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JANUARY 1962

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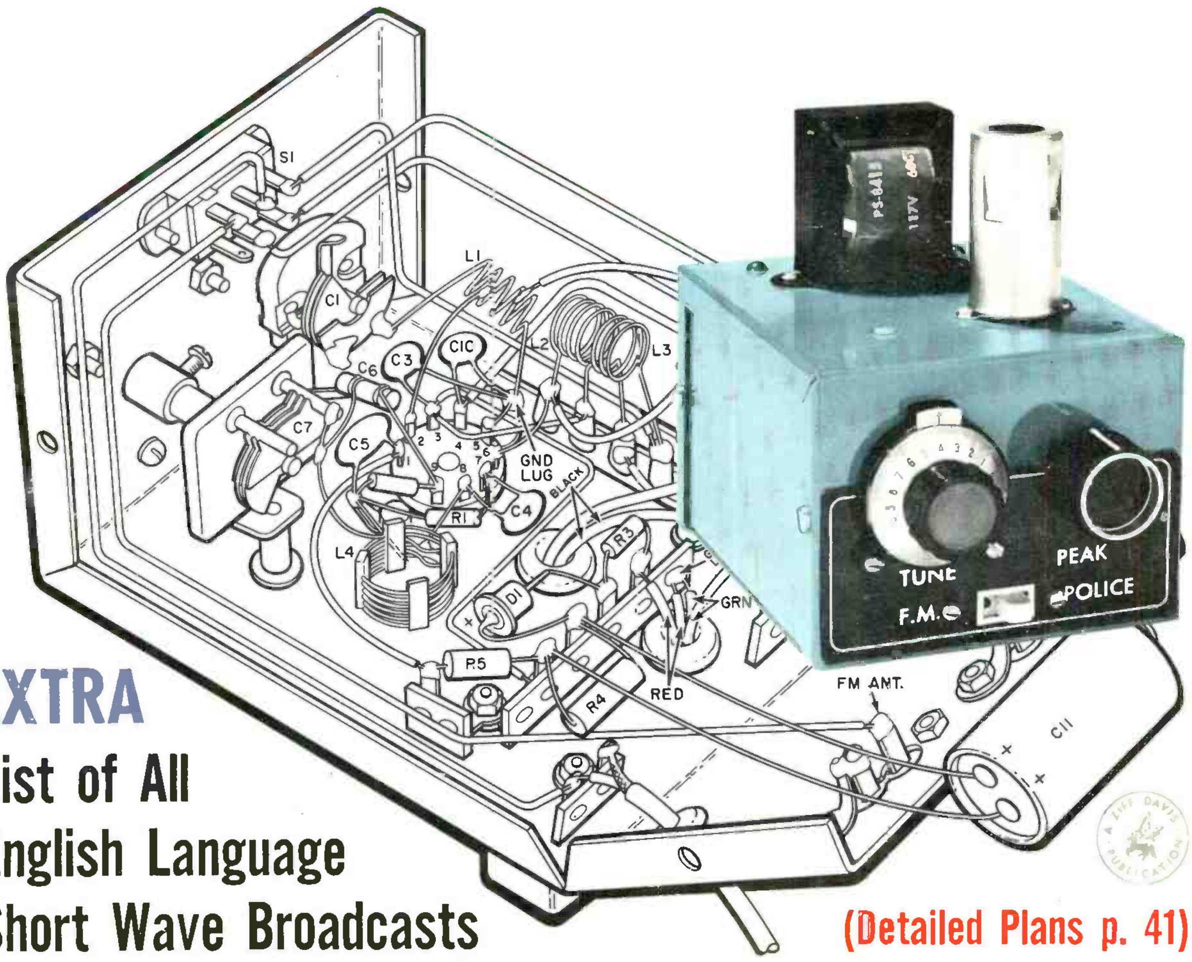

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(Detailed Plans p. 41)

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POPULAR ELECTRONICS

JANUARY 1962

VOLUME 16 NUMBER 1

POPULAR ELECTRONICS is indexed in the Readers' Guide to Periodical Literature

This month's cover photo by Joe Petrovec
Diagram by Technical Illustrators, Inc.

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Amateur, CB, and SWL

Departments

If you can't afford a Fisher tuner...

build one!

**Introducing the newest Fisher StrataKit:
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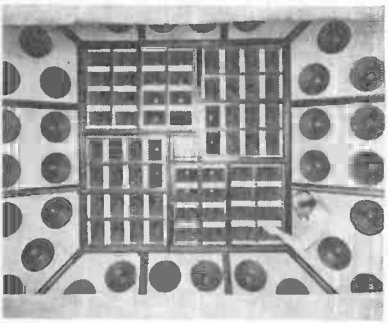
POP'tronics

