FM—35 STATIC-FREE YEARS

elementary Electronics

MARCH-APRIL
75c

2/23

BASIC COURSE:
Combination series and parallel DC circuits

in this issue

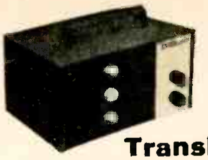
4 GREAT PROJECTS!!!

- **Pennypincher's Stroboscope**
  — you can't beat it at five times the price
- **Hot Line Intercom**
  — convenient as a telephone, private as a bedroom
- **1-FET Emergency-Band Converter**
  — tuck it under the dashboard, and put yourself in the action seat
- **DXer's S9 Module**
  — slams pizzaz aplenty into budget shortwave receivers

Dazzle your friends with lightworks.

Sound n' Color®

The *new* dimension to music pleasure. EICO All Electronic Solid-State Audio-Color Organs transform sound waves into moving synchronized color images. Connect easily to speaker leads of hi-fi or radio. From $29.95.



Translators

The electronics you need to create audio-stimulated light displays to your own imagination. Actuates Light Display Units, Strobe Lites, any lamp configuration (Xmas trees, patio lights, etc.) From $24.95 kit, $39.95 wired.

Strobe Lites

High-intensity bursts of white light from Xenon tube flash in cadence with each beat of audio. From $24.95 kit, $39.95 wired.

Build the Stereo Kits praised by experts.

All amplifier power ratings according to IHF standards. Cortina® designed and manufactured in U.S.A. and guaranteed by EICO.

70-Watt AM/FM Stereo Receiver including cabinet. Cortina 3770, $189.95 kit, $279.95 wired.

70-Watt FM Stereo Receiver including cabinet. Cortina 3570, $169.95 kit, $259.95 wired.

150-Watt Silicon Solid-State Stereo Amplifier, including cabinet. For the audio perfectionist. Cortina 3150, $149.95 kit, $225 wired.

70-Watt Silicon Solid-State Stereo Amplifier, including cabinet. Cortina 3070, $99.95 kit, $139.95 wired.

FM Stereo Tuner including cabinet. Cortina 3200, $99.95 kit, $139.95 wired.

EC-1100
EM WIRELESS MIKE $9.95

Build for fun and use with Eicocraft® jiffy project kits.

The newest excitement in kits. 100% solid-state and professional. Expandable, interconnectable. Excellent as introductions to electronics. No technical experience needed. Finest parts, pre-drilled etched printed circuit boards, step-by-step instructions. 36 kits to select from, $2.50 to $9.95. Just released: EC-2600 "Super Snoop" $8.95, EC-2700 Police & Fire Converter

(lo band) $7.95; EC-2800 Aircraft Converter $7.95; EC-2900 Police & Fire Converter (hi band) $7.95; EC-3100 2-Station Intercom (with cases) $10.95; EC-3200 "Do-It-Yourself" PC Etching Kit $4.95; EC-2300 Audio Preamplifier $8.95; EC-2400 Bullhorn $8.95; EC-2500 Fuzzbox $8.95.

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For all 6V/12V systems; 4, 6, 8-cyl. engines. Now you can keep your car or boat engine in tip-top shape with this solid-state, portable, self-powered universal engine analyzer. Completely tests your *total* ignition/electrical system. Complete with comprehensive Tune-up & Trouble-shooting Manual. EICO 888, $49.95 kit, $69.95 wired.

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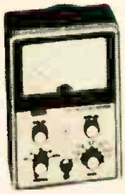

EICO 240 Solid-State FET-TVOM
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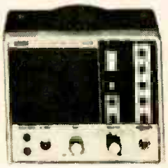
EICO 379 Solid-State Sine/Square Wave Generator
$69.95 kit, $94.50 wired

EICO242 Solid-State Deluxe FET-TVOM
$69.95 kit, $94.50 wired



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Here's a new, complete ICS course in TV Servicing that costs less than $100.

With the first two texts, you can repair 70 percent of all TV troubles.

You need no previous experience to take this complete, practical course in TV Repairing.

You don't even have to know a vacuum tube from a resistor. Yet in a matter of months, you can be doing troubleshooting on color sets!

Course consists of 6 texts to bring you along quickly and easily. 936 pages of concise, easy-to-follow instruction, plus 329 detailed illustrations. You also receive a dictionary of TV terms geared directly to course material so you'll understand even the most technical terms.

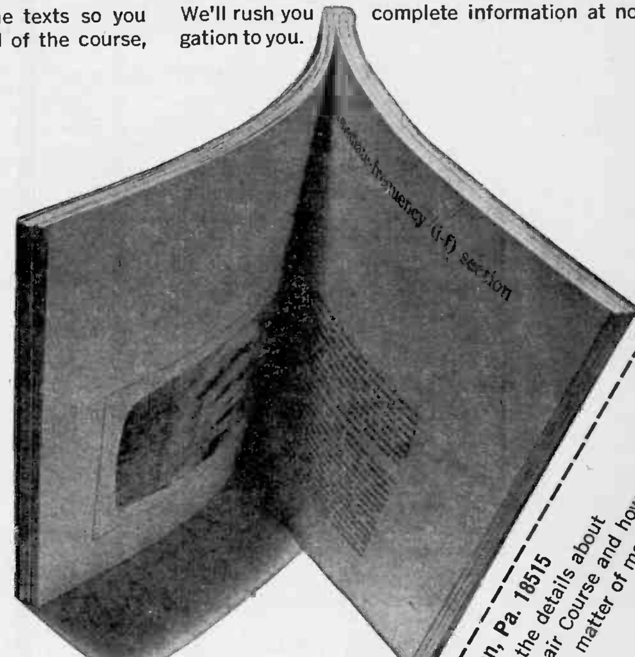
Instruction is simple, very easy to grasp. Photos show you what a TV screen looks like when everything is normal, and what it looks like when trouble fouls it up. The texts tell you how to remedy the problem, and why that remedy is best.

Quizzes are spotted throughout the texts so you can check your progress. At the end of the course, you take a final examination. Then you get the coveted ICS® diploma, plus membership in the ICS TV Repairman Association.

By the time you've finished the course, you should be able to handle tough, multiple TV problems, on color sets as well as black and white.

This new TV Servicing and Repair Course has been approved by National Electronic Associations for use in their Apprenticeship program. Because of its completeness, practicality and price, it is the talk of the industry. The cost is less than $100—just slightly over ½ the price of any comparable course on the market today.

Remember, the sooner you get started on your course, the sooner you'll be turning your spare time into real money. Fill out the coupon and mail today. We'll rush you complete information at no obligation to you.



ICS, Dept. J9771A, Scranton, Pa. 18515

Yes, I would like to have all the details about your new TV Servicing/Repair Course and how I can break into TV work in a matter of months.

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• March/April 1970 • Vol. 10, No. 1

elementary Electronics

Dedicated to America's Electronics Hobbyists

★ Cover Highlights

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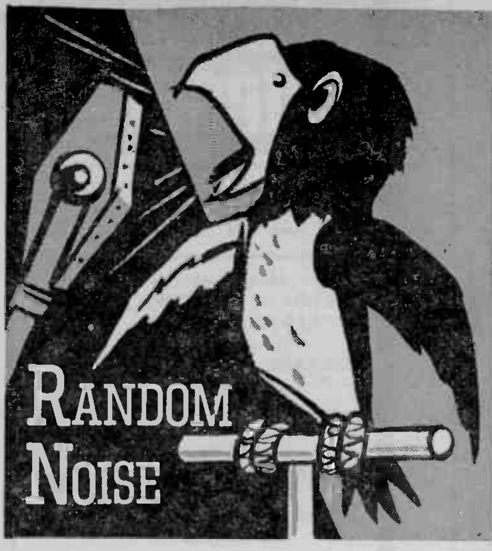
Cover photos by Leonard Heicklen



By Julian M. Sienkiewicz, Editor

WHAT'S YOUR HANGUP? Are you like me—a nut for large posters? If you are, there are two new treats awaiting you . . .

Courier Communications has created a full-color psychedelic poster about the world of Citizens Band 2-way radio. The poster, commissioned by Courier from Sal Madoca, the noted New York illustrator, measures 17 x 22 in. It colorfully incorporates elements of the CBer's

jargon, including the well-known 10-Code and one of the most advanced CB rigs made, the Courier Traveller II. For a copy, send $1.00 by check or money order to Department PEE, Courier Communications, 100 Hoffman Pl., Hillside, N.J. 07205.

Another ring-a-ding poster is offered by Koss, the makers of quality hi-fi headsets. This poster

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RANDOM NOISE

shows a very much tuned-in lass, depicted in a wild, wild moment of listening. Supersize 30 x 40-in. black-and-white poster is the first in a series of five being made available by Koss. If you're a nut like me, you can get all the posters from local hi-fi stores which carry Koss stereophones. Naturally, only one to a customer, so space out your visits.

Get a Copy! I just thumbed through a very interested parts catalog of new and used electronic equipment and parts. I believe the catalog is good because I found myself writing a letter requesting some of the parts. That's unusual for a guy with a seven-foot basement filled eight feet high with parts. Get a copy of the catalog today. Write to Baynton Electronics Corp., Dept. A1, 27C9 N. Broad St., Philadelphia, Pa. 19132. Don't tell 'em we sent you—keep 'em guessing.

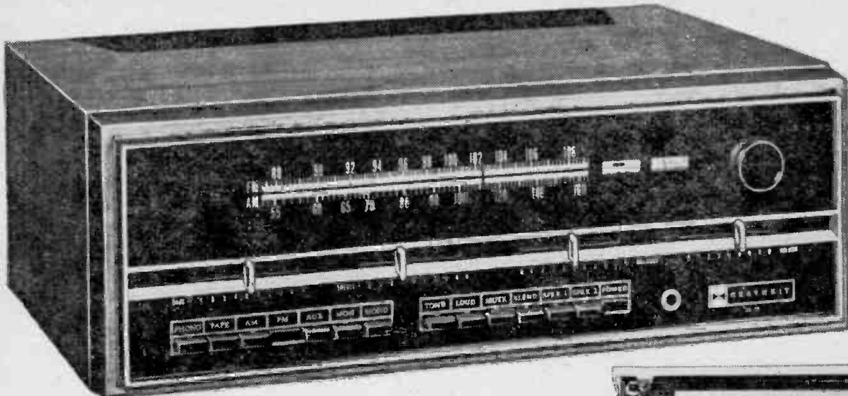
Good Clubs! There are many clubs, some good and some bad. From where this Editor sits, its very difficult to judge one club over another. However, one important criterion used to evaluate a club is its official publication to its members. Three excellent publications crossed my desk on the same day, so I decided fate has given me a special sign to inform my readers. Here goes:

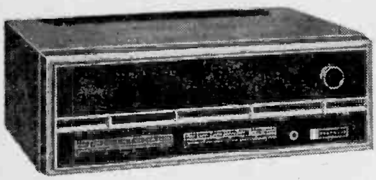
Soundcerely Cantra—the monthly newsletter of the Canadian Tape Recordists' Association, 33 Rosedale Ave., Hamilton 26, Ont.; Frank Birch, Director.

(Continued)

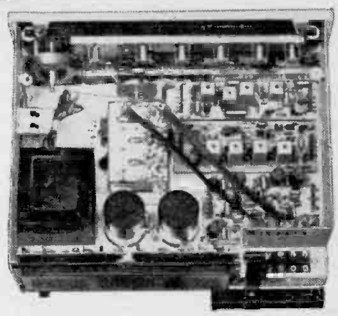
More New Kits From

Introducing The Advanced New Heathkit 60-Watt AM/FM/FM Stereo Receiver





Heathkit AR-19
$225.00*



Third In The New Generation Of Superb Solid-State Receivers From Heath . . . And Low In Cost

• Advanced solid-state circuitry with 108 transistors, 45 diodes and 5 integrated circuits • 60 watts music power output at 8 ohms • Less than 0.25% Harmonic & IM Distortion at any power level • Frequency response from 6 to 35,000 Hz • Direct-coupled, transformerless outputs for lowest distortion and phase shift • Dissipation-limiting circuitry protects outputs from damege even with a short circuit • Assembled, aligned FET FM tuner has 2.0 uV sensitivity to give you more listenable stations • Ball-bearing inertia flywheel tuning for smooth, accurate station selection • Preassembled, factory aligned FM IF circuit board speeds assembly and eliminates IF alignment, gives 35 dB selectivity • Multiplex IC circuit provides inherent SCA rejection • Pushbutton Mute control attenuates between-station FM noise • Blend control reduces on-station FM noise with a push of a button • Tone-flat pushbutton disables bass & treble controls for perfectly "flat" response • New linear motion controls for volume, balance, bass & treble • Individually adjustable level controls for each input including tape monitor eliminate annoying volume changes when switching sources • Switches for two separate stereo speaker systems for stereo sound in two different locations • Center channel speaker capability • Two front panel tuning meters give exact station selection • Stereo indicator light • Front panel stereo headphone jack • 300 & 75 ohm FM antenna inputs • High fidelity AM reception • Built-in AM rod antenna swivels for best reception • Massive power supply includes section of electronically regulated power • New Heath modular plug-in circuit board design speeds assembly, aids servicing • Built-In Testing facilities aids construction, simplifies servicing • Circuit board & wiring harness construction for easy, enjoyable 25 hour assembly

Ahead of its time . . . those who want to hear stereo high-fidelity as it will sound in the 70's can begin right now, at a modest price, with the Heathkit AR-19. Its design is an extension of the advanced circuitry concepts first introduced in the AR-15. These receivers are truly of a new generation . . . they've expanded audio engineering horizons and set the pace for the 70's.

Field Effect Transistor And Integrated Circuit Design. The AR-19 uses advanced semi-conductor circuitry . . . including five integrated circuits, with a total of 108 transistors and 45 diodes. The pre-assembled FM tuning unit uses an RF field effect transistor to provide high sensitivity and low cross modulation with no overloading on strong local stations. In the AM RF circuit also, field effect transistors give superior sensitivity and large signal handling capacity.

Ideal For Most Home Stereo Installations. The AR-19 is just right for the medium and high efficiency speaker systems that are so popular today. It can form the nucleus of a fine stereo system . . . and will probably be the most attractive part, thanks to its rich oiled pecan wood cabinet and to the "Black Magic" front panel. The scale and dial readings appear only when the power is on.

Features To Aid The Kit Builder. All 8 circuits of the AR-19 snap in and out in seconds. Think of the resulting convenience and ease of assembly! In addition, the AR-19 has built-in test circuitry . . . two test probes with the front panel meter for indications. With it, the user can check out circuit parts without the need for expensive external test equipment. Proper use of this feature is fully covered in the manual.

Don't Wait For Something Better To Come Along . . . it'll be a long wait. Up-grade your stereo system now, with this outstanding receiver value.

Kit AR-19, 29 lbs. **$225.00***
Assembled AE-19, cabinet, 10 lbs. **$19.95***

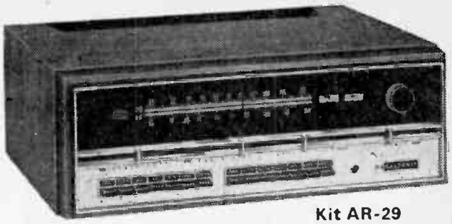
PARTIAL AR-19 SPECIFICATIONS — AMPLIFIER: Continuous power output per channel: 20 watts, 8 ohms. **IHF Power output per channel:** 30 watts, 8 ohms. **Frequency response:** (1 watt level) —1 dB, 6 Hz —35 kHz. **Power bandwidth for constant 0.25% THD:** Less than 5 Hz to greater than 30 kHz. **Harmonic distortion:** Less than 0.25% from 5 Hz to 20 kHz at 20 watts rms output. Less than 0.1% at 1000 Hz at 1 watt output. **IM Distortion:** Less than 0.25% with 20 watts output. Less than 0.1% at 1 watt output. **Hum and noise:** Phono input, —65 dB. **Phono input sensitivity:** 2.4 millivolts; overload, 155 millivolts. **FM: Sensitivity:** 2.0 uV, IHF. **Volume sensitivity:** Below measurable level. **Selectivity:** 35 dB. **Image rejection:** 90 dB. **IF Rejection:** 90 dB. **Capture ratio:** 2.5 dB. **Total harmonic distortion:** 1% or less. **IM Distortion:** 0.5% or less. **Spurious rejection:** —90 dB. **FM STEREO: Separation:** 35 dB at midfrequencies; 30 dB at 50 Hz; 25 dB at 10 kHz; 20 dB at 15 kHz. **Frequency response:** ±1 dB from 20-15,000 Hz. **Harmonic distortion:** 1.5% or less @ 1000 Hz with 100% modulation. 19 kHz & 38 kHz. **Suppression:** 50 dB. **SCA Suppression:** 50 dB. **AM SECTION: Sensitivity:** Using a radiating loop, 130 uV/M @ 1000 kHz. **Selectivity:** 25 dB at 10 kHz. **Image rejection:** 60 dB @ 600 kHz. 60 dB @ 1400 kHz. **IF Rejection:** 60 dB @ 1000 kHz. **Harmonic distortion:** Less than 2%. **Hum & noise:** —40 dB.

The Leader HEATHKIT®

New Heathkit 100-Watt AM/FM/FM-Stereo Receiver

World's finest medium power stereo receiver . . . designed in the tradition of the famous Heathkit AR-15. All Solid-State . . . 65 transistors, 42 diodes plus 4 integrated circuits containing another 56 transistors and 24 diodes. 100 watts music power output at 8 ohms — 7 to 60,000 Hz response. Less than 0.25% distortion at full output. Direct coupled outputs protected by dissipation-limiting circuitry. Massive power supply. Four individually heat sinked output transistors. Linear motion bass, treble, balances and volume controls. Push-button selected inputs. Outputs for 2 separate stereo speaker systems. Center speaker capability. Stereo headphone jack. Assembled, aligned FET FM tuner has 1.8 uV sensitivity. Two tuning meters. Computer designed 9-pole L-C filter plus 3 IC's in IF gives ideally shaped bandpass with greater than 70 dB selectivity and eliminates alignment. IC multiplex section. Three FET's in AM tuner. AM rod antenna swivels for best pickup. Kit Exclusive: Modular Plug-In Circuit Boards . . . easy to build & service. Kit Exclusive: Built-In Test Circuitry lets you assemble, test and service your AR-29 without external test equipment. The AR-29 will please even the most discriminating stereo listener.

Kit AR-29, (less cabinet), 33 lbs....................................$285.00*
AE-19, Assembled oiled pecan cabinet, 10 lbs.......................$19.95*



Kit AR-29
$285^95*

New Heathkit Deluxe 18-Watt Solid-State Stereo Phono

Looks and sounds like it should cost much more. Here's why: 16-transistor, 8-diode circuit delivers 9 watts music power per channel to each 4½" high-compliance speaker. Speaker cabinets swing out or lift off . . . can be placed up to 10' apart for better stereo. Has Maestro's best automatic, 4-speed changer — 16, 33-1/3, 45 & 78 rpm. It plays 6 records, shuts off automatically. Ceramic stereo cartridge with diamond/sapphire stylus. Has volume, balance & tone controls. Changer, cabinet & speaker enclosures come factory built . . . you build just one circuit board . . . one evening project. Wood cabinet has yellow-gold & brown durable plastic coated covering. This is a portable stereo you can take pride in.

Kit GD-109, 38 lbs..$74.95*

Kit GD-109
$74^95*

New Heathkit 80-10 Meter 2 KW Linear Amplifier

Incomparable performance and value. The new SB-220 has 2000 watts PEP input on SSB & 1000 watts on CW and RTTY. Uses a pair of Eimac 3-500Z's. Pretuned broad band pi input coils. Requires only 100 watts PEP drive. Solid-state power supply operates from 120 or 240 VAC. Circuit breaker protected. Safety interlocked cover. Zener diode regulated operating bias. Double shielded for max. TVI protection. Quiet fan — fast, high volume air flow. Also includes ALC to prevent over-driving. Two meters: one monitors plate current; the other is switched for relative power, plate voltage and grid current. Styled to match Heath SB series. Assembles in about 15 hours.

Kit SB-220, 55 lbs..$349.95*

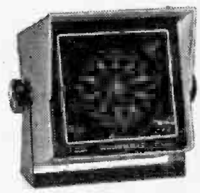
Kit SB-220
$349^95*

New Heathkit Solid-State Portable Fish-Spotter

Kit MI-29
$84^95*

Costs half as much as comparable performers. Probes to 200 ft. Spots individual fish and schools . . . can also be used as depth sounder. Manual explains typical dial readings. Transducer mounts anywhere on suction cup bracket. Adjustable Sensitivity Control. Exclusive Heath Noise-Reject Control stops motor ignition noise. Runs for 80 hrs. on two 6 VDC lantern batteries (not included). Stop guessing — fish electronically.

Kit MI-29, 9 lbs..$84.95*



Kit MI-19
$69^95*

New Heathkit Solid-State Depth Sounders

Let its flashing indicator light guide you through strange waters . . . day or night. Sounds to 200 ft. Has Noise Rejection and Sensitivity controls. Operates from your 12 VDC boat battery. Sun-shielded dial. All solid-state.

Kit MI-19-1, (with thru-hull transducer), 7 lbs...............$69.95*
Kit MI-19-2, (with high speed transom mount), 7 lbs.......$69.95*

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RANDOM NOISE

(Continued from page 7)

Airway Communicator—The Calgary General Radio Club, Box 147, Calgary 2, Alta.; Abram Mackay, President. This is a Canadian CB club open to GRS operators and non-radio operators.


FLORIDA SKIP

Florida Skip—Box 501, Miami Springs, Fla. 33166; Andy Clark, W4IYT, Editor. This newspaper is not the official organ of any club, but it does report regularly on club activities in the Florida area. Many clubs use *Florida Skip* to inform their members and non-members of their activities. Cost: $2 for one year—a great buy!

From time to time I will introduce other club and hobby-type publications my readers should know about. If you discover any, why not send a copy to me? I may agree with you and it'll hit this column. ■

Pollution Balloon

Last year, an unmanned balloon floated 114,000 feet above Chicago carrying a remote sensing telescopic chemical analyser and, for the first time, measurements of air polluting gases were made from outside the earth's atmosphere. Clouds of contamination were mapped beneath the path of the free floating helium-filled balloon.

The experimental flight explored the feasibility of continuous monitoring by space satellite of air pollution over the entire continent. The study is being conducted by the Manned Spacecraft Center of NASA under a contract awarded to Barringer Research Inc. of Toronto, Canada.

According to Dr. A. R. Barringer, president of the applied science firm and the inventor of the correlation spectrometer used as the basis of the experiment, the 22 mile high balloon flight was able to map the air column in a swath 10 miles wide across Northern Indiana, Chicago, Northern Illinois and a portion of Lake Michigan. The 60 meter diameter balloon and 500 pound payload were launched at the Dowagiac, Michigan, airport. Major individual pollution components, sulfur dioxide (SO_2) and nitrogen dioxide (NO_2), were measured with high sensitivity.

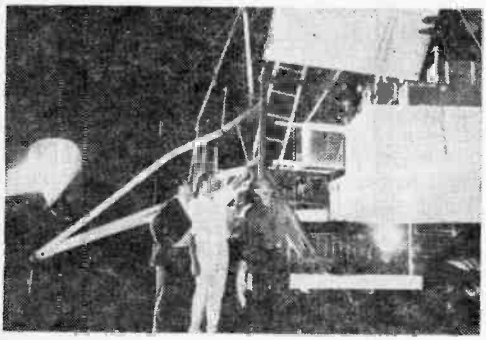
The objective of the near space test was to measure the content of these prime depoilers of the Midwestern atmosphere from a distance. The Barringer correlation spectrometer performs quantitative chemical analyses without making physical contact with the gas or other material under study.

Dr. Barringer said, "This successful test helps demonstrate the feasibility of remotely specific noxious gases from orbiting satellites. We look forward to the time when it becomes possible to maintain constant surveillance of nationwide and worldwide pollution of the lower atmosphere from spacecraft."

The balloon-carried spectrometer operates using natural scattered sunlight reflected from the ground. The gases under study produce a "fingerprint" on this light. The instrument can thus monitor the total amount of gas between itself and the ground. The bulk of pollution, in the lower mile of the atmosphere, is thus monitored from afar.

A station wagon installed with another remote sensing correlation spectrometer traversed beneath the balloon's path. It was driven along the Indiana Toll Road to Interstate 55 west of Joliet, then northeast to Chicago's Lakeshore Drive. This instrument viewed vertically using natural scattered sunlight as its energy source; it measured SO_2.

The data collected by the balloon-borne spectrometers have been compared with that gathered by the station wagon. Preliminary calculations for SO_2 have determined a dilution factor of only 70:1 for data collected by the balloon. This lower reading results from atmospheric scattering of the sunlight and compares very closely with that predicted by mathematical studies. The balloon measurements show excellent correlation with the ground data in the location of gaseous clouds.

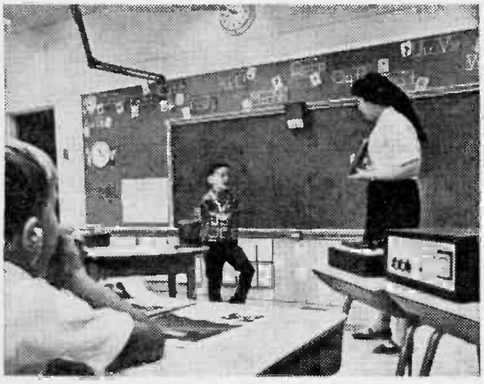


Barringer Research project staff ready spectrometer payload moments before pre-dawn launch at Dowagiac, Michigan. White gondola houses two correlation spectrometers; one measures NO_2, the other SO_2. Telemetry equipment sits atop the gondola together with a "sun sensor" which orients the 500-pound system. Balloon, 400 feet in the distance, is filled with 3,000,000 cubic feet of helium to lift the package 22 miles into near space.

DB on the Level

It's tough enough to absorb the complexities of space-age education today without being deaf. But for the hearing-handicapped child it's an even tougher job. Hearing aids have helped solve many problems for the deaf child. In the classroom, where the teacher often speaks toward a blackboard while she writes the lesson, or where Johnny is far from the action in the last row, additional amplification is a real necessity.

Now, there is a classroom auditory training system that frees the teacher from speaking directly into a microphone and lets her concentrate on teaching with confidence that every child will receive a uniform level of sound. The Tel-A-Group II (a Zenith development) has liberated the student from bulky headsets and continuous readjustment of his hearing device because of Zenith's new "Dual Time-constant" circuitry. With total mobility, the teacher can move up to 15 feet away from an overhead microphone. A compact solid state amplifier automatically adjusts the volume of her voice. No longer is she tied to microphone cords that become tangled and snarled or prohibit her classroom movements.



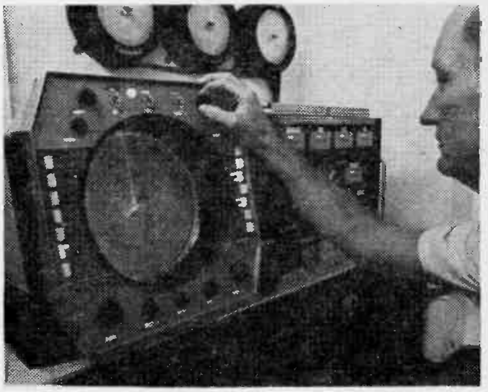
Deaf children go to school, too! But if they have to adjust hearing devices or strain to understand the teacher who talks into a blackboard, they can't use their full powers of concentration. The new Zenith Tel-A-Group II auditory trainer now frees the teacher from microphone cords and students from bulky headsets.

The system utilizes a magnetic signal projected from a wire loop surrounding the classroom and is received as sounds in the hearing aid. Zenith's all new "Automatic Current Sensing Device" adjusts current flow in the loop to insure a constant magnetic field as a function of frequency regardless of classroom size. A second cancelling loop may be used in the classroom to minimize magnetic "spillover" to and from adjoining classrooms.

A child's own hearing aid can be used if it is equipped with a common telephone pick-up coil. And, so as not to be left out of audio-recorded lessons transmitted to students, the teacher may listen in on a classroom speaker and monitor what the students hear. The amplifier control panel has only a few controls to set. A simple adjustment sets the system for the total teaching situation.

Florida Sky Watch

In Florida, which has the highest number of lightning days in the United States, the Florida Power & Light Company is doing something about getting advance warning of thunder storms. Instead of relying on Weather Bureau

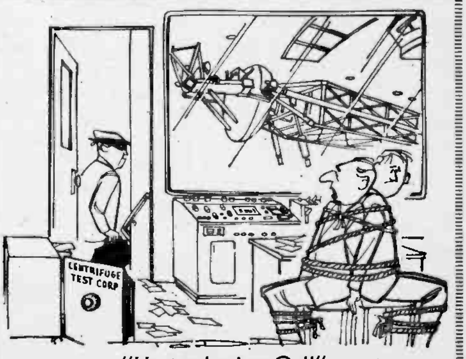


It's not all sunshine in Miami, Florida where O. B. Partridge of the Florida Power & Light Company monitors a nearby thunderstorm seen on the radar screen.

reports, the company has installed radar to scan the skies plus a network of lightning counter units which serve lightning strobes.

A Kaar Raymarc radar, designed for use on ships, has been installed in the Miami Central Service Center. On the 12-inch radar screen, company personnel can view clouds as far as 48 miles away. For closer observation, the range of the radar can be reduced in steps to as little as one quarter of a mile.

The radar antenna rotates 24 revolutions per minute and scans the skies in all directions. It emits pulses slightly more than a half of a



"He took nine Gs!!"

Science Fair™ KITS

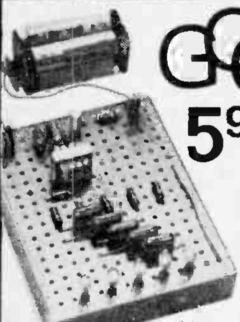
AVAILABLE IN 667 RADIO SHACK STORES OR BY MAIL

\# 28-171

DISCOTHEQUE IS A "PSYCHOLITE"

Science Fair's new "Psycholite" turns any sound—from the whisper of a transistor radio to the roar of an amplifier into a flashing fantasy of light! Great for parties, displays; doubles as a 600 watt light dimmer! You simply connect "Psycholite" to speaker terminals, plug lights into "Psycholite", adjust sensitivity and background controls to achieve desired lighting effects. Kit includes case, PC board, parts, AC cord, manual. 117 VAC.

14.95 *LOOK IN YOUR PHONE BOOK FOR THE RADIO SHACK STORE NEAREST YOU!*



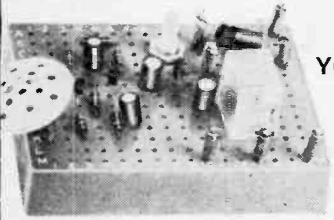
GOOFY-LITE!

5.95

MADNESS IN MOTION!

Build it in Science Fair's famous P-Box. A "do-nothing" kit that allows you to select random or sequential firing of six lights. 6 volts—not 90! It's fun just for the fun of it.

\# 28-130



VOX-BOX

YOUR VOICE TURNS IT ON AND OFF!

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Science Fair's latest magic—a voice-controlled relay kit that will turn a recorder on when a voice is present; turn it off 3 seconds after sound stops. DPST relay, sensitivity control, all parts.

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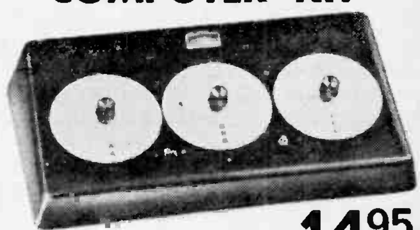
ELECTRONIC COMPUTER KIT



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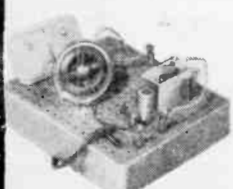
Custom Science Fair analog-type instrument with transistor circuitry that allows you to perform difficult operations in multiplication, division, square and cube roots, logarithmic functions, reciprocals. Has 2 sensitivity ranges. Includes a detailed manual, complete list of conversion tables, molded plastic case, all parts. Operates off one 9V battery.

MOISTURE-DETECTOR ALARM KIT



Know it the second after it starts to rain. Know immediately if someone uninvited jumps into your swimming pool. This Science Fair alarm reacts the moment moisture (even your breath!) touches it by activating a moisture-sensitive pickup.

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City __________ State __________ Zip __________ millionth of a second in duration, 1000 times a second, when the radar is operated on its 24- or 48-mile ranges. These short but powerful 20,000-watt pulses of radar energy are confined into a beam less than one degree wide.

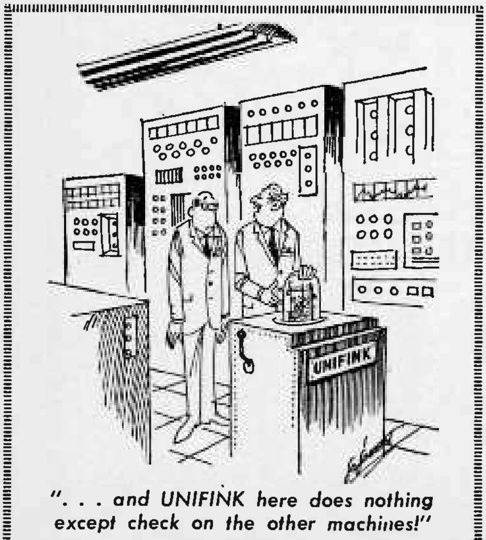
When the pulses strike a solid object or moisture molecules, they are reflected back to the radar. The distance to these targets is determined electronically by measuring the time it requires for the pulses to reach the target and return, traveling at 186,000 miles per second. The location of the targets can be seen on the circular radar screen which is calibrated in both distance and direction.

Although the radar generates 20,000-watt pulses, it consumes half as much power as an electric iron because it employs transistors in lieu of tubes in most circuits.

Florida Power & Light uses radar and lightning counters so it can alert crews prior to arrival of thunderstorms and possible high winds.

The Wisconsin-Michigan Power Company is also using a Kaar radar to obtain advance warning of tornados and thunderstorms. Most commercial and military aircraft use radar for navigating around clouds. And, practically all large commercial ships, as well as many harbor boats and pleasure craft, use radar for seeing other vessels through fog and the dark of night, and for advance warning of storms.

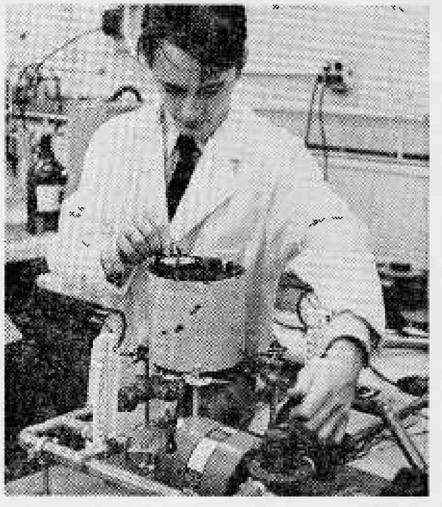
T. R. Moffett, Jr., service operations supervisor of Florida Power & Light, said that 504 lightning strokes were counted in Dade County in a single day, and that the county experiences nearly 80 lightning days annually. Radar helps him, he said, to know how bad a storm is and where it's headed so a sufficient number of men can be sent to the storm area before trouble occurs.



". . . and UNIFINK here does nothing except check on the other machines!"

Coffee Can Furnace

Mini Furnace from Raytheon Company's research laboratories has been named to the list of most significant new technical products of 1969. It is the unit the size of a two-pound coffee can that will heat a 9-room home.



Award winning Mini Furnace the size of a two pound coffee can is tested by William H. Hapgood, engineer for Raytheon Company, which developed the unit. The device burns gas and transfers the heat to water with extraordinary efficiency.

The Mini Furnace invention represents a significant breakthrough in heat transfer technology. Its unique internal structure presents a large surface area per unit volume. This structure also causes turbulence of the combusted gases that results in a heat transfer power density an order of magnitude higher than that obtainable with conventional boiler design.

The unit burns gas. Its heat transfer structure may be separated from the firebox and used in a variety of heat transfer applications outside the heating field. Used as a boiler, the unit produces hot water or steam.

As a source of gas-heated water, the unit is unusually effective, achieving an overall efficiency of 85 per cent. The combustion gases are not hot when vented but are more on the order of the exhaust from a clothes dryer. The unit itself runs coolly and quietly.

