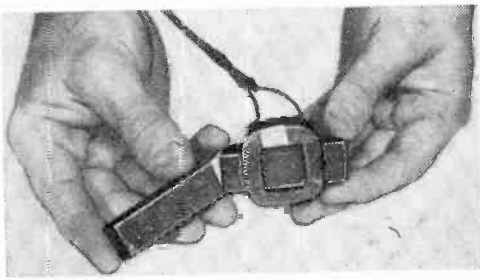
Telephone Lifter. The solenoid actuator should be adjusted so that the solenoid plunger pulls completely in and lifts the phone handset about half an inch. You can mount the solenoid on a piece of sponge rubber to deaden its hum. While adjusting the lifter, temporarily tape down the telephone button switch.

For the final test, plug the solenoid directly into the 117-volt line. The handset should pop up about half an inch, and when the line voltage is removed, it should drop back in place. Check it about a dozen times to be sure it is working dependably with a minimum of hum or vibration.

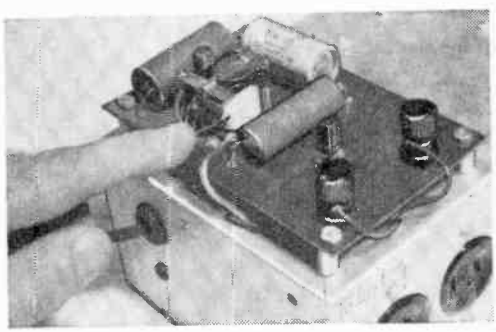
Your Secretary. The transistor control unit must be located near the telephone to keep the telephone bell pickup coil lead short. The tape machine can be a little further away from the phone.

Plug the tape machine and the handset lifter into their respective a.c. receptacles on the control unit. The inductive speech pickup is placed in the proper spot under the telephone. Preset the tape machine to

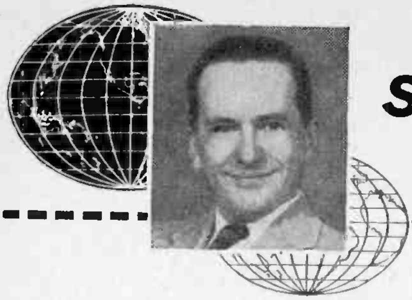
(*Continued on page* 106)



Bell pickup assembly showing the "I" laminations removed.



Transistor amplifier subassembly with RL1 and standoff mounts.



Short-Wave Report

By HANK BENNETT

ONE of the more active DX'ers in the Midwest is Frank Gilmore, whose Listening Post is on the outskirts of Springfield, Mo. A 17-year-old high-school student, he started DX'ing in the fall of 1955 with a Hallicrafters SX-18 receiver (which he obtained at a bargain price of $1.50).

Since that time, Frank has acquired another Hallicrafters receiver (an S-85), an FL-8 audio filter and an FCC-90B crystal calibrator. He also has a Heathkit Q-Multiplier. His antenna include: long wires for the 80- and 10-meter bands; a 15-meter doublet; and dipoles for the 15-, 20-, and 40-meter bands.

When Frank is not operating as KNØJPJ, he tunes the short-wave bands. To date he has a total of 78 verifications from 41 countries, with 115 countries heard. His most prized QSL's are from Bulgaria, Poland, Tangier, *Radio Ankara, Radio Ceylon,* and *Deutsche Welle* (Cologne, Germany).

With his S-85, Frank has logged stations in Algeria, Belgium, the Canary Islands, Kenya, Israel, Saudi-Arabia, the Fiji Islands, Poland, Malaya, India and Pakistan. The 31-meter band is his favorite, with Brazzaville and Prague taking honors for their excellent musical programs. For ham radio, Frank prefers the 20-meter band, especially since he was QRM'ed right out of the 40-meter band by no less than *Radio Moscow.*

In addition to being a regular contributor to this column (#85), he is a member of the Newark News Radio Club, the American Radio Relay League, the Rag Chewers Club, and the Amateur Radio Emergency Corps. His other hobbies include stamp collecting and writing.

Frank mentioned that he would like to see columns in POP'tronics covering the amateur DX'ing and broadcast-band phases* of our hobby. If you are interested in exchanging photos of yourself and your Listening Post with him, Frank's address is: Route 2, Box 286A, Springfield, Mo.

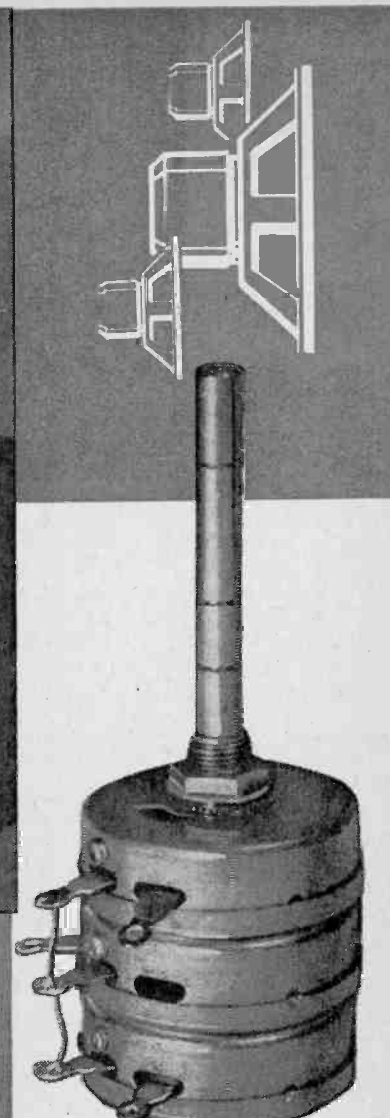
The Listening Post of Frank Gilmore, Springfield, Mo., features a Hallicrafters S-85 receiver and a Heathkit Q-Multiplier.

Listening Post Call-Signs. The block of call letters WRØ1AA to WR1ØZZ is being assigned to American DX'ers. While these calls are not issued by the Federal Communications Commission, they have been approved by the FCC. If you would like to have a certificate, write to Mr. Joe P. Morris, 10512 Parkview Ave., Cleveland 4, Ohio. The only requirements are that the DX'er must live in the USA and have an active interest in DX'ing. A charge of 20 cents covers printing, handling, etc.

Attention Newcomers. We'd like to remind our readers, especially newcomers to the hobby, that we have available report cards and letter-size report sheets (for reporting to this column), "High-Voltage" decals, Amateur Radio Reference Sheets, and DX Logs. Drop us a note if you would like any or all of these items.

(*Continued on page* 121)

* Anyone especially interested in the broadcast-band DX phase of short-wave listening should write to the National Radio Club, % Harold F. Wagner, R. D. #1, Lake City, Erie County, Pa., and request a copy of the "DX News." The yearly $4.00 dues includes 34 issues.



Suit Your Volume with a T-Pad

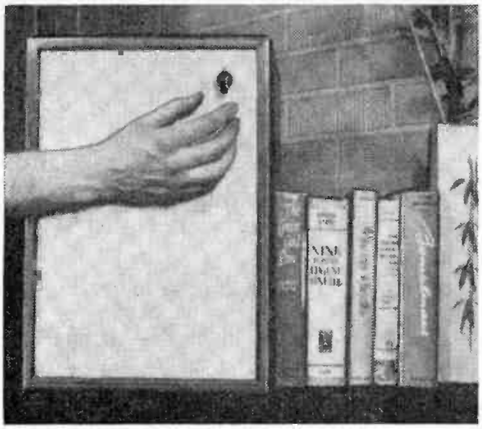
By HARVEY POLLACK

Individually control your remote hi-fi speakers

NOW THAT multiple-speaker installations have become popular in home hi-fi systems, knowledge of the workings of T-pads is a valuable asset to anyone interested in this type of installation. Such pads have been used in broadcast stations for years to control the level in audio transmission lines.

Control Each Speaker. Imagine that there are three speakers connected to the output of one hi-fi amplifier and that it is desirable to control the output of each speaker, individually, by means of its own volume control. The natural tendency of the uninitiated builder is to add a potentiometer between the secondary of the output transformer and the voice coil of the speaker, as shown in Fig. 1.

When he does this, he finds that the attempt to cut down the volume from this speaker results in very serious distortion,



Control can be mounted on front panel of speaker.

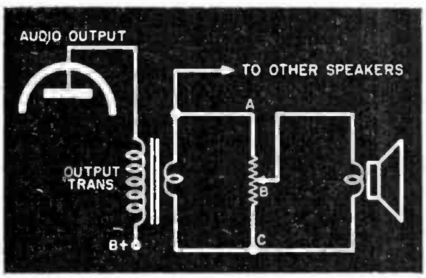


Fig. 1. Pot used as a speaker volume control (not recommended).

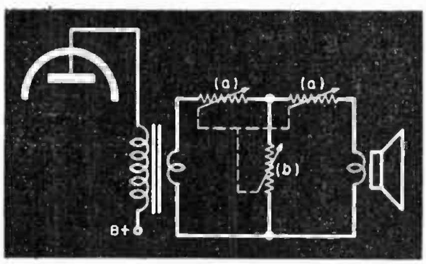


Fig. 2. Theoretical circuit of T-pad as discussed in the text.

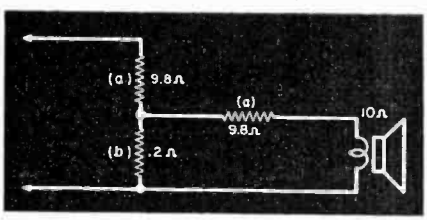


Fig. 3. Circuit of Fig. 2 with T-pad set for maximum attenuation.

particularly at low levels. This occurs as a result of the changing impedance presented to the output transformer by the potentiometer variations.

For example, when the wiper of the potentiometer is moved to point *A* of Fig. 1, the impedance seen by the output transformer is composed of the parallel circuit formed by the pot and speaker voice coil; at position *B*, section *AB* of the potentiometer has been placed *in series* with the voice-coil impedance while section *BC* is still in parallel. The total load impedance, therefore, is vastly different than before, a condition which invites distortion.

Prevent Distortion. A T-pad overcomes this problem by providing attenuation while maintaining a constant impedance to the output transformer and to the speaker. (The L-pad type maintains the impedance match for the output transformer *only*.) In Fig. 2, two identical variable resistors (*a*) are connected in series while a third resistor (*b*) shunts the circuit as indicated. All three are ganged to the same shaft, and as this is rotated, resistances (*a*) rise and fall together while resistance (*b*) changes in the opposite direction.

Suppose that the output transformer secondary winding has an impedance of 10 ohms to match a 10-ohm voice coil. When the T-pad shaft is rotated fully clockwise to the position of maximum volume, the (*a*) resistors might be 0.5 ohm each while the (*b*) resistor is approximately 87 ohms. The two 0.5-ohm resistors in series with the voice coil have practically no effect upon the total circuit impedance, and the 87-ohm parallel resistor has even less, considering that it shunts two 8-ohm windings (transformer secondary and voice coil).

It should be remembered that a comparatively high resistance in parallel with a low resistance produces very little change in the total circuit resistance. In this connection, then, the T-pad produces very little attenuation (about 1 db) and the output signal is just about as loud as it was before the pad was inserted.

Maintain Constant Impedance. If the output of this speaker is now to be reduced to a value so low that it cannot be heard, the shaft of the pad would be rotated fully counterclockwise. At this point, the (*a*) resistors would be 9.8 ohms apiece while the (*b*) resistor has changed to 0.2 ohms. Now there is practically no voltage appearing across the (*b*) resistor since its resistance is so low, all of the power being dissipated in left-hand (*a*) section; as the

(*Continued on page* 106)

Among the Novice Hams

By HERB S. BRIER, W9EGQ

WHAT WOULD YOU THINK of a ham who works several times as hard and takes several times as long as necessary every time he makes a contact and at the same time reduces its chances of being a success? Don't be too quick in answering, because this is what *most* Novices and *many* General operators do every time they make contacts. Compare the following transmissions:

". . . Good evening, old man. Thank you for the call. Your signals are RST 599 in Gary, Indiana. My handle is John, and my address is 1405 Washington Street. The weather here is cool and clear. Well, old man, that is enough for this transmission. How well are you receiving me? And what is your location? So back to you, old man. . ."

". . . GE OM Tnx fer cl— . . . —Ur sigs RST 599 in Gary Ind— . . . —Name is John es adr 1405 Washington St— . . . —Wx clr es cl— . . . —RST? QTH? . . . K"

The second transmission takes less than one-third as long to send as the first one; yet, to anyone familiar with amateur radio abbreviations, procedures and Q signals, it conveys the same information as the first.