This combination of properties makes possible a home heating unit that not only saves money on fuel bills, but can operate without a conventional chimney. The flue gases are simply vented through an outside wall or roof using a small diameter uninsulated pipe. Such a heating unit can actually be installed on a living room wall, serving both as a housewarmer and a conversation piece. ■

What good are clean ash trays when you can't get the car the ash trays come in even when you have a reservation and the reservation has been confirmed?

For a long time now, there's been so little difference between car rental companies they argued publicly about who had the cleanest ash trays. Max has changed all that.

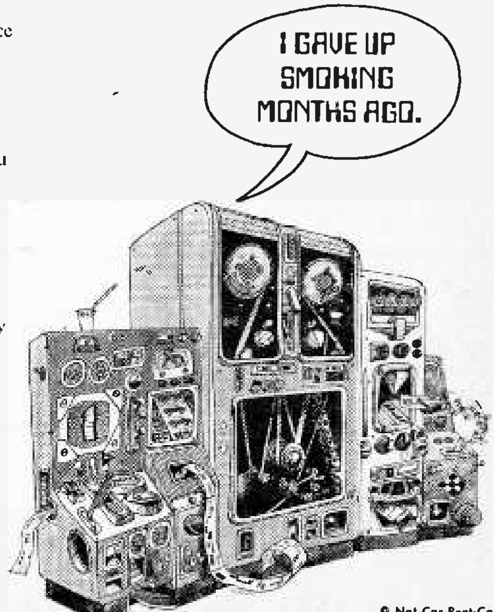
Max is National Car's computer. He knows from minute to minute which of our cars are available.

Wherever you are, anytime of the day or night, you can call National for a reservation toll-free at 800-328-4567. And thanks to Max, we don't have to make any assumptions or blind promises like those New York outfits do.

We just ask Max what's available, Max tells us, and we can guarantee you a car on the spot.

National also features GM cars, gives S&H Green Stamps, and has 1800 locations. Second only to old what's-its-name.

Now *there* are some differences you can sink your credit card into—any recognized credit card.



NATIONAL CAR RENTAL

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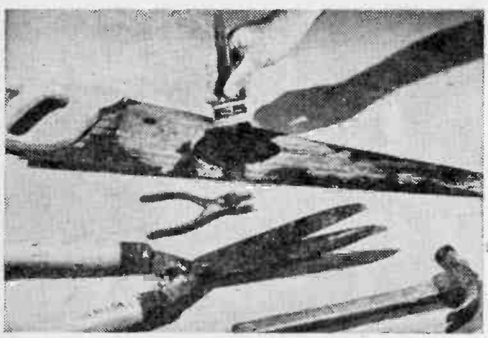
Arrest That Rust!

Now there's an easy way to remove rust from iron and steel, corrosion from chrome and aluminum, tarnish from copper, brass, and bronze. You don't have to scrape, wirebrush or sandblast with Acco Naval Rust-Removo. It's a jell you just brush on and it sticks to anything, even vertical surfaces and ceilings. You let it stand awhile and then flush it off with water and the rust is gone, leaving a protective coating that will help retard further rust. If the surface is to be painted, this surface



Acco Naval Rust-Removo

will make the paint adhere better. Rust-Removo is a blend of mineral acids, special solvents and wetting agents and contains no muriatic acid. A gallon goes for $14.95 and you can get information on quantity prices from Ace Chemical Co., 4401 Ravenswood Ave., Chicago, Ill. 60640.

Vehicular Base Antenna

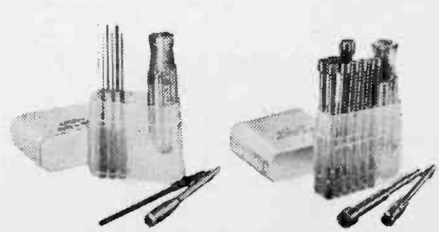
Antenna Specialists' new class of mobile antenna systems, designated "Mobile Scanner," feature diectional gain at 27 MHz and electronic beam control. Mobile Scanners comprise matched pair of 50-ohm, base-loaded mobile antennas interconnected through a dash-mounted control box. By means of a 3-position switch, the radiated or received signal is fed through the dividing circuitry to produce a highly directional pattern either forward, rearward, or simultaneously to the sides of the vehicle. Thus it can be used as an instantaneous electronic

Antenna Specialists Mobile Scanner

mobile beam for scanning the horizon and then for zeroing in on the desired signal. Mounting separation of the two antennas is an optimum of 9 ft. with a tolerance of 6 in. The Mobile Scanner is available with a choice of mounts; swivel type for curved surface (Model M-230), or deck/roof mount for flat surface (Model M-231). Either model is $49.95 and you can write for more dope to Antenna Specialists Co., 12435 Euclid Ave., Cleveland, Ohio 44106.

Tools for Raffles

Here is a new line of precision hand tools made to metric dimensions, particularly useful in the assembly and servicing of foreign-designed equipment. The line includes 18 medget, regular, and hollow shaft, fixed-handle nut-drivers in a hex size range from 3 mm to 17 mm. The new metric tools are also available in two set forms in pocket-size plastic cases. Set No. 99-PS-41-MM consists of 7 hex socket, interchangeable blades with hex sizes from 1.27 mm to 5 mm, plastic handle, and 4-in. ex-



Xcelite Metric Hand Tools

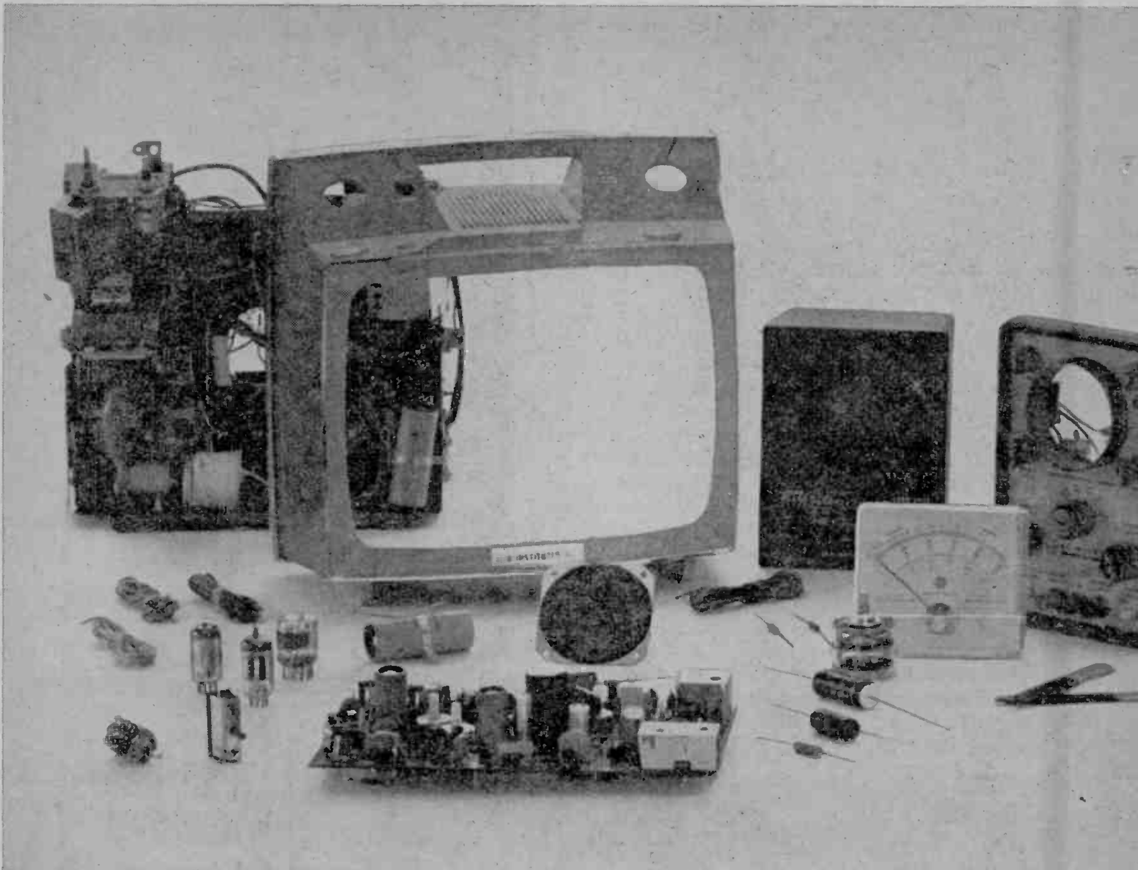
★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★

tension. Set No. 99-PS-51-MM contains 10 interchangeable nutdriver shanks with hex openings from 4 mm to 11 mm, handle, and 4-in. extension. The 99-PS-41-MM set sells for $6.75; 99-PS-51-MM is $8.63. If you want more information ask for Catalog 166 supplement from Xcelite Inc., Orchard Park, N.Y. 14127.

Non-Polluted Listening Environment

There's a new model of the LEE listening environment chair called the Contempo II which takes much less floor space than its predecessor. According to LEE's president, Irving R. Stern, "Each chair is a music chamber—a total environment which reproduces sound with a perfection that cannot be achieved in most larger room environments with even the finest high fidelity speakers." Speaker systems on each side are two-way tweeter-woofer assemblies with high compliance suspensions and sealed baffles of extensive cubic footage for full bass response. Connection to existing stereo equipment is by means of a single 4-conductor cable. The Contempo II chair is available in a wide variety of ScotchGarded upholstery fabrics, and carries a 5-year warranty on parts and labor. The original LEE (Listening Environment Engineers) chair went for $1000.00, but increased production efficiency has reduced the price of the Contempo II to $499.00. For more information write to Listening Environment Engineers, 4109 Burbank Blvd., Burbank, Calif. 91501. ■

Listening Environment Engineers Contempo II Chair



Look! You get 25 kits...

more than ever before at no extra cost...for your practical "hands-on" learning of electronics and TV with RCA Institutes Home Training! Send postcard today!

Now, RCA supplies 25 kits in its home-study career program—at no extra cost! Be sure to compare this with other home-study electronics programs. And note, you never have to take apart one kit to build another piece of equipment because there are literally thousands of parts making up the kits. Information on them is included in the catalogue which you'll get when you mail in the reply postcard or the coupon.

Absolutely practical, your kits are used to build such permanent, professional and useful equipment as an oscilloscope, a signal generator, a multimeter, and a fully transistorized breadboard superheterodyne AM receiver. They will give you years of valuable service.

In addition, an easy way to learn—the career programs are all based on the easy, step-by-step AUTOTEXT method. AUTOTEXT is unique and exclusive with RCA Institutes. Math and circuitry problems simply melt away! So check the wide range of electronics and TV career programs.

Eleven Career Programs: Television Servicing (including color TV and CATV) • FCC License Preparation • Automation Electronics • Automatic Controls • Industrial Electronics • Nuclear Instrumentation • Electronics Drafting • *including these four all-new:* Semiconductor Electronics • Digital Electronics • Solid State Technology • Communications Electronics.

Also check the new Computer Programming course—trains you to work on today's largest data processing systems including IBM/360 and RCA Spectra 70, the Third Generation Computers.

You get tuition plans as flexible as you wish: pay-as-you-order or pay-by-the-month...*you* choose! No interest charges! No other electronics home study school offers both these choices.

Classroom training also available—day and evening coeducational classes start four times a year. No previous training required—you can take preparatory courses if you haven't completed high school.

Placement service, too—with RCA Institutes classroom training, you get the full benefits of the RCA Job Placement Service. RCA Institutes graduates are now with companies that include Bell Telephone, GE, Honeywell, IBM, RCA, Westinghouse, Xerox, and major radio/TV networks. This placement service is also available to Home Study Graduates.

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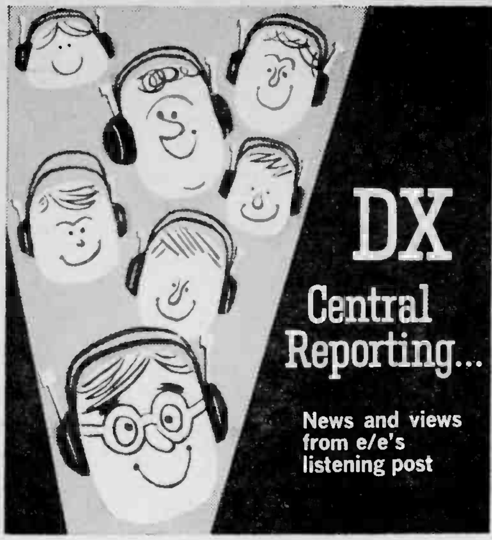

by Don Jensen

STRATEGIC Okinawa, largest island in the archipelago that stretches between Japan and Taiwan, is making headlines again.

As in 1945, when American forces wrested the Ryukyu Islands from the Japanese, its issue is who will control the "Gibraltar of the Pacific." Unlike the WW-II invasion, the present dispute will be settled across diplomatic tables. Simply, Japan wants Okinawa back—preferably by 1972. The U.S., still dickering for a security treaty that would keep military bases in Japan, apparently isn't ready to give it up quite yet.

One reason is that Okinawa is a keystone in our war efforts in South East Asia. Packed on this crowded volcanic rock, one-third the size of Rhode Island, are 45,000 U.S. troops, vast stockpiles of materiel, Army and Marine camps and the busiest overseas air base in the world.

With all this preoccupation with the Vietnam conflict, it's odd to find one military activity on Okinawa—The Voice of the United Nations Command—that seems an anachronism, a throwback to another time and another war.

For VUNC is a propaganda radio service whose programs are intended solely for Korean listeners. Officially, it operates as "a gift of the United States government to the United Nations" and its mission is "to support the objectives of the U.N." But since *that* war has been over these 16 years and a real U.N. presence in Korea would be hard to find now, that policy seems more convenient than correct.

Actually, VUNC is operated by the U.S. Army's 7th Psychological Operations Group. Programs used here are produced at the 7th Psyop headquarters at Maschinato, Okinawa.

Strictly speaking, its two 20 kW shortwave transmitters at Deragawa, 20 miles from Maschinato, aren't really broadcasting stations at all. Using three curtain rhombic antennas, programs are relayed, point-to-point, to several VUNC-operated medium-wave stations in Korea for rebroadcast.

Despite its directional arrays and its all-Korean programming, these Voice of the U.N. Command transmitters can be logged in the U.S. Over the years a number of far-out frequencies have been used. Latest reports indicate that 9,915 and 14,460 kHz. are the spots to tune. VUNC is scheduled for 0600 to 2100 GMT, best Stateside reception seems to be around 1200 to 1400 GMT.

Reports go to VUNC, Hq., 7th Psyop Gp, APO San Francisco 96248.

For easier Okinawan DX, try the Voice of America's relay transmitters. The VOA's 35 and 100 kW transmitters are located on a spit of land at the northern end of the island.

During the early morning hours you'll hear the VOA relaying Chinese programs on 6,010 and 7,255 kHz. Best bet is 7,165 kHz, where you'll hear the English language service.

Tip Topper. Tiny Anguilla, the Caribbean mouse that roared its defiance of the British lion by declaring independence back in 1967, speaks with a quieter voice these days, now that it has returned to the fold.

Its 6,000 residents opted for freedom from a British-forged federation with neighboring St. Kitts and Nevis, claiming years of neglect and discrimination. For nearly two years, Anguilla went it alone, to the exasperation of Her Majesty's government. Then, last March, a force of royal marines and London bobbies were sent ashore from the frigates Rothesay and Minerva to bloodlessly quash the rebellion.

Earlier there had been reports of a puny marine transmitter, used to link Bank of America branches in Anguilla and the Virgin Islands, which, it was said, was equipped, at the insistence of local officials, with a medium wave crystal. And Anguilan president Ronald Webster charged that three men had slipped ashore ahead of the troops to establish a secret British station. But it wasn't until after the dust settled and Great Britain again was firmly in control that the island's first broadcasting station went on the air.

Radio Anguilla, 1505 kHz, is operated by a staff of eight, two Britishers and six Anguillans, who do all the announcing. Studio and transmitters are located at a spot on the 15-mile long island known as "The Valley," according to W. E. Evans, station engineer.

Except for some BBC news and sportscasts, which are picked off the shortwave bands and relayed, most programs are locally produced. These include things like "Soul Session," "Calypso Time," "Evening Cocktail," and "Radio Anguilla's Top Five." There's a program called "Late Night Saturday." Since this is aired at 9 p.m. local time, there's more than a hint that Anguilla's nightlife doesn't exactly swing!

Radio Anguilla's schedule has just been extended, with sign on at 1030 GMT; sign off at 0200 GMT. Saturday's programs run an hour longer. The station is to be turned over to the local staff once they get a bit more experience under their belts.

Make no mistake, this is a toughie! Despite its rated 500 watts, Radio Anguilla's voice is more of a squeak than a roar.

Bandsweep. Frequencies in kHz, all times GMT—**3,883**—Usually swamped by the hams, Radio Clube Cabo Verde, Praia, Cape Verde Is., has been heard in Massachusetts until 2302 s/off. . . . **3,905**—Rare Radio Vila in the New Hebrides has been putting a good signal into Hawaii around 0645, but also has been heard as far east as Wisconsin. . . . **5,430**—Timeticker BVP, from Shanghai's Zika-Wei Observatory, heard in the Midwest on its mini-sked, 1101-1106, and 1301-1306. . . . **5,804**—After a stint in the 60 meter band, Yemen's Radio Sanaa again is logged in Arabic around 0300 s/on. . . . **6,100**—Nearly everyone has wondered about the mysterious time station heard here during the late evening hours. The scoop is that it belongs to Observatorio Naval de Cajical and reports go to Observatorio Astronomico, Sismologico y Geomagnetico; La Planicie; Caracas, Venezuela. . . . **9,610**—Addis Ababa's Voice of Ethiopia is alive and well on a brand new frequency. You'll hear some really weird music following 0330 sign on. . . . **11,718**—A newcomer to the bands is XERMX, Radio Mexico, which is logged with multi-lingual announcements, including English, during the early evening hours. . . . **15,165**—The long awaited Far East Broadcasting Associates missionary station is now testing from Seychelles Is. in the Indian Ocean. A number of U.S. listeners have been reporting this one, announcing as "Feeba-Seychelles," from 0030 to after 0300. . . . **21,635**—FEBA also reported here around 1900-2000 s/off.

Credits—Dr. F. Earle Hall, Mass.; Richard E. Wood, Hawaii; Gerry Dexter, Wis.; A. R. Niblack, Ind.; Gregg Calkin, Canada; Mike Macken, Mass.; Dan Ferguson, Fla.

Willis Who? That's the typical American's reaction to the name Willis Conover. But to millions overseas, the mellow-voiced VOA announcer ranks as their favorite Yankee! For 15 years, Conover's six-day-a-week, "Music USA" program has attracted the world's largest and most loyal audience—some 30 million. Though scarcely known here, when the 48-year-old Conover travels abroad, as on a recent Moscow trip, fans mob him at the airports. At home he's kept busy answering thousands of letters from his listeners.

His program—a half hour of pop music and 45 minutes of jazz—is carefully planned. With the skill of an orchestra conductor he works to build a particular mood with the musical selections he chooses. He tries, with great success, to be more than just another announcer or, and he hates the term, disk jockey.

He began announcing back in the 1940s and later produced jazz concerts in Washington, D.C. In 1954, when then-Ambassador to Russia, Charles "Chip" Bohlen convinced the VOA to beam a strictly non-political program of typically American music to Soviet listeners, music expert Conover was tapped to host the show.

Conover is an independent producer. He selects his own songs and his commentary is devoid of political overtones. No Foggy Bottom bureaucrat from the State Department leans over his shoulder. Despite his popularity, he receives an announcer's $300 a week from the VOA. He supplements his income with freelance announcing and film narrating, writing articles and record jacket blurbs, and composing an occasional song. He also produces the New Orleans Jazz Festival.

A New Yorker, Conover commutes weekly to the VOA studios in Washington, where he tapes the programs heard a month later. Because his programs offer some of the best popular and jazz music listening around, many American SWLs are Conover fans too.

Except for Sundays, "Music USA" can be heard at 1730 GMT on 15,205 kHz; 2015 GMT on 9,760 and 11,760 kHz; and 2230 GMT on 6,035 and 7,195 kHz, during European, African and Mid-Eastern VOA transmissions. To Asia and the Pacific, it is aired at 1115 GMT on 5,995 and 7,165 kHz; 1430 GMT on 7,105 and 9,655 kHz; and 1715 GMT on 11,835 and 15,155 kHz. ■

LITERATURE

10. *Burstein-Applebee* offers a new giant catalog containing 100s of big pages crammed with savings including hundreds of bargains on hi-fi kits, power tools, tubes, and parts.

11. Now available from *EDI (Electronic Distributors, Inc.)*: a catalog containing hundreds of electronic items. *EDI* will be happy to place you on their mailing list.

6. Bargains galore, that's what's in store! *Poly-Paks Co.* will send you their latest 8-page flyer chock-full of *Poly-Paks'* new $1.00 electronic and scientific "blis-dor" paks and equipment.

23. No electronics bargain hunter should be caught without the 1970 copy of *Radio Shack's* catalog. Some equipment and kit offers are so low, they look like misprints. Buying is believing.

ELECTRONIC PARTS

★2. Now, get the all-new 512-page, fully illustrated *Lafayette Radio* 1970 catalog. Discover the latest in CB gear, test equipment, ham gear, tools, books, hi-fi components and gifts. Do it now!

★5. *Edmund Scientific's* new catalog contains over 4000 products that embrace many interests and fields. It's a 148-page buyers' guide for Science Fair fans.

4. *Olson's* catalog is a multi-colored newspaper that's packed with more bargains than a phone book has names. Don't believe us? Get a copy.

1. *Allied's* catalog is so widely used as a reference book that it's regarded as a standard by people in the electronics industry. Don't *you* have the 1970 *Allied Radio* catalog? The surprising thing is that it's free!

7. Before you build from scratch, check the *Fair Radio Sales* latest catalog for electronic gear that can be modified to your needs. *Fair* way to save cash.

8. Get it now! *John Meshna, Jr.'s* new 96-page catalog is jam packed with surplus buys—surplus radios, new parts, computer parts, etc.

140. How cheap is cheap? Well, take a gander at *Cornell Electronics'* latest catalog. It's packed with bargains like 6W4, 12AX7, 5U4, etc., tubes for only 33¢. You've got to see this one to believe it!

135. *RCA* Experimenter's Kits for hobbyists, hams, technicians and students are the answer for successful and enjoyable building, creating, experimenting and learning. Find out for yourself by circling 135 now!

106. With 70 million TV and 240 million radios somebody somewhere will need a vacuum tube replacement at the rate of one a second! Get *Universal Tube Co.'s* Troubleshooting Chart and facts on their $1.50 flat rate per tube.

CB—AMATEUR RADIO SHORTWAVE RADIO

102. No never mind what brand your CB set is. *Sentry* has the crystal you need. Same goes for ham rigs. Seeing is believing, so get *Sentry's* catalog today. Circle 102.

146. It may be the *first—Gilfer's* specialty catalog catering to the SWL. Books, rigs, what-nots—everything you need for your listening post. Go *Gilfer*, circle 146!

100. You can get increased CB range and clarity using the "Cobra-23" transceiver with speech compressor—receiver sensitivity is excellent. Catalog sheet will be mailed by *B&K Division of Dynascan Corporation.*

141. Newly-designed CB antenna catalog by *Antenna Specialists* has been sectionalized to facilitate the picking of an antenna or accessory from a handy index system. Man, *Antenna Specialists* makes the pickin' easy.

130. Bone up on the CB with the latest *Sams* books. Titles range from "ABC's of CB Radio" to "99 Ways to Improve your CB Radio." So Circle 130 and get the facts from *Sams.*

107. Want a deluxe CB base station? Then get the specs on *Tram's* all new Titan II—it's the SSB/AM rig you've been waiting for!

96. Get your copy of *E. F. Johnson's* new booklet, "Can *Johnson* 2-Way Radio Help Me?" Aimed for business use, the booklet is useful to everyone.

129. Boy, oh boy—if you want to read about a flock of CB winners, get your hands on *Lafayette's* new 1970 catalog. *Lafayette* has CB sets for all pocketbooks.

46. Pick up *Hallicrafters'* new four-page illustrated brochure describing Hallicrafters' line of monitor receivers—police, fire, ambulance, emergency, weather, business radio, all yours at the flip of a dial.

116. Pep-up your CB rig's performance with *Turner's* M+2 mobile microphone. Get complete spec sheets and data on other *Turner* mikes.

48. *Hy-Gain's* new CB antenna catalog is packed full of useful information and product data that every CBer should know. Get a copy.

111. Get the scoop on *Versa-Tronics'* Versa-Tenna with instant magnetic mounting. Antenna models available for CBers, hams and mobile units from 27 MHz to 1000 MHz.

45. CBers, Hams, SWLs—get your copy of *World Radio Labs'* 1970 catalog. If you're a wireless nut or experimenter, you'll take to this catalog.

101. If it's a CB product, chances are *International Crystal* has it listed in their colorful catalog. Whether kit or wired, accessory or test gear, this CB-oriented company can be relied on to fill the bill.

103. *Squires-Sanders* would like you to know about their CB transceivers, the "23'er" and the new "SSS." Also, CB accessories that add versatility to their 5-watters.

TOOLS

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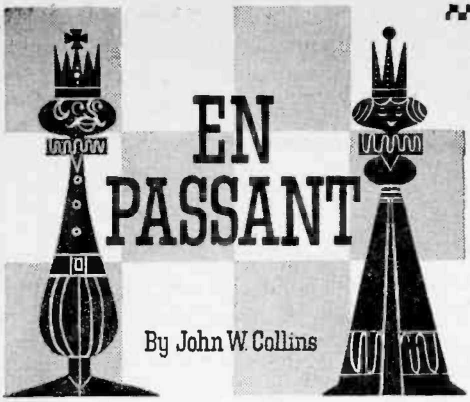
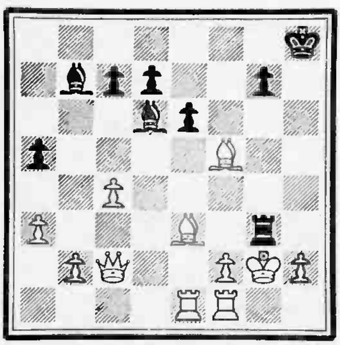


Here are five more miniature games to add to the quickies which have appeared in earlier columns. These five little gems were perpetrated by a quintet of American masters.

Hermann Helms, the late publisher of the American Chess Bulletin, and for sixty years the chess editor of the New York Times, winds up by forcing mate with a debonair Queen sacrifice. It is a Dutch Defense, played in New York, 1915, against Smyth, White.

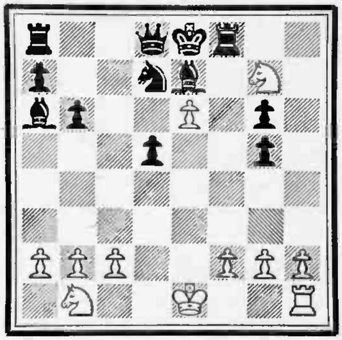
1	P-Q4	P-KB4	13	BxP#	K-R1
2	N-KB3	N-KB3	14	NxN	Q-R5
3	P-B4	P-K3	15	P-KN3	QxN
4	N-B3	P-QN3	16	B-Q3	R-B6
5	P-K3	B-N2	17	B-K3	Q-K4
6	B-Q3	B-Q3!	18	QR-K1	QR-KB1
7	P-QR3	P-QR4	19	BxP?	Q-R4
8	0-0	0-0	20	B-K3	Q-R6
9	Q-B2	N-B3	21	B-K4	R/1-B4
10	P-K4?	PxP	22	BxR/5	Q-N7#!!
11	NxP	NxN	23	KxQ	RxNP mate!
12	BxN	NxP!			



One can't argue with mate. *Brilliant!*

Isaac Kashdan, who bore the nicknames Cash and The Little Capablanca, was admittedly the best player in the country during the late Twenties and early Thirties. But he never got a crack at the title. In this odds game against Horneman, Black, New York, 1930, he displays his artistry in a French Defense. Remove White's Queen Rook.

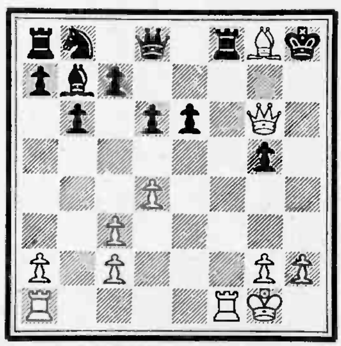
1	P-K4	P-K3	9	BxN	PxB
2	P-Q4	P-Q4	10	QxP	R-B1
3	P-K5	P-QB4	11	NxP	B-R3
4	Q-N4	PxP	12	NxP	N-Q2
5	N-QB3	N-KR3	13	B-N5!	P-B3
6	Q-R3	B-K2	14	P-K6!	PxB
7	B-Q3	P-QN3	15	Q-N6#!!	PxQ
8	Q-N3	N-B4?	16	N-N7 mate!	



On 13 .... BxB (instead of 13 .... P-B3), White has a queer perpetual check by 14 N-Q6# K-K2 15 N-B5# K-K1 (if 15 .... K-K3 16 N-Q4# K-2 17 N-B6# wins the Queen) 16 N-Q6# and so on. *Mind over matter.*

Arnold S. Denker, United States Champion 1944-1946, rips up Robbins', Black, castled position with two Bishop sacrifices in this Dutch Defense played in a Simultaneous Exhibition in 1934.

1	P-Q4	P-KB4	9	B-KN5	B-N2
2	P-K4!	PxP	10	N-K5	0-0
3	N-QB3	N-QB3	11	N-N4	P-Q3
4	P-B3	PxP	12	NxN#	PxN
5	NxP	P-K3	13	BxP#!	K-N2
6	B-Q3	B-N5	14	Q-R5	PxB
7	0-0	BxN	15	Q-N6#	K-R1
8	PxB	P-QN3	16	B-N8!	Resigns



For if 16 .... RxB 17 Q-R6 mate. And if 16 .... RxR# 17 RxR, QxB 18 Q-R6# Q-R2 19 R-B8 mate.

(Continued on page 28)

ELEMENTARY ELECTRONICS ETYMOLOGY

By Webb Garrison

Chip

▲ Artisans working in several north-European cultures used similar words to name some of their products. A small thin piece of gear (no matter whether made of stone or wood) was called *keppr* in Old Norse, *chipfa* in Old High German, and *kip* in Old Saxon.

In each case, the name referred to an artifact or product of a workman's skill.

Passing through Old English in the form *cipp,* the ancient term entered modern speech as *chip.* During the period of oral transmission, meaning of the word changed radically. Instead of naming a manufactured article, "chip" came to designate a useless bit of scrap—a byproduct of cutting or carving.

Most chips are small; some are tiny. Borrowing from the concept of "minute," the modern electronics industry adopted the term chip and restored much of its original meaning.

Today's chip is a minute but highly sophisticated component of the micro-mini circuit. Far from being a byproduct, the electronic chip is manufactured with scrupulous care. Only 12 to 15 thousand were made in 1962, the first year of commercial production. Within five years, the market was demanding 100,000,000 chips annually.

Germanium

▲ During the late 19th century Germany experienced a wave of intense nationalism. It was the era of Bismarck, "The Iron Chancellor", and of the Emperor Friedrich Wilhelm ("Kaiser Bill").

Super-patriotism affected the academic community as well as areas that most good Germans considered of more practical importance.

One of the most ardent flag-wavers among the nation's scientists was an obscure chemist. Prof. Clemens Winkler poked about in places more noted men neglected, became interested in a mineral found at Freiberg in Saxony.

Clemens analyzed argyrodite and its salts, proudly announced the discovery of a new element. Strangely, its properties were identical with the hypothetical element *ekasilicon* whose properties had been predicted earlier by Mendeleev (developer of the periodic table).

Winkler would have nothing to do with the name suggested by a Russian. Because a German had found it in minerals that occur in Germany it must be called *Germanium.* Coined by a patriot in 1896, the name stuck but use of the capitalized initial letter was soon dropped.

Rare and brittle, the element with atomic number 32 didn't create the sensation Winkler had anticipated. Far from convincing the world of Germany's scientific leadership, it was pushed aside as interesting but unimportant.

Unimportant, that is, until December 23, 1947. That day three scientists at the Bell Telephone Laboratories announced their discovery that a bit of germanium can be made to amplify a speech signal about forty times.

This use of the metal named by a zealous supporter of his Fatherland brought the 1956 Nobel Prize for physics to the Americans who put germanium to work. Immensely more important, effects produced by germanium triggered development of the now omni-present transistor.

Fermium

▲ Glenn T. Seaborg was only 30 when he joined the U. S. atomic energy team in 1942. Placed in charge of plutonium-separating experiments, he played a key role in finding that the element made by neutron bombardment has more than a dozen isotopes.

One of these isotopes, Pu^{239}, proved fissionable. Its discovery brought Seaborg (with E. M. McMillan) the 1951 Nobel Prize for chemistry.

Seaborg was among the scientists invited to study effects of the first H-bomb explosion. In "ashes" recovered from Eniwetok atoll he identified element #100.

Since the start of the system of counting by tens, 100 has been regarded as especially significant. Hence Seaborg proposed that element #100 be named for Enrico Fermi, pioneer physicist who first achieved atomic fission.

Delegates to the first Geneva Conference in 1955 responded to Seaborg's suggestion with enthusiasm. As a result the artificial element numbered 100 in the periodic table is universally known as *fermium.*

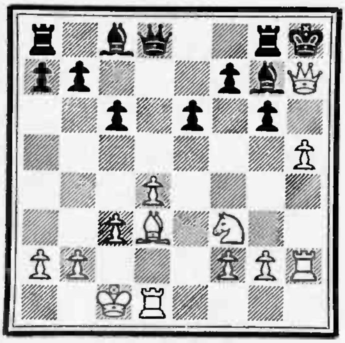
All forms of fermium are strongly radioactive. Its most stable isotope, Fm^{252}, has a half-life of only 30 hours.

So far, fermium has found no important role in war or in peace. But the man for whom it was named split the atom long before anyone dreamed of harnessing atomic energy. Some day, fermium may give Enrico Fermi the public recognition he deserves. ■

On 13 .... KxB (instead of 13 .... K-N2) there follows 14 Q-R5# K-N1 15 Q-N6# K-R1 16 RxP and White wins.

Arthur W. Dake of Oregon, a former member of the United States International Team, shows how a mere Pawn can do it. It is a French Defense, De Burca was Black, and it was played at Warsaw, 1935.

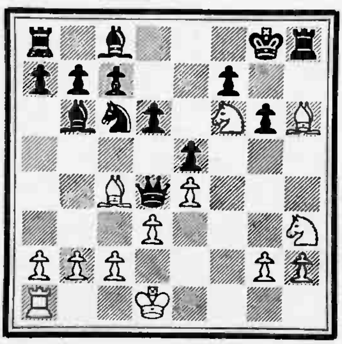
1 P-K4	P-K3	10 0-0-0	P-QB3
2 P-Q4	P-Q4	11 P-KR4	N-B3
3 N-QB3	N-KB3	12 NxN#	BxN
4 B-N5	PxP	13 B-Q3	P-KN3
5 NxP	B-K2	14 P-R5	K-N2
6 BxN	BxB	15 R-R2	R-KN1
7 N-KB3	N-Q2	16 Q-Q2	K-R1??
8 P-B3	0-0	17 Q-R6	B-N2??
9 Q-B2	B-K2	18 QxP#!!	Resigns



For if 18 .... KxQ 19 PxP is a discovered check, a double check, and a mate.

And the fifth one is a short short with spectacular Queen and Rook sacrifices by Israel A. Horowitz in a Simultaneous Exhibition at Los Angeles, 1940. His opponent was "Amateur" and the debut was a Vienna Game. Horowitz is a former U. S. Open Champion, editor of "Chess Review," and author of numerous books.

1 P-K4	P-K4	8 P-Q3	B-N3
2 N-QB3	N-QB3	9 R-B1	N-B3
3 B-B4	B-B4	10 RxN!	P-Q3
4 Q-N4	Q-B3	11 QxP#!!	KxQ
5 N-Q5!	QxP#	12 B-R6#	K-N1
6 K-Q1	K-B1	13 R-N6#!!	RPxR
7 N-R3	Q-Q5	14 N-B6 mate!	