Because everything must be spelled out, letter by letter, in code operation, the proper use of abbreviations and other short cuts is a great time saver for any c.w. (code) operator, but it is especially valuable to Novices who have not yet built up their code speed. Equally as important as the time saved is that being able to send the information contained in a normal transmission in less time greatly increases the chances of getting it through when the bands are crowded, which happens to be most of the time in the Novice bands.

Using Abbreviations. The first step in using abbreviations in your contacts is to learn what they mean and how they are formed. Many of the commonly used amateur abbreviations are listed below. At first glance, it may appear quite a formidable task to memorize so many. Fortunately, once you understand how they are formed, there is no need to memorize

COMMONLY USED AMATEUR ABBREVIATIONS

?AA—repeat all after
?AB—repeat all before
?AL—repeat all
adr—address
agn—again
am—amplitude modulation (phone)
amp—ampere, amplifier
ant—antenna
A1—continuous-wave telegraphy
A2—tone-modulated telegraphy
A3—amplitude-modulated phone
bn—between, been
bk—back, break
B—more to follow
buk—book
btr—better
b4—before
C—yes
cl—call, close
cul—see you later
cum—come
cw—continuous wave (code)
dnt—do not
dx—distance, distant (foreign) stations
es—& (and)
ez—easy
fer—for
fb—fine business
fm—from, frequency modulation
ga—good afternoon, go ahead
gb—good-bye
ge—good evening
gg—going
gl—good luck
gm—good morning
gn—good night
gnd—ground
gud—good
hf—high frequency
hi—laughter, high
hr—hear, here, hour
hw—how
K—invitation to transmit—go ahead
kc—kilocycle
kw—kilowatt
lid—poor operator
lf—low frequency
mi—my
mc—megacycle
msg—message
N—no
nite—night
nr—near, number
om—"old man"
osc—oscillator
ot—old-timer
ow—"old woman" (wife)
pa—power amplifier
pse—please
pwr—power
Q—see Q signals on p. 117
R—are, received (I copied 100%)
rcvr—receiver
rcd—received
rdo—radio
sa—say
sed—said
sk—end of work
stn—station
tks, tnx—thanks
tu—thank you
tt—that
U—you
ur—your
uhf—ultra-high frequency
vhf—very high frequency
vy—very
wl—well, will
wx—weather
xfrmr—transformer
xmtr—transmitter
xmsn—transmission
xtal—crystal
xyl—ex (married)young lady
yf—wife
yl—young lady
73—best regards
88—love and kisses

HELP US OBTAIN OUR HAM LICENSES

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

K1/W1 CALL AREA

Nathan Lewin, % Wilfred Bell, Mattawamkeag, Me. (Code, theory and selection of equipment)

Joseph J. McBride, 586 Mill Hill Terrace, Southport, Conn. Phone: CL 9-3889. (Code and theory)

Francis Ruel, Jr., 50 Elmlawn Rd., Braintree, Mass. (Code, theory and selection of equipment)

Joseph Picone, 35 Maplewood Ave., Marlboro, Mass. Phone: 2324-J. (Code)

David Sholes, 310 Norwood Ave., Cranston, R. I. (Code and theory)

Mark Bently (14), 175 Hayden Rowe St., Hopkinton, Mass. Phone: ID 5-4212. (Code and theory)

Melvyn Peskin, 209 Sumter St., Providence 7, R. I. (Code and theory)

Carl Ingerson, Box 171, Union, Me. (Code)

Donald E. Fulton (16), 29 Kenwood Rd., Everett 49, Mass. (Theory, regulations, and selection of equipment)

Leo Perrin, 26 Royal St., Lowell, Mass. (General code and theory)

K2/W2 CALL AREA

Robert Draper, 909 River Ave., Toms River, N. J. (Code, theory and selection of equipment)

John LaPierre, Chazy, N. Y. (Code, theory and regulations)

Gerald Fox, 151-22 19th Ave., Whitestone 57, N. Y. (Code and theory)

William Moore, North Road, Tivoli, N. Y. (Code and theory)

James Seacott, 31-18 35 St., Astoria 6, N. Y. (Code, theory and selection of equipment)

Howard Hager, 1750 Stevens Ave., North Merrick, N. Y. (Code, theory and selection of equipment)

William G. Amada (10), 16 Central Drive, Stony Point, N. Y. Phone: ST 6-2672. (Code, theory and selection of equipment)

Albert P. Fath (24), 499 Stockbridge Ave., Buffalo 15, N. Y. Phone: AM 4354. (Code and theory)

William Wall, Jr. (22), 485 Elmwood Ave., Buffalo, N. Y. Phone: GA 3954. (Code and theory)

Richard Bressler, 102-56 63 Ave., Forest Hills 75, N. Y. (Code, theory and selection of equipment)

Dan Felshin (24), 405 E. 5th St., New York 9, N. Y. (Code and theory)

Dennis Jaffe (12), 2156 Wantagh Ave., Wantagh, N. Y. (General Class code and theory)

Ed Bujanonski, 21 Edward St., Lancaster, N. Y. (Code)

Fred Mason, 726 Stratford Ave., Pleasantville, N. J. Phone: PL 4699-J. (Code)

James Byers, 52 Lark, Buffalo 11, N. Y. (Code and theory)

Alden Blackwell, 149 Sunset Lane, Tenafly, N. J. (Code and theory)

Thomas Boyle, 67 Pitts Ave., West Paterson, N. J. Phone: CL 6-2223. (Theory and selection of equipment)

Martin Quayle, 335 Norwood Ave., South Plainfield, N. J. Phone: PL 6-5165. (Code, theory and selection of equipment)

Johnny R. Golaszewski (14), 32 Virginia St., South River, N. J. Phone: CL 7-2905. (Code and theory)

Robert Richkin, 82-22 168 St., Jamaica 32, N. Y. Phone: OL 7-6615. (Code and theory)

Anthony Chisholm, 231 Clarissa St., Rochester 8, N. Y. Phone: LO 2-4386. (Code and theory)

Daniel Starley, 1701 W. 3rd St., Brooklyn 23, N. Y. Phone: DE 9-1186. (Code, theory and selection of equipment)

Mark D. Pallans, 30-46 35 St., Astoria 3, N. Y. (Code and theory)

John Moccio (41), 2816 Maitland Ave., Bronx 61, N. Y. Phone: UN 3-5382. (Code and theory)

Frank Perito, 1028 E. 93 St., Brooklyn 36, N. Y. Phone: NI 9-2935. (Code, theory and selection of equipment)

Charles Zusman, 338 Ave., Brooklyn 30, N. Y. Phone: DE 9-7956. (Code)

Howard Hager (15), 1750 Stevens Ave., N. Merrick, L. I., N. Y. Phone: MA 3-0317. (Code and theory)

K3/W3 CALL AREA

Richard Hughes, Box 112, Fredericktown, Pa. (Code and theory)

Ed Lambert, 500 E. Roosevelt Blvd., Philadelphia 20, Pa. Phone: PI 3-7638. (Theory and selection of equipment)

Mike Brady, 430 Hoodridge Dr., Pittsburgh 37, Pa. Phone: LO 1-6862. (Code and theory)

J. Michael Cox (15), 121 Third St., Elizabeth, Pa. (Code and theory)

Jack Alderson, Box 609, Houston, Pa. Phone: SH 5-5568. (Code and theory)

Ralph Brandt, Jr., R. D. #1, Gardners, Pa. Phone: MO 234-J-2. (Code and theory)

William E. Gutermuth, R. D. #2, New Brighton, Pa. (Theory)

K4/W4 CALL AREA

Lawson Gummerrow, Box 282, 301 S. Balsom St., Hazelwood, N. C. (Code and theory)

Mel Sandberg, 520 S. W. 1st St., Miami 35, Fla. Phone: FR 1-5227. (Code and theory)

Jack F. Haney, Jr., 8417 Taliaferro, Tampa 4, Fla. (Code and theory)

E. J. Harris, North Valley Apt. E, Macon, Ga. (Code and selection of equipment)

Dale Graves, 2111 N. W. 23 Ave., Miami, Fla. (Code, theory and selection of equipment)

Jim Freeman, 1708 27th St. W., Birmingham 5, Ala. Phone: ST 6-6195. (Code, theory and regulations)

Sandy Roman, Lake Rd., Lyndon, Ky. (Code and theory)

Alois W. Mobley, Box 266, Wallace, N. C. (Code and theory)

Robert H. Langford, Jr., 4519 Orange Dr., Louisville 13, Ky. Phone: EM 6-3310. (Theory)

Sherwood Ervin Rowley (27), 812 Southland Rd., Bradenton, Fla. (Code and theory)

Lee Hester, 300 Lake Boone Trail, Raleigh, N. C. (Code and theory)

Grant Luckhardt (14), Stuart, Fla. (Code, regulations and selection of equipment)

K5/W5 CALL AREA

Dick Baxter, Gen. Del., Reeves, La. (General Class code and theory)

Don James (17), Box 905, Fairland, Okla. (Code)

Clement Stewart Boulter, Jr. (19), 944 N. Liberty Ave., New Braunfels, Tex. (Code, theory and selection of equipment)

Bill Wahler, 1107 N. W. 5th, Andrews, Tex. Phone: LA 3-2259. (Code and theory)

Jim Evans, 2211 2nd, Galena Park, Tex. (Code)

Harold Callison, Star Route, Box 98, Pryor, Okla. (Code, theory and selection of equipment)

Ronald Gregg, 1305 Belin Dr., Houston 29, Tex. (Code and theory)

Bruce Wilson (15), R. R. 2, Grove, Okla. Phone: SU 6-9967. (Code and selection of equipment)

Don Maddox (17), 838 S. Montclair, Dallas 8, Tex. (Code and theory)

Robert Miller (15), 1515 Burlington, Dallas 8, Tex. (Code and theory)

Jeff Jordan, Route 1, Hockley, Tex. (Code)

A. T. Boullion, 309 Cresline, Houston 22, Tex. (General code, theory and regulations)

Mike Ellzey, 319 Rosewood Dr., Alexandria, La. Phone: 5-1268. (Code and theory)

Charles Vaughan, Jr. (15), 1506 Alter St., N. E., Albuquerque, N. M. (Code and theory)

K6/W6 CALL AREA

John G. McKean (13), 2230 North Catalina, Los Angeles 27, Calif. Phone: NO 5-0039. (Theory, code, regulations and selection of equipment)
Glenn Jackson, 750th AC & W Sq. B-107, Boron, Calif. (Code and theory)
Norbert J. Glance, 4762 Mission Blvd., Ontario, Calif. (Code)
Barry Thornton, 100 Sagamore Way, Sacramento, Calif. Phone: GI 2-8381. (Code and theory)
Frank Granicy, 1519 E. Ave. K, Lancaster, Calif. (Code, theory, regulations and selection of equipment)
Mike Talvola, 943 Bingen Ave., Eureka, Calif. Phone: HI 3-1187. (Code and theory)
Homer Fox, P. O. Box 254, Nipomo, Calif. (Code and theory)

K7/W7 CALL AREA

Frank Smith (13), 2801 Brackett Ave., Yakima, Wash. (Code)
Barbara Burkhardt, 7041 N. E. Killingsworth Ave., Portland 13, Ore. (Code and theory)
John Morrell, Rte. 3, Box 290, Wapato, Wash. Phone: TH 8-2343. (Code, theory, regulations and selection of equipment)

K8/W8 CALL AREA

Coleen Thacker, 5524 McClellan, Detroit 13, Mich. Phone: WA 3-7024. (Theory, regulations and selection of equipment)
Paul E. Carpenter, Route 1, Watson, W. Va. (Code and theory)
Bud Paxton, 722 Ellis Ave., Ashland, Ohio. Phone: 2-4551. (Code, theory and selection of equipment)
James A. Lovett, 875 Wine St., Plymouth, Mich. Phone: 1618-J. (Code, theory and regulations)
Frank Warsalla, 1506 Oak St., Port Huron, Mich. (General code and theory)
Jerry Fish (13), 1210 Sixth St., Moundsville, W. Va. Phone: TI 5-1675. (Code and theory)

K9/W9 CALL AREA

Michael Dunn, Box 39, Greenwood, Wis. (Code and selection of equipment)
Stephen Schwartz (13), 5844 Washington Blvd., Indianapolis 20, Ind. Phone: CL 2-3940. (Code and theory)
Terry Martin (15), Box 581, West Chicago, Ill. (Code and theory)
Paul Ostrof, 3005 W. Chase, Chicago 45, Ill. (Theory and selection of equipment)

KØ/WØ CALL AREA

Roger Saan, 3225 West 3rd St., Duluth, Minn. Phone: MA 4-7346. (Code and theory)
Donald Mincke, 3856 Brown Rd., St. Louis 21, Mo. Phone: HA 8-3922. (Code and theory)
Ted Kubic (14), 5585 Garrison, Arnada, Colo. Phone: HA 4322. (Code and theory)
Melvin E. Fluegge, 9601 Lackland Rd., St. Louis 14, Mo. Phone: HA 8-7919. (Code)

VE AND OTHERS

Daniel Sander, Box 787, Unity, Saskatchewan, Canada. (Code, theory and regulations)
Roger Archambault, Hopital Reine-Marie Des Anciens Combattants, 4565 Chemin de la Reine-Marie, Montreal 29, Quebec, Canada. (Code and theory)
Kenneth Paradise, 4518 St. Hubert St., Montreal 34, Quebec, Canada. (Code, theory and regulations)
Charles Schwartz, 215 Hartford Ave., Winnipeg 4, Manitoba, Canada. Phone: JU 9-4869. (Code and theory)
Percy Lerner, 370 Enneskillen Ave., Winnipeg 4, Manitoba, Canada. Phone: JU 6-2369. (Code and theory)
Peter Dale (15), 118 Balfour Ave., Mount Royal, Quebec, Canada. Phone: RE 8-2844. (Code)
Peter Short, 5 St. Mark Rd., Hurlyvale, via Edenvale, Transvaal, South Africa. (Code, theory and regulations)

most of them, because their meanings are obvious on sight.

The most easily recognized abbreviations are simply phonetic spellings of different words and phrases: *ani*—any; *B4*—before; *BCNU*—be seeing you; *U*—you. Also easy to recognize are those formed by leaving out letters (often the vowels) from words: *abt*—about; *hw*—how; *nr*—number; *rcvr*—receiver; *tt*—that.

A few long words are abbreviated by replacing part of them with the letter *X*: *DX*—distance; *WX*—weather; *Xtal*—crystal. Some abbreviations are combinations of the above, such as: *CUL*—see you later. Others are formed of the first letters of often used combinations: *GA*—good afternoon, or go ahead; *GE*—good evening; *OM*—old man (usually a licensed operator); *YL*—young lady.

Richard, WN6NQM, does most of his operating on weekends on 15 meters with his new "Quad" antenna.

Finally, there are a few abbreviations which were borrowed from the old-time wire telegraphers. These are actually "code words," rather than true abbreviations, because they have meanings other than their dictionary meanings. Therefore, they must be memorized. This is not difficult, however, because there are only a few of them in common use. The most used ones are: *es*—and; *73*—best regards; *88*—love and kisses.

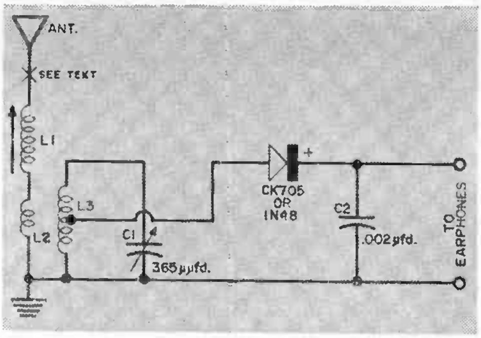
Q Signals. Q signals are three-letter groups beginning with the letter *Q* to which internationally recognized meanings have been assigned for use in radio communications. They differ from informal abbreviations in that they represent complete thoughts and have the same meanings in all languages. A Q signal alone represents a statement. When followed by

(*Continued on page* 117)

SELECTIVE CRYSTAL SET

This novel crystal set is ideal for those who live in the vicinity of one or more 50,000-watt broadcasting stations. You will find that it has unusual ability to separate stations while giving plenty of volume. In operation, the stations are located with variable capacitor *C1*, then fine tuning is accomplished with the Ferri-Loopstick (*L1*). The antenna should not be over 75′ long for best separation of stations. In some localities a ground may not be needed.

L2 has 20 turns and *L3* has 110 turns. They are wound in the same direction with No. 22 enameled wire on a 1½″ x 5″ length of cardboard or plastic tubing. *L3* is tapped at 30 turns. Leave a 3/16″ space between coils. If you use an antenna that *is* over 75′ long, insert a 3-30 μμfd. trimmer at point "X."



—*Jim Brooks*

EXPERIMENTER'S CHASSIS FOR TEST SETUPS

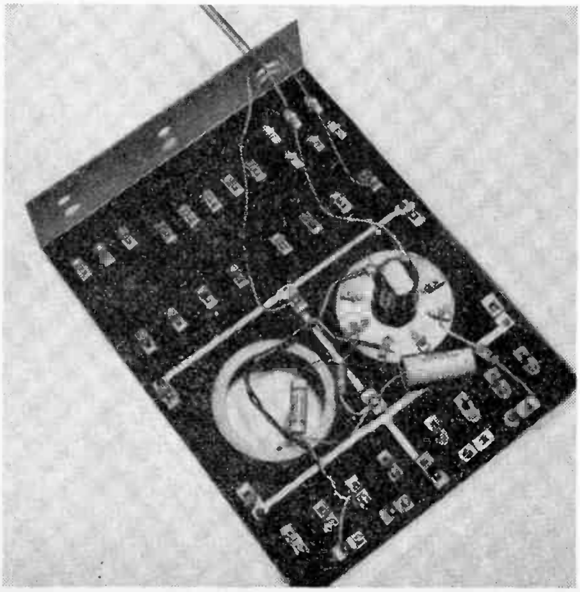
When you want to experiment with a circuit, or test a design, it generally involves using an old chassis and considerable point-to-point soldering. However, for many test setups, soldering really isn't required, and the "mock-up" chassis shown in the photo provides a flexible answer with a minimum of soldering.

The chassis consists of a small Bakelite panel, with six holes for switches, potentiometers, etc., attached to a breadboard. The breadboard section is a piece of Bakelite over a plywood sub-base, studded with three different sizes of Fahnestock clips, and spaces for two-tube socket assemblies.

The tube socket subassemblies are made by cutting two 3″-diameter holes in the Bakelite and 2″-diameter holes in the plywood sub-base, using the same center. Then cut several 3″ discs of Bakelite and mount the desired tube sockets in the center of the discs. Wire small Fahnestock clips on base panel for each tube prong. Each of these subassemblies will fit in the holes in the Bakelite base, resting on the plywood sub-base, with the tube prong clips on the top.

Since a common ground is needed in most circuits, several Fahnestock clips on the base panel are tied together under the sub-base for a common or bus connection.

Size of the unit and exact arrangement of the clips depend largely on the experimenter's preference. Usually, two tube spaces are sufficient, and the arrangement shown in the photo has proven convenient.



Three sizes of clips are used, depending on how many wires are to go in each, and all clips are mounted to the sub-base with wood screws. Power and grounding clips are 1″ long, general connecting clips are ¾″ long, and the tube socket clips are ½″ long.

Both ⅜″ and 7/16″ mounting holes are provided in the front panel for potentiometers, toggle switches, rotary switches, or any other panel mounting unit to be temporarily connected.

In using the mock-up chassis, the only soldering required is in connection with panel-mounted items. Resistors, capacitors, etc., can generally be connected by using the clips, and short lengths of wire are sometimes required to interconnect the clips. The same type of test chassis can easily be adapted to transistor experimentation. —*W. F. Gephart*

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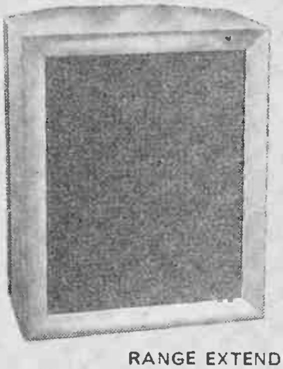
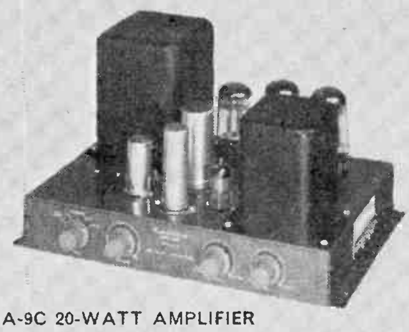


RANGE EXTENDER



A-9C 20-WATT AMPLIFIER

HEATHKIT "BASIC RANGE" HIGH FIDELITY SPEAKER SYSTEM KIT

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

Shpg. Wt. 30 Lbs.

Model SS-1
$39.95

HEATHKIT RANGE EXTENDING HIGH FIDELITY SPEAKER SYSTEM KIT

Designed especially for use with SS-1 "Basic" system. Contains 15" woofer and compression-type super tweeter. Extends basic unit to 35—16,000 CPS, ±5.db. Impedance 16 ohms. Measures 29" H x 23" W x 17½" D, and is constructed of ¾" veneer-surfaced plywood.

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

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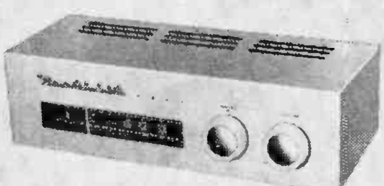
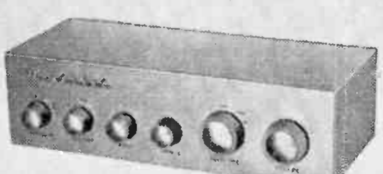
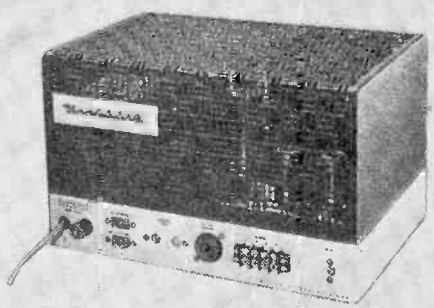


FM TUNER

AM TUNER



PREAMPLIFIER



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Model XR-1

$34.95

(with cabinet less batteries)

HEATHKIT BROADCAST BAND RADIO KIT

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

Model BR-2

$18.95

(less cabinet)

TABLE-MODEL RADIO

HEATHKIT CRYSTAL RADIO KIT

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

Model CR-1

$7.95

CRYSTAL RADIO

HEATHKIT ENLARGER TIMER KIT

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

Model ET-1

$11.50

ENLARGER TIMER

HEATHKIT FUEL VAPOR DETECTOR KIT

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

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

$35.95 each

HEATHKIT RF POWER METER KIT

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

Model PM-1

$14.95

HEATHKIT TRANSISTOR RADIO DIRECTION-FINDER KIT

The Heathkit Transistor Radio Direction-Finder model DF-1 is a self-contained, self-powered, 6-transistor super heterodyne broadcast radio receiver incorporating a directional loop antenna, indicating meter, and integral speaker. It is designed to serve primarily as an aid to navigation when out of sight of familiar landmarks. It can be used not only aboard yachts, fishing craft, tugs, and other vessels which navigate either out of sight of land or at night, but also for the hunter, hiker, camper, fisherman, aviator, etc. It is powered by a 9-volt battery. (A spare battery is also included with the kit.) The frequency range covers the broadcast band from 540 to 1600 kc and will double as a portable radio. A directional high-Q ferrite antenna is incorporated which is rotated from the front panel to obtain a fix on a station and a 1 ma meter serves as the null and tuning indicator. The controls consist of: tuning, volume and power (on-off), sensitivity, heading indicator (compass rose) and bearing indicator (antenna index). Overall dimensions are 7½" W x 5⅞" H x 5⅜" D. Supplied with slip-in-place mounting brackets, which allow easy removal from ship bulkheads or other similar places. Shpg. Wt. 4 lbs.