A pure Mate No. 19 (Bishop and Knight). On 10 .... PxR (instead of 10 .... P-Q3), White wins handily with 11 B-R6# K-K1 12 Q-N7.

Game of the Issue. He plays the way a world champion ought to play, Tartakover wrote. He applies common sense, he thinks and writes logically, and he is objective, Reti believed. And he loved to win, became furious when he did not, he did not have any superiors, his originality, profundity, and technical perfection were unsurpassed, and he ranks among the really great artists, Fine said. Who was this genius? Dr. Alexander Alexandrovitch Alekhine. Many consider him to be the best player of all time.

Alekhine was born in Moscow in 1892 and died in Estoril, Portugal, in 1946. He learned the game at an early age and was a master at sixteen. After the Russian Revolution, he moved to Paris and later took a degree in law at the Sorbonne. In 1927, he became World Champion by defeating Jose R. Capablanca at Buenos Aires in a match by winning six games, losing three, and drawing twenty-five. He lost the title to Dr. Max Euwe in 1935, but regained it from him two years later. He was preparing for another match with M. M. Botvinnik when he suddenly died.

A.A.A.'s tournament career stretched from Hamburg, 1910, to Madrid. 1945,—seventy-four battles. And in forty-seven of these he took first prize, or tied for it. One of his greatest triumphs was San Remo, 1930, where he allowed two draws and won every other game!

In addition to his achievements in match and tournament play, Alekhine was an excellent author, his two volumes of "My Best Games of Chess" and the book of the 1924 New York Tournament being classics, material for study by masters. And he was a superb simultaneous and blindfolded player. At the Chicago World's Fair, 1933, he played 32 games at once without sight of the boards!

The style of Alekhine was imaginative, aggressive, and combinative. Surprise moves in combinations often came at the end instead of the beginning. And his openings were painstakingly prepared, replete with theoretical novelties.

Dr. Alekhine considered the game below to be one of his two most brilliant ones. He had Black and his opponent was R. Reti. It is King's Fianchetto Opening and was played at Baden-Baden, 1925.

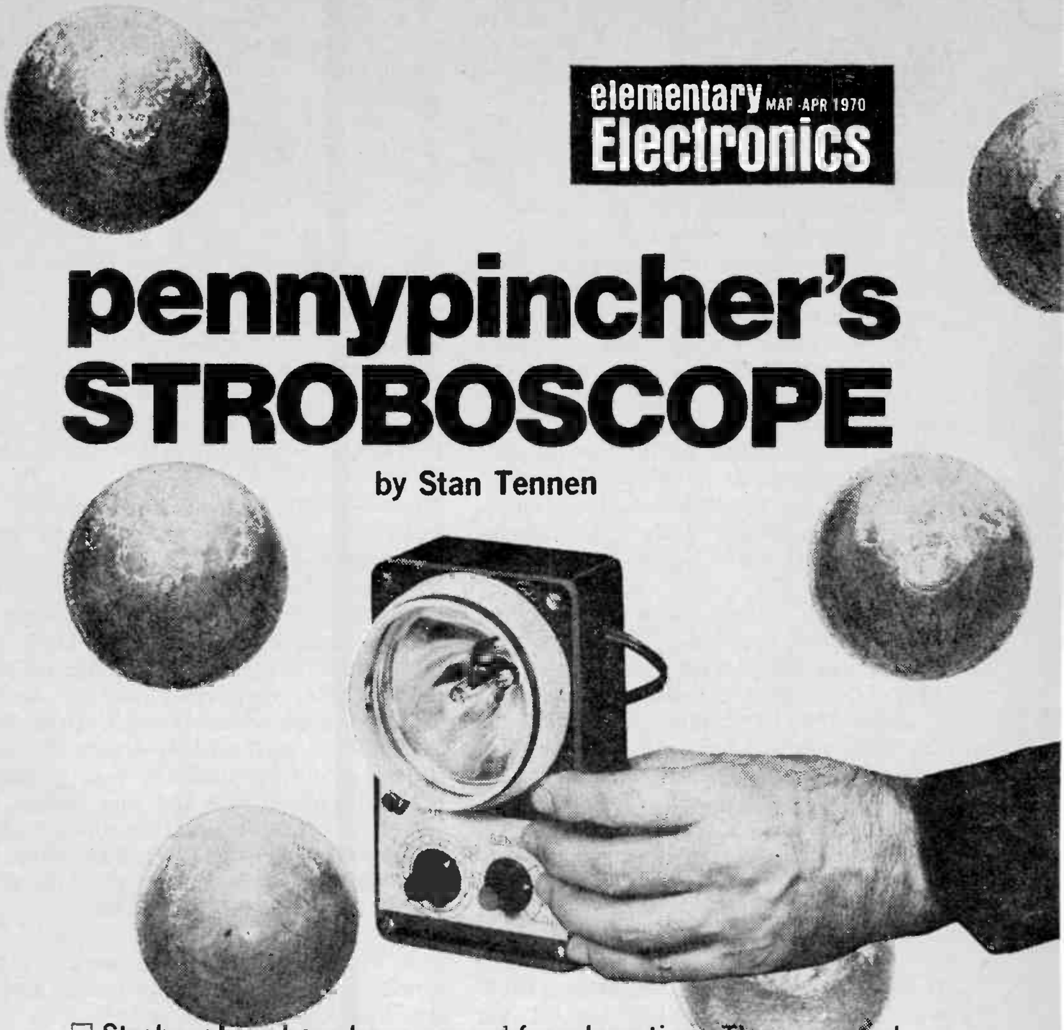
1 P-KN3	P-K4	8 NxB	0-0
2 N-KB3?	P-K5	9 P-QB4!	N-R3
3 N-Q4	P-Q4	10 PxP	N-QN5
4 P-Q3	PxP	11 Q-B4	QNxQP
5 QxP	N-KB3	12 N/2-N3	P-B3
6 B-N2	B-N5#	13 0-0	R-K1
7 B-Q2	BxB#	14 KR-Q1	B-N5!

(Continued on page 98)

elementary MAR-APR 1970 Electronics

pennypincher's STROBOSCOPE

by Stan Tennen



☐ Stroboscopes have been around for a long time. They are used in photography and science to stop motion, in auto shops to tune up your ignition, and generally to measure rotating speeds. They let you see what's happening on rapidly moving or vibrating machinery of all kinds. But don't look at a strobe—it might stop your brain, too!

Actually, the danger isn't all that great unless you're an epileptic or fail to take some simple precautions. The problem arises because your brain has a strobe of its own. One of the brainwave frequencies, called the alpha-rhythm, can become synchronized to the flashing stroboscope light if the frequencies are close enough. Most people have alpha-rhythms of between about 6 and 14 Hz; therefore, only these frequencies might be troublesome to an average person. Psychedelic light shows usually use flash rates above or below this band to prevent the possibility of harm.

If you're watching a stroboscope and become dizzy or ill at ease, close your eyes and turn the light *off* or walk out. And don't ever show a strobe-light flashing at low frequencies (less than about 40 Hz) to an epileptic; it can bring on a seizure.

Most people, luckily, aren't susceptible and can look at strobelight flashing at exactly their alpha-rhythm without any ill effect or discomfort. Many see different flashing colors at their alpha frequency. If you want to find out about stroboscopes, what they can do for you, and what kinds of fun you can have with one, this simple, easy-to-build, and inexpensive unit is for you.

How It Works. The stroboscope consists of four sections: a 300-V power supply, an unijunction relaxation oscillator clock, a high-voltage trigger using a silicon-controlled rectifier, and a Xenon flashtube discharge circuit.

The *power supply* is a conventional voltage doubler operating directly from the AC line. On the positive-going part of the 117-V, 60-Hz input, capacitor C1 is charged to about 150 VDC through rectifier D1 (D2 does not conduct and C2 does not charge). On the negative swing, D2 conducts, charging C2 to 150 VDC (D1 does not conduct). Since C1 and C2 are in series with respect to the rest of the circuit, the potential to which each is charged adds and about 300 VDC is available.

The *internal clock* provides timing pulses for the SCR trigger when S2 is closed. Q1 transistor functions as a relaxation oscillator; C4, C5, or C6 charge via R2 and R7 to determine the RC time constant. When C4, C5, or C6 has charged sufficiently to turn the unijunction *on*, the capacitor discharges through the emitter base 1 circuit and a pulse appears across R6. The cycle then repeats, producing a sawtooth voltage at the emitter and a continuous series of timing pulses across R6.

Alternately, when S2 is open, a repetitive signal applied to T2 through J1 will be rectified by D3. Capacitor C4, C5, or C6 will trigger the unijunction as above and produce pulses at R6 in time with the signal. Because of the polarity of D3, T2 does not provide an alternate discharge circuit for C4, C5, or C6.

The *silicon-controlled rectifier trigger* is a scaled-down transistorized automobile ignition. Capacitor C3 is normally charged to about 300V. But when a timing pulse appears across R6, SCR1 conducts, discharging C3 through the "primary" of "ignition transformer" T1. This produces a 5-kV trigger pulse for the Xenon lamp. Meanwhile the SCR is turned *off* by the back emf induced in T1; this allows C3 to recharge and the cycle to repeat.

The 5-kV trigger pulse causes an initial ionization of the Xenon gas in the flashtube. Capacitor C7, C8, or C9, charged during the *off* period to 300 V via R5, discharges through the Xenon tube. Result is a short intense burst of light.

Construction. Almost all components are mounted directly to the top of the perforated board and supported by their leads. Resistor R5 is the only part mounted under the board; R7 S2, T2, D3, and J1 are mounted on the back of the front panel.

To begin construction, first cut the perfboard to fit the Bakelite case and mount the four ⅜-in. bushings at the corners. The four rubber feet screw into the bottom of the bushings through the case. Drill four holes in the case so they will line up with the standoffs. Also drill a hole for the line cord strain-relief feed-through. Drill three holes in the perfboard to accept the three contact pins from flashtube base (a socket may be hard to find and may mount the tube too high to fit your reflector properly), and a hole to support T1 (it fits through the board to save space and is glued in place under the board—orient terminal 3 close to the flashtube trigger strap).

If the selector switch you use has all its terminals on its bottom, you'll also have to drill holes through the perfboard to mate with these. The switch is held in place by its bent-over terminals. (If your switch cannot be mounted this way, mount it on the front panel with R7 S2 and J1 and run leads to the perfboard.)

Safety First. Only one lead is critical. The high-voltage lead (5-kV trigger pulse) from terminal 3 of T1 to the external metal trigger strap on I1 must be as short as possible and must not touch any component the perpboard, or the reflector. The 5-kV *could* be dangerous and any contact other than at the flashtube could shortcircuit or reduce the pulse, and I1 might not trigger reliably. Except for this, layout and lead dress are completely non-critical. Be sure the mesh electrode of I1 is connected to ground.

Also for safety's sake, use a plastic case and take care that none of the screws or metal parts of R7/S2 or S1 contact the circuitry (except J1 which is isolated by T2). Reason for these precautions is that the stroboscope operates without isolation from the AC line. (If you wish, an isolation transformer, such as Lafayette 33E75029, can be used. Just wire it to R1 and the junction of C1 and C2 where the line cord is shown connected. Wire R1 to D1 and D2 and move S1C to one of the primary leads of the transformer. You'll probably need a larger case for this minor modification.)

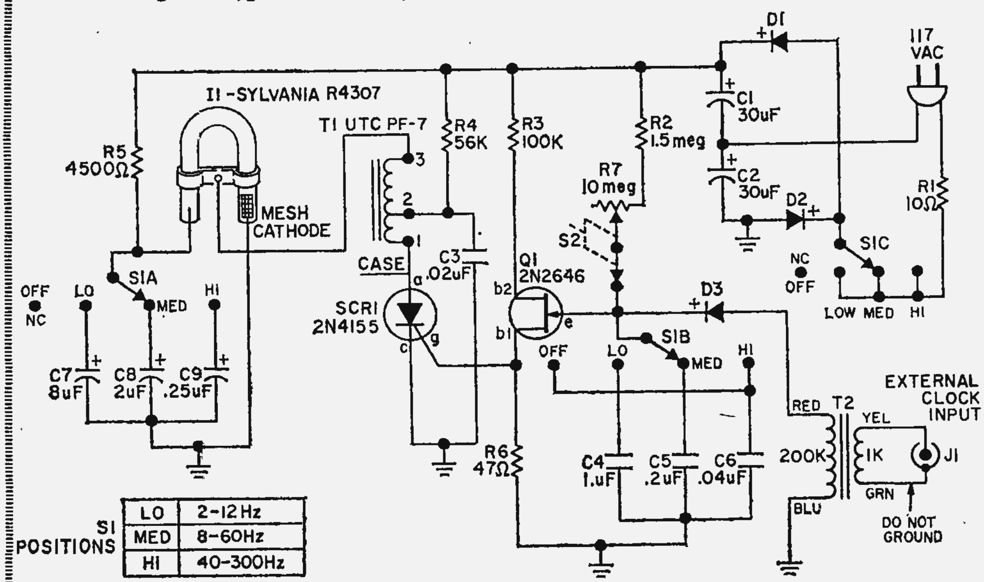
The case of SCR1 is the anode connection. Carefully solder a lead to it, using as little heat as possible to prevent damage. The case is well tinned and this isn't difficult. The long lead is the cathode and the short lead is the gate connection for the SCR recommended in Parts List.

Now mount the components to the perfboard by running their leads through the holes and bending them over. Large parts can be soldered to flea clips for added

PARTS LIST FOR PENNYPINCHER STROBELIGHT

C1, C2—30-uF, 150-VDC electrolytic capacitor
C3—0.02-uF, 400-VDC mylar capacitor, ± 10% tolerance
C4—1-uF, 100-VDC mylar capacitor
C5—0.2-uF, 100-VDC mylar capacitor
C6—0.04-uF, 100-VDC mylar capacitor electrolytic
C7—8-uF, 350-VDC electrolytic capacitor
C8—2-uF, 350-VDC electrolytic capacitor
C9—0.25-uF, 400-VDC mylar capacitor
D1, D2—750-mA, 200-PIV silicon rectifier (any general purpose type having these ratings, or better, will do.)
D3—1N34A diode
I1—Xenon flashtube (Sylvania R4307 or equiv.)
J1—RCA-type phono jack, single-host mount
R1—10-ohm, 8-watt wire-wound resistor
R2—1.5-megohm, ½-watt resistor
R3—100,000-ohm, 2-watt resistor
R4—56,000-ohm, ½-watt resitsor
R5—4500-ohm, 10-watt wire-wound resistor
R6—47-ohm, ½-watt resistor
R7—10-megohm, ½-watt carbon potentiometer, linear taper (IRC/CTS type Q11-143 complete with 76-1 spst. switch or equiv.)
S1—3-pole 4-position rotary switch
S2—Spst switch (part of R7)
SCR1—Silicon-controlled rectifier (Motorola 2N4155 or equiv.)
T1—Photoflash trigger autotransformer (UTC FF-7 or equiv.)
T2—Input transformer: primary, 200K; secondary 1K (Lafayette 99E60345 or equiv.)
1—6¼ x 3¾ x 2-in. Bakelite case with Bakelite front panel (Lafayette 19E-20016 or equiv.)
1—Perforated circuit board to fit case (Lafayette 19E37010 or equiv.)
1—3-in. dia. plastic reflector assembly (taken from Ray-O-Vac L295 flashlight or equiv.)
4—⅜-in. high bushings to raise circuit board

Misc.—Knobs, rubber feet, line cord with AC plug, strain-relief feedthrough for cord, screws, nuts, wire, solder, glue, etc.



S1 POSITIONS		
	LO	2-12Hz
	MED	8-60Hz
	HI	40-300Hz

support. Use regular solid hookup wire for point-to-point wiring beneath the board.

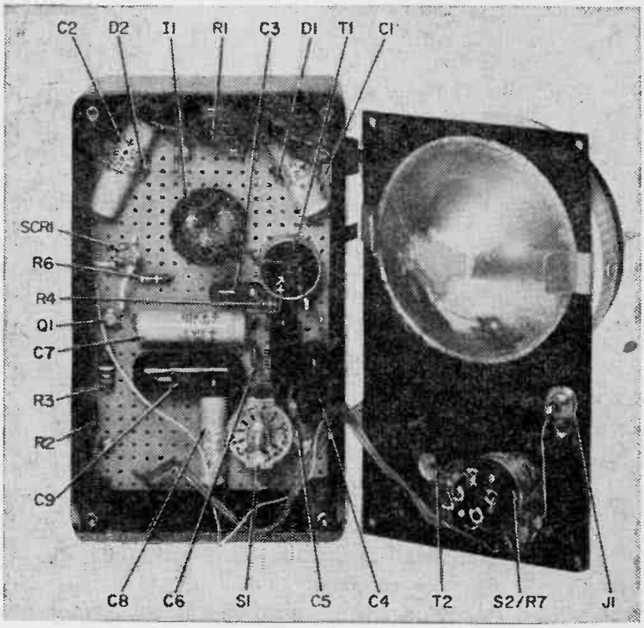
Finishing Up. Finally, mount the reflector, J1, R7/S2, T2, and D3 to the back of the front panel. Almost any plastic reflector will do. Make certain you cut a large enough hole at its apex so it won't touch I1 or any of the leads; cut a mating hole in the Bakelite panel and glue or screw the reflector assembly to it. Doublecheck that it will be properly positioned over I1 before cutting. Drill a hole to clear the shaft of switch S1, a hole for jack J1, and a mounting hole for potentiometer R7 with shaft-actuated switch S2 attached to its rear.

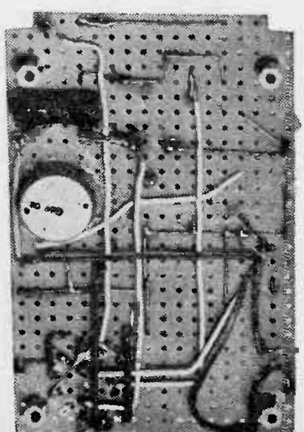
Diode D3 is supported by its leads on the terminals of S2 (a dpst switch such as IRC/CTS type 76-2 has two extra leads and may be convenient instead of the spst 76-1 specified.) The case of input transformer T2 is soldered to the side of R7 for support; alternately, it can be glued to the back of the panel. Observe the color code on the schematic when wiring T2. Note that it is used backwards—the 1k secondary is used as the primary winding and the 200k primary becomes the secondary. If you don't plan to use an external clock, omit J1, T2, D3, and S2. These low-cost parts can always be added later if you change your mind for any reason.

Adjustment and Calibration. Switch S1 turns on the stroboscope and selects the frequency range desired. Rheostat R7 is a vernier for each range; in its extreme counterclockwise position, it opens S2, disabling the internal clock, for external operation via J1. The Pennypincher's Strobe flash ranges are nominally *Lo*—2-12 Hz; *Med*—8-60 Hz; *Hi*—40-300 Hz.

However, the unijunction transistor may have a substantial effect on the higher frequencies on *Hi* range and the lower frequencies on *Lo* range. (If the unijunction is leaky or has an unusually high turn-on voltage the upper frequencies will be limited; if it has high emitter/base-1 resistance, the lower frequencies won't trigger the SCR gate.) The circuit will function with almost any low-cost unijunction but a Motorola 2N4870 or 2N4871, for instance, may not allow frequencies over about 200 Hz in this circuit.

Capacitors C4, C5, and C6 determine the ranges. Smaller values give higher frequencies; larger values give lower frequen-





Innermost secrets of our Pennypincher's Stroboscope are revealed here in all their glory. Removing cover from box exposes all components except R5, which is mounted on bottom of circuit board and is shown in our photo of bottom of board. Controls and reflector are mounted on box cover. Be sure to provide sufficient clearance between reflector and I1. Because voltages are relatively high we suggest you use plastic case similar to one we used.

cies. (With external clocking, C4, C5, and C6 provide filitering and smoothing.) If the frequency ranges don't overlap or aren't correct, change C4, C5, or C6. If you try to increase the highest frequency in any range much above its nominal value, however, the flashtube may not trigger reliably because C7, C8, or C9 will not be able to recharge fast enough.

Do *not* appreciably increase the values of C7, C8, C9. Not only will this reduce the highest frequencies available, but, since more energy will be dissipated in I1, its life will be reduced and R5 will overheat. Fortunately, for almost all applications, the higher frequencies are more a convenience than a necessity. The strobe will stop motion with lower frequencies at a subharmonic of the motion with no loss of effectiveness. (You might even eliminate the *Hi* range to save cost and space or if you cannot get a 4-position switch for S1.)

Almost any SCR with a breakdown voltage of at least 300 VDC can be used in place of the 2N4155. General Electric C22C or C22D SCRs work just fine. Even the lowest current units are usable, since the average current is only a few milliamperes.

There is one circuit precaution. Sometimes at high frequencies the flashtube may overheat and fail to shut off when C7, C8, or C9 has discharged. It can glow dimly, receiving current through R5. If this occurs turn the unit *off* for a few seconds and operate at a lower flash rate for a while. If you don't R5 will overheat and the flashtube life may be reduced.

After the unit is checked out and operating you are ready to calibrate the flash rate. On *Lo* range just count the number of flashes in, say, 10 seconds, and divide by 10 to get the number of flashes-per-second. On the *Med* or *Hi* ranges, it's easiest to watch a strobe disc on a hi-fi turntable. When the bars stop moving, the strobe is flashing at 60 Hz or a harmonic or subharmonic of 60 Hz. A little experimentation will tell if the strobe is flashing at 15, 30, 60, 120, 180, or 240 Hz.

If you don't have a hi-fi and a strobe disc, just look at a small electric fan or other household appliance with an AC-only motor. The fan blades will stand still at the same frequencies as the strobe disc. (Don't use an AC/DC motor with brushes; it probably won't be synchronized with the 60-Hz line.)

Using It. First, try some simple experiments in a darkened room with a friend. Turn the strobe *on* (the *Lo* range is best) and watch your friend clapping hands while you vary the flash rate. When you get it just right you will hear the hands clapping, but you won't see them touch! It's eerie.

Next, clap *your* hands. They'll seem to touch. But watch yourself clap in a mirror. You'll hear the sound and feel your hands touch, but you won't see them touch and you won't believe it.

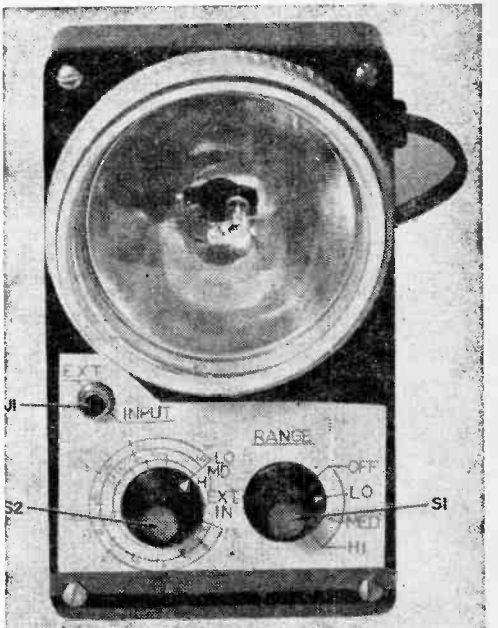
Spin a short piece of string with a weight on the end (or a yo-yo) and watch what happens. Try bouncing a ball or playing catch.

If the flash rate is very low (say about 3 or 4 Hz) and you move about rapidly, you will bump into things and the world will look like an old silent movie. But be careful and if you or your friend feel dizzy, turn the strobe *off* or use it only in a lighted room.

On the *Lo* range, if you connect the external input to the distributor lead on the ignition coil in your car, the strobe will work as a timing light—though it will flash when all cylinders fire instead of only the no. 1 cylinder.

Connect it to your hi-fi's speaker, play

(Continued on page 99)



Simplicity of operation is exposed in this view of the front panel. All controls are readily available in easy reach.

newest tack for profitable SWLing—

DXing the DXers

LONG-TIME DXers sometimes reach the point where they find the same old news formats, square music, and dull commentaries adding up to a slight but nonetheless real bore. How to revive interest in the DX game? Simple—become a QSL specialist.

Stamp collectors who grow tired of general collecting often specialize by concentrating on one country or a single topic. An SWL can also specialize. And what could be more logical than for a DXer to specialize in DXers?

At the present time, there are more than 50 DX programs on the air. Among them are Switzerland's *Shortwave Merry-Go-Round*, Japan's *Listener's Corner*, Holland's *DX Jukebox*, Denmark's *DX Window*, HCJB's *DX Party Line*, and many, many more. Why not try collecting a QSL card for each DX program on the air?

Some will be easy; others will be a real challenge. But whether you complete your collection or not, you're guaranteed to have many fun-filled hours. Reason is that the bulk of your listening will be right down DX alley.

Our table below lists the DX programs that are currently on the air, the times of the programs, and the frequencies they are most likely to be heard on. All programs, by the way, are in English.

Good DX DXing! —*J. Bennings* ■

DX PROGRAMS FROM 22 SITES AROUND THE GLOBE

Country	Day	Time (GMT)	Frequencies (kHz)
Australia	Saturday	2200	15180
Bulgaria	Saturday	0000, 0400	9700
Canada	Saturday	2306	9625, 11945, 15190
Ceylon	Second and last Saturday of month	1100	17830 •
Czechoslovakia	Second Friday of month	0100, 0330	9540, 9630
Denmark	Tuesday	0145	9520
Ecuador	First and third Monday of month	0230	9745, 11910, 15115
Finland	Saturday	2315	15185
Germany	Monday	0100, 0230	6075, 6100, 9655, 9735
Radio Berlin International	Monday	0100, 0230	9730
Great Britain	Monday	1430	21610, 15260
Haiti	Thursday	0300	9770, 11835
Holland	Friday	0142	11730, 9590
Hungary	Wednesday, Sunday	0030, 0300	9755, 11910
Japan	Every third Saturday of month	0020, 0235	15445, 17725, 17825
Netherlands Antilles	Sunday	0335	9695, 11855
New Zealand	Saturday after the first Wednesday of month	2345	15110, 17770
Portugal	Monday	0215, 0315	6025
Romania	Thursday, Saturday	0130, 0300	9570, 11885, 11940
Sweden	Tuesday	0050, 0220	11915
Switzerland	Monday	0220	9535, 6120, 11715
U.S.A.	Saturday, Sunday	1735, 1935	17845, 21525, 15440, 17760

• This is a tough one!

PHONECOM

-The Hot Line Intercom

IF THE DECIBEL LEVEL in your home has been going up, and up, and up . . . and you're wondering where it will end so you won't have to become a stentorian to raise pop in his basement shop . . . take heart—here is a possible solution. Our PHONE-COM is an inexpensive, easy-to-build, 2-station telephone intercom.

Now, with the aid of PHONE-COM, when the little lady of the

Convenient as your telephone, private as your bedroom

by Edward A. Morris, WA2VLU

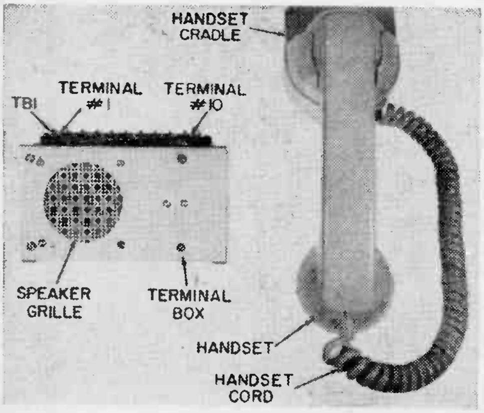
house calls out to hubby that din-din is ready, the entire neighborhood won't have to know about it. Seriously, though, if you are an average home owner, you'll readily see lots of advantages over the loud mouth method.

PHONE-COM is easy to operate: you use it just like a direct-line telephone. There are no *on/off* or *talk/listen* switches to operate, since none are necessary. When the handset is picked up, a pleasant beeping tone signals one party that the other is waiting on the line. Upon answering the call, normal two-way conversation can take place. As with a standard telephone, the communicators can talk and listen at the same time, and the conversation is private.

Unlike many loudspeaker-type intercom systems, with PHONECOM, unless both parties are on the line, neither station can listen in on room conversations taking place at the other station.

Total cash outlay to build the system (two stations) will run slightly under $50.00, with all parts purchased new. However, by a little judicious shopping for bargains, the complete system cost can be cut almost in half.

Maximum station separation, using the ordinary intercom cable specified in the Parts List, is about five miles. This is certainly more than enough for most applications.



Each complete PhoneCom station consists of a handset, a hookswitch assembly with handset hanger, and a terminal box.

Each station is indepedently powered by a single, inexpensive 9-V transistor radio battery. Battery life, especially if you use one of the new premium types, should be about a year under normal usage. The average hobbyist should be able to complete construction in six to eight hours.

How It Works. For simplicity, we'll break PHONECOM down into four separate sections: a) power supply, b) talk amplifier, c) receive amplifier, d) signalling section. The word *line* as it's used in this article refers to the interconnecting cable between the two stations.

The Power Supply. In the normal *on-hook* state, the handset is resting on the cradle switch. The cradle switch is then in the position shown in the interconnection diagram for Terminal Box 1. Positive 9V is present on the arm of switch S1B. When the handset is removed from the cradle, switch S1B closes and applies positive 9V to both the talk and receive amplifiers.

The Talk Amplifier. With power now applied to the talk amplifier, audio output from the dynamic microphone in the handset is fed to the base of transistor Q1 through coupling capacitor C1. Bias for the stage is set by the voltage divider formed by resistors R1 and R2. Emitter resistor R4 helps to stabilize the stage. It also helps to reduce variations in circuit performance due to the wide differences in current gain among individual transistors of the same type, which may be used for Q1.

Capacitor C2 bypasses the emitter resistor to prevent the undue loss of gain at audio frequencies. Resistor R3 serves as the collector load for Q1, and the amplifier output is developed across it. The amplified audio output is coupled to the XMIT line through capacitor C4. Note that the output (XMIT line) of one station should, of course, be connected to the input (REC line) of the other station.

The Receive Amplifier. The input REC line is fed to the arm of potentiometer R7, the receive level control. Pot R7 also serves to set the bias point for transistor Q2, along with resistor R6. The receive amplifier is basically similar in oprration to the talk amplifier. The amplified output is coupled to the receiver cartridge in the handset via coupling capacitor C7.

A small amount of talk amplifier audio output is also fed into the input of the receive amplifier, through capacitor C3 and resistor R5. The signal thus produced is referred to as sidetone. It permits the user to hear his or her own voice in the receiver when talking into a handset, thus creating the effect that the handset is working.

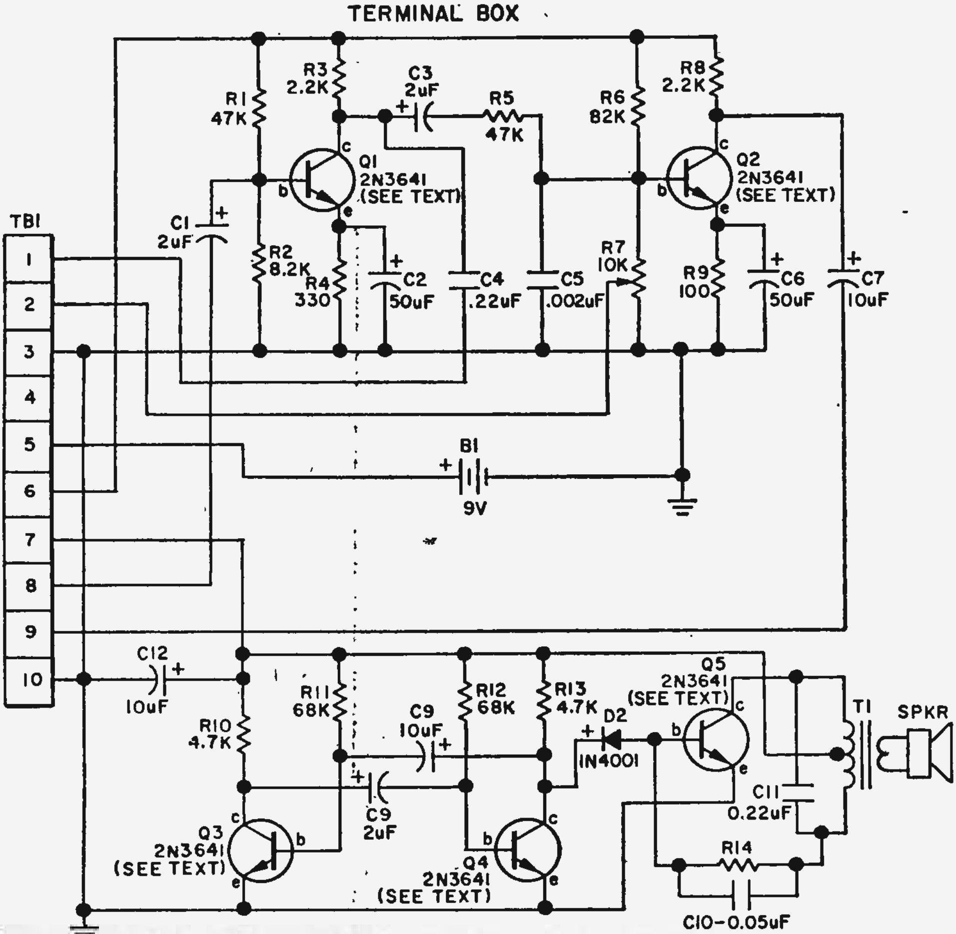
The Signalling Section. PHONECOM uses a form of DC signalling. Ringing, or signalling the other station is accomplished simbly by removing the handset from its cradle switch which causes the hook switch to operate. This applies +9V to the talk and receive amplifiers, as mentioned earlier, and in addition it also applies +9V to the Signal Line via terminal 4 on TB1, through diode D1. Diode D1 is forward biased by the positive voltage on its anode.

We must assume that the handset of the other station is in the *on-hook* condition (i.e., resting in its cradle against actuator lever of S1A and S1B). The positive ringing voltage is received from the other station via the Signal Line and is routed through switch S1A to terminal 7 of TB1, the input to the signaling circuit.

PARTS LIST FOR ONE PHONECOM TERMINAL BOX

B1—9-V transistor radio battery (type 2U6 or equiv.)
C1, C3—2-uF, 6-VDC miniature electrolytic capacitor
C2, C6—50-uF, 16-VDC electrolytic capacitor
C4, C11—0.22-uF, 12-VDC disc ceramic capacitor
C5—0.002-uF, 1000-VDC disc ceramic capacitor
C7, C9, C12—10-uF, 16-VDC electrolytic capacitor
C8—2-uF, 15-VDC electrolytic capacitor
C10—0.05-uF, 25-VDC ceramic capacitor
D2—50 PIV @ ½ A or better silicon diode (Motorola 1N4001)
Q1, Q2, Q3, Q4, Q5—2N3641, npn small signal silicon transistor (2N697, 2N3705, SK3020, GE-21, HEP 54 or equiv.—see text)
R1, R5—47,000-ohm, ½-watt resistor
R2—8200-ohm, ½-watt resistor
R3, R8—2200-ohm, ½-watt resistor
R4—330-ohm, ½-watt resistor
R6—82,000-ohm, ½-watt resistor
R7—10,000-ohm miniature potentiometer (Mallory type MTC-1 or equiv.)
R9—100-ohm, ½-watt resistor
R10, R13—4700-ohm, ½-watt resistor
R11, R12—68,000-ohm, ½-watt resistor
R14—18,000-ohm, ½-watt resistor
T1—Transistor output transformer: 500 ohm CT primary; 8-10 ohm secondary (Lafayette 99E61293 or equiv.)
TB1—10-terminal, screw, barrier type terminal strip (Lafayette 33E86109 or equiv.)
1—Aluminum minibox, 5¼ x 3 x 2⅛ in. (Lafayette 12E83738 or equiv.)
1—2½-in. speaker, 10-ohm voice coil (Lafayette 99E60972 or equiv.)
1—Keystone battery holder, type 203P
1—Battery connector for 9-V transistor batteries (Lafayette 99E62879 or equiv.)

TERMINAL BOX



The positive voltage received on terminal 7 is filtered by the action of capacitor C12, and serves as the source of power for the signaling unit. The signaling unit comprises a multivibrator consisting of transistors Q3 and Q4, their associated components, and the audio oscillator composed of transistor Q5 and its associated components.