Model DF-1

$54.95

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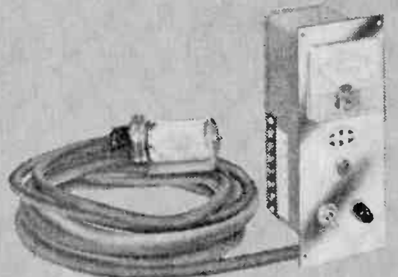
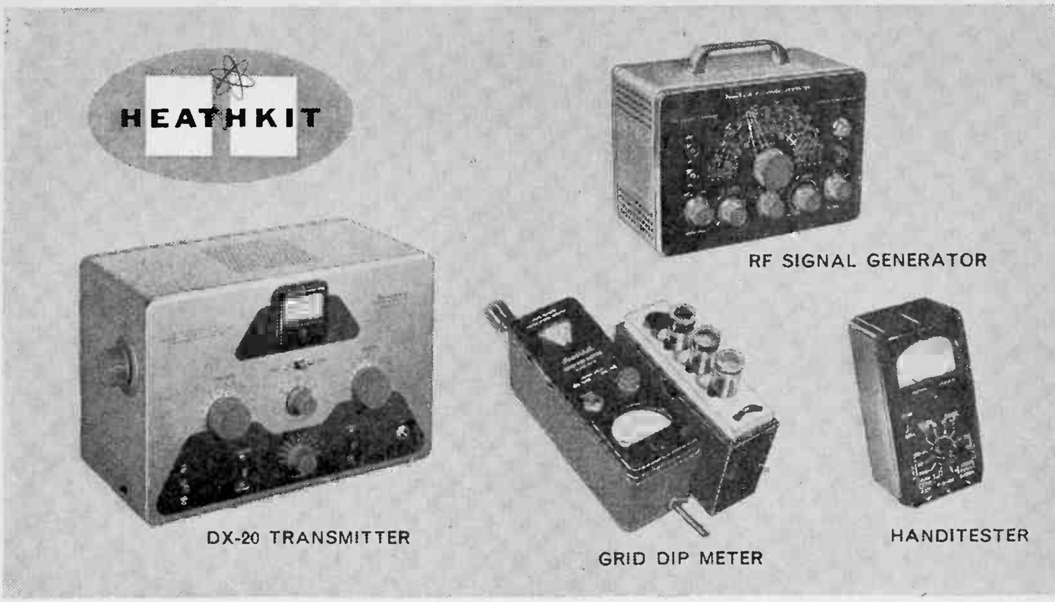


FUEL VAPOR DETECTOR

POWER METER

RADIO DIRECTION-FINDER



HEATHKIT DX-20 CW TRANSMITTER KIT

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

Model DX-20
Shpg. Wt. 18 lbs. **$35.95**

HEATHKIT GRID DIP METER KIT

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

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

HEATHKIT RF SIGNAL GENERATOR KIT

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

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

HEATHKIT HANDITESTER KIT

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

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

HEATHKIT ETCHED-CIRCUIT VTVM KIT

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

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

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

Model AR-3
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This oscilloscope sells for less than the previous model, yet incorporates features for improved performance. The OM-2 provides wider vertical frequency response, extended sweep generator coverage, and increased stability. Vertical channel is essentially flat to over 1 mc. Sweep generator functions from 20 CPS to over 150 kc. Amplifiers are push-pull, and modern etched circuits are employed in critical parts of the design. A 5BP1 cathode ray tube is used. The scope features external or internal sweep and sync, 1-volt peak-to-peak reference voltage, three-position step attenuated input, and many other "extras."

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ELECTRONIC DILEMMAS AND PARADOXES

THE DISTURBING THING about logical quandaries is that they often form an insecure foundation for knowledge that is later to come. Start with one wrong concept and you are likely to find that your entire superstructure is unsound. The way to avoid a tragedy like this is to think your way through conceptual problem situations at the very beginning.

Let's peek in at some electronic dilemmas and paradoxes to observe how they fall to pieces under the right kind of attack. We'll begin with one of the simplest of all, yet one that can cause no end of trouble for the beginner.

Plus-and-Minus Dilemma. Does an electric current flow from plus to minus or from minus to plus? Some textbooks read one way on this subject and others state the opposite case. To resolve this question once and for all, it is essential that the phrase "electric current" be properly defined and—what is more important—that this definition be accepted by everyone.

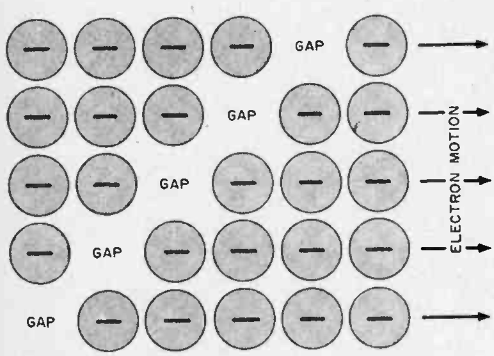

Fig. 1. Gaps between electrons in electric current flow have an apparent travel direction opposite from that of electrons.

We know that an electric current is a movement of electrons in a conductor. Since electrons are negatively charged particles, they must flow toward a more positively charged region if they flow at all, in accord with the law of charges which states that unlike electrical charges attract each other. Thus, *electrons must flow from minus to plus.*

When an electrical engineering textbook speaks of an electric current as movement from plus to minus, the author is referring to the original convention (attributed to Benjamin Franklin) that was adopted before the discovery of the electron. Hence, he is defining an electric current not as a flow of electrons but as a *motion of electrical energy in a direction opposite from that of electron drift.*

The surprising part of this dilemma is that either approach may be used with perfect safety as long as you are *consistent.* There is nothing wrong with defining the direction of an electric current as opposite

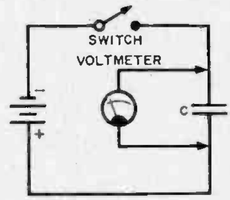

Fig. 2. Theoretical circuit for measuring voltage drop across a capacitor.

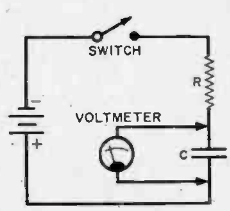

Fig. 3. Circuit of Fig. 2 with "hidden" resistances of circuit shown as R.

from that of electron flow. If one wishes to stretch the imagination a bit, it can be shown that something does seem to travel backward as electrons travel forward (Fig. 1).

Suppose that a row of pennies—simulating electrons—are laid end to end in a straight line. The penny at the right is moved further to the right over a distance equal to its own diameter, leaving an equal-size gap behind it. The next penny is then moved to fill the gap, the third is displaced

to fill the newly formed space, and so on. Obviously, as the pennies travel in one direction, *the gap proceeds just as rapidly in the other!* (This may seem to suggest an explanation of the motion of "holes" in transistors to some of you; actually, transistor action is considerably more complicated.)

Thus, the "plus-and-minus dilemma" resolves itself into a question of words. Most people in electronics prefer to deal with electron flow, particularly when working with vacuum tubes where the space current consists only of electrons. But the principal thing to remember is that either way of looking at it will work out in careful hands.

Capacitor-Charging Paradox. When a capacitor is set up in a circuit like that of Fig. 2, it is readily evident that the voltage—as read by the voltmeter connected across its terminals—builds up slowly. If the capacitor is on the order of several thousand microfarads, it may require two or three seconds to acquire a full charge equal to that of the battery potential.

This time lag, however, appears to contradict the fact that electrical energy is transmitted through wires at close to the speed of light! With this velocity involved, the battery voltage should appear across the capacitor instantaneously with the closing of the switch. Here, as we see, fact appears to contradict observation.

The solution to this riddle, as with so many others, lies in the omission of a not-too-evident fact: *no electrical circuit can ever be entirely free of ohmic resistance.* The internal resistance of the battery, the resistance at the connections and in the wires must be added to the total picture. Symbolizing these "hidden" resistances, as shown in Fig. 3, we can now explain the apparent paradox without difficulty.

Resistance *R* represents the internal battery opposition, that of the switch contacts and other circuit connections, plus the resistance of the connecting wires. The voltmeter is clearly measuring the potential drop across one portion of the voltage divider comprising *R* and *C*. When the switch is first closed, the capacitor offers no opposition to the charging current because it has not yet taken on a charge that could buck the applied e.m.f.; also, the small magnitude of *R* permits a large initial charging current to flow.

A large voltage drop therefore develops across *R*, leaving almost nothing for the capacitor. This explains why the voltmeter reads negligible voltage at the beginning of the process. As the current flows into *C*, however, the latter begins to build up a charge and, consequently, starts to develop a back-e.m.f. that opposes the charging cur-

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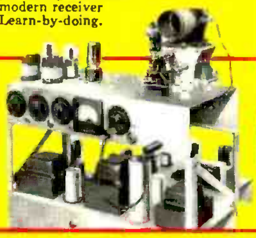

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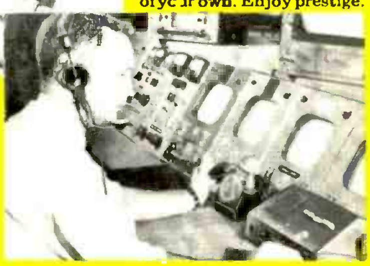

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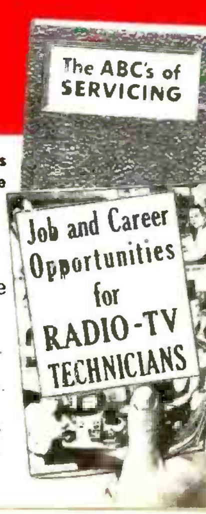

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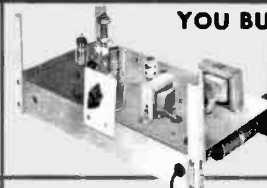

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YOU BUILD Broadcasting Transmitter

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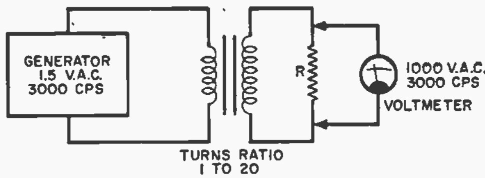


Fig. 4. This circuit appears to defy the turns-ratio rule of transformer voltage output. See text.

rent. Hence, the current diminishes slightly, the voltage drop across *R* likewise decreases, and the voltmeter now reads a higher potential across the capacitor.

This process continues until the counter-e.m.f. in the capacitor becomes equal to the battery voltage. At this point, the charging current ceases, the voltage drop across *R* becomes zero, and the capacitor shows the same potential as the battery. Thus, although the transfer of electrical energy from the battery may take place at high velocity, the charging of a capacitor is a matter of quantity of charge rather than speed of particle motion.

Sky-Rocketing Voltage. To the novitiate in electricity, an ordinary power transformer at first appears to violate the fundamental law of energy conservation because it can "step up" voltage and thereby seems to give "something for nothing." Later, when he finds that the current output of a transformer diminishes in the same proportion as the voltage is stepped-up, the beginner is ready to accept the turns-ratio-voltage-increase relationship: secondary voltage = primary voltage × number of secondary turns / number of primary turns.

Now our beginner is satisfied that a transformer can step up 100 volts to 500 volts if the secondary has five times as many turns as the primary. The current in the primary will be greater than five times the secondary current, and thereby makes up for the voltage gain.

But once having understood all of the above, imagine his discomfiture when he reads about a circuit (Fig. 4) that will produce *more than 1000 volts* across the secondary with only 1½ volts applied across the primary winding, the transformer having a turns ratio of *only* 1 to 20! According to his figures, the output voltage ought to

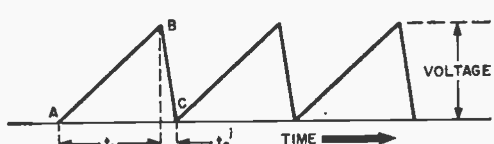


Fig. 5. Sawtooth waveform output of the generator which utilizes self-induction for voltage boost.

be about 30 volts, not 1000 or more. That is: secondary voltage = 1.5 × 20/1 = 30 volts.

"No!" he says, "This can't be! But wait a minute . . ." he adds as a thought strikes him, "the frequency of the a.c. in this circuit is 3000 cycles per second. Can that be the answer?"

Looking back at the turn-voltage equation, it is evident that frequency has nothing to do with the question since it does not even appear in the relationship. This leaves him in a real quandary. Is the equation wrong or is the author of the circuit trying to pull someone's leg?

The answer lies in neither of these possibilities. The author committed the unforgivable blunder of omitting to mention that the waveform of the input voltage was a *sawtooth* rather than a *sine wave*. In the circuit upon which this discussion is based, a transistor blocking oscillator was employed as the source of primary e.m.f. The d.c. source was a 1.5-volt dry cell. The set-up ratio is actually 20 to 1, and the transformer-induced secondary voltage is only 30 volts as predicted by the transformer equation. But the sawtooth waveform is the secret of the sky-rocketing output voltage that appears across the load resistor *R*. It works this way:

Line *AB* in Fig. 5 shows how the voltage across the primary slowly climbs from zero to its peak value during time t_1. The same waveform appears in the secondary winding, only it is amplified 20 times by the step-up turns ratio. When the applied potential reaches its peak at *B*, it drops sharply down to zero once again, this time in a very short interval (t_2). The magnetic field built up in the transformer during t_1 therefore cuts swiftly back through the turns of the windings and induces a new voltage of much greater magnitude than existed there before.

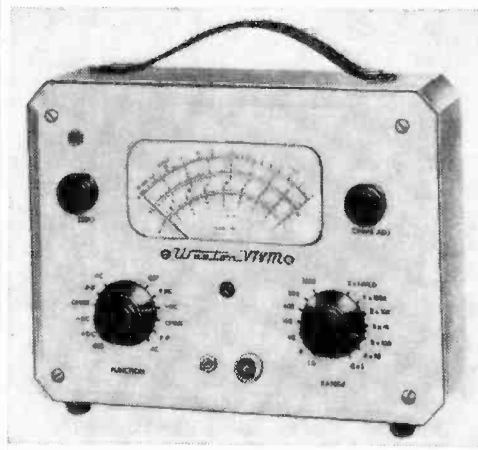
This voltage of self-induction has nothing to do with the turns-ratio of the transformer. Its size is dependent only upon the sharpness of magnetic field cutoff; the smaller the interval t_2 is, the greater will be the self-induced voltage in any given transformer. Thus, it is perfectly practical to obtain a voltage gain which far exceeds that predicted by the transformer equation when the primary a.c. has sawtooth or rectangular waveform.

Perhaps you, as a reader, have never been bothered by the dilemmas and paradoxes we have just described. It is more than likely, however, that you have been bewildered by others (and maybe still are). If they apply to electricity or electronics, write and tell us about them. —30—

TOOLS and GADGETS

BATTERY-OPERATED VTVM

Self-contained and battery-operated, this vacuum-tube voltmeter is particularly adaptable to the radio-TV servicing industry. It makes possible quantitative measurement of all complex waveform voltages



found in video, sync and deflection circuits. A special feature is its unique one-piece Plaskon Alkyd scale and mechanism mount. (*Weston Electrical Instrument Corp.*, 614 Frelinghuysen Ave., Newark 5, N. J.)

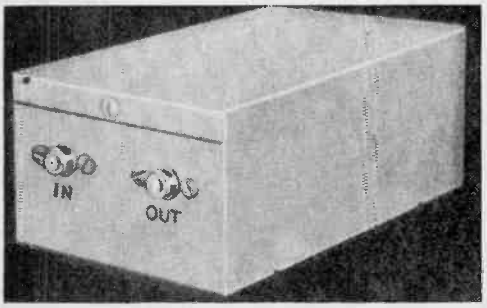
IN-CIRCUIT RECTIFIER TESTER

You can test all types of power rectifiers right in the circuit with the SRT-1 in-circuit selenium rectifier tester. It will check selenium, germanium and silicon units both in-circuit and out-of-circuit, with 100% effectiveness, according to the manufacturer. Tests can be made for quality (current emission), fading (falling emission after warm-up), shorts, opens, arcing and life expectancy.

Accurate readings are obtained on a large multi-color 3" meter which is highly sensitive yet rugged. Special circuitry prevents damage to the instrument and line fuses from blowing, while the rectifier being tested cannot overheat or otherwise be damaged. Price $29.95. *(Century Electronics Co., Inc.,* 111 Roosevelt Ave., Mineola, N. Y.)

REVERBERATION UNIT

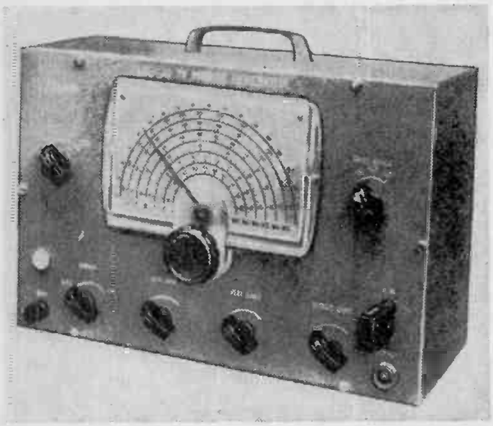
Said to contribute realism to the average home hi-fi system at minimum cost, the Model U-2 reverberation unit makes pos-



sible an illusion of "presence" without the necessity of special stereo program material. You simply connect this simple device between the basic amplifier output and the input of any auxiliary amplifier and speaker combination. Price, $18.75, prepaid or C.O.D. *(Ultron Company,* 7943 Haskell Ave., Van Nuys, Calif.)

TV MARKER GENERATOR

Designed to provide precision and flexibility in the alignment of FM and TV equipment, the Model LSG-30 is a combination



marker generator and vertical-horizontal bar generator. It has a frequency range of 3.5 mc. to 250 mc. in six bands with 1% accuracy. Calibration is checked by means of a 4.5-mc. crystal, accurate to 0.002%, mounted on the front panel.

There are simultaneous markers (crystal and variable oscillator) for r.f. and i.f.

alignment. Vertical and horizontal bar generator controls are provided on the front panel, and the horizontal bar frequency serves as an internal modulator for the r.f. output. Dimensions of the LSG-30 are 8" x 12" x 5", weight 9 lbs. The metal cabinet is finished in gray wrinkle and has a carrying handle. Net, $49.95. (*Lafayette Radio,* 165-08 Liberty Ave., Jamaica 33, N. Y.) -30-

Suit Your Volume with a T-Pad

(*Continued from page* 84)

speaker gets its operating voltage from across the (*b*) resistor, the response of the former would be practically zero. The attenuation in this case is about 40 db.

In making the above change, however, the impedance presented to the output transformer *has not changed*—it is still about 10 ohms, as shown in Fig. 3. The 9.8-ohm (*a*) resistor and the voice coil shunting the 0.2-ohm (*b*) resistor have very little effect upon the joint resistance of this branch so that, effectively, the upper 9.8-ohm (*a*) section is in series with a 0.2-ohm section for a total impedance of 10 ohms. Thus, a full range of volume control is possible with no distortion being introduced by large impedance variations. -30-

POP'tronics Secretary

(*Continued from page* 81)

record when the power is supplied to it, and you are ready for operation.

Arrange to have someone call you and watch what happens. The bell will ring, and each time it does, *RL1* will close. After about 15 seconds, *RL2* will close, and the recorder will start warming up, ready for the coming message. About 30 seconds later, when *RL3* closes, the handset pops up, enabling the induction coil beneath the phone base to send the message through to the recorder.

After about 30 seconds more the handset will go back in place, and the whole works will shut off—all but the transistor amplifier which continues monitoring the telephone bell. You may have to experiment a few times to get the correct volume control setting for the tape or wire machine.

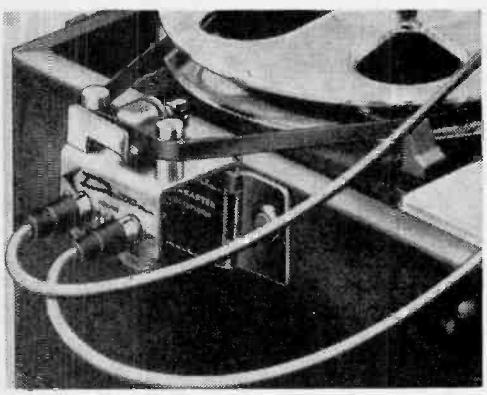
You can change the timing sequences in your telephone secretary within certain limits. *C2* controls the amount of times it will be necessary for the telephone bell to ring before relay *RL2* pulls in. To increase this time, use a larger capacitor, perhaps another 100-μμfd. unit. The values chosen were the result of many experiments and are a good compromise. -30-

Hi-Fi Highlights

(*Continued from page* 75)

8

Production version of experimental XP-3 cartridge with new design elements including air damping said practically to end groove jumping. It tracks as low as 1 gram, and uses an 0.7-mil diamond. Fairchild Micro-7.



9 **In-line stereo** attachment to convert most popular make tape recorders without alteration. It consists of in-line stereo head, tape guides, pressure plate and mounting hardware. Cables feed recorder and amplifier. Dactron Steradapter 4902.

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Out of Tune

Build a "Conversation Piece" (*March*, 1958, *page* 63): For better gain in preamplifier, connect *R3* (470,000 ohms) from base to collector of *TR2*, instead of to emitter.

Wireless Mike for Short Distances (*February*, 1958, *page* 63). Parts List shows a PA27 mike. If this is too large to fit cabinet, use Lafayette's MS108. —30—

Global TV

(*Continued from page* 53)

incide with the communication line direction, as this can create serious interferences.

"Let us assume that one satellite is over USSR, the second is over the Chinese Peoples Republic [Red China] and the third over USA. The transmitting TV center operates from 0000 to 0800 hours (by local time); this secures reception from the western satellite from 1600 to 2400 hours. With such an arrangement of stations, the USSR can operate on USA, the USA on China, and China on USSR. To use three other combinations of TV transmission corresponding to the same reception intervals (from 1600 to 2400), each of the TV centers must operate from 0800 to 1600 hours.

"Under such a time schedule and system of transmissions, the direction of the solar radiation will never coincide with the communication line direction. An exception is moments of shifting from transmission to reception at point *A* [in diagram on page 51], when the direction of solar radiation coincides with communication line *earth—C;* at the same time, however, the artificial earth satellite situated at point *C* is screened by the earth.

"The second case when solar radiation direction coincides with communication line occurs when the satellite arrives at point *r;* however, at the same time, the sun's radiation is directed toward transmitting waves coming from the earth. Thus, the sun does not shine on the satellite's reception antenna.

"All the aforesaid permits assuming that with directional antenna systems interference from solar radiation will not have a significant effect on the quality of TV transmissions."

WHICH BANDS WILL BE USED?

While transmission on u.h.f. short waves is desirable from the viewpoint of the weight and size of requisite relay units as well as gain in narrow antenna radiation patterns, the Russian designer is inclined to reject this possibility because it requires too exacting stability in the position of the orbiting satellites.

Current satellite exploration in orbits of 200 to 2000 miles from earth should throw new light on wave propagation in outer space, according to Mr. Petrov, who adds: ". . . but it can already be said that satellite reception of TV programs from earth will most probably be realized on the meter wave band, and satellite to earth transmission will be on microwaves, or even millimeter waves, in view of the desirability of minimal weights and dimensions.

"The attenuation of radio waves in cosmic space at a distance of 35,800 km. from earth will be the deciding factor," Mr. Petrov stated. "The bulk of the weight of radio equipment will be the power source; therefore, conversion of atomic energy to electric power is a most important problem of the global TV relay system."

A minimum of 10-kw. antenna power, with 100-kw. power source, is what Mr. Petrov estimates for a projected TV space station. He suggests that TV transmission in the future by pulsed instead of continuous radiation may cut down power requirements to one hundredth of the figure now estimated.

"At any rate," Mr. Petrov concludes, "the speed of development in peaceful use of atomic energy permits assuming that lightweight atomic power supply sources will be brought into being a great deal sooner than an earth satellite will be put in orbit at 35,800-km. altitude." —30—

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Is Radio Earthbound?

(*Continued from page* 52)

This will settle once and for all whether or not the radio wave, our only present-day hope for signaling other intelligent creatures on other planets, can conquer the void between our interstellar neighbors and ourselves. What a wonderful inspiration it will be to mankind to realize that there exists elsewhere than on earth other living, thinking beings.

Some plans were made for carrying a man as a passenger in the Goddard Rocket, and volunteers were even listed for the journey. Such a human sacrifice has been discouraged, for there is little doubt but that a man thus carried could not survive the trip for many reasons. It is also believed that the first tremendous impulse of the rocket in flight would be great enough to burst the blood vessels of the passenger; therefore the idea of the passenger has been abandoned.

In lieu thereof, the radio transmitter has been suggested as a passenger. It will certainly provide intelligent means for obtaining important facts about the vast spaces existing throughout the universe.

When the world of science knows for a certainty that the radio waves can carry through interstellar space, the time when further and more ambitious attempts to communicate with our planetary neighbors will be hastened.

This may answer the cynical queries of skeptics who demand to know what use all this sort of thing is to the world. Every new scientific fact produced supplies further tools with which to better our fast-growing and complicated structure of civilization. Let us hope success crowns the efforts of all men who dare to pioneer the distant fields of our universe. —30—

Electronic Computers

(*Continued from page* 43)

Each location can be described and located, so that either the information which it contains can be obtained or the location for new storages can be described.

In this type of computer, all of the information needed for a solution to a problem may be stored in the memory, including all of the steps or program required for the solution. Once the proper information is placed in the memory, the computer is independent of all outside devices until a solution is reached. Then the final results are stored until they are needed through the output device.

A magnetic-core memory is an example

■	1 M	2 E	3 G	4 O	5 H	M	■	6 R	7 F
■	8 A	R	R	A	Y	■	9 B	U	M
10 S	■	11 A	I	R	■	12 H	E	■	■
13 T	14 E	S	T	■	15 P	U	L	16 S	17 E
18 A	D	E	■	19 V	I	M	■	20 A	B
21 G	I	■	22 P	A	N	■	23 A	G	O
24 E	T	25 H	E	R	■	26 W	R	E	N
■	■	27 O	R	■	28 F	I	T	■	Y
29 V	30 A	T	■	31 A	U	D	I	32 O	■
33 U	S	■	34 S	C	R	E	E	N	■

Answer to crossword puzzle appearing on page 65.