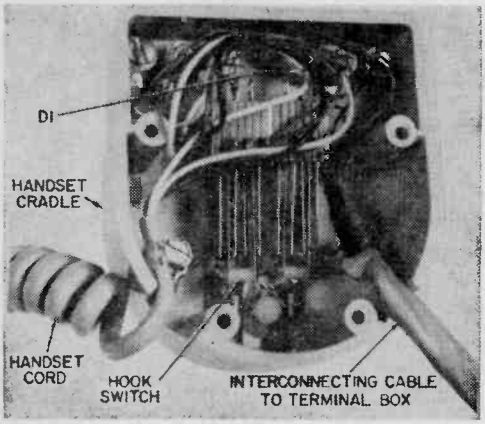
When DC power is applied, the multivibrator is activated. Its output is an asymetrical square wave, and it appears at the collector of Q4. The frequency of the multivibrator is determined by the values of capacitors C8 and C9, along with resistors R11 and R12. The output from the collector of Q4 is coupled to the base of the audio oscillator by diode D2. The square wave applied to the base of the audio oscillator transistor turns the oscillator *on* and *off*, thus producing sound in the speaker.

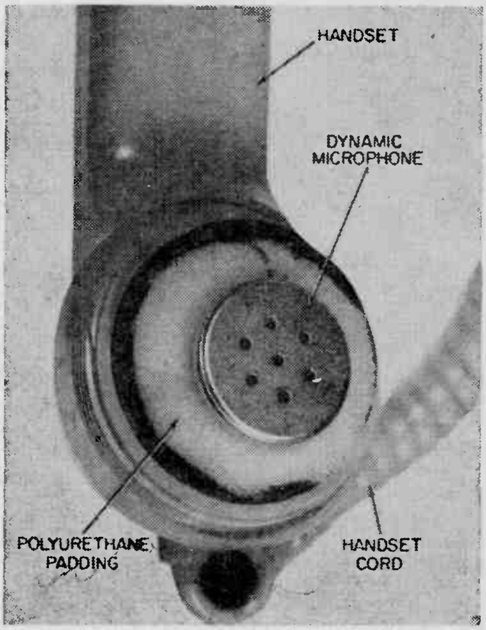
When the other station answers, its switches, S1A and S1B, close, and transfer the Signal Line to +9V through diode D1. The beeping stops because no current is now flowing on the Signal Line. Diodes D1 at both stations are reverse biased with positive voltage on their cathodes.

Mechnical Construction. Though we constructed the models in standard aluminum miniboxes, because the mechanical and electrical layout isn't critical, the electronics may be arranged to fit any suitably sized enclosure. For instance, in the interests of economy, the intercom stations could be built in discarded wooden cigar boxes. Suitably finished, these boxes present quite a good appearance.

The first step in construction is to lay out and spot the holes to be drilled in the case. A small T-square and sharp pointed scriber can be helpful here.

Center-punch the holes to be drilled to ensure that the holes will be accurately placed. The 2-in. dia. hole cutout for the





Above, hookswitch assembly and handset hanger. Diode D1 is mounted on hookswitch. Right, miniature dynamic microphone replaces standard carbon one normally used. Polyurethane cushion is forced into microphone well to hold dynamic unit in place.

speaker can be made easily with the aid of a nibbler. De-burr all holes and cutouts.

The aluminum surface is prepared for painting by rubbing it down with a steel wool pad, and a slurry consisting of an abrasive household cleaner (Ajax or Comet and water). A fine grade of sandpaper can also be used. The case is then washed thoroughly. A slightly matte, roughened surface on the aluminum case to which spray paint can readily adhere will result from this type of preparation. This also helps to remove shallow scratches on the aluminum surface, which would otherwise be noticeable through the painted finish.

The prepared case, along with a 2½-in. section of perforated aluminum to be used as the speaker grille are now ready to be painted. We used spray paint which matched the color of the handsets and cradle switches used in the models. You may want to follow this color scheme or one of your own selection. It's immaterial to the functional qualities of the PhoneCom.

When applying the spray paint, remember not to over spray it. Several light coats are preferable to a single heavy coat. A good durable finish can be applied in as little as a half hour. The trick is to use three or four light coats which dry quickly, that can be applied about 10 minutes apart, or when the previous coat is dry. When the surface has been prepared as suggested, the resulting finish will adhere tightly, and will be more resistant to chipping, peeling, and abrasion.

Electrical Construction. The bulk of the components, except for the speaker, the hook switch (S1A and S1B), the terminal board (TB1), the battery (B1), and diode D1, are mounted on a 2¾ x 4¼ in. piece of perf board. As stated earlier, the exact physical layout isn't critical. However, care should be taken to avoid poor layout techniques. A good bet is to follow our layout as shown in the photos. Relatively exact component placement can be determined from them.

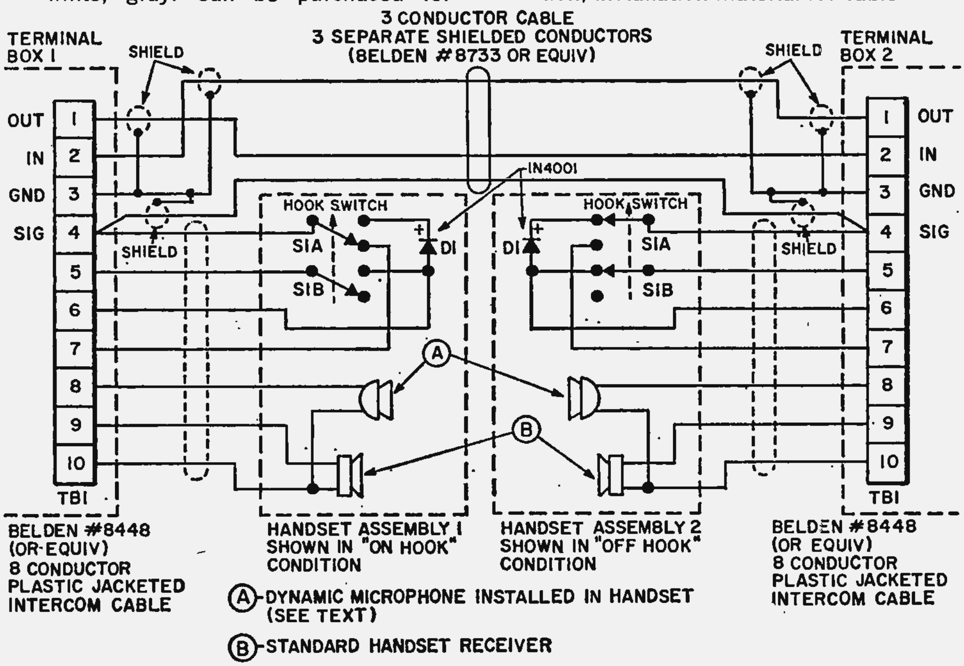
As can be seen in photos, all components are mounted via push-in terminals. The terminals anchor the components firmly to the board, and provide wiring points on the reverse side of the board. Wiring was carried out using small gauge, bare copper wire. Insulated plastic tubing was added at crossover points to prevent possible shorts.

A wide variety of substitutions for transistors Q1-Q5 are possible, only a few of

PARTS LIST FOR PHONECOM HANDSET ASSEMBLY

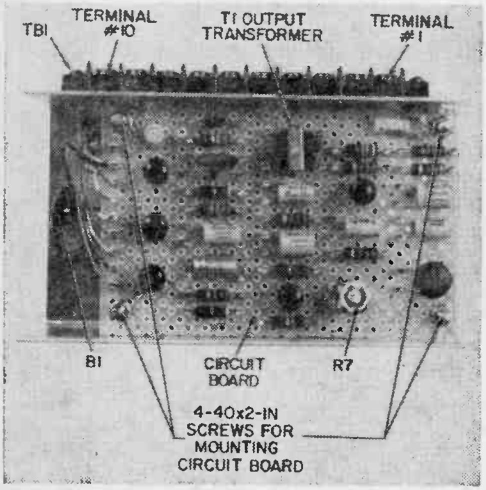
D1—1N4001 Motorola silicon diode (any silicon diode rated at 50 PIV, ½ A or better will do)
1—Handset cradle and hook switch assembly for S1A and S1B Switchcraft type 14412G, specify color of plastic—black, beige, white)
1—Miniature dynamic microphone cartridge, 600-ohm impedance (Lafayette 99-45270 or equiv.)
1—Telephone handset, less transmitter cartridge, complete with receiver cartridge and 4-wire coiled cord. Specify color when ordering: red, black, beige, white, gray. Can be purchased for $6.50 each plus postage from:
Grandcom Inc.
1152 Avenue of the Americas
New York, N.Y. 10036

Misc.—Wire, solder, bolts, nuts, push-in clips, perfboard, spray paint, polyurethane foam sheeting, Belden #8733—3 separate shielded conductors in one jacket for interconnecting stations, 7 single conductors in one jacket for connecting cradle and hook switch assembly to terminal box (Belden #8448), lengths of cable for installation, installation material for cable



which are tabulated in the Parts List. The model uses 2N3641s, obtained new at five for a dollar from Poly Paks. Fact is, just about any small signal, npn silicon transistor having a gain over 20 can be used with good results.

Assuming reasonable care is taken, the transistors may be soldered directly into the circuit. Modern silicon transistors are quite rugged and will not be damaged by the heat from soldering if just a bit of care is exercised. Simply use a low-to-medium power soldering iron (under 60 watts or so). Make sure it's well tinned, and leave more than ⅜ in. lead length between the soldered joint and the transistor case. Complete the soldering operation as quickly as possible. To be safe use a heat sink (an alligator clip on the lead being soldered).



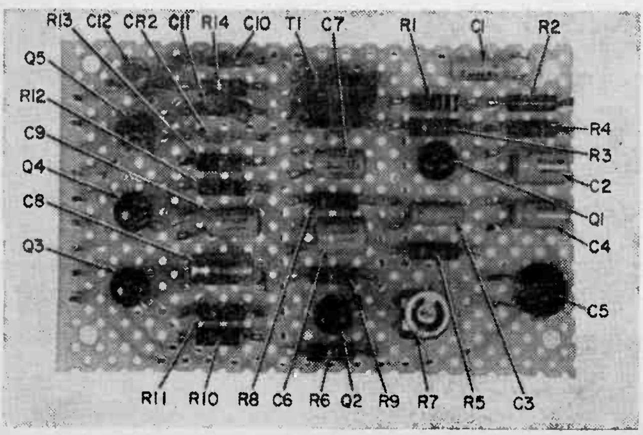
After the circuit card has been wired in accord with the schematic diagram, recheck your work for possible errors. Make sure all polarized components (electrolytics, diodes, etc.) are installed correctly. You should also check for accidental shorts and cold soldered joints.

Modifying the Handsets. In order to use a single inexpensive battery as the PHONECOM's power supply, the carbon microphone normally used in telephone handsets has been replaced with a miniature dynamic microphone element. Refer to the photos for mounting details. Note that the dynamic element is cushioned by a small piece of polyurethane foam placed in the microphone well of the handset. Connect the leads from the dynamic element to the red and black leads in the handset. If the handset is obtained from the vendor mentioned in the Parts List, it will be shipped less the carbon element.

The completed, checked, electronics circuit card is now ready to be mounted in the aluminum case. By referring to the photos, you can see how 4-40 x 2-in. machine screws and nuts were used to mount the card, and space it about 1⅜ in. above the aluminum panel. The various interconnecting wires between the circuit card, the speaker, and the terminal board should be installed now.

The Hook-Switch. Prior to wiring the handset cradle with hook-switch, the handset, diode D1, and the 7-conductor cable, decide where the cradle assembly is to be mounted. Check to see if it's possible to

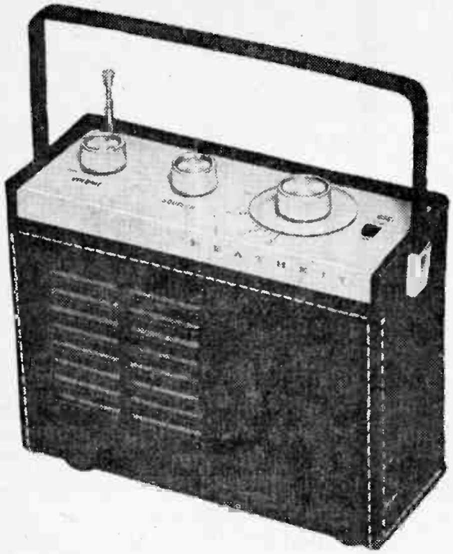
Upper left, rear view of Terminal box showing circuit board and terminal board for external wiring. Lower left details circuit board. Components are neatly oriented to facilitate interwiring. All are identified to assist in your layout.



mount the cradle switch in such a position that the 7-conductor cable can be fed directly through a hole in the mounting surface to the cradle assembly from the rear. If this isn't possible, it will be necessary to use one of the semi-circular knockouts on the edge of the cradle's mounting surface. One of these knockouts will have to be removed to allow the handset cable to pass.

(Continued on page 99)

e/e COMMUNICATIONS



HEATHKIT MODEL GR-88
Solid-State VHF-FM Monitor Receiver

When it comes to vhf public service receivers—popularly referred to as police-fire receivers—nearly every one of them is described as *professional*, though a *pro* communicator wouldn't be caught dead using the majority of this gear. The Heathkit GR-88 is about the only receiver in the low-priced field under $100.00 that comes close to being compared to professional equipment. It's a receiver a *pro* might really use.

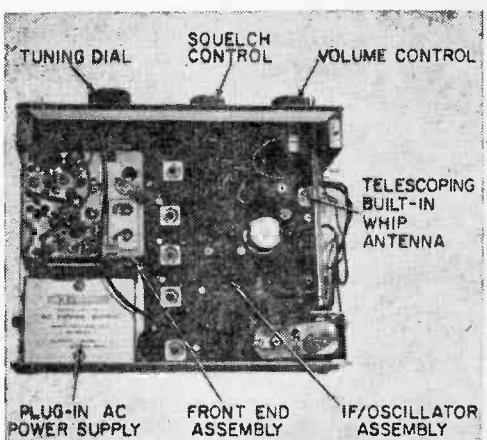
The GR-88, supplied in kit form for $49.95 complete with leather case and carrying handle, tunes over the frequency range of 152-174 MHz. In addition, a single switch-selected crystal-controlled frequency is also provided. The unit is battery powered by 6 "C" cells, or can be powered by an optional built-in AC power supply. An adjustable squelch and a volume control are provided, as is an external antenna jack and a built-in telescopic whip antenna.

What's Inside. The receiver is comprised of the following sections: tuned RF amplifier, IF filter, 5 stages of IF amplification and limiting, ratio detector, noise gated squelch, AF amplifier and separate continuously tunable and fixed tuned crystal-controlled oscillators.

The kit is supplied with a completely assembled and prealigned front end, and prealigned IF transformers. Except for the front end and optional built-in AC power supply, everything is assembled on a single PC board, with lots and lots of room between components.

Upon completion of assembly the receiver is ready to go. A slight touch-up in IF alignment will assure optimum performance. Our test unit required only a slight adjustment of the IF coils to obtain maximum sensitivity. An alignment using accurate test instruments produced no significant improvement in performance.

It is somewhat unusual and interesting to find a noise-operated squelch circuit in low-cost equipment. The commonly used FM ratio detector is known as a self-limiter. At very low signal levels it doesn't limit the noise—it passes the noise through to the audio take-off. At high signal levels the detector, in conjunction with a limiting IF amplifier, almost totally eliminates noise appearing with desired signal.



There's plenty of room on this circuit board to do a neat job. It's almost like a beginner's kit, but what a set!

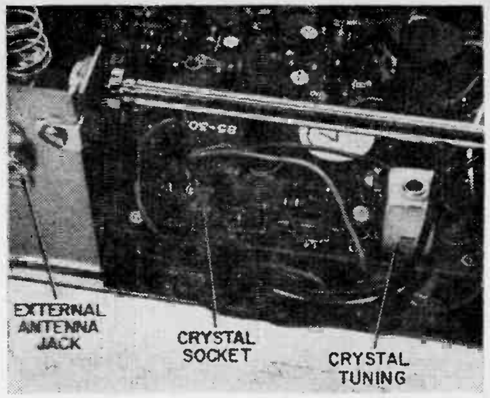
e/e HEATHKIT MODEL GR-88

In the GR-88, the *no-signal noise* passing through the detector is fed to a noise amplifier whose output is rectified and filtered into a DC reference level. This DC reference is then used to turn *off* a transistor gate in the audio amplifier. The more noise the greater the gating action. Occasionally relatively *long-time-spaced* noise pulses break through the squelch. When a signal is received the ratio detector sharply limits the noise level, the noise fed to the noise amplifier drops and the squelch gate is released, allowing the modulation signal to be fed through the AF amplifier. It's a very effective squelch system.

Performance. The sensitivity of the GR-88 checked out a shade higher than the rated 2 μV. Because of what appears to be a toroid IF filter and sharply tuned IF transformers, the GR-88's selectivity is considerably greater than that of the usual low-cost police receiver. For example, we tested a $40.00 receiver that could not separate the closely spaced New York City fire frequencies; whereas the GR-88 brought each one in clearly and without interference.

Image rejection proved excellent, better than 45 dB down, considerably better than other low-cost receivers. In fact, we experienced no multiple image reception at all within one mile of a vhf transmitter.

Considering the price of the receiver, frequency stability of the variable tuning is

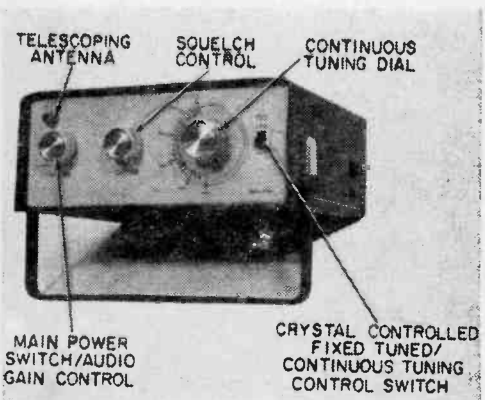


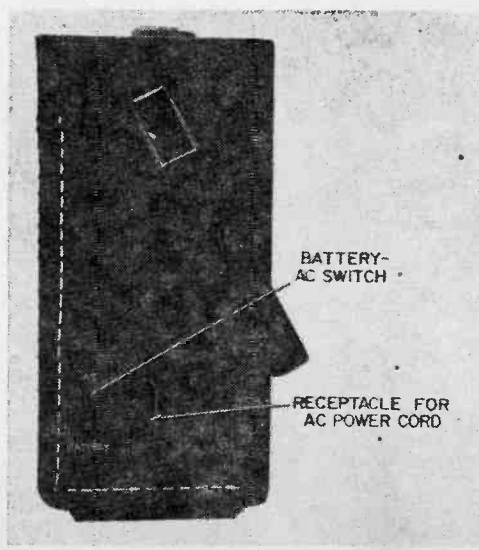
In addition to the continuous tuning over the full range, the GR-88 is provided with one crystal controlled spot frequency.

good, and a lot better than most budget-priced equipment. No instability or self-oscillation was noted.

For single channel monitoring, such as for the weather frequency(s), the crystal controlled oscillator is recommended. While Heath does not supply the crystals, they do provide the specifications needed to purchase the correct crystal from any crystal manufacturer.

Summing Up. The Heathkit GR-88 VHF FM Monitor Receiver, priced at $49.95, is presently just about the best thing available in police-fire receivers priced under $100.00. Fact is, you would have to go considerably over $100.00 to obtain comparable performance, convenience, and relatively light weight. For additional information write to Heathkit, Dept. 139, Benton Harbor, Mich. 49022. ■

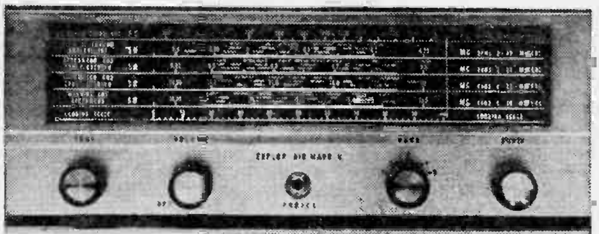




Above, the neat layout and well identified controls make the Heathkit GR-88 receiver a pleasure to use. Right, note the two position power select switch for either battery or AC power line operation and also the receptacle for the AC power cord.

Be a magician — changeo — presto — make that budget SW receiver perform like the best

the

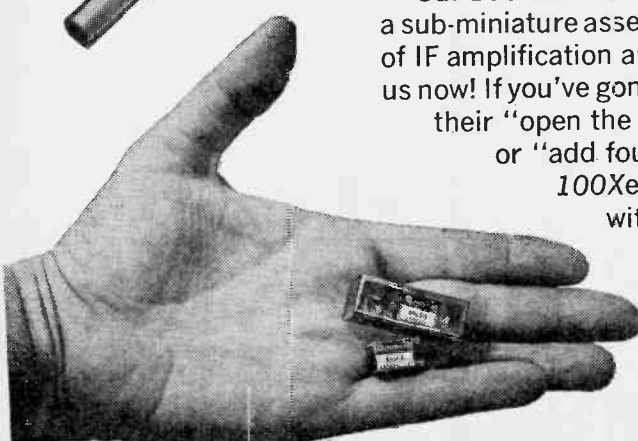


100Xer

by Herb Friedman
W2ZLF/KBI9457

WOULD YOU like to give your budget shortwave receiver a swift kick in the a . . . ntenna input? You can—by making its selectivity so sharp you can knock an interfering CW signal over the cliff into never-never land, and at the same time raise its sensitivity so high that it may be almost unusable. Nope! You don't have to buy a new super-gold-plated receiver—all you need do is tuck our little *100Xer* into the innards of your present budget SW receiver and you'll pick up at least 40 dB (100X) gain and an additional 18 dB or so of selectivity at 10 kHz.

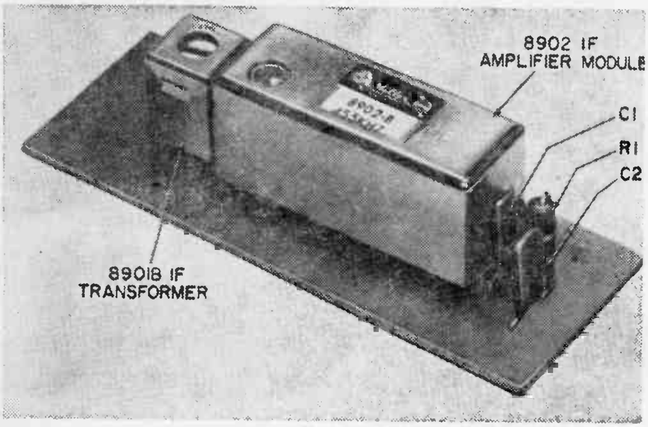
Our *100Xer* is basically the Miller solid-state IF strip, a sub-miniature assembly providing two complete stages of IF amplification and a detector. Hold on! Don't leave us now! If you've gone through these articles before with their "open the case and change an itty-bitty lead" or "add four widgets to the IF," fear not. Our *100Xer* can be dropped into your receiver without having to make advanced engineering changes, without loss of AVC, or needing to ride every station with an RF gain control. You won't lose the receiver's BFO, nor will you have to build a new BFO. Most difficult task you'll have will be making a printed circuit



e/e **THE 100Xer**

board. Roughly speaking, figure on about one evening's work and approximately $15.00 to effect a super-colossal improvement in budget receiver performance. (We keep saying "budget receiver" because the AVC action of a gold-plated receiver would mask any improvement made by the *100Xer*, and, in addition the noise level would be brutal.) The only prerequisite for adding the *100Xer* is that your receiver have a 455-kHz (or 456 kHz) IF. The *100Xer* will not work with a set having another IF. is our *100Xer* will work with either positive or negative grounds.

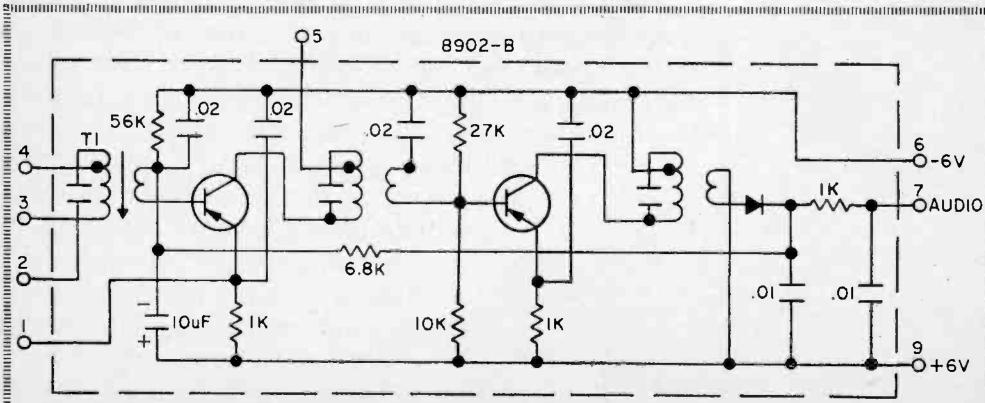
The Miller 8902B basic module affords roughly 40 dB of amplification and has a bandwidth of 18 kHz at 20 dB down. When a sub-miniature IF coil is used ahead of the module, the gain is approximately 40 dB with a bandwidth of 12 kHz at 20 dB down. Because of the rather sharp improvement in selectivity we suggest the module be used with the Miller 8901B IF coil. Even though some projects still use it, note that the 8901 coil is not a direct replacement for the 8901B; therefore, make certain you get the B model. Both the IF module input and the 8901B input are each



Completed assembly makes small, neat package, easily installed. Aside from printed circuit board, Miller IF module, and transformer, just three other parts are needed: R1, 4700 ohm, ½W resistor; C1, 0.005uF, 75V ceramic capacitor; and C2, which for tube type sets is a 0.01uF, 75V ceramic capacitor and for transistor sets is a 10uF, 6V electrolytic capacitor. The 100Xer assembly is only 1-1/16 x 3-in.

The circuit of the Miller module is shown in the schematic. Note that there is nothing tricky or unusual about it. It's a straightforward two-stage IF amplifier with a detector. And you forget voltage polarity, or if npn or pnp transistors are used. Reason approximately 47 ohms. They can be connected directly to almost any detector output transformer without upsetting the original receiver circuit.

First step in construction is to make a small printed circuit board which will hold



Circuit diagram of Miller model 8902B IF module. Note that this unit consists of conventional transistorized stable 2-stage amplifier tuned to 455kHz and a detector.

the IF coil, the IF module, and the three external components we have added, as shown in the block schematic. The board arrangement is critical. Do not make it larger or change the foil leads layout as either could cause receiver-disabling instability. Make the board this way . . . please!

Making the PC Board. Cut a piece of XXXP Bakelight or epoxy glass board with foil on one side to a 1$\frac{1}{16}$ x 3-in. size. Scrub the foil clean with a piece of soapless steel wool and place a piece of carbon paper face down on the foil. Slip the board, with carbon paper, under the full-scale template shown and tape it securely under the template.

Next, using a sharp-pointed instrument such as an awl or ice pick, push through the template at the center of each circle until an indent is pressed into the copper foil, in order to identify lead holes. Make certain every lead hole is indented, as well as the hole for the unused transformer pin, and the mounting tabs on the cases for transformer and the IF module. Next, using a ball pen, trace the outline of all foil circuit ribbons onto the foil.

Remove the template and carbon from the PC board. Using a Kepro resist pen (which has a wick tip, and is available from Allied Radio), not a resist ball pen, fill in the outlines traced on the foil with resist. It's best to make the ribbons as thin as possible to ensure they won't touch one another and short—they needn't be thick. So you'll know where to drill after etching, make certain you place a dot of resist over all of the indents including the ones for the unused coil lead and the tabs for the cases. Use as little resist as posible to make very small markers for drilling centers. Print the terminal code letters on the foil as they appear in the template.

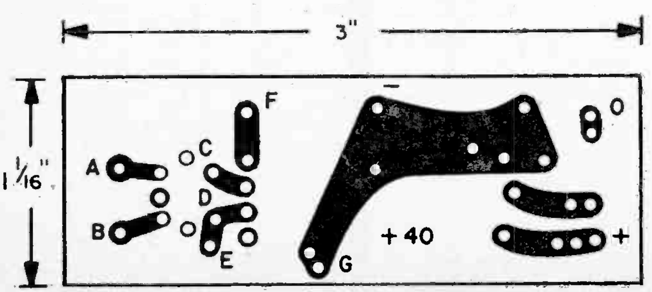
Let the resist dry thoroughly for a minimum of 10 minutes, then immerse the board in etchant to a depth of at least 1 in. for about 30 minutes, or as long as it takes to remove all the unwanted copper foil. Agitate the etchant frequently to be sure of complete removal of the unwanted copper. When all unwanted foil has been removed, rinse the board under running water and then dissolve the resist with resist solvent (or nail polish remover) or by rubbing over it with steel wool.

You are now ready to drill the holes. Use a #58 drill for the component and transformer leads' hole. Use a #44 drill for the holes for the module and transformer case tab holes, and a #52 drill for the holes for the T-28 push-in terminals used for external connections.

Installation. When the *100Xer* is installed in a receiver having a negative ground, which is the case for all tube-type receivers and some transistor models, connect a wire jumper from hole E to hole G on the newly-made printed circuit board. Hole G is one of the tab holes for the case of the module. When the receiver has a positive ground, connect an insulated wire on the foil side of the board from hole E to the push-in terminal used for the + battery connection. (Note: the 8901B transformer must be used in transistor receivers, but not necessarily with tube-type models.)

When the *100Xer* is installed in the receiver the original AVC circuit is not disabled. In addition, the 8902B module has its own AVC. During reception of CW or sideband signals, the receiver's original AVC is normally disabled. The 8902B module's AVC stays on, but this creates no unreasonable problems.

You should understand the AVC circuit thoroughly before making any attempt at installing the *100Xer*. As shown in schematics depicting typical detector circuits, whether tube or transistor, the last IF transformer feeds a detector diode (which may be either a separate solid-state diode or the diode part of a tube) that rectifies the RF. A capacitor extracts the modulation and couples it to an AF amplifier, and



Once you've traced outlines of circuit ribbons onto foil side of a circuit board by placing ordinary carbon paper between this full scale pattern and circuit board, fill outlines with resist, allow it to dry, then etch as directed in text to complete board for assembly.

an RC filter network smooths the DC rectifier output for AVC control.

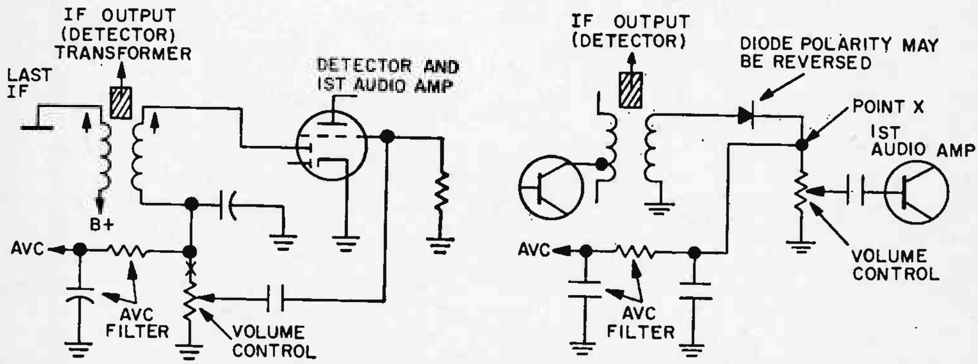
When the *100Xer* is installed you modify only the modulation take-off point. The AVC connections are not modified in order that AVC for the receiver's original IF and RF amplifiers is maintained. Note from the tube-type receiver schematic that the receiver's volume control is the load for the detector; therefore, the AVC voltage is developed across the volume control. The receiver's normal AF output is disconnected from the volume control at point X and the volume control is connected to the output of the *100Xer*.

For proper receiver operation, a fixed resistor must be installed from point X to ground when the *100Xer* is installed. The resistance value of the resistor should be equal to that of the volume control. Resistor Ry is this added resistor, as shown in the schematic for the completely modified detector circuit.

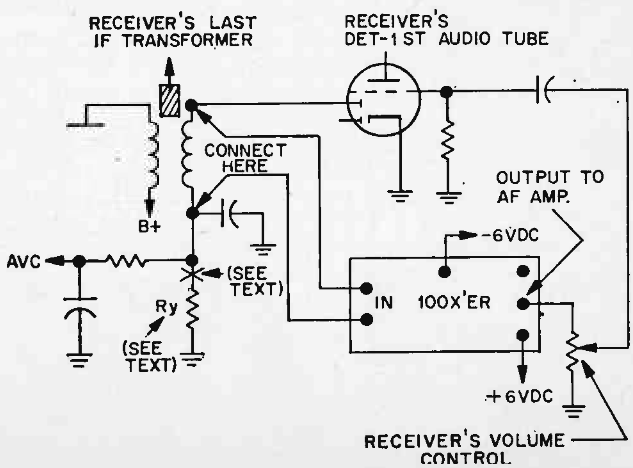
Don't be concerned about a "detected" signal feeding another IF amplifier, since budget receiver, modified as detailed in this article, works well. Everything remains as is, except for the original audio connection.

Special Note. In some transistor receivers the gain of the *100Xer* is so high it might cause the receiver to be unstable, depending on where you mount the *100Xer*. If you should experience instability because of this, remove the 8901B coil from the circuit by connecting jumpers from A to C and from B to D on the PC board.

Install the *100Xer* as close as possible to the receiver's last IF transformer. Cement it to the chasis or any convenient spot with two or three drops of GE's RTV adhesive, making certain that the foil doesn't short out against the chassis. A very important word



Left, circuit for IF, Detector, 1st audio portion of tube type receiver; right, same portion of transistorized receiver. Note audio take-off point and how AVC voltage is developed.

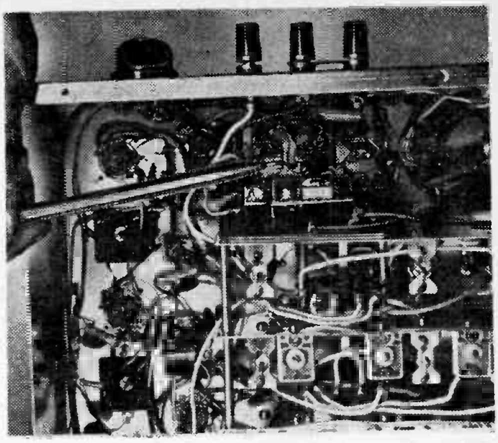


This schematic details how you connect 100Xer to IF output of your SW receiver. Be sure to replace volume control with fixed resistor(Ry) having same total resistance as control. Volume control is disconnected at X and reconnected between output of 100Xer and 1st audio stage of your receiver.

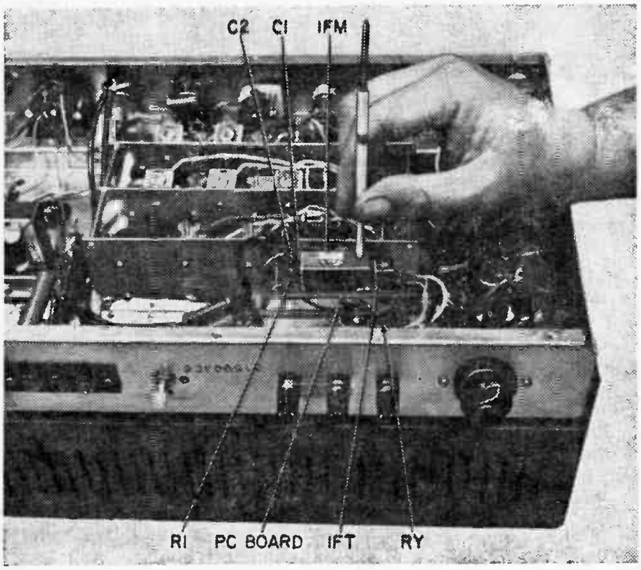
of warning: do not use Silastic or anything other than RTV. Though they look the same, in reality RTV adhesive will not affect tuned circuits even if it should run onto the *100Xer* terminal while Silastic, etc., will create a dead short to RF.

Allow at least 24 hours for the RTV to dry and then connect the *100Xer* as shown in the schematic for the modification.

The Power Supply. The *100Xer* requires 6 volts maximum at 2 mA. You can get it the easy way by using a 6-V battery and a separate battery switch (a Burgess type Z4 battery will work for hundreds of hours). We suggest this arrangement when modifying transistor receivers since it's the easiest



Complete assembly is small enough to be tucked on chassis of your SW receiver as close as possible to last IF transformer of set. It's easy to fasten assembly there—just use RTV adhesive. It cements board of 100Xer to set's chassis.

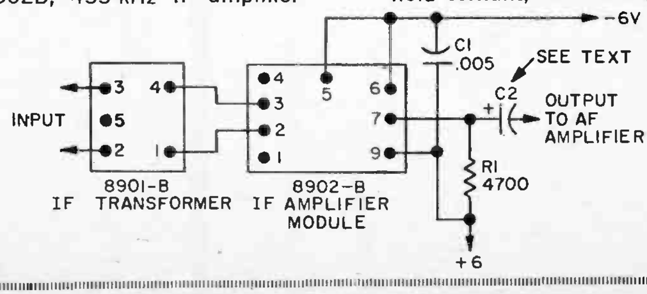


Once you have wired 100Xer in accord with schematic on opposite page, you are ready to check alignment. To get maximum benefit from 100Xer, even though module and IF transformer are factory aligned, go through steps outlined.

PARTS LIST FOR 100XER

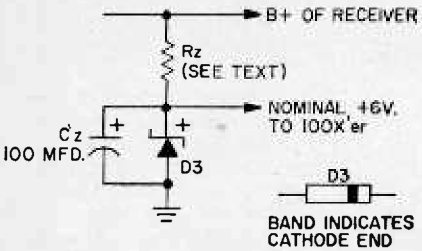
C1—0.005-uF, 75-VDC ceramic capicitor
C2—0.01-uF, 75-VDC ceramic capicitor or 10-uF, 6-VDC electrolytic capacitor (see text for correct choice)
D3—Zener diode, 6.1V, 180mW (see text)
R1—4700-ohm, ½-watt resistor
Ry—See text for resistance value
1—Miller 8901B, 455-kHz IF transformer
1—Miller 8902B, 455-kHz IF amplifier and detector module
1—1-1/6 x 3-in. piece XXXP Bakelite or epoxy glass circuit board with copper foil on one side only (see text for etching instructions)

Misc.—GE RTV cement, solder, etchant, resist, Kepro RMP-700 resist pen, hookup wire, small glass dishes to hold etchant, steel wool, etc.



way and doesn't require tapping into the receiver's PC board. If the receiver has a 6-volt power supply—which is very unusual—you can tap directly onto this battery supply.

For tube receivers a Zener regulator circuit as shown in schematic for low-voltage regulator is suggested. Zener diode D3 can



To get 6 VDC required for 100Xer, use bleeder resistor and Zener diode to regulate voltage as discussed in text.

be any 6-V Zener having the lowest possible power rating, say 180 mW. The object is to keep the total current, both the Zener's and the *100Xer* current which flows through Rz, as low as possible to keep Rz's heat dissipation down. Allow about 4 mA for D3, added to the 2 mA. *100Xer* current, the total current through Rz, will be 6 mA. It's most important the Zener be rated no more than 6.1 V maximum. If necessary, use a Zener rated below this value, but as close as possible to 6 V.

The value of Rz is determined by the voltage of the receiver's B+. Carefully measure the B+ and note the voltage. For illustration, assume this is 250 V. The drop across Rz will be 250 V, less the 6V of the Zener drop, or 244 V. Since there will be 6 mA current through Rz (4 + 2), the value of Rz from Ohm's Law (R = E/I) is: Rz = 244 V .006 A, which is 40,000 ohms. Use a standard resistance as close to 40,000 ohm as possible, which, in this instance, would be a standard resistance value of 39,000 ohms.

Power-handling capacity for this resistor should be at least twice the power dissipated in Rz. Again, from Ohm's Law ($P = I^2R$), the power dissipated by Rz is: $P = 0.006^{2A}$ x 40,000 ohms which is 1.44 watts. Twice 1.44 is approximately 3 watts, so use the next highest value, a 4-watt resistor, or two 2-watt resistors, each 80,000 ohms, connected in parallel.

Because you might be using "bargain" Zeners make certain you have the proper voltage across S3 before connecting to the *100Xer*. (The Zener you use may not pass enough holding current.) If the voltage across the Zener is higher than the rated voltage, raise Rz's resistance in small increments by seriesing a resistor until you reach the rated voltage across D3. Once you are certain that the voltage is correct, you can safely connect the *100Xer*.

Regardless of the type of power supply, capacitor Cz must be used or the *100Xer* will actually reduce the overall receiver gain. Even if you use a battery supply capacitor, Cz must be connected across the *100Xer's* power terminals.

Alignment. The *100Xer* will be in almost perfect alignment unless you displace the receiver's original detector transformer. To check, or to peak align, connect a signal generator tuned to 455 kHz to the input of the receiver converter or mixer, set the generator's output level till you barely hear the tone from the receiver's speaker, and adjust the receiver's detector transformer, the 8901B, and the IF module for maximum audio output. Make certain that you keep reducing the generator output to the lowest possible level as you reach the peak in adjustments of each unit.

Using the 100Xer. The *100Xer* does not affect a standard BFO; you use the BFO in your receiver as you always have. For CW and sideband reception disable the receiver's AVC (the *100Xer's* built-in AVC is always operative) and adjust the RF gain for usable signal level. In some receivers the AVC is automatically disabled when the BFO is switched on—that's fine. For phone reception you use the receiver's AVC.

With the *100Xer* the overall receiver gain when running wide open is very high and the hiss level similarly will be high. However, when a signal is received, the AFC of both the receiver and *100Xer* becomes operative and you will actually hear the noise level drop down behind the signal. So don't worry about a high noise level.

The overall selectivity will also be very high, producing sideband cutting of phone signals—tending to make the signal bassy. That's the price paid for super-selectivity. On CW you should be able to drop all but zero-beat interference over the "selectivity cliff." ■

FM

AIRWAVES ARE

Come on in: the ~~water's~~ wonderful!

by Michael Dorner, Jr.

Time was when a listener could spin the dial across the FM broadcast band, and, save for such large cities as Chicago, New York, and Los Angeles, encounter few stations, if any at all. Today things have changed for the better. As of November 27, 1969, there were 2450 FM stations on the air in the U.S. All large cities have at least one: Greater Los Angeles leads with 26; Greater New York has 25; Greater Chicago, 23; and Greater San Francisco, 17. Even such small towns as Blue Earth, Minn. (pop. 4200) and Central City, Ky. (pop. 3694) boast of FM service.

The advantages of FM are fairly well known: reception is "static free," though the term does demand some qualification. FM is free from the bursts of thunderstorm static, clearly a boon in certain parts of the nation such as the Gulf Coast and Midwest. Still, it is subject to other types of interference, as is television. Man-made static may cause problems; in large cities the signal is sometimes deflected by tall buildings with resultant multipath or "ghosts." Also, areas located near high-power vhf transmitters have considerable FM reception problems.

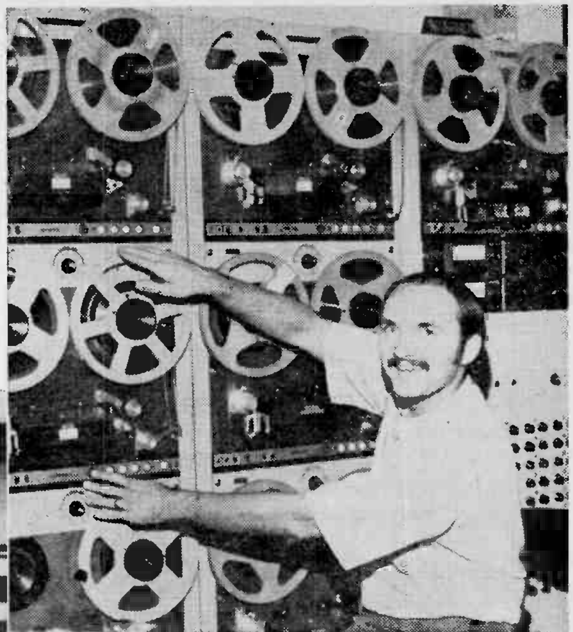
But improvements in set design have made these problems less serious today than they once were. The most outstanding aspect of FM reception is that there is no interference from distant stations. One reason is that the FM band (88-108 MHz) is in the vhf region; reception is rarely possible or reliable beyond the immediate horizon. A second reason is that all but the cheapest receivers have what is called good rejection ratio; that is, the set completely ignores a weaker station on any given frequency.

What Price AM? Just what a salvation FM could be to our national system of broadcasting can be appreciated by listeners who have dialed past local stations in the AM band and attempted to pick up out-of-town stations. The number of AM stations has swollen considerably and now has climbed past the 4200 mark. The clutter and noise are incredible—and this despite FCC attempts to ameliorate interference by granting a large number of these stations daylight-only licenses, and by requiring the vast majority of full-time stations too use often highly complicated directional antennas and reduced power to protect distant co-frequency stations. Even the giant 50,000-watt stations have their problems, not only on their own channels, but also from stations on adjacent channels.

But if the so-called clear channels are now protected by damming the flow of new stations on or near clear-channel frequencies, the other frequencies are not. These—the regional and so-called local channels—are utter chaos at night. Hundreds of full-time stations occupy the six local channels (1230, 1240, 1340, 1400, 1450, and 1490 kHz). Because of their large number and low power, they are seldom heard even a respectable distance from their licensed com-

In days when what is now called stereo was known as binaural, FM did little more than ape AM. Proof are these early stereocasts by New York's famed WQXR. Right channel was broadcast over AM outlet, left channel over FM outlet. Reason was FCC had yet to license FM multiplex, demonstrated by famed FM inventor Major Armstrong decades before.

FM today is far cry from yesteryear, thanks in large part to inauguration of FM-stereo broadcasting in 1957. Setup at Garden Grove, Calif.'s KTBT is fully automated, enabling station to transmit round-the-clock in stereo. Disc jockey below pretapes his show on Ampex four-track recorder; show is later aired from automation rack. Rack was custom-made, covers entire wall in KTBT's modern studios.



munities; at night, some fail even to cover these.

One such station, New Orleans' WNPS, comes into the densely populated suburbs no better than the clear-channel stations of Chicago, Dallas, and Atlanta. The FCC's attempt to remedy the problem of the congestion some years ago was to permit local-channel stations to increase their daylight power to 1 kW, retaining a night-time power of 250 watts. But the din has only become louder. DX fans label these six as "the graveyard frequencies."

The solution that FM offers to this din becomes apparent; the AM band has become so bad that the FCC recently ordered a total freeze on all new AM applications for new AM stations; i.e., it will not accept them and will process only the present backlog. Only new stations which will serve "white areas"—areas having no present strong-signal service—will be accepted. Obviously, there are almost no such populated areas remaining.

More and Merrier. What does all of this have to do with FM? Because of its limited range, the vhf-situated FM band allows for many more stations to exist, and this despite the fact that it has six less channels than the AM band. A 50,000-watt AM station can easily be heard for a thousand miles if the channel is interference-free; a 50,000-watt FM outlet is normally inaudible beyond 80 miles save for the most sensitive receivers and costly outside aerials.

Also worth noting is that the FCC distinguishes four classes of FM stations. The first, Class A, is for local service. Stations are limited to a maximum of 3 kW effective radiated power, and are spaced a minimum of 65 miles apart on the same frequency. There are 20 A channels: 92.1, 92.7, 93.7, 94.3, 95.3, 95.9, 96.7, 97.7, 98.3, 98.9, 100.1, 100.9, 101.7, 102.3, 103.1, 103.9, 104.9, 105.5, 106.3, and 107.1 MHz. The second grouping comprises Class B and C channels which operate on the remaining frequencies between 92.3 and 107.9 MHz with no maximum power limits. Houston's KQVE runs 250 kW, and 100 kW is common.

The last category is Class D stations, which are the low-power high-school and college outlets in the educational part of the FM band (88.1-91.9 MHz), chiefly in the 88-89 MHz section. Because such stations are low-powered, the FCC waives the licensing requirements for their operators.

e/e FM'S AIRWAVES

FM has long been the FCC's hope of getting all fair-sized towns and cities decent, full-time, competitive service. But until recently, the poor interest in FM on the part of both public and broadcasters gave little hope to anyone. First demonstrated by its inventor, Major Edwin Armstrong in 1936, FM soon found its growth stymied by the biggest war in history—World War II. And immediately after the war, the FCC moved all FM stations to the 88-108 MHz band; previously, they had been on 42-50 MHz. The FCC further allocated particular frequencies to thousands of communities. Broadcasters, new and old, jumped in eager-beaver fashion; by 1948, there were nearly 2500 stations on the air—roughly today's figure.

But the public did not respond; a novelty called television had captured its fancy. With the decline of national network broadcasting by 1954, the AM band itself became hard-pressed until it hit upon its present talk/music/news formula. Simultaneously, FM licenses returned for deletion became a flood tide. By 1959, the number of FM stations on the air had sunk to near the 500 mark. And those still operating (often only for the minimum legal hours) mainly duplicated their AM affiliates. Only a small number of FM independents survived.

Enter Stereo. It was in 1957 that the FCC began authorizing several FM stations to broadcast experimentally with the new multiplex system. This meant that in addition to the main intelligence content of the signal, there was buried in it one (or two) more bits of information on subcarriers. Some FMs used the multiplexed subcarrier to broadcast background music, which they sold to commercial establishments. Special equipment was needed to decode the subcarrier and reject the main carrier programming. This gave a short reprieve to more than a few FM stations. However, the number of potential subscribers was not unlimited, and the stations were competing for them not only with such established firms as Muzak but with each other as well.

What saved the day was the advent of stereo. At this time the new standardized microgroove stereo disc was introduced, shortly would come standardized 4-track stereo tape; a little later, stereo tape cartridges. Stereo had caught the public's ear. The subcarrier was then used to broadcast the second audio channel of stereo; FM-stereo receivers picked up both, separately amplifying them and sending them to separate speakers.

The new stereo advantage, which AM stations did and do not have, and the inherent high fidelity of FM the channel is much wider, and thus can contain a signal of wider audio range) began to ignite interest in broadcasting's orphan. This interest soon turned to outright enthusiasm for a growing group of radio listeners who had become disenchanted with the noisy commercials that proliferated on the AM band. The stereo effect, high-fidelity sound, limited number of commercials, and generally better programming slowly but surely are putting FM at the top of the heap.

Rock disc jockey Rosko is aired by New York's WNEW-FM to delight of thousands.

For the Tuning. The programming offered on FM is now much more varied than before—it is less the domain of the classical music connoisseur and ping-pong stereo fan. Literally all types of programming can be had if one is fortunate enough to be able to tune in more than a few stations. There are still, of course, such classical music giants as New York's WQXR-FM, Chicago's WFMT, and Atlanta's WGKA-FM. But most stations cater to what is called MOR—middle of the road, that is, standard, non-rock popular music.

A new species is the underground station, which plays acid rock and psychedelic

(Continued on page 100)

e/e COMMUNICATIONS

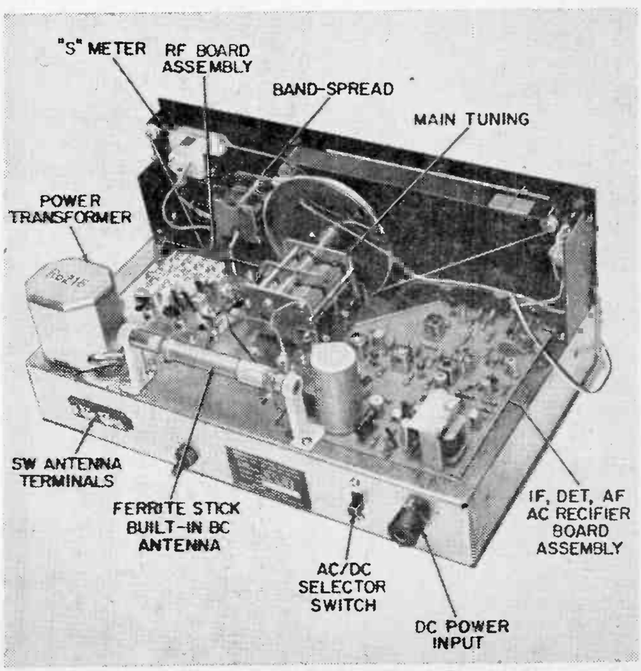
REALISTIC MODEL DX-120
Star Patrol Solid-State Globe-Spanning Receiver

Solid-state technology really staggers the mind. If, just a short while back, someone had asked could $69.95 buy a decent SW communications receiver, the questioner would have been laughed out of the room. Yet, by taking advantage of the latest solid-state technology, Radio Shack has produced a $69.95 communications receiver that really works well—considering its relatively low cost.

The DX-120 is a revamped version of that old standby—the All-American-Five SW receiver employing all solid-state circuitry (which in tube models was the worst junk ever produced). All-American-Five inferred very simply that the circuitry was cut to the bare bone; no RF amplifier (the antenna worked directly into a converter), the minimum in IF amplification and AF output. The DX-120 takes the same route, but, only because of its solid-state performance, it doesn't fade away at 14 MHz.

The DX-120 tunes from .535 to 30 MHz in four bands, each color coded, from standard broadcast to 10 Meters. An uncalibrated bandspread (logging scale) is active on all bands. Front panel rotary controls include AF gain power, variable BFO (that's right, *variable*), band selector, RF gain, tuning, and bandspread. Slide switches control BFO *on-off*, noise limiter *on-off*, and receive-standby. There's a front panel mounted jack for 8-ohm headphones or external speaker. An easily read S-meter is also provided on the front panel.

The DX-120 is powered by either the built-in AC power supply or by a battery pack for portable use. A DC power input jack and AC-DC power switch is mounted on the rear apron in addition to the antenna terminals. Nominal DC power requirement is 12 to 15 volts. *(Continued overleaf)*

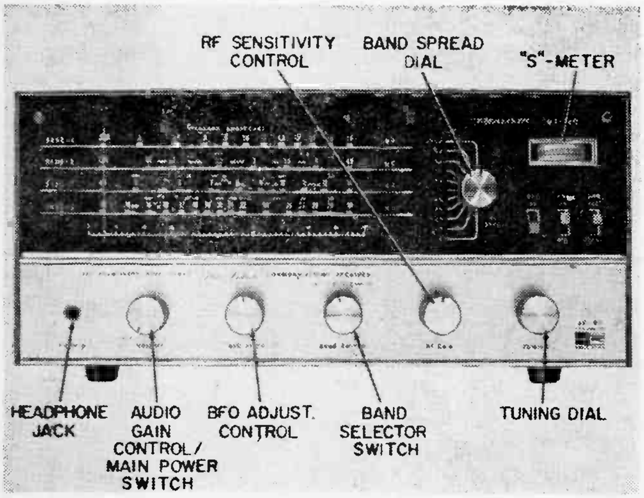


FETs and transistors make DX-120 into a surprisingly good replacement for old All-American-Five vacuum-tube budget SW receiver. Two circuit boards contain most components; built-in BC antenna is adequate for normal BC reception.

e/e REALISTIC MODEL DX-120

Except for the RF input the circuitry follows more or less conventional lines. A separate local oscillator is used to avoid loading of the RF input, with the resultant low Q producing poor image rejection, and to avoid moderate strength signal overload. The DX-120's input is an FET (field effect transistor) mixer. Two stages of IF amplification are employed, followed by the detector, automatic noise limiter (ANL) and S-meter sensor, and then the AF amplifier. The variable BFO oscillator is a separate unit, not a regenerative IF amplifier which is mixed into the first IF amplifier. A panel-mounted headphone jack disables the internal speaker when phones are used.

A study of the circuitry shows that the lineup is almost identical to that of receivers priced well over $100, except for absence of an RF amplifier and calibrated amateur-band bandspread in the DX-120.



Controls are well oriented on front panel. Slide switches turn on and off BFO, ANL, and STANDBY. AC/Battery selector switch is only control not on front panel; it's on rear apron of chassis.

Performance. The rather surprising performance of the DX-120 is shown by the chart. Measurements cover both the bottom and top of each band. Admittedly, this is not the hottest performance available, but considering the price of the DX-120 it's darn good. What other low-cost receiver ever had a 6.3 μV sensitivity at 30 MHz? The low sensitivity of 16μV at 13 MHz is unusual, based on succeeding sensitivity measurements at higher frequencies. We traced this to poor factory alignment and improved 13MHz performance to 4μV.

DX-120 Performance

Band	Frequency (MHz)	Sensitivity for Dipole Input (μV)	Image Rejection (dB)
A	Broadcast Band not measured.		
B	1.55	2.8	30.
B	4.5	3.2	32.
C	4.5	3.2	18.
C	13.0	16.0	11.
D	13.0	8.0	13.
D	30.0	6.3	11.
CB Adjacent Channel Rejection (10kHz), 19dB			

The image rejection, though low and somewhat comparable to a few receivers priced around $100.00, is notably good for a budget receiver—far superior to the original All-American-Five performance.

The selectivity, expressed in terms of Citizens Band Adjacent Channel Rejection (10 kHz) is 19 dB; sort of low, but again favorable when compared to the old tube-type inexpensive receivers and to some CB transceivers.

The DX-120 really shines when it comes to stability. If you have ever handled a tube-type budget receiver you will remember that above 14 MHz (the high band) heavy breathing was enough to detune the receiver, and a strong signal or a tap on the cabinet was enough to cause the receiver to break into microphonic howls. The DX-120 has none of this. It's possible, by careful adjustment of the BFO, to obtain reasonably good SSB reception at 30 MHz from the DX-120. At lower frequencies SBB reception is sufficient for the SWL or "budget ham."

(Continued on page 102)

NO CHARGE FOR HIGH FASHION

Here's a 400,000-volt steel mod suit that takes the killer out of high-tension cables

MOST CHILDREN are taught at an early age that playing with live electric cables is one big no-no. One man who obviously didn't learn this lesson is 31-year-old Harry New. Fact is, Harry recently had the distinction of being the first man in Europe to deliberately sit on killer cables carrying 400,000 volts.

Maintenance and repair work on the pylons and high-tension cables which carry electricity is usually a very long and expensive job. "It involves," said a spokesman for England's Central Electricity Generating Board, "turning off or re-routing the current on a section of the line. While necessary for the safety of the linesmen, it's an expensive process. What's more, there are occasions when it can black out whole communities for hours." *(Turn page)*

Cables Harry's sitting on carry 400,000, but Harry pays them no-never-mind. Explanation is that wire-mesh-and-cotton suit he's wearing places him at same 400,000-V potential as line. Remainder of team look on from safety of pylon as Harry juggles his equipment trolley into place.

Answer to the problem is a spaceman type suit which now enables linesmen to work on cables without turning the current *off*. The suit is made from stainless-steel wire mesh woven into cotton material. Worn with special boots, it forms a protective "cage" around the wearer.

When the linesman is working on pylons carrying live cables he is hoisted up to them by an insulated bosun's chair. Before he leaves the safety of the chair he attaches a cord which is connected from his suit to the cables. Both he and the suit then become live, which enables him to leave the bosun's chair. Reason is that he's now carrying the same potential as the cables he is working on, so he's in no danger of being electrocuted.

Before being allowed to work on such high-voltage cables, linesmen must undergo an intensive two-year training period. They are now so confident when using the suits that one of them, talking about his job, said, "Danger? There's more danger in plugging in the TV at home." ■

Thanks to suit, Harry feels no pain though cables pack power enough to burn him to a cinder.

build

SimCon...

. . . the 1-FET converter that puts you where the real action is

by Edward A. Morris, WA2VLU

BY NOW, JUST about everyone who dabbles in electronics knows where the real action is. That's right—it's on the so-called emergency bands. Here's where you can listen in on the day-to-day communications of your local and state police and fire departments. Here, in fact, is where you can tune in on the drama of everyday life.

Our SimCon (for simplicity converter), designed to be used in conjunction with an auto radio, brings you close to the action. The converter can be used to receive any 1-MHz band between 25 to 55 MHz. No modifications to the radio it's used with are necessary and the converter even employs the same antenna.

Aside from the more casual listeners, some of the more serious types—rural volunteer firemen, say—will also be able to put the converter to good use. SimCon enables the volunteer fireman or Civil Defense worker to receive directions and information while en route, eliminating a possible stop at a central meeting point.

SimCon is packaged in a small attractive, vinyl-clad housing. It's compact enough to be mounted unobtrusively under the dash, and there's no chance in the world of it posing a threat to your knees.

Cost? About $14.00 builds it. Construction time should be under 4 hours (say two evenings' work). Sound good? Read on.

How It Works. First, let's take an overall look before we go into circuit details. Our SimCon uses a field effect transistor, Q1, as a mixer. The input to the FET consists of two signals. One is the RF input signal we wish to receive; the other is generated by a crystal-controlled oscillator, consisting of transistor Q2 and its associated components. The two signals, which differ in frequency, are mixed by the FET. *(Continued overleaf)*

Among the FET's output products is a signal which is identical to the signal we wish to receive, except that its frequency is the difference frequency between the original frequency and the local oscillator frequency. By picking the proper frequency for the local oscillator, we can receive this new difference frequency on a BCB radio.

For a more detailed look, let's start at the beginning. With switch S1 *on*, power is applied to the circuit, and the converter is placed between the antenna and the receiver. RF input signals are coupled to the resonant circuit consisting of coil L2 and capacitor C1 by the antenna input coil L1. The desired signals are applied to the gate of Q1; undesired signals falling outside L2/C1's bandpass are rejected.

The FET is operated with its gate negative with respect to its source terminal. Bias is provided by the voltage drop of the source drain current across resistor R1. With the source positive with respect to ground and the gate at DC ground potential, the gate is negative with respect to the source terminal. The source resistor is bypassed for RF by capacitor C3.

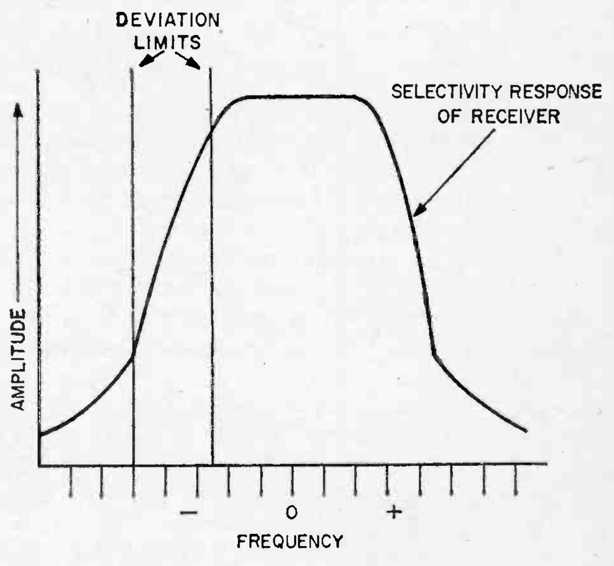
Local Oscillator. Along with the desired RF input signal at the gate of the mixer, we also need a signal from the local oscillator (LO). The LO signal is generated by transistor Q2 and its associated components. Most hams will recognize the circuit as that of a Clapp oscillator, widely used as a VFO. The version used here is its solid-state, crystal-controlled twin.

Operating bias for Q2 is provided by the voltage divider formed by resistors R2 and R3. The collector of Q2 is placed at RF ground by bypass capacitor C4. Frequency control is accomplished by X1, operating is its series mode. Positive feedback, necessary for oscillation, is controlled by the ratio of the values of capacitors C6 and C7.

Emitter resistor R4 raises the impedance of Q2's emitter above RF ground, as is necessary for proper feedback and circuit operation. The RF output appears across the emitter resistor and is injected into the gate circuit of Q1 by coupling capacitor C2.

We now have two RF signals at the gate of the mixer: the signal we wish to receive, and the injection voltage from the local oscillator. As a result of the mixing action in the FET, one of the mixer's outputs will be the difference frequency of the two input signals. If we choose our local oscillator frequency properly, the difference frequency will fall in the standard broadcast band. This output appears at the drain terminal of the mixer, and is coupled to the output of the converter, output jack J2, by coupling capacitor C5.

The converted signal is then received and detected by the radio it's used with. At this point we may have some readers scratching their heads, wondering how a diode detector in the auto radio is going to cope with FM-modulated stations in the emergency and business bands.



Graph gives some idea of how AM radio is able to detect FM signals. Secret is to detune receiver slightly so incoming signal falls on slope of radio's selectivity curve. Signal can then be detected and amplified.

Slope Detection. Key to this problem is a little trick called slope detection. To receive FM transmissions, the auto radio is tuned a bit off to one side of the desired station. This places the received signal on the slope of the receiver's selectivity curve. Frequency deviation (FM modulation) is then converted into a varying-amplitude signal, which is detected and amplified just like an ordinary AM signal!

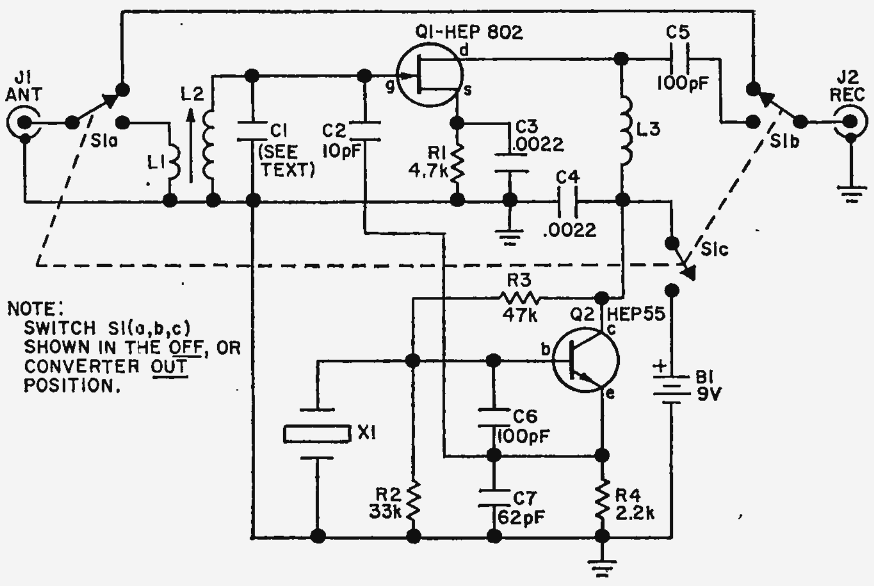
Though this method of detecting FM signals negates some of the benefits of FM, it is satisfactory for general use. It also has the advantage that no modifications are necessary to the radio it is to be used with.

Mechanical Construction. The author chose to construct his model in a small aluminum box chassis. The circuit layout isn't critical, however, so you have considerable freedom in picking your layout and packaging technique. Even so, a metal enclosure should be used to ensure proper shielding. And if you've had little or no previous experience in HF/VHF layout and construction, you'd do well to follow the general layout used by the author just to be on the safe side.

Construction is simple and goes easily. Begin by laying out the pattern of holes to be drilled in the case. A small T-square can come in handy here. Spot the holes with a centerpunch to ensure accurate placement of the drilled holes. The rectangular cutout for switch S1 is most easily made by first scribing the outline of the cutout onto the box. Then drill a connecting pattern of 1/16-in. holes just inside the scribed outline. Remove the material in the center, and fin-

PARTS LIST FOR SIMCON

B1—9-V battery (Eveready 216BP or equiv.)
C1—Dipped silver mica capacitor (Elmenco DM-10 or equiv.—see text and Table 1)
C2—10-pF, 500-V dipped silver mica capacitor (Elmenco DM-10 or equiv.)
C3, C4—0.0022-uF, 1000-V miniature ceramic capacitor (Erie display card # A 23 or equiv.)
C5, C6—100-pF, 500-V dipped silver mica capacitor (Elmenco DM-10 or equiv.)
C7—62-pF, 500-V dipped silver mica capacitor (Elmenco DM-10 or equiv.)
J1, J2—Motorola auto radio jack (Lafayette 11E66024 or equiv.)
L1—3 turns #26 plain enameled wire, close wound over ground end of L2—see text
L2—7½ turns #26 wire close wound over ¼-in. dia. form, ferrite slug tuned (Miller 20A687RB1 or equiv.)
L3—2.5-mH RF choke (Miller 6302 or equiv.)
Q1—HEP-802 transistor (Motorola)
Q2—HEP-55 transistor (Motorola)
R1—4700-ohm, ½-watt resistor
R2—33,000-ohm, ½-watt resistor
R3—47,000-ohm, ½-watt resistor
R4—2200-ohm, ½-watt resistor
S1—3-pdt slide switch (Lafayette 99E-6166 or equiv.)
X1—Crystal—see text and Table 2 for instructions on calculating frequency. Available from Sentry Mfg. Co., Crystal Park, Chickasha, Okla. 73018 for $4.75 plus postage. Specify series resonant 3rd overtone crystal, type SGP-6.
1—5⅝ x ⅜ x 1 5/16-in. aluminum case (LMB 139 or equiv.)
Misc.—Crystal holder, battery holder, perforated board, push-in terminals, solder, hardware, wire, vinyl covering material, press-on lettering, etc.

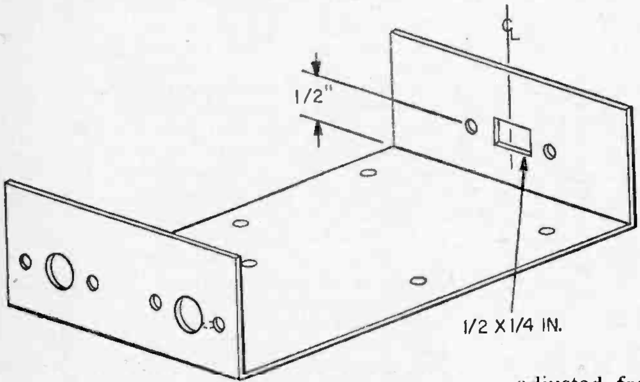


NOTE:
SWITCH SI(a,b,c) SHOWN IN THE OFF, OR CONVERTER OUT POSITION.

ish the sides of the cutout with a small file.

After the mechanical work has been completed, the case can be spray painted or covered with vinyl contact adhesive material, as was the author's model. The vinyl material looks great and is easier to apply than spray paint. A wide variety of wood grain and solid tone patterns are available.

In either event, the case should be thoroughly cleaned before it's covered or painted. Hot water and soap will do a good job. Rinse well, then dry thoroughly.



Chassis for SimCon is cinch to prepare. Hole at far end is for switch S1; two holes at near end are for jacks J1 and J2.

To cover the case with vinyl, first remove the paper backing from the vinyl material. Place the material adhesive side up on a flat surface, then place the case on the material. Alternately press each side of the case onto the material, and trim excess material with razor blade or pocket knife. Remove entrapped air bubbles by working them out to the edge of the material. In stubborn cases, try puncturing the vinyl by pricking the bubble with a small needle. For maximum adhesion and permanence, press the vinyl firmly against the case. Remove the material over the various holes and cutouts with a sharp knife blade.

Press-on lettering can then be applied to the case to lend a finished, professional appearance to the project. Follow the manufacturer's directions in applying the lettering. To protect the lettering from abrasion, spray on several light coats of a clear acrylic spray.

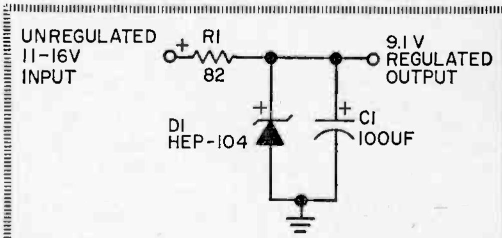
Electrical Construction. With the exception of switch S1, the input and output jacks, and the battery, all components are mounted on a small section of perforated epoxy-glass board. Miniature push-in terminals are used to mount various components, as well as to serve as wiring terminals. Wiring is point-to-point, using small gauge bare wire, and is carried out on both sides of the board. Care should be taken to use short, direct leads whenever possible.

The general components layout can be determined from our photos. Though not exactly wide open, the layout shown allows even the beginner enough room to work.

Transistors Q1 and Q2 are soldered directly into the circuit. No special precautions are necessary: just a bit of solid-state-oriented common sense. Use a small (under 50 watt), well-tinned iron, and complete the job quickly. Beginners should perhaps use a heat sink on each lead while soldering.