DECIMAL NOTATION				
10^4	10^3	10^2	10^1	10^0
10,000	1000	100	10	1
		3	5	2
	4	1	6	7
5	0	2	1	3

Table 1. Decimal system is based on the number 10. The number 352 is actually 3x100, plus 5x10, plus 2x1. Figure out 4167 and 50,213 for yourself.

of an internal memory system in actual use. This is a large group of tiny ring transformers which are magnetized in one direction (clockwise) or the other (counterclockwise). Other memories include the early use of relays (open and closed for 1 or 0), magnetic drums (circular tracks of magnetic materials with pulses or no pulses for a 1 or a 0), the Williams tube (a cathode-ray tube with dots stored on the face for data), the capacitor store (where the charge on a capacitor changes with the digital data), a transistor or vacuum-tube memory (where the tube or transistor is either on or off for a 1 or a 0), and the delay line (which takes pulses and delays them until they are needed).

In the *control section,* the implementation of the program is directed. The control unit observes the instructions and plans their proper execution by following the principles of operation for a given machine. This selection may translate a multiply order into a series of additions, which it actually is to the computer.

Both the *input* and *output* devices are similar but they perform opposite functions. An input unit reads information from punched cards, magnetic tapes or special keyboards, and codes this data so that the computer can handle and use the information. The opposite function is performed by the output unit, which converts the results of computer operation to usable form such as typed sheets or punched cards for the control of production machines.

Binary Notation. Binary numbers which represent instructions or quantities for computation are usually presented in the binary or two-value system rather than the decimal system.*

Any on-off device can be used with the binary system. Numbers can represent letters and combinations of letters can, of course, make words, and complete sentences can be remembered.

A look at the ordinary decimal notation is helpful. Table 1 shows what everyone

* We count by tens because we have ten fingers but a relay switch, tube, or transistor is either *on* or *off*, which is the reason for the binary (two-number) system. See *After Class* in the January 1958 issue for details of binary system.

knows; the decimal system is based on 10. But, look again. The number 352 is really 3×100, plus 5×10, plus 2×1. (Any number to the zero power is 1.)

The binary system in Table 2 is the same but powers of 2 are used rather than powers of 10. Thus, decimal 1 is binary 01 or 0×2 (which is zero) plus 1×1 or 1. Also this is 0×2^1 plus 1×2^0. Decimal 3 is binary 11 or 1×2^1 plus 1×2^0 (or 1×2 plus 1×1 which is 3). In the same way, 4 is 100 (4+0+0), 5 is 101 (4+0+1), 6 is 110 (4+2+0), 7 is 111 (4+2+1), and 8 is 1000 (8+0+0+0). From Table 2, decimal 10 is 1010 (8+0+2+0), and 37 is 100101.

Digital computer "language" is usually a form of binary notation. In Fig. 7 are several stages of a transistorized computer. Each stage (*A* through *E*) is a transistor switching circuit which is either *on* (conducting) or *off* (non-conducting). A neon lamp is attached to each stage as a visual indicator. If decimal 20 is represented, stages *C* and *E* only are *on*, indicating 1's. All other stages are *off*, indicating 0's. In the same way, decimal 10 means that only stages *B* and *D* are *on*. If decimal 5 is represented, *A* and *C* are *on*, all others *off*.

Modular construction of computers is becoming increasingly significant. Since a digital computer performs many simple operations it is natural to expect that the basic circuits are repeated many times. A multivibrator with two states (a flip-flop) is a basic circuit.

There are disadvantages to a digital computer: the cost is high because a great number of small building blocks is required. There is a minimum size below which you just do *not* have a digital computer but, in effect, there is no minimum size for an analog machine. Digital computers are large, although desk-size for business and suitcase-size for airborne use are available. Usually, however, the digital computer tends to be larger than its analog counterpart.

High Precision. A digital computer is most useful when high precision is needed, several independent variables are required, and when the program or instructions have several "forks" or possible paths. It is also useful when the input is inherently present in digital form.

Speed is a characteristic of digital computers. Many can perform more than 10,000 operations in one second. But, this does *not* mean that a given problem is solved faster than on an analog computer, for the faster digital machine (in terms of individual operations) may have to do thousands of operations to arrive at an answer. Memory capacity is high in many digital computers: experimental memories can now store

1,000,000,000 digits. UNIVAC, for example, has a magnetic tape memory for 86,000,000 digits.

THE HUMAN COMPUTER

A *human* is a computer, and our own methods of calculating resemble both digital and analog. When a child counts on his fingers, he is computing with digits. When you lead a target with a shotgun, you are doing an analog computation. If you lay out a problem on paper, you are preparing a program.

The computer operates very quickly—far more quickly than any human operator—but it requires instructions for each step. In a sense, a digital computer may be thought of as a very fast clerk of limited intelligence.

While the differences between the human brain and the electronic computer (size, reliability, input-output, and organization) are important, the similarities are even more striking. All of the following points are indications of these similarities:

Arithmetic—Both can perform the basic operation of addition and by derivation, subtraction (negative addition), multiplication (repeated addition) and division (repeated subtraction).

Program—Both can and do follow a fixed program, for problem solving and computing.

Decisions—Both can make decisions based upon the need for one or another course of action (a digital computer is good at this).

Storage—Both can store information and transfer information both into and out of storage. Note that the computer has a *completely erasable* memory (no human has this). Since the computer memory can be erased, the computer has no prejudice; it will never prejudge a problem. —30—

BINARY NOTATION

Decimal Values	2^5	2^4	2^3	2^2	2^1	2^0
	32	16	8	4	2	1
1					0	1
2					1	0
3					1	1
4				1	0	0
5				1	0	1
6				1	1	0
7				1	1	1
8			1	0	0	0
9			1	0	0	1
10			1	0	1	0
15			1	1	1	1
25		1	1	0	0	1
30		1	1	1	1	0
37	1	0	0	1	0	1

Table 2. Binary system is same as decimal system, but it uses powers of 2 rather than 10. See text.

Kit Builder's Korner

(*Continued from page* 73)

enough room for the power and output transformer leads to be easily inserted in the grommets. With some wiggling and twisting of the leads, the job can be done, however, and things go smoothly thereafter.

Special Features. The last sections of the construction manual are devoted to detailed directions relating to the interconnection and operation of the UM-1 with several different c.w. transmitters. Among the transmitters with modifications listed are the Globe Chief 90 and 90A, the Knight 50-watt model, the Johnson Adventurer, and Heath's AT-1 and DX-20.

Output impedances of 500, 3000, 5000, 6500, 7500, 10,000 and 20,000 ohms are provided by the multi-tapped output transformer.

Comment. This unit's versatility is demonstrated by such features as provision for the use of a carbon, crystal or hi-Z dynamic microphone. A meter jack allows monitoring of cathode current. Output tubes used determine the output power available.

The comprehensive manual, the top-grade components and the well-designed circuit of the WRL modulator make it very attractive for any brass-pounder whose wrist is getting tired and who would like to exercise his vocal chords for a change. —30—

Transistor Topics

(*Continued from page* 78)

Any standard 4" to 8" PM loudspeaker having a 3-4 ohm voice coil can be used with the basic receiver circuit. The power supply battery (*B1*) can be a standard 6-volt lantern battery or four flashlight cells connected in series. *S1* can be any s.p.s.t. toggle or slide switch.

In operation, r.f. signals are fed to the first and second direct-coupled stages which serve as r.f. detector and audio amplifier. Additional amplification is provided by the third and last stages. The common-emitter arrangement is used in all four stages. *R2* serves as a feedback resistor and its connection to *T1's* secondary winding should be chosen experimentally; try connecting it first to one side of the secondary, then to the other, connecting the secondary's *opposite* terminal to circuit ground in each case. *R1* serves as a "sensitivity" control.

Triodes and Tetrodes. I have received a number of letters and postcards from readers who have somehow acquired transistors having *four terminal leads.* Assuming the transistors to be tetrodes, many readers have tried to use them in experimental circuits, and have had disappointing results.

There are *two* types of transistors that may be equipped with four leads. One is the familiar double-based junction tetrode, while the other is the relatively new high-frequency "drift" transistor. Although the drift transistor is basically a triode and has only *three* active terminals, some of these units are provided with an internal interelectrode shield brought out to a fourth terminal lead. The lead (or pin) spacing and arrangement of these four-terminal drift triodes may closely approximate that of common tetrodes.

Triode and tetrode transistors can be identified by their type number. If the type number's prefix starts with the numeral "2," the unit is a *triode;* if the prefix starts with a "3," it is a *tetrode.*

For example, RCA's new Type 2N544 is a *p-n-p* r.f. triode. It is a drift transistor with an alpha cutoff frequency of 30 mc. and a collector dissipation rating of 80 mw. (at 25° C). This unit is designed specifically for r.f. amplifier service. Although a triode transistor, the 2N544 has *four terminal leads.*

A typical tetrode is Texas Instruments' Type 3N25. This is a *p-n-p* double-base tetrode designed for use as an oscillator up to 250 mc. Like the drift triode, it has just four leads.

So, if you obtain a transistor having four leads, don't assume automatically that it is a tetrode—check the unit's type number. Typical tetrode and drift triode lead connections are identified in Fig. 4.

That does it for now. See you next month. . . .

Lou

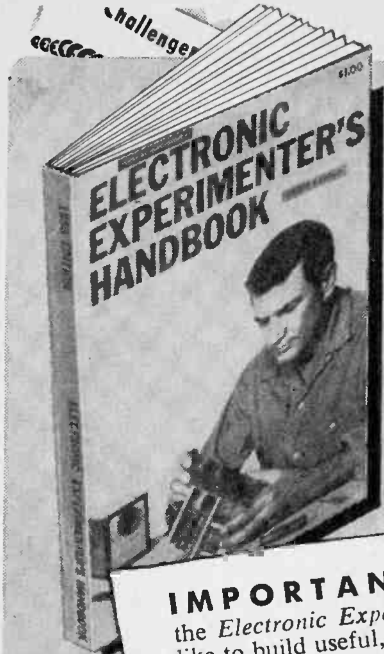
Wipe Out Record Scratch

(*Continued from page* 54)

to your amplifier or radio, then plug the record player pickup cable into the filter. If you have room in the record player, you might prefer to solder the two resistors and two capacitors directly to the back of the phono jack.

The resistors can be of any wattage—they only need to be small enough to fit inside the can. The capacitors can have any voltage rating, and can be mica, ceramic or paper.

If scratch is your problem, this filter is for you. —30—



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Among the Novice Hams

(*Continued from page* 87)

a question mark, it asks the corresponding question.

For example, *QTH* means: "My location (position) is ——. *QTH?* means: "What is your location (position)?" Thus, it is unnecessary to say: "My QTH is——," or "What is your QTH?" The extra words add nothing to the meaning.

To use Q signals, you must either memorize them and their meanings or have a list of them available at your operating position. You have to memorize some of them (QRK, QRM, QRT, QRX, QSA, QSY,

Q SIGNALS MOST USED BY AMATEURS

A question mark after the Q signal indicates that a question is intended

QRG—Will you indicate my exact frequency? Your exact frequency is. . . .
QRK—What is the legibility of my signals (1 to 5)? The legibility of your signals is (1 to 5).
QRL—Are you busy? I am busy with ..... Please do not interfere.
QRM—Are you being interfered with? I am being interfered with.
QRN—Are you troubled with static? I am troubled with static.
QRO—Must I increase power? Increase power.
QRP—Must I decrease power? Decrease power.
QRQ—Must I send faster? Send faster (....words per minute).
QRS—Must I send more slowly? Send more slowly (.... words per minute).
QRT—Must I stop transmitting? Stop transmitting.
QRU—Have you anything for me? I have nothing for you.
QRX—When will you call again? I will call you again at .... (on .... kc.).
QRZ—By whom am I being called? You are being called by .....
QSA—What is the strength of my signals (1 to 5)? The strength of your signals is .... (1 to 5).
QSB—Does the strength of my signals vary? The strength of your signals varies.
QSL—Can you acknowledge receipt? I acknowledge receipt.
QSO—Can you communicate with .... directly (or through)? I can communicate with .... directly (or through ....).
QSP—Will you relay to .... free of charge? I will relay to .....
QSY—Shall I change to .... kc. without changing the type of wave? Change to .... kc. without changing the type of wave.
QSZ—Shall I send each word or group twice? Send each word or group twice.
QTC—How many telegrams have you to send? I have .... telegrams to send.
QTH—What is your position (location) in latitude and longitude (or by any other indication)? My position (location) is . . . . in latitude and longitude (or by any other indication).
QTR—What is the exact time? The exact time is .....
QRRR—Unofficial APRL land SOS. (For emergency use only.)

and QSZ) in preparing for the General Class examinations, so you might as well use them. A list of the most used Q signals appears above; it should be helpful to you.