Coil L2 can be store-bought or home brew, depending on how ambitious you feel. If you opt for the home-brew version, wind 7½ turns of #26 plain enameled wire, close wound, over a ¼-in. dia. ferrite slug tuned form. Position the coil on the form so that the ferrite slug can be adjusted from fully in, to fully out of the coil. Coil L1 consists of 3 turns of #26 plain enameled wire close wound over the cold (ground) end of coil L2.

Selecting Frequencies. Both the value of capacitor C1 and the frequency of the crystal will depend on what frequency(s) you want the converter to cover. Refer to the table at right to calculate the crystal frequency; the table above specifies the value of



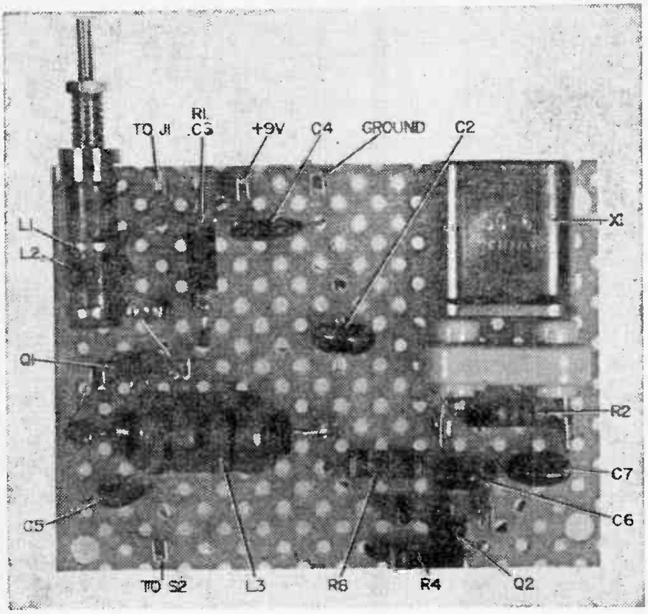
PARTS LIST FOR AUXILIARY POWER SUPPLY

C1—100-uF, 25-V miniature electrolytic capacitor (Sprague TE or equiv.)
D1—9.1-V, 1-W, 10% Zner diode (Motorola HEP-104 or equiv.)
R1—82-ohm, 1-watt resistor
Misc.—Wire, solder, hardware, push-in terminals, perforated board, etc.

	25/35 MHz	35/45 MHz	45/55 MHz
C1	33 pF	15 pF	10 pF

C1 over the operating range of the converter. The actual value of C1 isn't critical, so long as it allows C1/L2 to tune to the signal input frequency.

Bypass capacitor C3 should be located close to the source terminal of Q1 and should have short, direct leads. Likewise, it's best if the collector bypass capacitor for



SimCon's perfboard, all wired up and ready for mounting in chassis. Since wiring is carried out on underside of perfboard, board must be spaced from chassis with nuts when mounted. Note that L1/L2 and L3 appear at right angles to each other.

Q2 (capacitor C4) is wired in close to the collector terminal and with short leads for proper circuit action.

After the electronics card has been wired according to the schematic diagram, recheck your work for possible errors and shorts. Remember, it's a rare builder who can honestly boast that he never ever makes a wiring mistake.

Final Assembly. Prior to installing the electronics card in the case, first mount switch S1, the battery clip, and jacks J1 and J2. The jacks specified in the Parts List will match most all auto-radio antenna systems.

When installing components with nuts and bolts, take care not to pull the vinyl material. The easiest way around this is to tighten up on the nut from the rear while holding the screw head in a fixed position with a screwdriver.

Mount the electronics card with 4-40 x ¾-in. bolts and matching nuts. Space the card about ⅜ in. from the chassis using additional nuts to achieve the correct spacing. Take care to prevent possible shorts between wiring on the underside of the electronics card and the chassis.

Though not shown in the schematic diagram, an extension cable is needed to connect the output of the converter to the input of the auto radio. A short length of RG-58 coaxial cable can be used; however, better results will be obtained by using a length of

Calculating the Crystal Frequency

For spot frequency operation:

$F_{XTAL} = F1 - F2$

where F_{XTAL} is the frequency of the crystal to be ordered.

F1 is the spot frequency to be received.

F2 is the frequency (between .54 and 1.6 MHz) where you wish to receive the converted frequency on your radio.

For 1 MHz band operation:

$F_{XTAL} = F1 - 0.55$ MHz

where F1 is the frequency of the lower edge of the 1 MHz band to be covered. The lower edge of the 1MHz band to be covered will appear at 0.55 MHz, and the upper edge at 1.55 MHz on the auto radio.

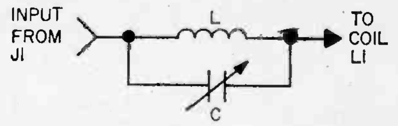
low capacitance auto antenna lead-in cable. Terminate both ends with Motorola plugs.

Alignment. Connect the output of the converter to the input of the receiver, using the extension cable. If a signal generator is available, connect its output, through a 15-pF capacitor, to the input of the converter. Set the radio where you want the spot frequency to appear at, or to the center of the band if you want 1-MHz coverage. Set the generator approximately on frequency, then vary it a bit to obtain maximum signal output from the auto radio. Peak coil L2 for maximum output. Reduce the generator output and repeak L2. Continue the procedure until no further improvement is noted.

If a signal generator isn't available, connect the auto antenna to the converter. Tune L2 for maximum noise output from the receiver. Further improvements can be made by peaking L2 with the aid of an on-the-air signal.

tween the antenna and the input to the converter. Tune the trap until the offending station disappears or is greatly attenuated.

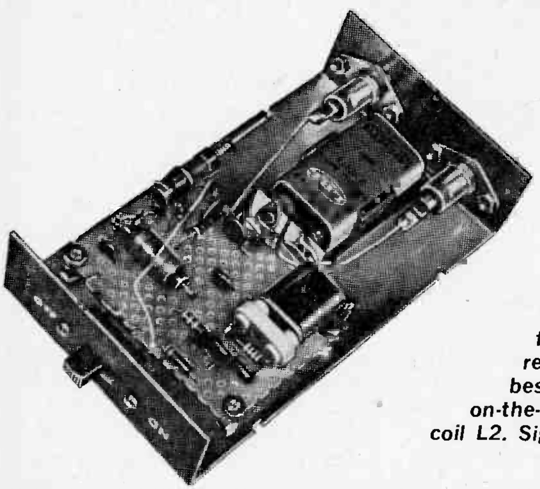
This type of interference can be prevented by picking a quiet spot on the broadcast band for the converter to work into, and picking the crystal for the local oscillator accordingly.



Interference trap for SimCon. L is Miller 2002 antenna coil or equivalent in parallel with 25-280 pF mica trimmer capacitor.

If desired, the converter can also be used with a portable radio. For temporary operation, good results can be obtained by wrapping several turns of insulated hookup wire around the portable's case, close to the radio's ferrite antenna. Connect one end of the wire to the hot (center conductor) output of jack J2.

A more permanent connection would involve wrapping 10-15 turns of #26 plain enameled wire, close wound, around the ferrite antenna rod inside the portable's case. The connection could be brought out through a small jack installed in the set's case.



Completed SimCon with perfboard neatly mounted on chassis, battery B1 installed, switch S1 mounted at front of chassis, jacks J1 and J2 at rear. As explained in text, unit is best aligned with signal generator, but on-the-air signal can also be used to peak coil L2. Signal should be weakest one on band.

Operation and Use. Best results will be obtained if the auto antenna is extended to its maximum length. The auto radio's push-button selector can be taken advantage of and pre-set to frequencies of most interest. This is most handy when you want to switch frequencies rapidly.

In some locations, where the converter is used to receive only one frequency and a strong local broadcast station lies close to the converter's output frequency, the broadcast station may ride through and interfere with the desired station. The interference can be reduced by connecting a trap be-

Auxiliary Power Supply. Though the self-contained battery supply will be adequate for most uses, there are those—like the volunteer fireman or Civil Defense worker—who may want a more dependable source of power. Batteries have a habit of giving out when they are needed most. For these reasons we have included a Zener-regulated power supply (see page 60) which operates directly from the vehicle's 12-VDC electrical system. Note that the supply cannot be used with positive-ground electrical systems; this requires reversing the polarity of both D1 and C1.

INTERVAL SCREAMER

IT'S DIABOLIC, IT'S ELECTRONIC, IT'S DELAYED INSANITY

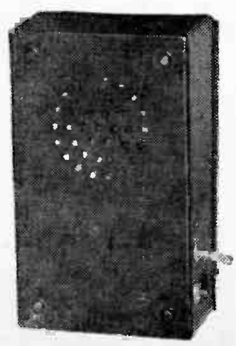
by Steve Daniels, WB2GIF

HAVE YOU HAD occasion to wish for some oddball happening to liven up a dull party or uninteresting meeting? Or perhaps you wanted to get even with the boss, or a teacher, or fellow worker for his past disregard of your talents, knowledge, and capability?

Our Interval Screamer should be just the thing to help you even the score. What is it? What does it do? How does it do it? How can you use it?

Well, it's an innocent looking black box that could easily be misconstrued for a desk radio, an intercom, or an extension speaker. Don't you believe it.

Most people are curious and have an uncontrolled urge to flip a switch whenever they confront a device having toggle and/or pushbutton switches exposed. This means that if our little innocent looking Screamer is casually tossed on a desk or table top, you can be sure someone will pick it up and flip a switch. Will their face be red—because when the switch is flipped that innocent looking black box lets out a continuous scream and, unless you know how to stop it, it just keeps on wailing!



In short order everyone will have been wakened from their stupor. And if you don't get hold of the gadget quickly someone may just toss it out a window as the only means to restore peace and tranquility. Well, we've told you what it is, what it does, and how to use it, so now—

How It Works. Actually what we have is a solid-state electronic timer combined with a solid-state electronic siren having concealed controls for stopping

e/e INTERVAL SCREAMER

the action and resetting the device for the next curious one who isn't yellow.

By referring to the schematic you will note that SCR1 is in series with the positive battery supply lead to the timing circuit, which consists of Q1, C1, R1, and the coil of K1. Also, SCR2 is in series with the positive battery supply feeding the siren through the normally closed contacts of relay K1.

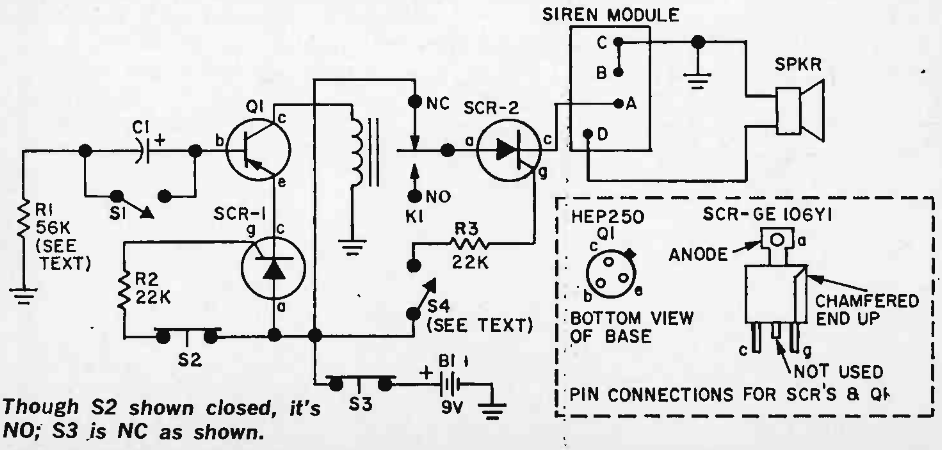
When S4 is closed it applies bias to the gate of SCR2, which immediately energizes the siren. If S2 is closed first, starting the timing action, K1 will be energized and will disconnect the siren. When C1, in the timing circuit, becomes fully charged, Q1 is reverse biased and is *cut off*. This drops out relay K1 and the siren is activated. Since our innocent switch flipper doesn't know the secret we defy him to turn *off* the siren.

You ask what is the secret? But of course! It's S3, the momentary switch that can be operated only by inserting a pointed pencil, pin, paper clip, or whatever is convenient, through one of the holes in the perfboard that covers the bottom of the plastic case. The timing delay, predicated on the value of the components shown in the schematic, is approximately 40 seconds. This can be varied by changing the value of resistor R1. plus or minus 10%.

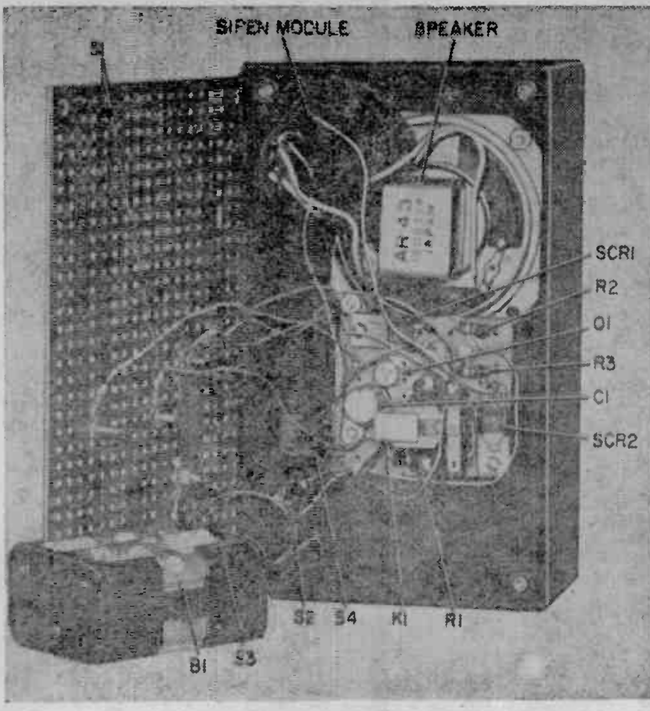
Building the Beast. Our model was built in a black molded plastic box 3¾ x 6⅛ x 2 in. (available from Radio Shack). We used this one because a speaker grille was molded in the box and we were too lazy to drill holes for one. You may use any suitable box that's handy (even an empty cigar box). First chore is to drill holes in the box for mounting the speaker, S2, S4, and the circuit board. Next make S3 (from the blades of an old phone jack or phosphor bronze strip) and mount them on the perfboard bottom supplied with the box. The two leaves or strips are mounted so that one end of each is over the other and making contact with it, thus making up a normally closed (NC)

PARTS LIST FOR INTERVAL SCREAMER

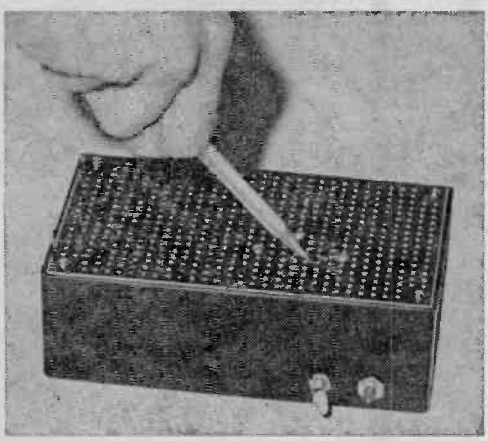
B1—6 type AA 1.5-V penlight cells
C1—100-uF, 6-V electrolytic capacitor (Allied 43A1753 or equiv.)
K1—Sigma relay type 11F1500G/Sil (Allied 41D5070 or equiv.)
Q1—Motorola HEP 250
R1—56,000-ohm, ½-watt resistor
R2, R3—22,000-ohm, ½-watt resistor
SCR1, SCR2—Silicon-controlled rectifier GE 10EY1
S1—See text
S2—Spst normally open pushbutton switch (Lafayette 99E62184 or equiv.)
S3—See text
S4—Dpdt toggle switch used as spst switch (Lafayette 99E62124 or equiv.)
1—Plastic battery holder for B1 (Radio Shack 270-384 or equiv.)
1—Battery connector (Allied 18A5307 or equiv.)
1—3¾ x 6⅛ x 2-in. molded plastic box with perfboard bottom (Radio Shack 270-097 or equiv.—see text)
1—2½-in., 8 to 10-ohm speaker (Lafayette 99EG60972 or equiv.)
1—Siren module (Lafayette 19E55053 or equiv.)
Misc.—Hookup wire, solder lugs, solder, perfboard, flea clips or push pins, ¼-in. bushings, bolts, nuts, leaves from old phone jack or phosphor bronze strip, etc.



Though S2 shown closed, it's NO; S3 is NC as shown.



Above, be sure to leave enough room for battery holder when locating circuit board. Below, pencil operates hidden S3. See text for application of S3.



switch that can be opened by inserting a pointed object through a hole in the mounting board for the purpose or separating the two leaves. (See photo.)

Make a hole slightly larger than the perf opening so that a pencil or ball-point pen or toothpick can be inserted to open the contact leaves of the switch.

Switch S1 is made by placing two nickel-plated 6-32 bolts approximately ½ in. apart adjacent to S3. Space between bolts that make up S1 should be such that a key or paper clip or short scrap of bare wire can be placed momentarily between them to short out C1, the leads of which are connected to the two bolts.

Though we placed S1 and S3 on the bottom perfboard, you may want to locate them elsewhere in your Screamer. Remember, though, they are far less conspicuous on the bottom of the box even though it may be a little more difficult to conceal your operating them, which would reveal the secret of how to silence the Screamer.

Fasten the siren module in place with epoxy cement where the module contacts the sides of the plastic box. To be certain module does not jar loose use cement both at the bottom and top extremities of the points of contact.

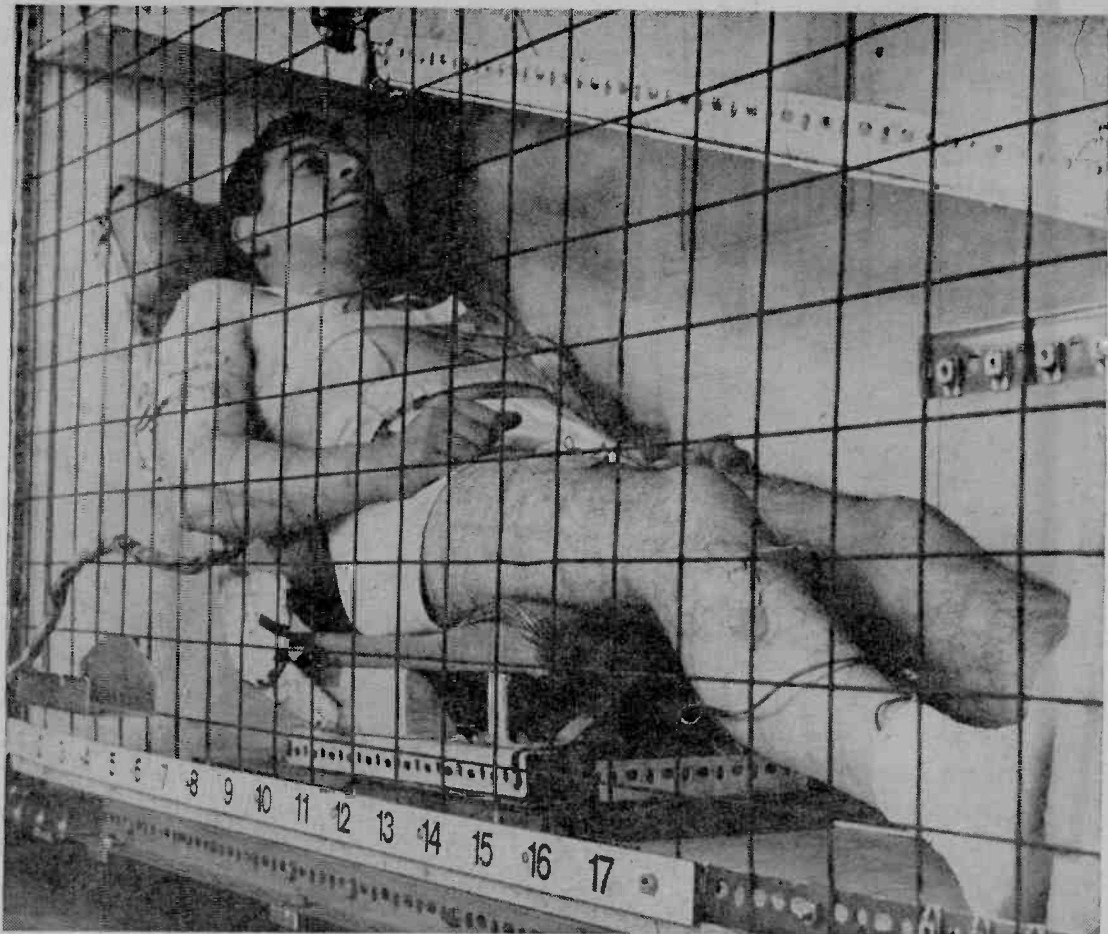
A 2 x 2-in. piece of perfboard is used as the circuit board and contains the SCRs and the timing components. Even though we didn't use them for this project, it is suggested that you mount and wire components via push pins and/or flea clips. It makes a neater circuit board and facilitates replacement of parts. Also, since anyone can make a wiring error, this type of construction makes it easy to spot and correct goofs.

Layout isn't critical and needn't be the same as ours. The components we selected are relatively inexpensive and are readily available from most parts suppliers. If you should use different ones be certain that their characteristics are similar to the ones we used. Our layout does lend itself to simplifying the wiring and mounting in the box we chose.

The relay we selected is mounted by a single bolt screwed through the perfboard into a threaded mounting stud on the relay.

Before fastening the SCRs to the board, shorten the gate and cathode leads to about one-third their original length. Use a soldering lug under the bolt that passes through the anode tab for mounting the SCR, to connect to the anode.

(Continued on page 102)

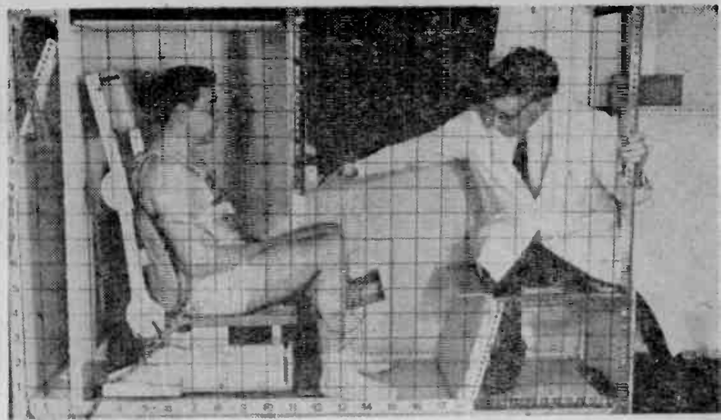


Before he is caged up for 24 hours, the human guinea-pig is wired to record heart beat and skin temperature remotely.

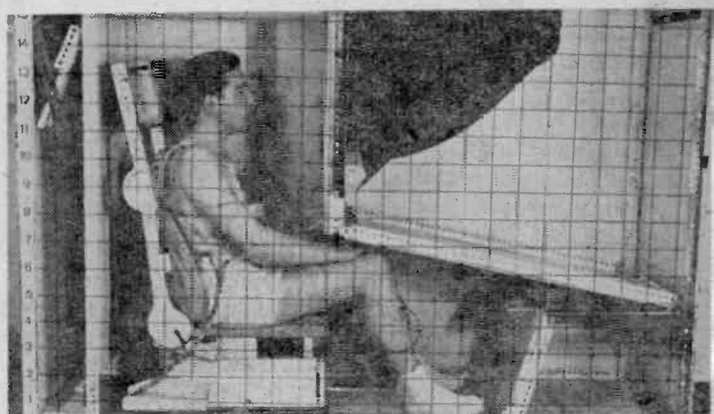
☐ Each year the cost of travel increases and supersonic aircraft, if they are to make a profit, must pack into their slender fuselage hundreds of passengers. When designers are constantly asking themselves just how many can be packed into a plane, it is important to know how much space a person needs.

To get this information British scientists at the National Institute for Medical Research in a quiet backwater of London's Hampstead have been squashing men into small cages and closely watching and recording their reactions. Eight soldiers in all have been used in the experiments over 32 weeks, and each time they have been put into the cage they have been wired up for heartbeat and skin temperature. The cage was closed off so that the "guinea pig" stared at blank walls on three sides and a wire grille on the fourth. A screen was fitted directly in front of the soldier's face, and by means of an inverted periscope they were shown

Can the man in the cage hold his tiger?



Dr. Reginald Whitney fits the barriers which will restrict the subject for 24 hours.



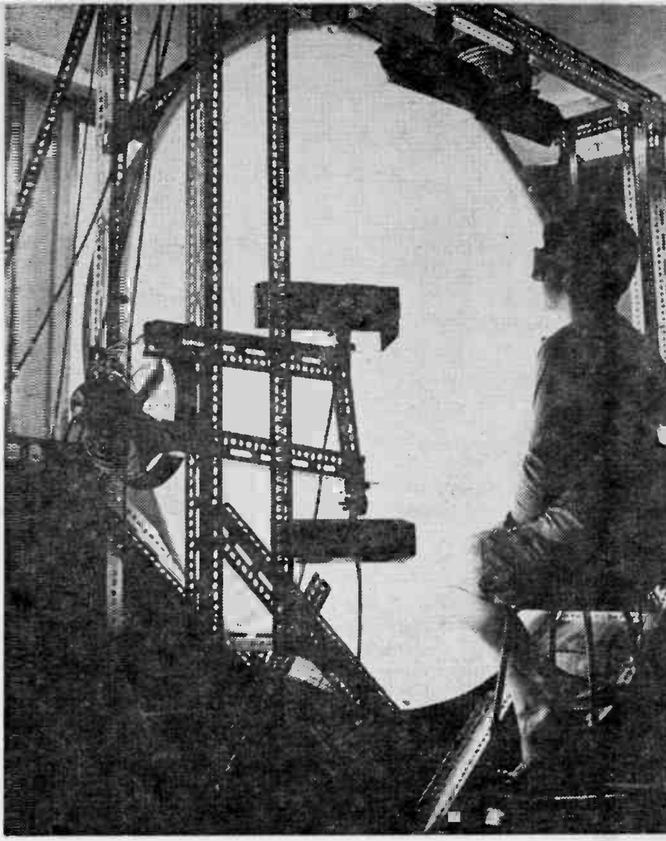
The subject is in the fully seated position, one of four he must assume during the test.

films which incorporated psychological tests.

"We had four positions we allowed the soldier to sit in," explains Dr. Reginald Whitney, who leads the team of researchers. "We were anxious to find out just what effects the different positions had on the mental alertness of the occupants. The positions varied from lying almost flat to sitting straight up. It is important that we know this so we can adjust the right position for a pilot."

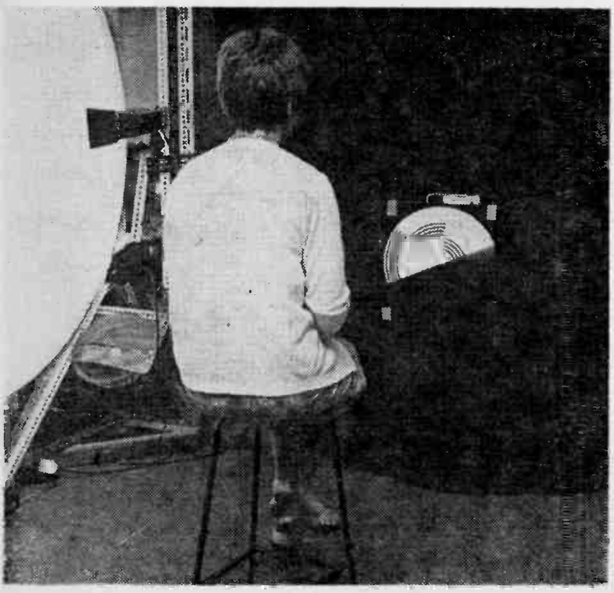
During the experiments the occupants were photographed with time-lapse cameras. The resulting information showed that even in the most confined space the human body will not use all the space available to it. What does all this mean to you, the air traveller? Well, there may come a day when you will be packed like a sardine and super-jetted to London in 30 minutes. Olive oil, anyone? —*Joe Gronk*

It's chow time in the cage and the guinea-pig enjoys a small meal offered at regular intervals. Food is passed through a hatch.



LOOKING INSIDE MAN'S SUPERCOMPUTER

To improve the electronic computer of the future scientists are studying the brain we've had for eons!



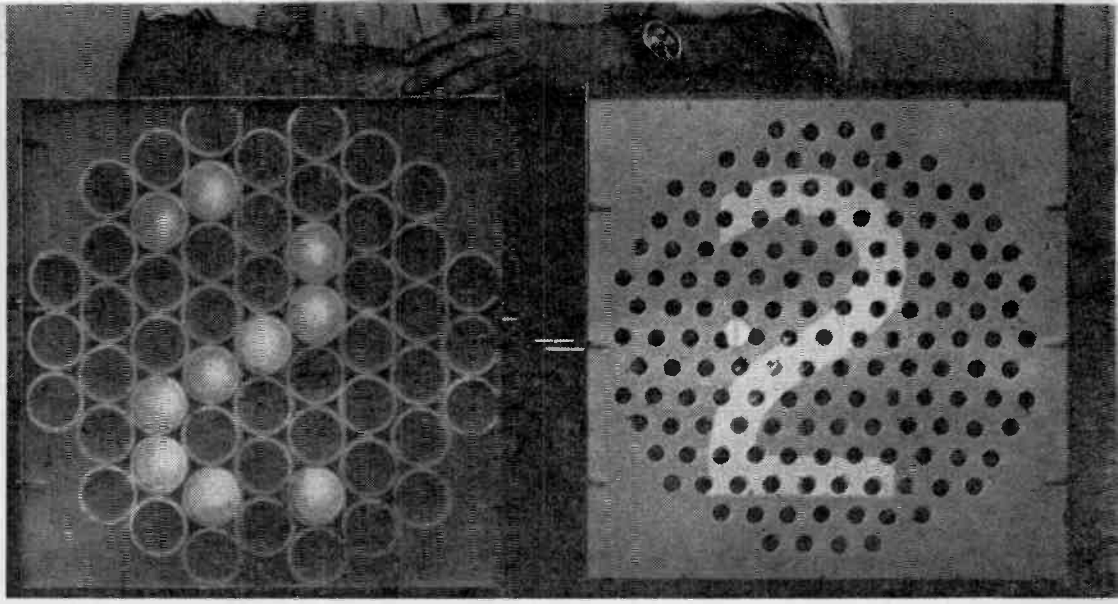
"Our research here is just like taking a scalpel to the brain and finding out how it works. Only difference is we don't open up the brain. Instead, we let it reveal itself to us."

The speaker is Dr. Chris Evans, who works at England's massive National Physical Laboratory complex just outside London. He is in charge of experiments in human perception in the laboratory's Computer Science Division.

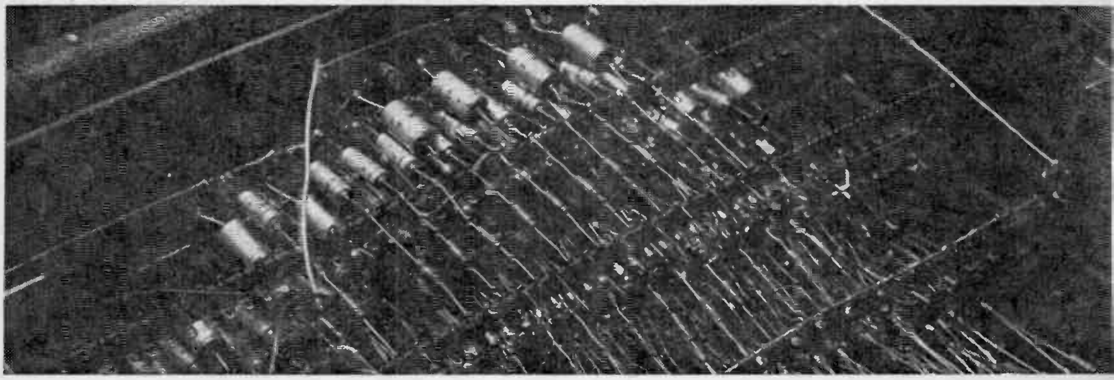
"The brain is a supercomputer. And by finding out how it works we'll be able to improve computers that are to be made in the future," says Dr. Evans.

Seeing and Hearing. The doctor concentrates his work on the visual and auditory pattern recognition capabilities of the brain.

Wearing tinted goggles, volunteer helps researchers find out whether it's brain or eye that's fooled in Benham's Problem.



Electronic eye created by Dr. Evans is packed with components (see below) but straightforward in its operation. Number—two in this instance—projected on right box automatically appears on left box, just as eye sees object by projecting its image on retina.



His recent experiments have thrown new light on the functioning of the mind.

"Computers presently have to be fed with special data in special mathematical language. But if we can find out how the brain recognizes patterns then we can build computers that can read handwriting and respond to the human voice," explains Dr. Evans.

"To determine what and how the brain sees, the eye and the retina must receive a constant and stabilized image. At first, work in this field was hampered because the eye moves constantly and scans everything so that the image changes."

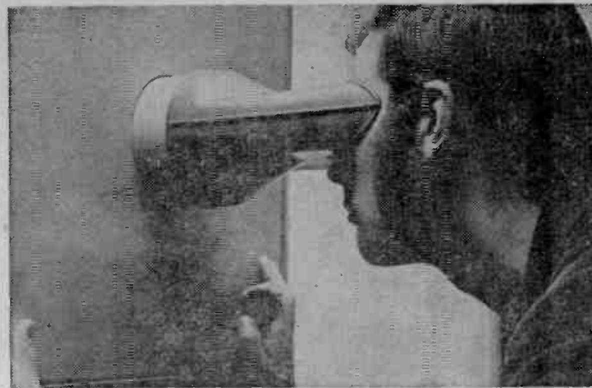
To perceive a stabilized image, researchers put large contact lenses on their eyes. Stems were attached to the lenses and patterns placed at the ends of the stems. As the eye moved, the contact lens moved and the researchers saw constant images.

Patterns and Subpatterns. The researchers have learned that a pattern fixed on the retina breaks down into subpatterns. For example, a circle with crossed lines inside disintegrates into a circle, semi-circle, lines, crossed lines, and other parts of the pattern.

"Because the brain is receiving only one image, it breaks the image down into parts to try to get more information about it and classify it," says Dr. Evans.

By studying the after-image of the pattern and how it breaks up, the researchers hope to discover the perception systems at work in the brain so that they can utilize the information in making better computers.

Similar experiments in sound are carried out. Volunteers listen to a recording tape and are asked to write down all the different words they hear. The longer one listens to the tape, the more words are added to their list. In reality, however, the volunteers hear e/e



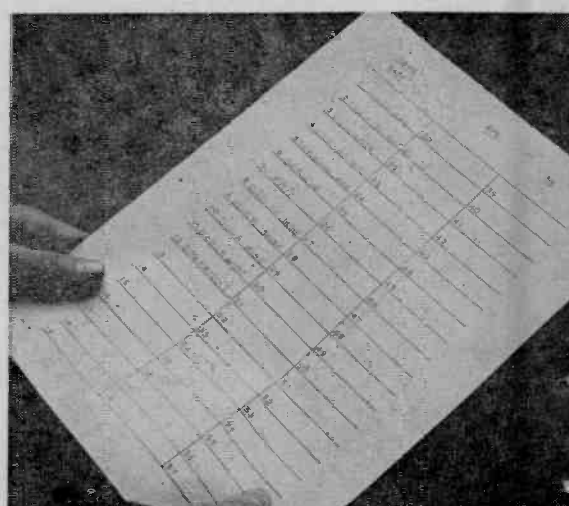
Volunteer peers into cabinet which contains pattern illuminated with flash of light. After having looked at briefly illuminated pattern, subject informs Dr. Chris Evans what he sees and how pattern breaks down. Subject normally "sees" more than he was shown due to brain's tendency to classify even simple images.

only one word over and over. This is another example of showing how the brain breaks a sound or image down to obtain more information.

Colors Yet. Research at the lab also includes experiments to solve Benham's Problem. When a disc with lines on it is spun rapidly, the observer sees bands of colors even though the disc and lines are black and white. This phenomenon is known as Benham's Problem.

"In this phenomenon either the eye or mind is fooled and gives a faulty interpretation and we are trying to determine which," observes Dr. Evans.

Though he acknowledges that his work is far from finished, Dr. Evans sees practical applications within the decade. ■



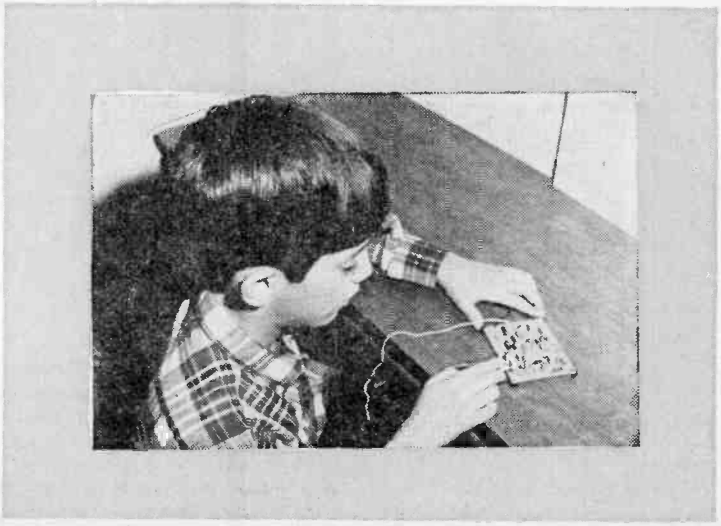
In still another experiment, volunteer is asked to listen to tape and jot down all words he hears. Though only one word—"dobermine"—was repeated over and over, subject came up with twelve words or groups of would-be words, ranging from "don't be mad" to "dogamight."

TEN BUCK AIRCRAFT RECEIVER

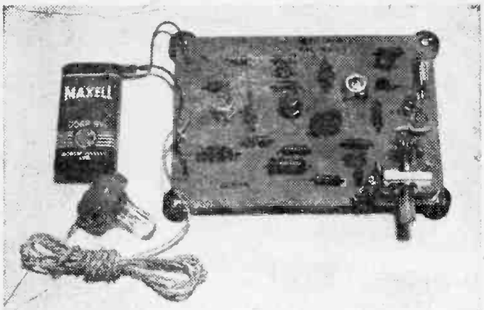
A SLIGHT MODIFICATION TO AN EICO EC-1400
AND VOILA—YOU EAVESDROP ON BOTH PILOTS AND TOWER

DID YOU SAY you'd like to listen to the tower of your nearby airport? You can, you know, with just a few simple modifications to an FM receiver so that it will tune to the airport frequencies and let you virtually ride along in the cockpit with the pilot and crew. Of course, you must live near an airport in order to hear the control tower and the aircraft; you won't hear anything if you're 20 miles from the runway, unless by chance you should be under the holding pattern. However, if you're within ten miles, this simple aircraft receiver conversion will put you on top of the action.

What You Need. Our Ten Dollar Aircraft Receiver is basically an Eicocraft FM radio which is a three-transistor set consisting of superregenerative detector and two stages of AF amplification. To convert this set to an aircraft receiver involves only stretching the tuning coil, or cutting one turn off it, depending on how your particular



receiver now tunes, plus the addition of an antenna isolation capacitor to prevent a long antenna from blocking the regen detector with excessive signal level.



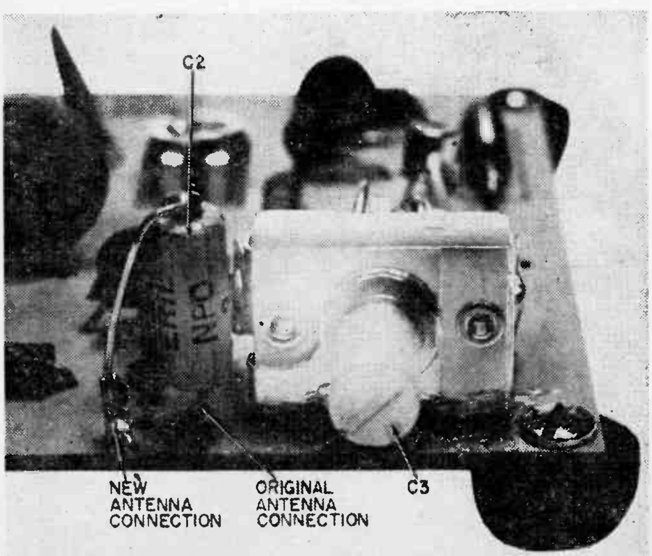
You start by building this FM set from an Eico EC-1400 kit. Once it's operating you're ready to make necessary modifications.

Getting Started. First step of the conversion project is to build the Eicocraft EC-1400 FM Radio exactly as described in the instructions for the kit. You cannot do the conversion until you are certain the original circuit is working. The EC-1400 is supplied with a pre-drilled printed circuit board and you need only to mount the components by pushing their leads into the matching holes and solder them to the circuit board.

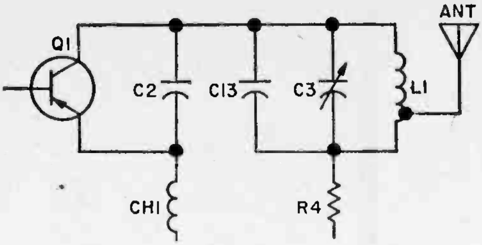
Mounting Capacitors. However, for the conversion project capacitor C2 must be moved. Therefore, when you solder it in to test the original circuit do not trim the leads too close to the circuit board as indicated in the kit's instruction sheet; leave the leads about ½-in. long and don't fold them flat against the circuit board—C2's leads should be left sticking out straight from the board. Also, it's recommended that you cement tuning capacitor C3 to the top of the circuit board. Tuning the high frequencies used by aircraft requires a capacitor that is physically stable in its mounting on the circuit board. The two wires that normally connect the tuning capacitor to the PC board don't provide an adequately rigid mounting. After C3 has been installed as described, place a few drops of General Electric RTV Silicon Adhesive (don't overdo the cement) under trimmer capacitor C3. Press C3 into the adhesive, but not so hard that the adhesive squishes out, and let it set for 24 hours. Finally, remember that capacitor C13, which is connected across C3, will be removed for the aircraft conversion; in the initial construction just tack-solder it across C3's terminals—don't wrap C13's wires around C3's terminals.

No Power Switch Needed. Though the FM radio's schematic and pictorial diagrams show a power switch, none really is needed since the battery can be easily unplugged from its terminals. Connect the red wire of the battery connector to the + connection on the circuit board and the black connector wire to the − connection on the board.

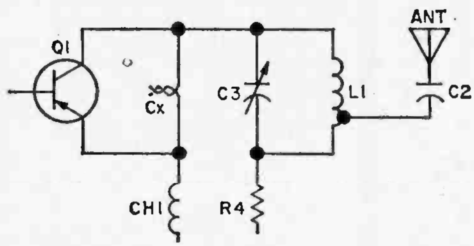
Checking Reception. Set the trimming potentiometer R1, so that the slider adjusting notch faces the top of the PC board. Plug-in the battery connector to a fresh battery and, by listening to the phone supplied with the kit you should hear a rushing sound. Adjust tuning capacitor C3 fully clockwise (maximum capacity) and then adjust this tuning capacitor counter clockwise until you hear an FM station. If



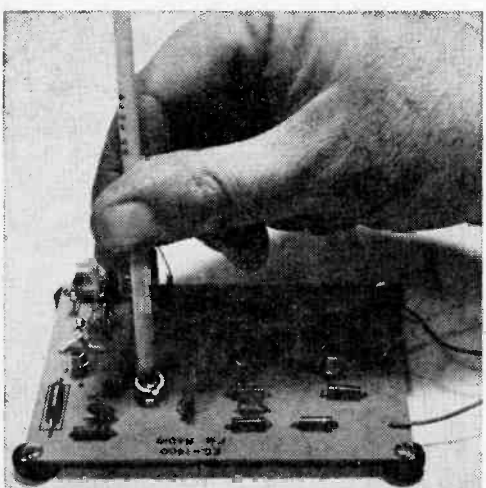
Use original antenna connection to mount C2 and install a push-in terminal nearby as new antenna terminal. C3 is cemented to circuit board to make its mounting sturdier for higher frequencies.



Above, circuit for kit before modification. Below, circuit modified by removal of C13 and repositioning of C2.



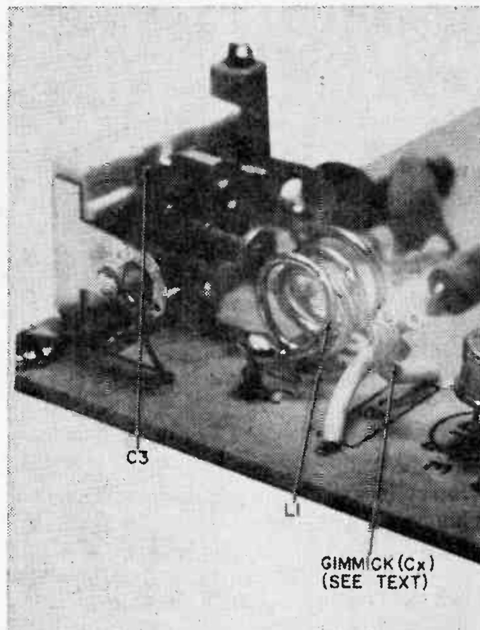
you can't pickup a station connect your TV antenna or a long wire to the FM radio's antenna lead; it needs a lot of signal. If you can hear any sound the radio is ready for conversion. Note that the regen detector is an AM detector and uses slope detection to receive FM signals; therefore, even when working correctly, on FM signals the sound level in the earphone will be very low. However, since aircraft radio communications uses AM modulation the sound level on the control tower and aircraft transmissions will be loud on this receiver. If the radio doesn't work, check your assembly for a possible error in wiring.



With modifications finished, set can be aligned either on airways signals or, if signal strength is low, from signal generator.

Converting To Aircraft Band. Being careful to use as little soldering iron heat as possible, remove C2 and set it aside. A "gimmick" capacitor (Cx) will replace C2. Cut two pieces of #20 or #22 solid insulated wire about ¾-in long and connect one end of each to the holes where C2 had been connected. Now twist them together one full turn (caution, be sure that they are insulated from one another electrically) and cut away any excess wire left hanging after the one turn twist. Use a #49 or #50 bit to drill a hole just off the edge of the circuit board about ¼-in from the present antenna hole (marked C).

Make certain that you do not drill into any of the printed circuit wiring copper strips. Insert a flea clip or T-28 type push-in terminal in the added hole and connect C2 between this terminal and the old antenna connection (marked C). Your antenna will now connect to this new terminal (see photographs).



After it's replaced by gimmick, C2 is used to couple antenna to set. L1 may have to lose one turn to cover airways bands.

Coil Modification. In order to extend the tuning range of the EC-1400 FM radio to cover the aircraft band it will be necessary to modify tuning coil L1. Grasp both ends

(Continued on page 102)

Clock innovator William Cassedy designer, constructor and proud owner of the Demonstrative Patriot. Clock gets its name from an American flag that is raised and lowered automatically each day by the clock with each sunrise and sunset. Local tide information is an added feature for local Huck Finns.

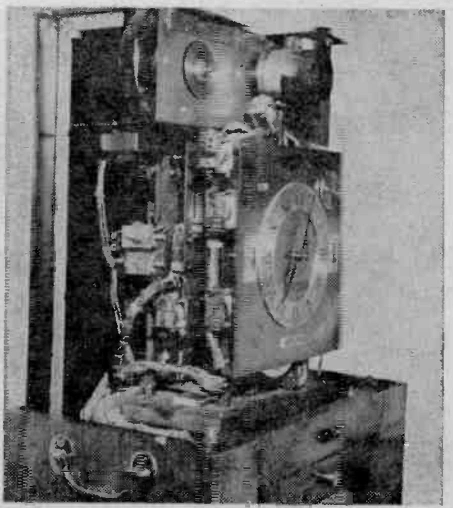
This Patriot Goes Tick Tock

☐ Mr. William Cassedy, of Short Hills, New Jersey has spent the last five years in building what he calls "The Demonstrative Patriot" which is in fact a clock that raises an American Flag at sunrise every morning, lowers the flag to half mast on days of national mourning and provides music to suit all occasions. It also tells the day, month, phase of the moon and the time of sunrise and sunset. The least impressive thing about Mr. Cassedy's clock is that it does, in fact, also tell the time.

On suitable occasions, the Demonstrative Patriot plays "Ave Maria" and also numbers "The Anniversary Waltz" and "Happy Birthday" in its repertoire.

When Mr. Cassedy retired, as president of a large electronics corporation, he set himself the task of making the "most elaborate clock I could think of". Clocks and antiques have long been a hobby of

(Continued on page 98)



With the top cover removed some of the electronics is seen. Clock took a lot of time and money to create and assemble.

e/e's all NEW BASIC COURSE in ELECTRICITY & ELECTRONICS *

PART 3
UNDERSTANDING COMBINED SERIES AND PARALLEL CIRCUITS

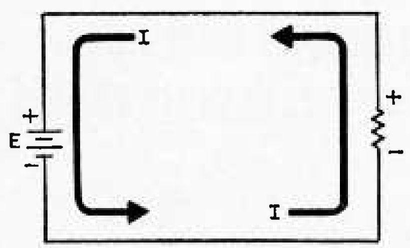
WHAT YOU WILL LEARN: This part contains applications of the series and parallel fundamentals you learned in preceding issues. You will now learn how to determine the direction of current flow in series-parallel circuits. When you complete this part, you will be able to reduce combinations of series and parallel circuits to a series equivalent. Also you will be able to determine and compute currents and voltages in each part of the circuit, and to apply Kirchoff's law properly when needed. A good understanding of the material in this part prepares you for complex electrical and electronic circuit examination, using a simple step-by-step logical process. *(Turn page)*

* This series is based on **Basic Electricity/Electronics, Vol. 2**, published by **Howard W. Sams & Co., Inc.**

IDENTIFYING INDIVIDUAL CIRCUITS

A basic electrical circuit consists of a source, a load, and conductors that connect the source to the load. The basic circuit was discussed in preceding chapters as if it were a loop. An applied voltage will cause a current to flow through a resistive element in a complete round-trip path. There are two ways to explain the direction of current flow—conventional and electron. If you employ the conventional theory for current flow, you describe all electrical flow in terms of positive ions in motion. Electron flow (the concept used in this text) states that current is the movement of electrons. According to this theory, electrons leave the negative terminal of a source, move through the circuit, and return to the positive terminal.

ELECTRON CURRENT FLOW



SERIES CIRCUITS

A series circuit is a basic circuit with all electrical components connected end to end. The key for determining the total voltage when there are two or more sources having different voltages and polarities is to find the potential difference between them. Next, assign the polarity of the larger voltage to the output terminals.

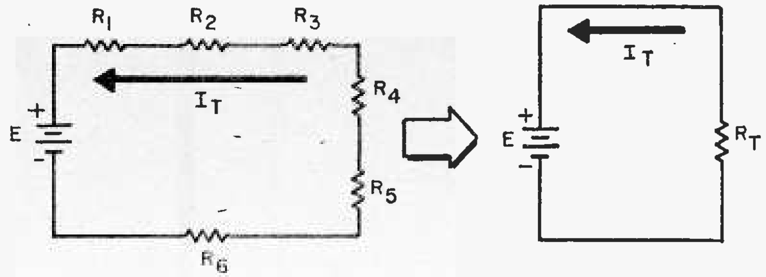
In a series circuit the total resistance is calculated by finding the sum of the individual resistances. Current in a series circuit is found by dividing the source voltage by the total resistance.

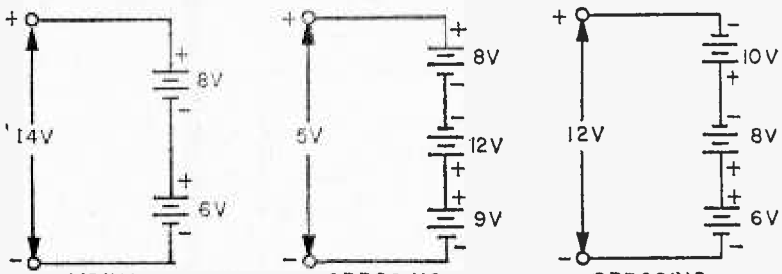
Since the total current (I_T) is flowing through all resistances, the voltage drop across a series resistance can be found by multiplying the current by the individual value of resistance. In other words, $E = IR$. The voltage drop across any resistance is equal to the current through the resistance multiplied by the value of the resistance. *(See drawing top on next page.)*

$$R_T = R_1 + R_2 + R_3 + R_4 + R_5 + R_6$$

$$I_T = \frac{E}{R_T}$$

A series circuit can have more than one source connected in such a manner as to aid or to oppose one another *(See drawing second from top on next page.)*





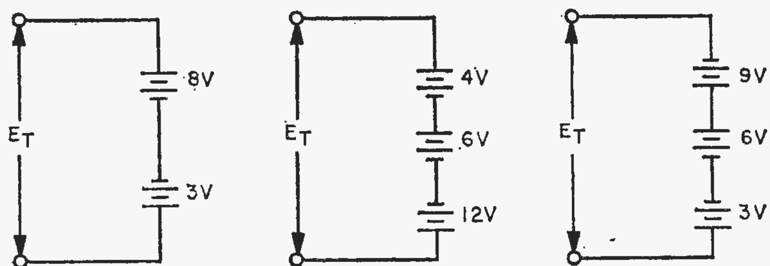
AIDING OPPOSING OPPOSING

Q1. In which direction does current flow inside the source when the conventional current-flow theory is being employed?

Q2. Draw a basic circuit and indicate the direction of current flow. (Use the electron theory.)

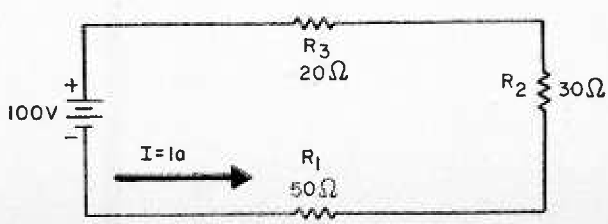
Q3. Can a basic circuit be considered a series circuit?

Q4. What is the total voltage at the terminals of the following sources?



A B C

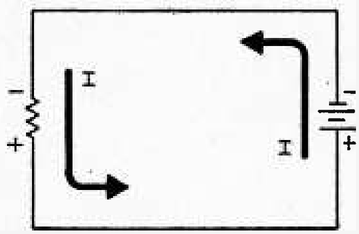
Q5. How does I_T compare with the value of current through any one of the resistances in the following circuit?



Your Answers Should Be:

A1. When conventional current theory is being employed, current will flow *from the negative terminal to the positive terminal* within the source.

A2.



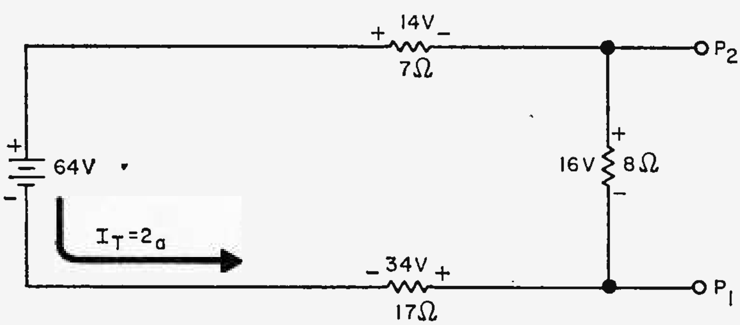
A3. A basic circuit *is* a fundamental series circuit.

A4. A. Negative to positive, bottom to top, *5 volts.*
B. Negative to positive, top to bottom, *2 volts.*
C. Negative to positive, top to bottom, *6 volts.*

A.5 I_T has *the same value* as the current through any of the resistances.

Voltage Division

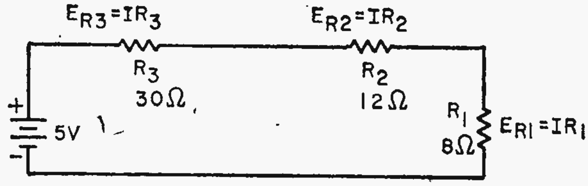
When current flows through a resistance, a voltage can be measured across it. The voltage across each resistor in a series circuit is equal to the total cur-



rent times the value of its resistance. That is, the 17-ohm resistor in the above circuit will have 34V (2 amps times 17 Ω) developed across it. The other voltages are determined similarly. Thus the voltage between P_1 and P_2 is 16V.

IR Drop

What is another way of expressing voltage drop across a resistor? Since voltage equals *IR*, it may be called *IR drop*. This is the same as saying the voltage developed across R_1, R_2, etc. The resistor voltage drops would be IR_1, IR_2, etc.

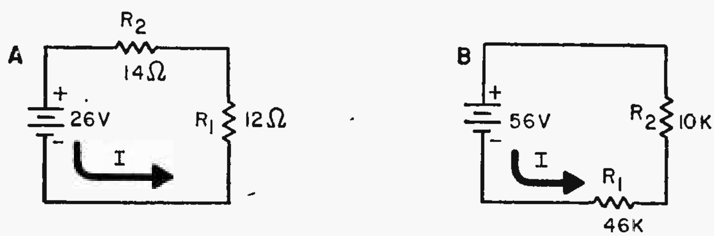


$$I_T = \frac{E}{R_1 + R_2 + R_3} = \frac{5}{50} = 0.1 \text{ amp}$$

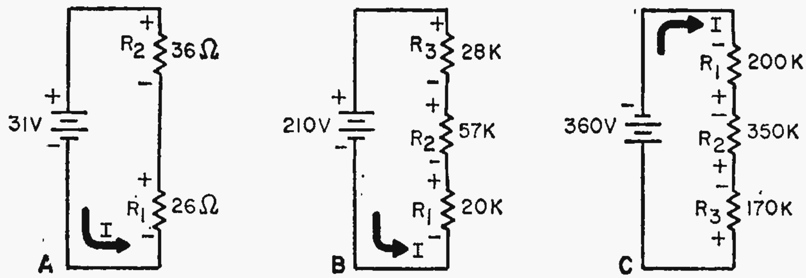
The voltage across R_1 equals IR_1, or $0.1 \times 8 = 0.8V$. The voltage across R_2 equals $IR_2 = 0.1 \times 12 = 1.2V$. The voltage across R_3 equals $IR_3 = 0.1 \times 30 = 3V$. The total IR drop is equal to the source voltage.

$$0.8V + 1.2V + 3.0V = 5V$$

Q6. What is the voltage drop across the R_1 resistors in the following circuits?



Q7. What is the IR drop across each resistor in the following circuits?



Q8. How does the voltage drop across the 36-ohm resistor affect the amount of voltage drop across the 26-ohm resistor in (a) above?

Your Answers Should Be:

A6. (a) *12 volts* = 1 amp times 12 Ω.
(b) *46 volts* = 1 ma times 46 K.

A7. (a) IR_1 = *13V*, and IR_2 = *18V* (I_T = 0.5 amp)
(b) IR_1 = *40V*, IR_2 = *114V*, and IR_3 = *56V* (I_T = 2 ma)

(Continued on next page.)

(Continued from previous page)

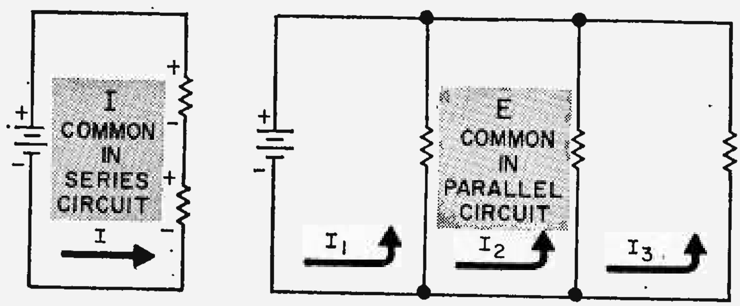
(c) $IR_1 = 100V$, $IR_2 = 175V$, and $IR_3 = 85V$ ($I_T = 0.5$ ma)

A8. The voltage across the 26-ohm resistor will be *decreased* from the source voltage by an amount equal to the voltage drop across the 36-ohm resistor.

PARALLEL CIRCUITS

A parallel circuit has two or more loads (resistances) connected across a source. The current flow through each resistance depends on the amount of that resistance. The total load (R_T) can be determined by dividing the source voltage by the total current. The total current equals the sum of the separate branch currents. $I_T = I_1$ (branch 1) $+ I_2$ (branch 2) + etc.

How does this compare to the series circuit? In a series circuit, the same current flows through all resistances, and thus a portion of the source voltage is dropped (proportional to the value of resistance) across each resistance.



A parallel circuit has a common supply voltage, and thus a possible different current through each resistance (branch), depending on the value of the resistance.

These two factors must be remembered in all operations concerned with calculations in both series and parallel circuits—to work problems in series circuits, employ the common current as the working component of Ohm's law along with the different resistances; to work problems in parallel circuits, employ the common voltage as the working component of Ohm's law. Let a parallel circuit with two resistors serve as an example.

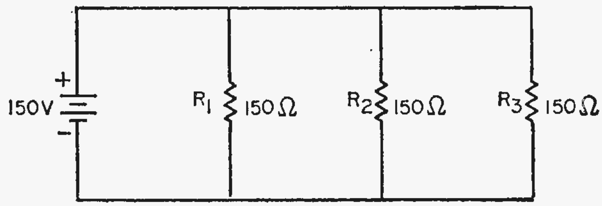
$$(1)\quad R_T = \frac{E}{\frac{E}{R_1} + \frac{E}{R_2}} = \frac{E}{I_T}$$

This can also be stated as:

$$(2)\quad R_T = \frac{R_1 \times R_2}{R_1 + R_2}$$

If all resistors are equal:

$$(3)\quad R_T = \frac{\text{R (value of one resistor)}}{\text{the number of resistors in parallel}}$$



Using (1):

$$R_T = \frac{150V}{\frac{150V}{150} + \frac{150V}{150} + \frac{150V}{150}} = \frac{150V}{1a + 1a + 1a}$$

$$R_T = \frac{150V}{3a} = 50 \text{ ohms}$$

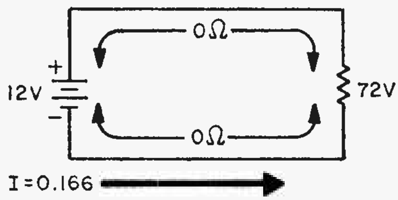
However, using (3):

$$R_T = \frac{150}{3} = 50 \text{ ohms}$$

Q9. When working problems from a schematic, what value of resistance do the conductors have?

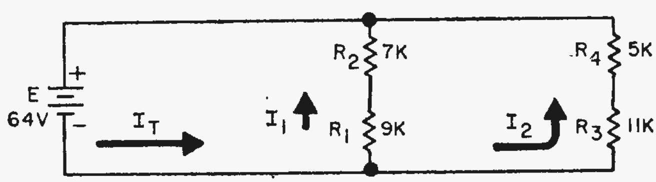
Your Answer Should Be:

A9. The conductors are considered to have a *zero resistance*, unless otherwise stated, when working problems from a schematic.



SERIES AND PARALLEL COMBINATIONS

From the basic series and parallel circuits there are many combinations possible which will contain both series and parallel characteristics. The diagram below demonstrates the two in combination.



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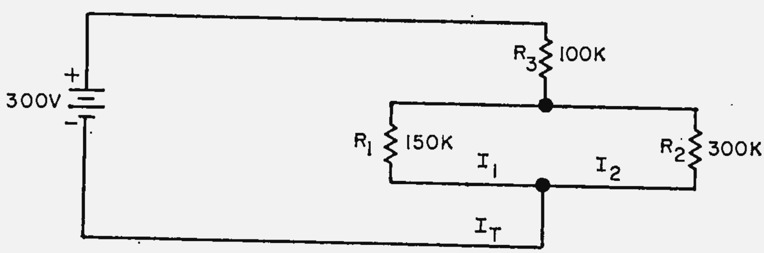
The first parallel branch consists of two resistors in series (R_1 and R_2). The second parallel branch contains two more resistors in series (R_3 and R_4). Many solutions can be derived from the problems which may stem from such arrangements. For instance, the first branch resistance is determined by finding R_T for the series circuit. The second branch resistance is determined by the same process. The total resistance can be determined by employing the $R_T = E\ I_T$ expression. In this case, I_T would be the result of the sum of I_1 in branch 1 plus I_2 in branch 2. This is the parallel circuit process.

The possible routes of solution for the circuit above may be evaluated using many processes. The best approach is always the direct application of Ohm's law expressions. In this case, $R_T = E/I_T$. E is known but I_T must be determined. $I_T = I_1 + I_2$. $I_1 = E/R_T$ for branch 1, and $I_2 = E/R_T$ for branch 2. Since they are series branches, R_T is the sum of the resistances. That is, $R_{T1} = R_1 + R_2$ for branch 1, and $R_{T2} = R_3 + R_4$ for branch 2.

The total resistance of each branch can be used to find the branch currents, the branch currents to find the total circuit current, and the total circuit current to find the total circuit resistance (R_T). Other combination circuits may take on almost any form. The forms are limited only by the designer's need to construct a circuit which will perform a specific function.

Another example of a combination circuit is shown below:



To find the effective load for the 300V source, R_T must be calculated. One approach for finding R_T is to first find the total resistance for the parallel branch (R_1 and R_2); then the sum of the total parallel resistance plus R_3 should be found. After the total resistance has been determined, the total current can be calculated.

The total resistance for the parallel combination of R_1 and R_2 may be found by employing the product-over-the-sum process. That is:

$$R_{T1} = \frac{R_1 \times R_2}{R_1 + R_2} = \frac{150K \times 300K}{150K + 300K} = 100K$$

for the parallel branch. The final series-circuit resistance becomes $R_T = 100K + 100K = 200K$. The total current for the entire combination is 300V/200K, or 1.5 ma.

Q10. What is the total resistance in the circuit on the opposite page?

(Continued on page 90)

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NATTS

(Continued from page 86)

Q11. What is the total current in the circuit appearing on page 85?

Q12. What is the voltage drop across R_4?

Q13. Draw the equivalent circuit.

Your Answers Should Be:

A10. $R_{T1} = R_1$ plus R_2 for branch 1. $R_{T2} = R_3$ plus R_4 for branch 2.

$R_{T1} = 9K + 7K = 16K$ for branch 1.

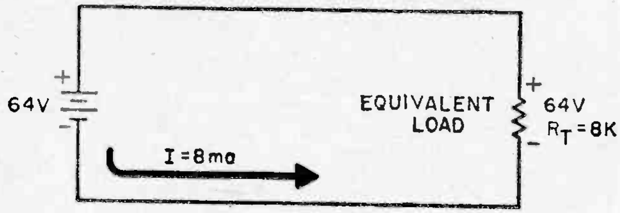
$R_{T2} = 11K + 5K = 16K$ for branch 2.

Total resistance equals 16K/2 = 8K.

A11. $I_T = E/R_T = 64V/8K = 8\ ma.$

A12. The voltage drop across R_4 equals $IR_4 = 4\text{ ma} \times 5K = 20V.$

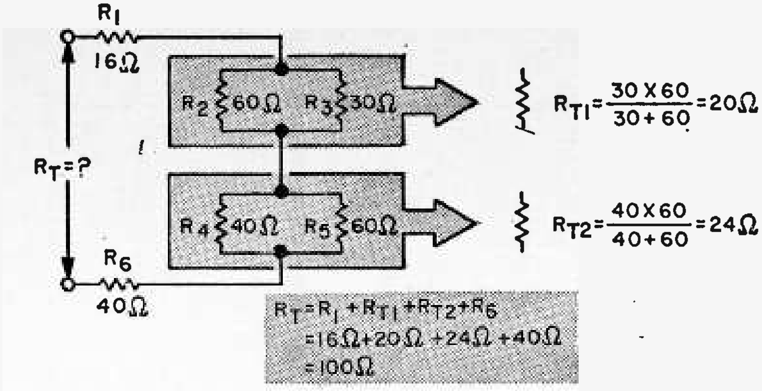
A13.



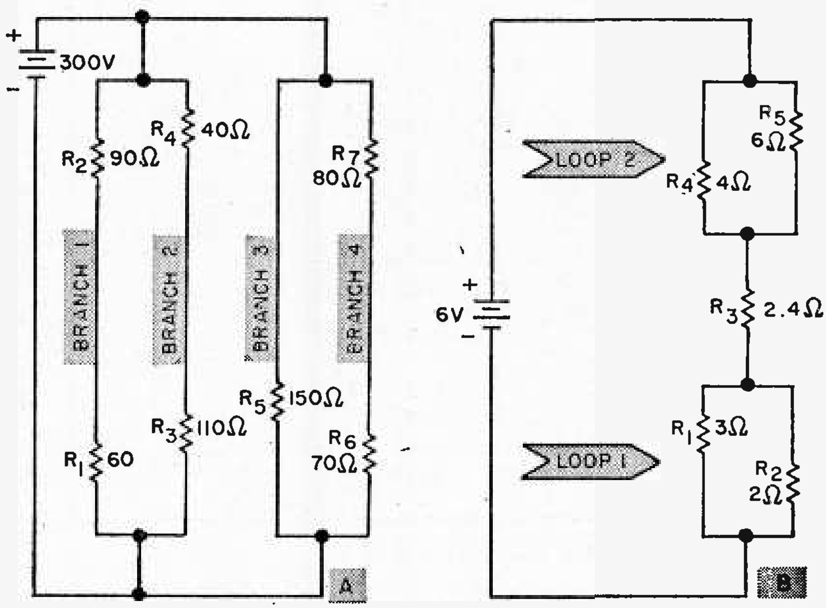
The voltage drop across R_3 (refer to diagram on page 86) is equal to IR_3. $IR_3 = 1.5\text{ ma} \times 100K = 150$ volts. The voltage common to both R_1 and R_2 is the source voltage minus the voltage drop across R_3. This results in a voltage of 150 volts across the two resistors in parallel. R_1 will have 1 ma of current flowing through it. R_2 will have 0.5 ma of current flowing through it. The total current of the branches (and the circuit) will equal 1.5 ma. The equivalent circuit would consist of a 300-volt source connected to a 200-ohm load.

The illustration under Question 14, shows another example of a combination series-parallel circuit. Included in this illustration is a method recommended for converting this type of circuit to an equivalent series circuit. This conversion simplifies the calculations.

Q14. If a 100-volt source is applied to the circuit below, what will be the voltage drop across R_4? What will be the current flow through R_4? ***(See drawing top on next page)***



Q15. What is the voltage drop across each resistor in the following circuits?



Your Answers Should Be:

A14. The total current will be 1 ampere. The current through R_4 will be 0.6 amp. So, $E_{R4} = 24V$.

A15. (a) To find the voltage drop across each resistor, you must find the current through each branch. In this case, total current is of no concern.

Branch 1:

$$I_{\text{loop 1}} = \frac{300V}{R_1 + R_2} = \frac{300V}{150\Omega}$$
$$= 2 \text{ amps}$$
$$IR_1 = 2a \times 60\Omega = \mathit{120V}$$
$$IR_2 = 2a \times 90\Omega = \mathit{108V}$$

(Continued on next page.)

(Continued from previous page)

Branch 2:
$$I_{loop\ 2} = \frac{300V}{R_3 + R_4} = \frac{300V}{150\Omega}$$
$$= 2 \text{ amps}$$
$$IR_3 = 2a \times 100\Omega = \mathit{200V}$$
$$IR_4 = 2a \times 40\Omega = \mathit{80V}$$

Branch 3:
IR_5 will equal the *supply voltage (300V).*

Branch 4:
$$I_{loop\ 2} = \frac{300V}{R_6 + R_7} = \frac{300V}{150\Omega}$$
$$= 2 \text{ amps}$$
$$IR_6 = 2a \times 70\Omega = \mathit{140V}$$
$$IR_7 = 2a \times 80\Omega = \mathit{160V}$$

(b) To find the voltage drop across each resistor, proceed as follows:

$$R_{T\ (loop\ 1)} = \frac{R_1 \times R_2}{R_1 + R_2} = \frac{3 \times 2}{3 + 2}\ 1.2\Omega$$
$$R_{T\ (loop\ 2)} = \frac{R_4 \times R_5}{R_4 + R_5} = \frac{4 \times 6}{4 + 6} = 2.4\Omega$$
$$R_T = R_{T\ (loop)\ 1} + R_3 + R_{T\ (loop\ 2)}$$
$$R_T = 1.2\Omega + 2.4\Omega + 2.4\Omega = 6\Omega$$
$$I_T = \frac{E}{R_T} = \frac{6V}{6\Omega} = 1 \text{ amp}$$
$$IR_{\ (loop\ 1)} = 1a \times 1.2\Omega = \mathit{1.2V}$$
$$IR_{\ (loop\ 2)} = 1a \times 2.4\Omega = \mathit{2.4V}$$
$$IR_3 = 1a \times 2.4\Omega = \mathit{2.4V}$$
$$IR_T = 1.2V + 2.4V + 2.4V = \mathit{6V}$$

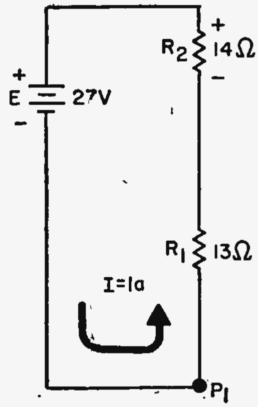
KIRCHHOFF'S LAW

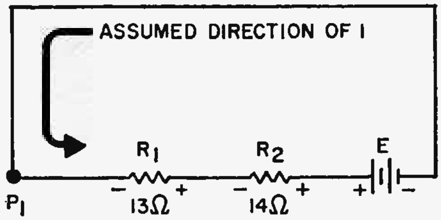
Kirchhoff's law defines the distribution of currents and voltages within an electrical circuit. This law is used as a method of checking to see if you have assigned the proper direction for current flow and to see if your arithmetic is correct. It consists of two parts—one for voltages and one for currents. You will find this law a very useful tool when the direction of current is in question and or when the total voltage or crurrent is to be determined.