Punctuation. Most Novices use too much punctuation in their radio contacts. Punctuation marks are essential in any kind of formal writing, but they seldom do much for a radio contact—except slow it down. Experienced amateurs get by very well with just two punctuation marks: the double dash (— . . . —), and the question mark.

They use the double dash between sentences to indicate a change of subject and the question mark after Q signals and a few other signals to indicate a question. The question mark is also used in correcting an error and to emphasize an important or difficult word. When an operator realizes that he has made a mistake, he sends a question mark, repeats the last correctly sent word, and continues his transmission from that point. To emphasize a word, he may follow it with a question mark and then repeat the word.

Precautions. Obviously, the reason for using abbreviations on the air is to save time. But they waste time if the other fellow does not know what they mean. If in doubt, avoid them. Also, abbreviations should *not* be used in formal messages to be relayed by other stations to their destinations. The chance of errors creeping in is too great.

Let me point out, too, that the FCC prohibits the use of secret codes and ciphers by amateurs. This does not apply to Q signals or abbreviations such as those described above, but it prohibits you from using your own secret code on the air.

Abbreviations and Q signals were designed primarily for c.w. (code) operation; therefore, they are not very satisfactory for phone work. They seldom save time or do as good a job of getting your thoughts across as plain English does. However, most amateurs feel that an occasional c.w. term sprinkled in their phone contacts brings out their flavor, like salt on tomatoes. One reason for this is that a few of them have acquired a special meaning of their own. For example, most amateurs agree that there is a suitable difference between the meaning of DX and just plain *distance*.

News and Views

Bruce, VE3CLU, runs 35 watts to a "surplus" ATR-11 transmitter which feeds a 135' antenna. He operates mostly on 80-meter c.w. and has racked up 15 states—10 confirmed—in three weeks on the air. Bruce also operates on 6 and 2 meters, but he did not mention what he uses on those bands. He offers to help others obtain their licenses. . . . . **Charles, W3INW/WN3INW,** runs 26 watts to a home-built transmitter on 40 meters to feed a 40-meter folded-dipole antenna. He has made about 20 contacts in a month on the air. Charles receives with a Hallicrafters S-40A and an S-38; his best DX is Cuba. He has an HT-9 transmitter and HT-18 VFO waiting for the day he gets his General Class license, but he needs a little help with his code speed.

Jackie, KN4QXE/K4QXE, started with a 25-watt, home-built transmitter to feed a 20'-high dipole antenna through a home-built antenna tuner. He has now graduated to a Knight transmitter at 60 watts, and he receives on a Heathkit AR-3. With this equipment, in five months on the air, Jackie has worked 43 states, all confirmed, and Brazil, Puerto Rico, Peru, and Canada on 40 and 15 meters, making 400 contacts and getting 328 QSL cards in the process. . . . . **Orrin, KN9KEJ,** did not impress anyone with the strength of his signals with his original 10-watt transmitter. So he graduated to a converted ARC-5 running 50 watts. He has tried a variety of antennas—including a short "long wire," an in-and-out doublet, which was half in the house and half outside, and a non-radiating dipole (?) to amass a total of 15 states in five months. But watch his total

---

QRRR!

There were about five inches of snow on the ground when **Jack, KN2KSL,** and **Bob, K2ZSQ,** both 14 and Senior Patrol Leaders of Troop #38, Rahway, N. J., and about 15 other scouts arrived at Camp Winnebago, Marcella, N. J., on February 15 for an "overnight." In the two hours it took to put up a "long-wire" antenna and tune up their Harvey-Wells TBS-50 transmitter, another ten inches of snow had fallen. It snowed all that night and all day Sunday. Their only contact with the outside world was through KN2KSL/2 and K2ZSQ/2.

Dick, K2PHR, took the first message notifying the scouts' parents that they were safe but snowed in. He stood by all that Sunday, handling many messages and keeping the local newspapers and radio stations informed. On Monday morning, it was 6° below zero, and still snowing. The scouts' water supply was exhausted, fuel was low, and food was being rationed. John, K2ZHK, was worked every hour starting at 8:00 a.m. He reported that if the snow plow did not break through to the camp by afternoon, a helicopter would drop supplies to them.

The plow did break through, and, soon afterwards, it stopped snowing, leaving 5½ feet of snow on the ground. But their troubles were not over. It was impossible to dig a single car out of the snow. Word was flashed to K2ZHK to notify everyone concerned that the scouts would have to spend another night in camp. On Tuesday, after hours of digging, one car was dug out and started, and by 4:00 p.m. the last scout was evacuated after the longest and most exciting "overnight" any of them had ever experienced.

Bob and Jack say: "If it had not been for the help of K2PHR and K2ZHK, we would probably still be in the camp. We also want to thank K2QNI, K2DQU, K2QWF, W2FSL, W2QYW and the other hams who helped us."

---

climb now—Dave, K9JEJ, has just presented his old "all-band" vertical antenna to Orrin!

Pete Humprey, Jr. (16), 912½ W. Long St., Orlando, Fla., thinks that most prospective amateurs study the code in the wrong manner; he has devised a Novice course of his own, which he offers free of charge. If interested, I suggest that you include a stamped envelope with your request. . . . . **Ken, K6TWT,** now in his second year as a General, advises new Novices to avoid quick, easy contacts. By carrying on regular conversations, he says, your code speed will improve, and you will make a lot of friends. Besides, you will find out how much fun the code really is. . . . . **Bill, KN1DDR,** has worked 23 states, 21 confirmed, with his WRL Globe Chief transmitter feeding a dipole antenna. He receives with an S-38 receiver. Bill hopes that his General license is on its way. He and other Novice W1's and W2's are planning a 40-meter phone net on Saturday mornings when they get their General tickets. Write to KN1DDR if interested.

Ed "Red" Skelton expects to have his Novice license soon. He receives with a S-38 which he retrieved from the city dump, where it had been *under salt water for several weeks!* It worked fine after being dried out! . . . . **Steve, KN3BVV,** feeds his Johnson Adventurer transmitter into a 40-meter folded dipole via a pair of balun coils. Although only 18′ high, this antenna has pushed a signal into 39 states, Puerto Rico, Guantanamo Bay, Panama Canal Zone, Chile, Canada, and Alaska. Steve receives on a Hallicrafters SX-99. He

FOR PROSPECTIVE NOVICES

The *Study Guide For Novice Class Amateur Radio License* is a booklet that backs up its title. Its 30 pages tell what amateur radio is and how to obtain a Novice license. It gives practice questions and answers to help you prepare for the examination, and tells how to learn code. Also included is a "practice" exam to enable you to decide when you are ready for the official test. At 25 cents a copy, this study guide is a bargain for any prospective Novice. It's available from World Radio Laboratories, 3415 West Broadway, Council Bluffs, Iowa.

was just given a 45′ steel tower on which he plans to erect a tri-band beam when his General Class license comes through.

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Why don't *you* tell us about *your* experiences on the air? Include a picture of yourself and your equipment if you have one available.

Until next month, 73.

Herb, W9EGQ

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Short-Wave Report

(*Continued from page* 82)

The following is a compilation of current reports. All times shown are EST and the 24-hour system is used. Although reports are correct at time of compilation, we cannot be responsible for late changes made by stations with little or no advance notice.

Algeria—*Radio Algerie,* Algiers, has been noted on a new 11,835-kc. outlet at 1500-1645 in French. (*100*)

Antigua—*R. Antigua,* St. Johns, is reported operating on 3255 kc. on Mondays and Wednesdays at 0530-0600 and on Fridays at 0500-0600 in Eng. (*349*) Has anyone heard this one yet? (*Ed.*)

Argentina—The new schedule for *R. Nacional,* LRA, Buenos Aires, 9690 kc., reads as follows: 1600-1630, Spanish; 1630-1700, French; 1700-1730, Portuguese; 1730-1800, German; 1800-1830, Italian; 1830-1900, English; 2300-2330, Spanish to N.A.; 2330-0000, English to N.A. (*AN*)

Austria—OEI22, *Osterreichische Rundfunk,* Vienna, 7245 kc., is noted in the East at 2300-2345, although not often due to heavy QRM. It is also reported in the Western area at 0430-0530 with an English xmsn. (*349, 398*)

Brazil—*Radio Rio Mar,* Manaus, 9695 kc., is a new station noted from 1800 to 2000 s/off in Portuguese language. ID is with three gongs. (*100, 420*)

Burma—The Burma B/C Service, Rangoon, is now on 7117 kc. with the second of their new 50-kw. xmtrs, and is heard around 0700 in the Home Service, dual to 11,765 kc. Eng. news is carried daily from 1000 to 1015. (*MEC, 28, 100*)

Cambodia—*Radiodiffusion Nationale Khmere,* Phnompanh, 6090 kc., has been noted in Cyprus from 0800 to 0902 s/off. French news is heard at 0800-0815; remainder is classical music from 0820 to 0830 and popular Western music to close. ID is given in French and Cambodian. (*MEC*)

Canada—*Radio Canada* has opened a new xmsn to the Caribbean area on CKUS, 15,105 kc., at 1645-1705 in French and at 1705-1740 in English. This is dual to CKNC, 17,820 kc. Eng. is broadcast to the USA at 2000-2040 on CKLX, 15,190 kc., and CHLR, 9710 kc. (*JG, 192, 242, 378, 401*)

Ceylon—The Commercial Service of *R. Ceylon* is widely noted on 15,265 kc. at 2030-2130 with pop music, at 2100-2110 with news relay from the BBC. The 15,120-kc. outlet is heard at 1400-1600 with "Music USA;" 9520 kc. carries a quiz show at 1000-1100. These programs are all English. (*11, 286, 348*)

China—English services from *R. Peking* are as follows: 2045-2115 to Eastern N. A. on 9665 and 11,820 kc.; 2200-2230 to Western N. A. on 15,115 and 17,745 kc.; 0730-0800 to S. E. Asia on 11,820 and 15,095 kc.; 0400-0500 to Australia and N. Z. on 15,060 and 17,835 kc.; 1000-1030 to India and Pakistan on 9700 and 11,805 kc.; 1400-1430 to N. Africa, Middle and Near East on 9510 and 11,945 kc.; and 1430-1500 and 1630-1700 to Western Europe on 7080 and 9460 kc. *(11, 348)*

Columbia—HJGC, *R. Sutatenza,* Bogota, 5075 kc., is heard well from 1900 to 2210 s/off with American pop records, classical music, and news in Spanish. *(61, 190, 396, 420)*

A new station is HJBJ, *R. Quibdo, La Voz del Choco,* Quibdo, and is tuned on 5043 kc. irregularly at 1900-2200. *(100)*

Useful Books

Better Shortwave Reception, by William I. Orr, W6SAI, covers many phases of the hobby not usually treated elsewhere—how to choose equipment, check alignment, etc. It is available from Radio Publications, 555 Crestline Drive, Los Angeles 49, Calif., for $2.85. (This book was reviewed in the January "POP'tronics Bookshelf.")

The International Shortwave Club, Dept. FR, 100 Adams Gardens Estates, London, SE 16, England, has published a *Yearbook* including country prefixes, mileages, time conversion, addresses of stations, and QSL Bureaus of the world. Price is $1.25 in the USA and Canada, with a special discount of 10% for ISWC members.

Costa Rica—TIFC, San Jose, 9647 kc., has an Eng. religious program at 2300-0000. This is in dual with 6037 kc. (not often heard). *(SH, 338, 349)*

TIHBG, San Jose, 6006 kc., formerly *R. Cristal,* now announces as *Radio Reloj.* It was noted at 1900-0000. *(100)*

TIGG, *R. Excelsior,* San Jose, 6075 kc., made a rare appearance around 2130 kc. *(420)*

Dominican Republic—New stations include: HI2S, *Onda Musical,* Ciudad Trujillo, 3345 kc., heard irregularly at 2230-2300; HI2D, *Radio Hit Musical,* 3891 kc., heard fairly well at 1900-2300; HI1N, *La Voz de la Reeleccion,* formerly on 6050 kc. and inactive for some time, now on 3530 kc. and noted at 1900-2200. HI2D and HI1N are in Santiago de los Caballeros. *(100)*

Egypt—United Arab Broadcasting Service, Cairo, is widely heard on 11,991 kc. at 1400-1500 in Arabic and at 1600-1700 with Eng. news, pop music, some requests. The 17,915-kc. outlet is noted with Eng. news and pop music at 0830-0930. *(PG, HJ, TM, 59, 61, 190, 226, 277, 349, 365)*

France—See item under "Haiti."

French Guinea—*R. Conakry,* 4910 kc., opens at 0130, closes at 0230 with "La Marseillaise." Most anmts are in French, with French music and news. *(28, 61, 396)*

Haiti—Your Editor continues to receive numerous reports of *Radio Paris* on approximately 9480 kc. with the program "Paris Star Time." This is a recorded program that is broadcast over stations in other countries. The station from which this program originates, usually on Sundays at 1830, is 4VC, *R. Commerce,* Port-au-Prince, 9485 kc., and *not* Paris.

Honduras—What may be a new outlet is

HRCM, location unknown, on 6030 kc. Noted at 2300, this one could do with some further checking. *(420)*

Hungary—Budapest operates to N. A. in Eng. at 1900-2000 and 2200-2330 on 9833, 7220 and 6195 kc. On Tuesdays there is a special program for hams and DX'ers in Eng. at 1930-2000. A new xmsn to S. E. Asia at 0730-0830 on 7472 and 6198 kc. has been reported. *(RB, JE, 196, 386)*

Japan—*Radio Japan,* Tokyo, can be heard at 1800-1900 in Eng. to Eastern N. A. on 11,705 and 9525 kc., and at 0000-0100 to Western N. A. on 11,705 and 15,325 kc. The last 10 minutes is in Japanese. *(223, 226)*

Luxembourg—*R. Luxembourg,* Junglinster, is noted on 6090 kc., s/on at 0027 with an eight-note melody IS, ID at 0030 with popular European music to 0145 and news to 0200. This is in the European service. *(JG)*

Malaya—*Radio Malaya,* Singapore, was noted and confirmed on a new 9545-kc. channel with English at 0630 followed by music. *(377, 400)*

Mexico—A new station is XECMT, Ciudad El Mante, 6090 kc., heard from 1900 to 2100 s/off, relaying m.w. outlet XECM. They seem to feature L.A. and N.A. records and frequent ID. *(100, 420)*

Mozambique—Lourenco Marques, 4945 kc., has pop records, some Westerns, and requests at 2315-0000 with anmts in English and Portuguese. *(226)*

Nepal—*Radio Nepal,* Kathmandu, 7100 kc., is back on the air, presumably with a used 20-kw. xmtr purchased from Brazil. It is noted in Cyprus as early as 0635; world and local news in Nepali at 0730-0745; world news in Eng. at 0745-0750. Off the air promptly at 0750, this station is believed to be operating on Wednesdays only. *(MEC)*

Nicaragua—YNEQ, *Voz de la Victoria,* Managua, 6065 kc., has shown up at 2255 to 2300 s/off at strong level. It is rarely heard. *(420)*

Nigeria—The Nigerian B/C Corp. operates from Kaduna on 3326 kc., opening at 0200 with a news relay from the BBC, and from Lagos on 4990 kc., as a dual station. *(DR)*

North Vietnam—The *Voice of North Vietnam,* Hanoi, is noted at 1010-1029 with Eng. from 1015. This is usually heavily QRM'ed by teletype stations. *(396)*

Poland—*R. Warsaw* carries this schedule

(Continued on page 126)

SHORT-WAVE ABBREVIATIONS

anmt—Announcement
BBC—British Broadcasting Corporation
B/C—Broadcasting
Eng.—English
ID—Identification
IS—Interval signal
kc.—Kilocycles
kw.—Kilowatts
L.A.—Latin America(n)
m.w.—Medium wave
N.A.—North America(n)
QRM—Station interference
QSL—Verification
R.—Radio
s/off—Sign-off
xmsn—Transmission from station
xmtr—Transmitter used by station

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Short-Wave Report

(Continued from page 123)

to N.A.: 0600-0630 on 15,120 and 11,740 kc.; 0715-0745 and 0745-0815 on 15,120 and 11,755 kc.; 1930-2000, 2000-2030, and 2130-2200 on 11,705, 9615, and 9540 kc.; and 0030-0100 on 11,705 and 9615 kc. *(348, 376)*

Warsaw has also been noted in Danish to Europe at 1330-1400 with poor modulation. This may possibly be the commercial xmtr SOE49 on 4932 kc. *(MEC)*

Portugal—CSA66, *Emissora Nacional*, Lisbon, is heard well in their beam to East and South Africa at 1215-1300 with Eng. music, news, and talks. *(SG, 61)*

Sierra Leone—Freetown is noted on 3316 kc. with BBC news at 0200, local news and weather from 0215, and light music to 0259. S/off, 0300. *(60, 61)*

South Africa—S. African B/C Corp., Johannesburg, can be noted on 25,800 kc. with Eng. at 0600-1300 on Tuesdays, Thursdays, and Saturdays, and is best heard at 1000-1230. Eng. news at 1100. Religious programs on Sundays at 1200. *(61, 383, 398)*

South Korea—Seoul can be heard on 11,930 kc. at 0300. It is scheduled for 0030-0500. Another outlet is on 9640 kc. with Eng. at 0530-0600. *(225, 313)*

Sudan—*R. Omdurman*, Khartoum, has moved from 4970 to 5008 kc. and is scheduled daily at 2315-0030 and 1030-1530, Fridays at 0000-0400 and 0930-1530, Sundays at 0230-0400 and 1000-1530. *(MEC, 375)*

Sweden—*Radio Sweden*, Stockholm, uses the following schedule: to N.A. (Eastern) at 2000-2115 on 11,810 kc. in Eng. and Swedish and at 0900-0930 on 17,840 kc. in Eng.; to N.A. (Western) at 2130-2245 on 11,810 kc. in Eng. and Swedish. "Sweden Calling DX'ers" is broadcast Mondays to N.A. in Eng. at 0900 on 17,840 kc., and at 2045 and 2215 on 11,810 kc. They issue a weekly program bulletin. *(SS, SW, 10, 61, 303, 386)*

Switzerland—Catholic Midnight Mass on Christmas Eve, originating through *R. Lausanne*, is also carried on HER4, 9535 kc., at 1800-1900. *R. Lausanne* reportedly does not verify but HER4 did confirm this broadcast. *(235, 240)*

Tangier—The *Voice of America* relay station has a DX program on Tuesdays at 2315-2330. *(225)*

Thailand—HSK9, Bangkok, is heard from 0500 to 0900 s/off, with the only Eng. noted at 0900. *(286)*

Turkey—The Naval War School operates a new station on the Heybeli-ada Island near Istanbul with American recordings and Turkish anmts on Sundays at 0330-0430 and 0630-0730 on 7154 kc. *(377)*

Uruguay—CXA60, *R. Sarandi*, Montevideo, 15,388 kc., is heard on Mondays at 2000-2100 in Eng., other days at 1800-2100 in Spanish. *(KC, SG, 59, 100, 360, 420)*

USSR—*Radio Tashkent*, widely heard on 11,690 kc., is now being noted on 7100 kc., paralleling the 11,690-kc. outlet, at 0730-0800 in Eng. to India and Pakistan. Other xmsns include: 0800-0900 in Urdu to Pakistan; 1015-

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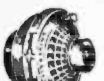

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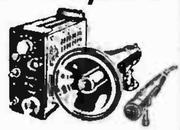

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1030 in Ulghur to Sinkiang; 1030-1100 in Persian to Iran and Afghanistan (also at 1230-1300); 1130-1200 in Eng. to India and Pakistan. This one causes much QRM to Nepal on the same channel. (*MEC, 377*)

Vatican City—The Vatican radio has been noted with Eng. news at 1000-1015 on 15,120 kc. with a generally poor signal. (*279*)

Clandestine—*Sawt ya Africa Hurru* (*Voice of Free Africa*) is being noted between 17,890 and 17,900 kc. S/on is at 1200, s/off at 1240, with timpani and samba record. They feature old American records and emotional speeches in Swahili. (*396*)

Non-QSL Stations—During the course of the past three years, the following stations have failed to respond to numerous reports: *Radio Clube do Huambo, R. Clube de Huila, R. Clube do Cuanza Sul, R. Clube Mindelo, R. Tchad,* ELBI (Monrovia), *R. Pax* (Beira, Mozambique), *R. Lome, R. Bahrein, R. Kuwait,* Burma Broadcasting Service, *Radiodiffusion Nationale Lao, Ankara Police Radio, R. Sana, Emissora Vila Verde,* and the Thai National Broadcasting Station. The following are erratic in verifying: *R. Addis Ababa, R. AEF, R. Kabul,* Saudi B/C Station, *R. Ceylon, Istanbul University Radio, Radio Goa,* and HLKA (Seoul). (*MEC*)

—30—

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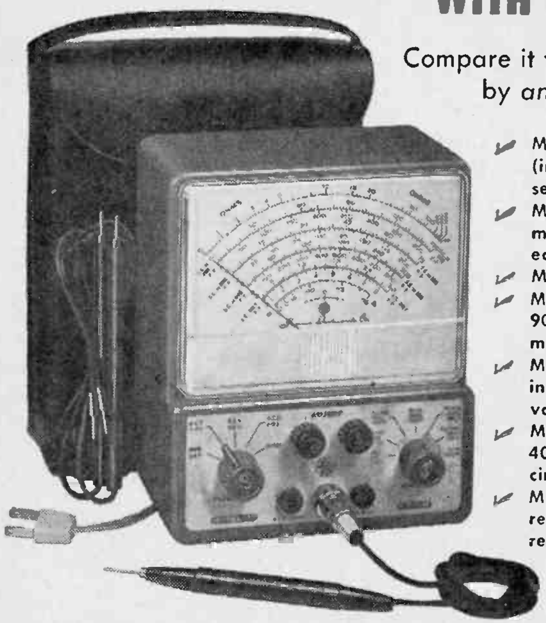

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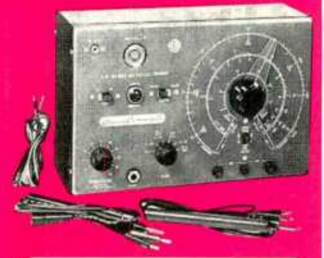

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- ✔ Color Dot Pattern Generator
- ✔ Marker Generator

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.

R. F. SIGNAL GENERATOR: 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: Provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

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.)

BAR GENERATOR: Pattern consists of 4 to 16 horizontal bars of 7 to 20 vertical bars.

CROSS HATCH GENERATOR: The pattern consists of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

Complete with shielded leads **$47.50 Net**

Model TV-50 — Genometer
Total Price $47.50
Terms: $11.50 after 10 day trial, then $6.00 per month for 6 months.

We invite you to try before you buy any of the models described on this page, the preceding page and the following pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

SEE OTHER SIDE

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Dept. D-468, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligation.

☐ Model 76 .... Total Price $26.95
$6.95 within 10 days. Balance $5.00 monthly for 4 months.

☐ Model TW-11 .... Total Price $47.50
$11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ Model TV-50 .... 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 77 .... Total Price $42.50
$12.50 within 10 days. Balance $6.00 monthly for 5 months.

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Model TW-11 — Tube Tester
Total Price $47.50
Terms: $11.50 after 10 day trial, then $6.00 per month for 6 months.

SHIPPED ON APPROVAL

NO MONEY WITH ORDER

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Superior's New Model TW-11 STANDARD PROFESSIONAL

TUBE TESTER

• Tests all tubes, including 4, 5, 6, 7, Octal, Lockin, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Subminars, Proximity Fuse Types, etc.

• Uses the new self-cleaning Lever Action Switches for individual element testing. All elements are numbered according to pin-number in the RMA base numbering system. Model TW-11 does not use combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

• Free-moving built-in roll chart provides complete data for all tubes. Printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE

SEPARATE SCALE FOR LOW-CURRENT TUBES Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

Housed in hand-rubbed oak cabinet **$47.50 Net**

Model TV-12—Transconductance Tube Tester—Total Price $72.50
Terms: $22.50 after 10 day trial, then $10.00 per month for 5 months.

Superior's New Model TV-12 TRANS-CONDUCTANCE

TUBE TESTER

★ Employs improved TRANS-CONDUCTANCE circuit. An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

★ NEW LINE VOLTAGE ADJUSTING SYSTEM. A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.

★ SAFETY BUTTON — protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

EXTRA FEATURE:

Model TV-12 Also Tests Transistors!

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

Housed in hand-rubbed oak cabinet **$72.50 Net**

TRY FOR 10 DAYS

BEFORE you buy! **THEN** if satisfactory pay in easy, interest free, monthly payments. See coupon inside.

We invite you to try before you buy any of the models described on this and the preceding pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate. (See other side for time payment schedule details.)

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

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