Primarily, Kirchhoff's law is a complete circuit application of Ohm's law. It makes use of Ohm's law many times in some circuits. Because of this application and the unique methods employed in handling points in the circuit—one with respect to another—you should master every process.

Voltage Applications

Upon determining voltage and polarity for each source and across each resistance, choose a point in the circuit and assign a direction of current flow. Find the algebraic sum of all the IR drops plus the source, from the chosen point, around the entire circuit and return. It should be zero.





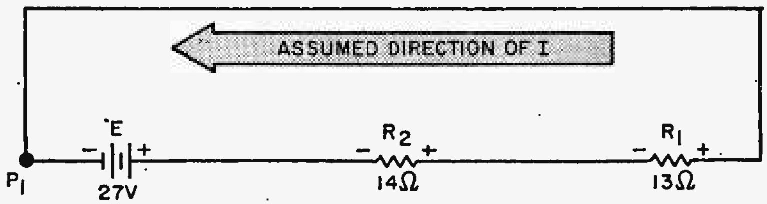
$IR_1 + IR_2 + E = ?$

$(-13V) + (-14V) + (27V) = ?$

$-27V + 27V = 0$

The sum of voltages in the loop from point 1 back to point 1 is zero. The current was assumed to be in the correct direction, and I_T and the IR drops were calculated properly.

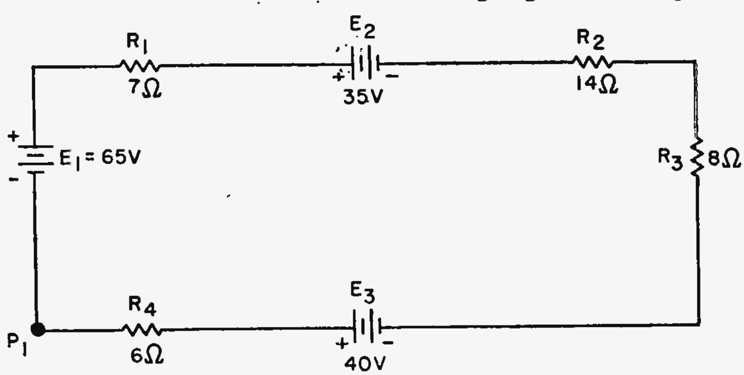
Another look at the same circuit, with an opposite direction of current assignment, is as follows.



$E + IR_2 + IR_1 = ?$

$(-27V) + (-14V) + (13V) = 54V$

The sum of the voltages in the loop from point 1 back to point 1 equals —54V. Therefore the current was assumed to be going in the wrong direction.



(1) $E_T = +E_3 - E_2 + E_1 = (+40V) + (-35V) + (65V)$

(2) $R_T = 6\Omega + 8\Omega + 14\Omega + 7\Omega = 35\Omega$

(3) $I = \frac{E_T}{R_T} = \frac{70\Omega}{35\Omega} = 2a$

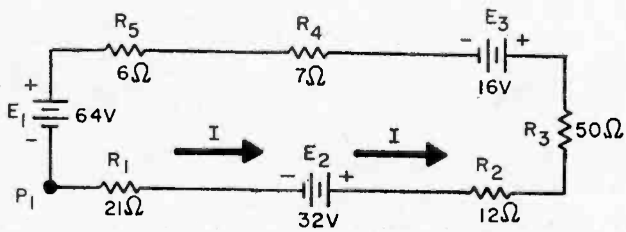
(4) $(-IR_4) + (+E_3) + (-IR_3) + (-IR_2) + (-E_2) + (-IR_1) + (+E_1) = ?$

Calculating the IR drop across each resistor: $IR_4 = 12V$, $IR_3 = 16V$, $IR_2 = 28V$, and $IR_1 = 14V$. Kirchhoff's application (4) above: $-12V + 40V - 16V - 28V - 35V - 14V + 65V = ?$ $105V - 105V = 0V$.

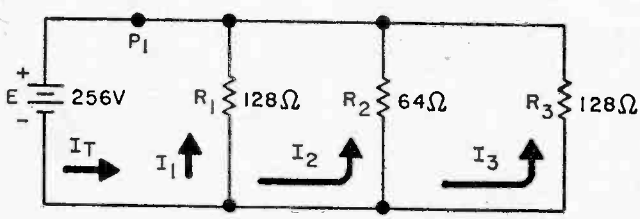
Current Application

Finding the sum of the voltages around the circuit for the series network is one basic application of Kirchhoff's law. Finding the sum of the currents is another application and is the process employed in a parellel circuit. Kirchhoff's current law states that *the current flow away from a given point in a circuit must equal the current flow to that point.*

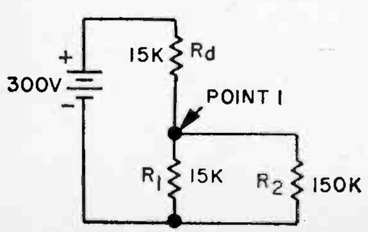
Q16. What is the E_T for the following circuit?
Q17. What is the R_T for the following circuit?
Q18. What is the I for the following circuit?
Q19. Write the complete Kirchoff expression for the following circuit, starting at P_1.

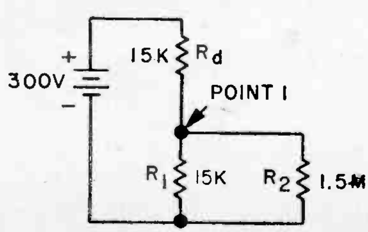


Q20. Write Kirchoff's current expression for the following circuit.



Q21. What is the voltage at point 1 and the current through R (dropping resistance) for the following circuits?





Your Answers Should Be:

A16. $E_T = 64V - 32V + 16V = 48V$

A17. $R_T = R_1 + R_2 + R_3 + R_4 + R_5 = 21\Omega + 12\Omega$
$50\Omega + 7\Omega + 6\Omega = 96\Omega$

A18. $I = E_T/R_T = 48V/96\Omega = 0.5$ *amp*

A19. $-IR_1 - E_2 - IR_2 - IR_3 + E_3 - IR_4 - IR_5 + E_1 =$
$-10.5V - 32V - 6V - 25V + 16V - 3.5V - 3V$
$+ 64V = 0V$

A20. $I_T = I_1 + I_2 + I_3$
$E/R_T = E/R_1 + E/R_2 + E/R_3$
$256V/32\Omega = 256V/128\Omega + 256V/64\Omega + 256V/128\Omega$
8 amps = 2 amps + 4 amps + 2 amps

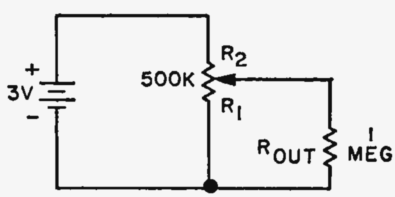
A21. $I_T = 300/R_T$

$$R_T = \frac{R_1 \times R_2}{R_1 + R_2} + R_4$$

$R_T = 28.6K$ for (A); $R_T = 29.8K$ for (B)
$I_T = 10.49$ *ma for (A)*; $I_T = 10.06$ *ma for (B)*
Voltage at $P_1 = 300 - (15K \times 10.49 \text{ ma}) = 300$
$- 157.35 = 142.65$ *volts for (A)*
Voltage at $P_1 = 300 - (15K \times 10.06 \text{ ma}) = 300$
$-150.9 = 149.1$ *volts for (B)*

APPLICATION

Some circuits have their components connected in series, others have a parallel-circuit form. Still others are different combinations of series and parallel circuits. Combination-type circuits are the most widely used arrangements. These arrangements often are a result of switching action or of variable resistance. When such applications need to be constructed or examined, you need a good command of Ohm's and Kirchhoff's laws. One example is shown below.



The output voltage (across R_{out}) equals $3V - I_T R_2$ $I_T = 3V/R_T$, and $R_T = \dfrac{R_1 \times R_{out}}{R_1 + R_{out}} + R_2$. Another method or approach would be to find IR_{out}. This would require calculating I.

$$I = I_T - I_{R1}$$

The following diagram is an example of resistor voltage division. The goal in this case is to control the current through the two paths. *(Turn page)*

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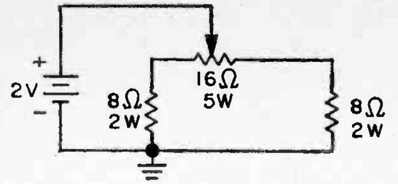
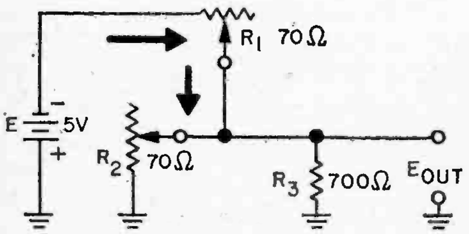


If the wiper of the potentiometer is centered, the resistance from either side to ground will be equal.

The following circuit is another example of a variable voltage output, presenting to the source a constant or near-constant resistance. With the wiper centered on both rheostats, the output voltage is approximately 2.5 volts.



$$R_T = 35\Omega + \frac{35\Omega \times 700\Omega}{35\Omega + 700\Omega}$$

$$= 35\Omega + 33.3\Omega = 68.3\Omega$$

$$I_T = \frac{5V}{68.3\Omega} = 0.073 \text{ amp} = 73 \text{ ma}$$

The voltage across R_1 will equal 73 ma times 35 ohms, or 2.555 volts. This leaves 2.445 volts for the output. Dividing 2.445 volts by R_3 equals approximately 3.49 ma.

Q22. Solve for the current through the output resistor in the potentiometer circuit on the opposite page, with the wiper arm first at the top of the 500K potentiometer and then in the center (as shown).

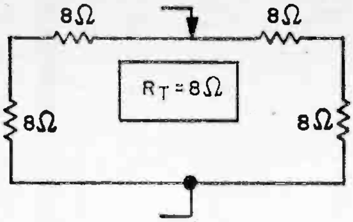
Q23. What would be the total current in the potentiometer circuit at the top of this page? (Assume the wiper is in the center of the potentiometer.)

Q24. What will be the total resistance in the same circuit if the wiper is all the way to the left?

Your Answers Should Be:

A22. If the wiper is all the way to the top, the output voltage will be 3 volts. Therefore the current will be equal to the 3 volts divided by 1 megohm of resistance. This results in 3 μa of current flow. The total resistance across the source at this time will be 333K. If the wiper were in the center position, the total resistance would be 450K. This results in 6.66 μa of current flow. The current flow through R_2 (250K) causes 1.68 volts to be dropped across R_2. The resulting output will be 3V — 1.68V, or 1.32V.

A23. The total current for the circuit would be 2 volts divided by the total resistance. $I_T = 2V/R_T$
(R_T = 8 ohms plus 8 ohms divided by 2).



The total current will equal: $2V/8\Omega = 0.25$ *amp*

A24. If the arm is all the way to the left, the total resistance will equal: $\frac{8 \times (16 + 8)}{8 + (16 + 8)} = 6\Omega$. I_T for this setting is $2V/6\Omega =$ *0.33 amps.*

WHAT YOU HAVE LEARNED

1. The basic circuit is a series circuit.
2. The series circuit has the same current through all components.
3. The parallel circuit has the same voltage across all branches.
4. IR drop is determined by multiplying the value of a resistance (in ohms) by the value of the current (in amps) flowing through it.
5. In a series circuit the total IR drop across the resistances is equal to the effective total source voltage.
6. The sum of the branch currents in a parallel circuit is equal to the total current of the circuit.
7. Both series and parallel solutions may be employed when solving for current, voltage, or resistance in combination circuits.
8. Kirchhoff's law is an application of Ohm's law.
9. Kirchhoff's law for series circuits states that the sum of all voltages around a circuit, from one point through the circuit and back to the point, will be equal to zero. In addition, the sum of all the voltage drops will equal the effective voltage of the source.
10. Kirchhoff's law for parallel circuits states that the amount of current leaving a junction must be equal to the amount of current entering the junction.
11. The total voltage of the source will be the product of R_T times I_T.
12. In a series circuit, the Kirchhoff's law application results in zero if the direction of current is assumed correctly.
13. If the current is assumed to be going in the wrong direction, the result is equal to twice the effective voltage of the source.

NEXT ISSUE: Part 4—Understanding Electromagnetism

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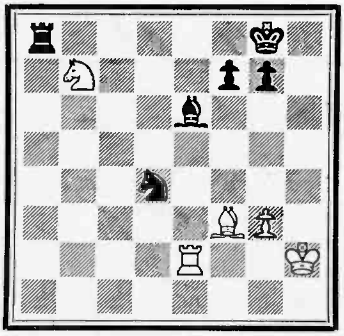
En Passant

Continued from page 28

15 R-Q2	Q-B1!	29 QxP	QxQ
16 N-QB5	B-R6!	30 NxQ	NxP#
17 B-B3	B-N5	31 K-R2	N-K5
18 B-N2	B-R6	32 R-B4	NxBP
19 B-B3	B-N5	33 B-N2	B-K3!
20 B-R1?	P-KR4!	34 R/4-B2	N-N5#
21 P-N4	P-QR3	35 K-R3	N-K4#
22 R-QB1	P-R5	36 K-R2	RxN!
23 P-R4	PxP	37 RxN	N-N5#
24 RPxP	Q-B2	38 K-R3	N-K6#
25 P-N5?	RPxP	39 K-R2	NxR
26 PxP	R-K6!!	40 BxR	N-Q5!
27 N-B3?	PxP	Resigns	
28 QxP	N-B6!		

Position after 40 .... N-Q5!



Why did White resign? Because he must lose a piece. Here is the analysis—

A. If 41 K-N2, NxB 42 KxN, B-Q4# 43 K any, BxN and wins.

B. If 41 R-B2 (41 R-K3), NxB# 42 RxN, B-Q4 and wins. There is no safe square to which the Rook can go that will protect the Knight.

C. If 41 B-R5, NxR 42 BxN, R-R7 and Black emerges a Rook ahead.

Alekhine observed it was peculiar there was no *brilliancy* prize awarded in this tournament!

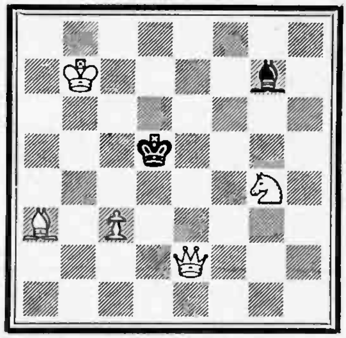
Solution to Problem 22: 1 B-N6. If 1 .... K-R7 2 B-B4 mate. If 1 .... R-R8# 2 B-B1 mate. If 1 .... R-R3 2 QB any mate. And if 1 .... P-B7 2 B-K3 mate.

News and Views. CHESS REVIEW, THE PICTURE CHESS MAGAZINE, has been acquired by the U. S. Chess Federation. Henceforth, CHESS REVIEW, which had a successful run of thirty-seven years, and CHESS LIFE, the official organ of the USCF, will merge as CHESS LIFE and REVIEW. Al Horowitz, Editor of CHESS REVIEW, will become a consultant for the new and greater periodical.

World Champion Boris Spassky, 11½-3½, won the Puerto Rican Invitation Masters Tournament. Bisguier, Browne, and Parma, 10-5, tied for 2nd, 3rd, and 4th, and Schmidt was 5th with 9½-5½.

Problem 23
By G. Mott-Smith
Chess Review, 1934

Black



White

White to Move and Mate in Two.
Solution in Next Issue. ■

This Patriot Goes Tick Tock

Continued from page 78

Mr. Cassedy's—he has 29 vintage clocks in his home, all of them working.

The clock is electrically operated, and its functions are controlled by systems of relays and micro-switches. All the functions are operable by switches on a control panel, specially built in for demonstration purposes. Naturally, the clock doesn't let itself be beaten by anything so ordinary as a Leap Year. It automatically corrects itself every four years. Oh yes. There's an alarm built in as well, which first plays five minutes of radio music and then buzzes noisily until it's turned off.

Mr. Cassedy is well pleased with his clock —and so are the neighbourhood kids who love watching it go through its paces. But he admits "I have to reset it by hand for daylight saving, and if I took it into a different time zone, it wouldn't correct itself. But," he adds proudly, "very few clocks automatically correct themselves for leap year. No, it won't make coffee, either. All it will do is to tell you when to put the coffee on. . . ." —*Joe Gronk*

Pennypincher's Strobe

Continued from page 33

some music with a pronounced beat, and watch it flash in time with the music. Try different ranges. Connect the external input to the earphone jack on a battery operated transistor radio (so the radio's speaker is disconnected). Turn up the volume. On the *Hi* range you may be able to understand the sound of the flash (so to speak).

Use the strobe to stop motion. Look at a fine stream of water from a faucet. If you are sharp of eye, you will see the individual droplets in mid-air.

Still Life. Watch a plucked string on a musical instrument. When the strobe is flashing exactly at the same frequency (or exactly at a harmonic), the string will stand still. If the frequency is very slightly higher or lower, the string will move in slow motion—you will be seeing the beat note between the strobe and the musical string. If you don't know the note being played when the motion is stopped by the light, just read the calibrated strobe dial. You can analyze vibration modes or tell how fast machinery is going the same way. The stroboscope makes an excellent no-contact, no-connection tachometer.

Measure your car's idling speed by stopping the motion of the radiator fan (the fan has to be connected to the crankshaft, of course).

A single-flash photographic strobelight (or a flashbulb) will stop motion for photography but the stroboscope will let you take multriple-exposure stop-motion pictures. Use high-speed black-and-white film (such as Polaroid 3000 or Kodak Tri-X) and a fast lens. If you set the camera to take a one- or two-second exposure (or a time exposure) while using the flashing stroboscope as the only light, you will get multiple pictures of anything moving during the exposure. Try different flash rates, exposure times, and subjects. Take a picture of a ping-pong ball in flight or of someone walking or waving his arms.

If you know the time between strobe flashes (1/flash rate), you can calculate the speed of motion from the distance between images in the multiple exposure.

With a little imagination you will think of dozens of other uses. And for fun, you can always hold a psychedelic party—just try dancing in strobelight! Groovy, man! ■

PhoneCom

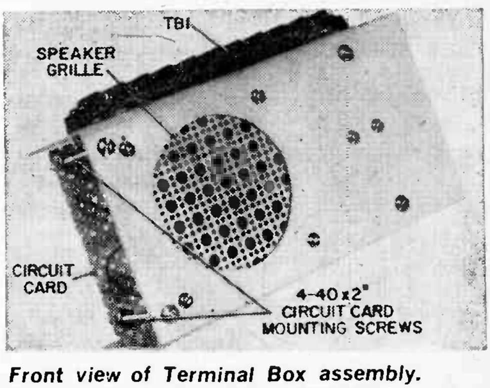
Continued from page 40

When wiring the switch, note that only two of the 4PDT switches are used. Be sure to observe the proper polarity when installing diode D1.

Check Out. Before interconnecting the two completed intercom stations as a system, several checks should be made on each unit to assure their proper operation. With the battery (B1) installed and the handset *on hook*, clip a jumper lead between terminals 5 and 7 of TB1. This applies +9V to the signaling section, and a beeping tone should be heard from the speaker. If not, first check the wiring associated with the multivibrator and the oscillator, then the individual components.

Lift the handset *off hook* and clip a jumper lead to terminals 4 and 7. This checks the polarity, of D1 and the switch wiring.

With the jumper removed, you should hear sidetone when speaking into the microphone. Good sidetone indicates both the transmit and receive amplifiers are functioning properly. If sidetone is not obtained, remove the handset receiver connection to terminal 2 and connect it to terminal 1. If sidetone is now heard, the trouble will be found in the receive amplifier. With the possible fault isolated either to the transmit or



Front view of Terminal Box assembly. Perforated metal makes attractive grille to protect speaker used to amplify calling signal that sounds automatically when handset is raised.

receive amplifier, check the wiring to the appropriate section.

Interconnecting the System. After the intercom units have been tested individually to assure proper operation, they may be wired together as shown on the Interconnection Diagram. The Xmit Line wires should be shielded. This helps to avoid problems arising from excess coupling between the Xmit and Rec lines. A suitable intercom cable is Belden 873 or its equivalent. This cable contains three shielded conductors. The shield is used as the Ground Line connection, the 4th conductor shown in the schematic connected to terminal #3.

The maximum line length between the two stations is limited only by the total resistance in the Signal Line/Ground Line loop. The greater the resistance, the greater the drop in signaling voltage on the line, and the lower the signaling tone level will be at the other station. The loop resistance may be as high as 300 ohms before the signaling level drops excessivly. This corresponds to a maximum line length of about five miles, using #18 wire. Substituting #22 wire cuts the distance to half that of #18 wire.

Sidetone level can be adjusted to compensate for individual preferences by increasing or decreasing the value of resistor R5. Likewise, if it is desired, the pitch of the beeper can be changed by altering the value of capacitor C10 or C11.

The level of the signaling tone may be reduced by inserting a small resistor, under 30 ohms, in one of the leads between the secondary of transformer T1 and the speaker.

The last step in setting up the system is to adjust the receive level control (potentiometer R7) at each station to a comfortable listening level. If the control is adjusted too low, it will lower the sidetone level at the distant station. This, however, should not be a problem, as the control is normally set above this level to produce an adequate listening level in the receiver. ■

FM's Airwaves

Continued from page 52

music; its listeners obviously are Flower People and the college set. Other FMs stick to standard rock, more or less approximating the AM Top Forty sound, though a few specialize in Golden Oldies, or subdued rock, such as CBS' nationally syndicated "The Young Sound." A sizable number of school boards and educational institutions own stations; some distribute programs to the entire school system of a county or city; others, mostly Class D stations, are operated by individual school either as part of their language arts curriculum or an extracurricular club.

College stations are often an essential part of the curriculum for broadcast arts majors, offered, by the way, by a large number of colleges and universities. Then there is a growing number of Country-and-Western outlets, which have an unusually loyal group of listeners. A few other choices of programming are available only in isolated instances, such as ethnic-group programming.

Two unusual stations are Pacifica Foundation's KPFA and KPFB in Berkeley, Calif., which are noted for their lively and liberal (often controversial) programming. Talk programs were popular on these long before the likes of Johnny Carson and William Buckley. One station in Los Angeles broadcast want ads exclusively, but abandoned this policy after racking up a severe deficit; a Puerto Rican station once broadcasts the English sound tracks of Spanish films simultaneously telecast by a local TV station.

A boost to national FM came when the ABC radio network split into four separate networks on January 1, 1968, earmarking one of them for FM service exclusively—the American FM Network. Its affiliates number nearly 200. American FM broadcasts five minutes of news hourly at quarter past the hour, with additional optional features at night.

Up And Over. Today, FM is crowding the leading AM stations. In New York City, for example, WOR-FM is already third, fourth, or fifth in the marketplace, depending on what hour of the day the rating services measure. On weekends, WNEW-FM often outrates its AM sister, and the same is true of several other leading New York FM outlets. In short, FM is well on its way toward becoming the dominant music broadcast medium. In Chicago, another major market, there is no all-classical music format on AM.

The future? Many broadcast experts predict that AM will become an all-talk/news format and that by 1980 FM will lead in audience, advertising revenue, and set sales.

Again, technology has offered an answer —the development of semi-computerized, automated equipment. Music, commercials, station breaks, and weather forecasts are recorded on tape reels and cartridges. An automatic switching mechanism cuts from one reel to another, varying the sequence of the musical selections, inserting commercials at the proper time, breaking the station within the legal time limits, even joining and leaving the network on cue. New equipment even types out the required programming and transmitting logs during station operation. Thus, a station can be staffed at a bare minimum of employees.

Fact is, a new proposal before the FCC would permit such an automated station to operate completely unattended, signing *on* and *off* by itself. In case of serious technical problems, the transmitter would signal an alarm; if the difficulty were not corrected within ten minutes, the transmitter would automatically shut down. This advance is presently technically feasible; only radio law prevents its being used now. One southern FM station operates with a staff of three people, period!

Forging Ahead. As a result of these advances, the number of FM stations is increasing at a steady rate, despite the fact that it takes several years of operating in the red to establish a station. In some cities, the number of allocated channels has already been filled. There are broadcasting executives who believe that radio will one day be FM exclusively. And well it may, for sales of all kinds of FM radios continue to boom faster than firecrackers on the Fourth.

According to industry figures, about half of all radios sold last year were FM-equipped. The weak spot, a handicap in winning over commercial sponsors, is the scarcity of FM car radios. But here again, the rate of car radio sales is increasing, much faster than for home radios. Evidently FM has won such devotion in the home that the listeners don't want to miss it while traveling.

The FCC has been encouraging broadcasters to go FM for many years. It particularly wants to see daytime-only AMs introduce an FM nighttime service, but the daytime stations have not been, until very recently, very interested. A careful study of *White's Radio Log*, comparing call letters of AM and FM stations, adding also those FMs with different call letters but nevertheless owned by a local AM station, shows that out of 2000 daytimers listed, only about 500 had FM counterparts—roughly 31%. There is reason to project a greater percentage increase, for daytimers generally do not have the problems in operating FM affiliates which fulltime AM stations do.

Under a 1967 ruling, an FM station may not simultaneously air the programming of the AM affiliate for more than 50% of its broadcast day. However, this FCC ruling is waived for all FM stations licensed to communities of less than 100,000. Separate and therefore expensive programming is less a problem for daytimers. Reason is there are fewer hours possible to duplicate, and besides, the majority of daytimers are licensed to communities below that cut-off figure.

The Obstacle Course. Things indeed have never looked better for FM growth. But a problem still plagues the industry at this moment. The FCC and the Department of Justice, in their efforts to diversify ownership of local communications media, have seriously proposed a new ruling which would forbid a company to own more than one station of any kind in a given community. This "Duopoly Rule," if effected, would demand that an AM/FM/TV combination dispose of two facilities—its choice. Only daytime stations would be permitted to possess either an addtional FM or TV outlet. The proposal is currently being challenged by the National Association of Broadcasters and other industry people.

FM—State of Industry*

Stations now operating	2450
Stations licensed	2387
Construction permits outstanding	301
Applications for new stations	287
Stations broadcasting stereo	612

* November, 1969

Since the bulk of FM stations are owned by fulltimers, and since FM tends to be less profitable an operation than AM, a few believe that the FM stations would be disposed of. The FCC is meanwhile asking for comments on the proposed ruling from any interested party—readers who are faithful FM fans would do well to let the FCC know how they feel. The decision will come soon. If the federal government decides to abandon the idea, there is clearly no stopping FM ■

DX-120 Receiver

Continued from page 54

The only complaint, as far as stability is concerned, is the bandspread tuning knob. There is a round loop on the bandspread capacitor, and touching the metal trim on the bandspread knob causes the receiver to detune sharply above 25 MHz. This can be easily corrected by simply replacing the original knob with one that is all plastic.

The ANL (automatic noise limiter) is average; it will clip sharp impulse noise to a tolerable level, but without too much clipping as to severely distort the audio.

Special Features. While an external BC antenna can be used, the DX-120 has a built-in ferrite antenna for the broadcast band. All circuits have voltages regulated by Zener diode. Hence, a change in battery or AC supply voltage does not essentially affect the DX-120's tuning stability. The S-meter readings represent approximately 4 dB per S unit below S9, with S9 representing nominally 100μV at the antenna terminals.

Summing Up. To date, the Radio Shack DX-120 Star Patrol Globe-Spanning Receiver is the best truly budget-priced receiver we've seen. It's sensitive, easy to tune, and most of all, it's reasonably stable.

The DX-120 is priced at $69.95. Optional accessories include a 12-V power pack at $7.95 and a shortwave antenna kit at $1.98. For additional information write to Radio Shack Corp., Dept. JS, 730 Commonwealth Ave., Boston, Mass. 02217. ■

$10 Aircraft Receiver

Continued from page 77

of the coil and stretch it approximately 1/8 to 1/4-in. If necessary, simply fold outward the turn at each end. Adjust tuning capacitor C3 fully clockwise until you pick up a station on the high end of the FM band. A slight additional counterclockwise adjustment should bring in the the aircraft frequencies loud and clear. If the range of C3 is such that you can't tune above the FM band, remove one turn from the right side of the coil (the side farthest from the tap). Remove the turn by cutting this end of the coil about 1/8-in above the circuit board and unwinding one turn. Then solder the free end of the coil to the piece left in the board when the cut was made. Don't try to unsolder the coil from the board as you may permanently damage the coil.

Aligning Aircraft Band. If you still have no luck tuning in the aircraft frequencies, try aligning the tuning range by using a signal generator to spot the correct setting for C3. Set C3 fully clockwise and position the antenna wire near the signal generator output, or the output of a grid-dip oscillator, either of which has been tuned to 120 MHz. Then back-off C3 1 1/3 turns. If you don't tune through the 120 MHz test signal within 1 1/2 turns of C3 try squeezing the coil together in small increments until you can tune in the 120 MHz test signal within the 1 1/2 turns range of C3. Once you have either an aircraft or test signal tuned in, then, using an alignment screwdriver, adjust the trimmer potentiometer (R1) for maximum signal strength.

Note that though the radio will work on FM band with the antenna connected directly to the antenna terminal on the circuit board, it will not work on the aircraft band unless the antenna is connected through 2pF capacitor C2. —*Joe Gronk* ■

Interval Screamer

Continued from page 65

Different colors of hookup wire will simplify final hookup of the Screamer. Remember, before soldering the SCRs, the transistor and C1, be certain that they are correctly wired. The circuit board should be raised from the box with 1/4-in. spacers.

Operating the Screamer. Now that the wiring has been checked and all the construction has been completed, you're ready to practice the various methods of operating the Screamer. This way, you'll be ready to stop it after some curious person has turned it *on*—and to do so before he tosses it out the window, or at you.

To turn *on* the Screamer flick *on* S4. To turn the thing *off* when started this way open S4 and press S3, then reset the Screamer by shorting the bolt contacts you made to serve as S1.

Got the operation down pat? OK, then rush off to that dull party and wait for the fun to start after you've tossed your Screamer on a table to tempt some unsuspecting switch flipper. ■

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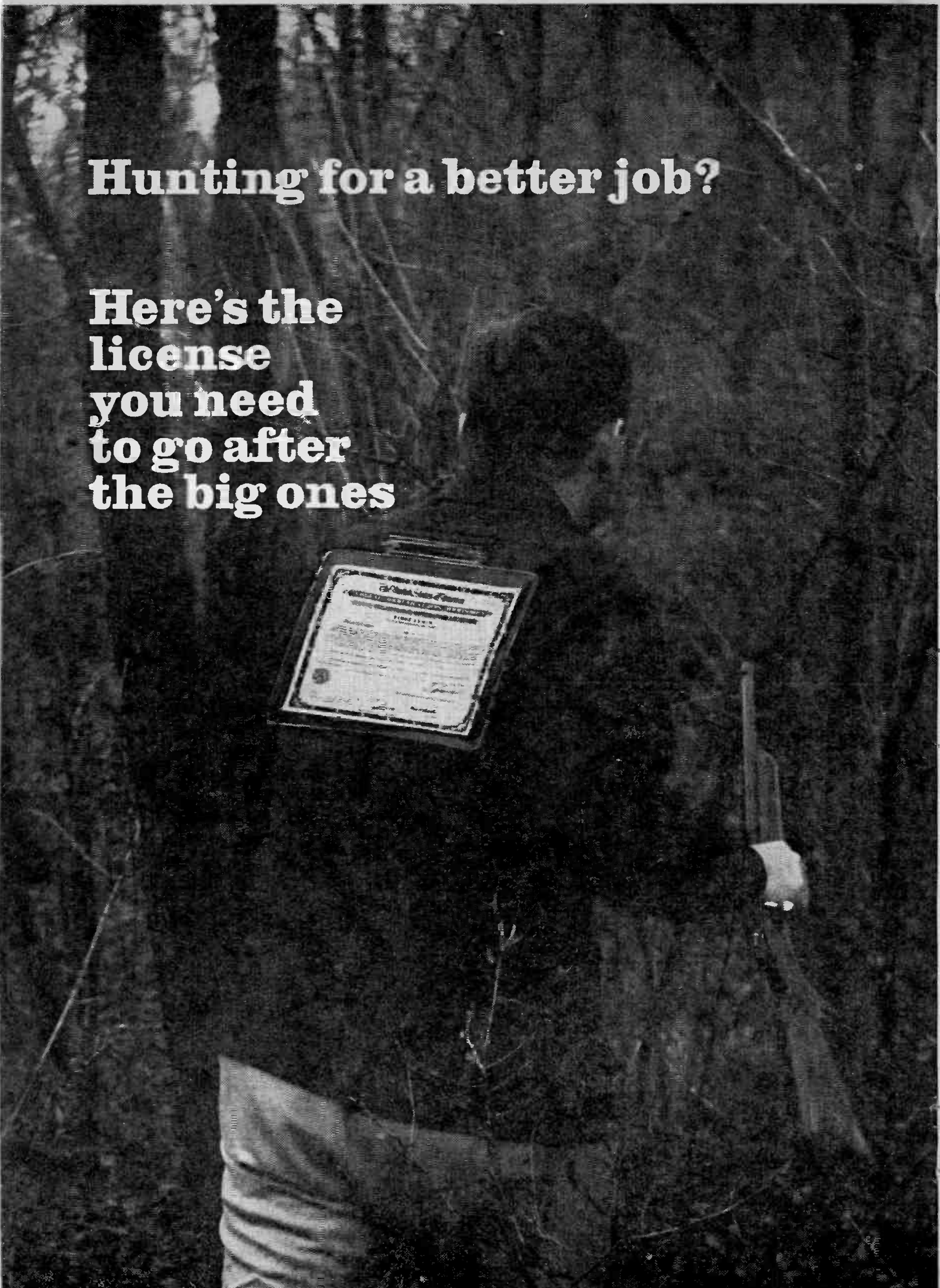
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THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build twenty different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, coils, volume controls and switches, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C. Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

Progressive "Edu-Kits" Inc., 1189 Broadway, Dept. 536DJ, Hewlett, N. Y. 11557

FREE EXTRAS

- SET OF TOOLS
- SOLDERING IRON
- ELECTRONICS TESTER
- PLIERS-CUTTERS
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

FROM OUR MAIL BAG

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

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

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

UNCONDITIONAL MONEY-BACK GUARANTEE

Please rush my Progressive Radio "Edu-Kit" to me, as indicated below:
Check one box to indicate choice of model

- ☐ Regular Model $26.95.
- ☐ Deluxe Model $31.95 (Same as Regular Model except with Superior Parts and Tools plus Valuable Radio and T.V. Tube Checker).

Check one box to indicate manner of payment

- ☐ I enclose full payment. Ship "Edu-Kit" post paid.
- ☐ I enclose $5 deposit. Ship "Edu-Kit" C.O.D. for balance plus postage.
- ☐ Send me FREE additional information describing "Edu-Kit."

Name ....

Address ....

City & State .... Zip ....

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PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

A Printed Circuit is a special insulated chassis on which has been deposited a conducting material which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.

Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.