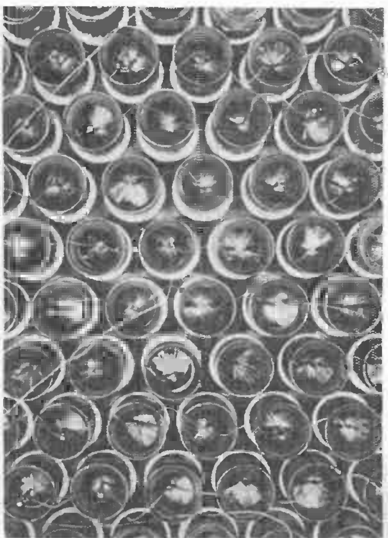
NEWS SCOPE

OUT OF THE DARK come video pictures from the Bendix Corporation's new TV "owl." Their transistorized closed-circuit TV system, which "sees" in the dark, has been adapted to missile surveillance. Using an image orthicon tube, it combines ruggedness with high sensitivity and contrast that can meet strict military requirements. In fact, the "owl" doesn't give a hoot how rugged the surroundings are, and can see in brilliant daylight as well as in the dark of a moonless night. Bendix engineers say the system's optional automatic controls make it easier to operate than most closed-circuit TV equipment, pretty operators not withstanding.

NUCLEAR HEDGE-HOPPER—Computers flying by the seat-of-their-pants are now capable of guiding Republic Aviation's F-105D tactical fighters at "hedge-hopping" altitudes of 500 to 1000 feet. In a recent test flight, the supersonic jet was flown blind on radar instruments, by Col. Paul Hoza of the U.S. Air Force, through the rugged mountain passes of New Mexico and Arizona, just a few hundred feet above the terrain. This flight demonstrated the F-105D's all-weather capability of penetrating enemy territory beneath a radar detection network. No special training was given to Col. Hoza other than that normally given pilots who fly Mach 2 aircraft.



HI-FI NOISE—The man peering at the hi-fi speaker system through one of the 48 woofer ports is not an audio addict but a Goodyear engineer checking out the giant acoustic testing facility in Litchfield Park, Arizona. The Goodyear Aircraft Corporation uses the titanic baffle to test the reliability of modern aircraft and missile parts under the enormous stresses and strains of one of nature's underrated but most destructive forces—sound. The giant noisemaker duplicates exactly the awesome sound vibrations of jet and missile engines that can, at 150 decibels, damage or even mutilate a piece of steel. So powerful is the speaker system that a bop phonograph record played into its amplifier will keep Phoenix, 20 miles away, in step with the twist.



WHAT IS IT? Although it looks like a display of trout fishing flies, the photo actually shows the interior of an ozone generator—part of a new six million dollar ozone-oxidation plant put into operation by Emery Industries, Inc. of Cincinnati. Ozone is produced by subjecting oxygen to a high voltage inside of 3-inch glass tubes where a silent electrical discharge converts it to ozone. A unique three-atom molecule, ozone oxidizes oleic acid in producing "unique" acids used in the growing plastics and synthetic lubricant industries.

FCC Report

By ROBERT E. TALL
Washington Correspondent

THE INCIDENCE of Citizens Band rule violations of a "technical nature" is not high enough at the moment to induce the FCC to launch a "type-acceptance" program among manufacturers of CB equipment. Some thought has been given to the idea, however, and the agency has cautioned that such a step is "not beyond the realm of possibility."

In offering its views on the subject, the Commission was responding to a number of suggestions that an equipment type-acceptance program—which involves a strict laboratory test of specific models of radio equipment and the manufacturer's guarantee to keep production-line models in conformity with the standards of the tested unit—might be one way to weed out technical rule offenders working the Citizens Band.

Several CB equipment manufacturers have voluntarily submitted their units to the FCC for a type-acceptance inspection, and have received the Commission's endorsement. The agency would like to leave it on the voluntary basis, however.

Home-Constructed Units. The Commission has not departed from its position that either factory-assembled models, certified kits, or home-designed or -constructed CB units are all acceptable for use, provided that the equipment is built to specifications to insure its operation consistent with the CB rules, and further, that the home-constructed units are "checked out" by or under the direct supervision of a holder of an FCC first- or second-class radio operator's license before they're put on the air.

The agency warns, however, that its experience since the establishment of the CB service has been that "in general, persons constructing such equipment do so as a hobby and lack not only the necessary construction and test facilities, but the required technical skills as well." In other words, the official government line is that anyone can

(*Continued on page* 12)

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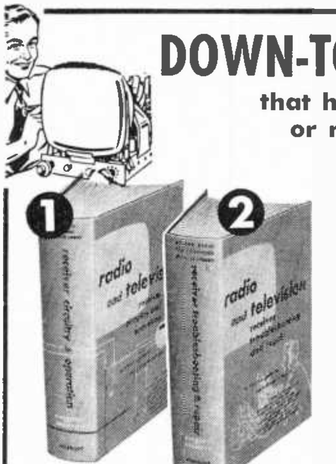

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A good working knowledge of electronic computers may not be as complicated as you think—and this new 248-page book proves it! Written for technicians, students and experimenters it explains computer theory, design, application and output interpretation in readily understandable terms. Includes details on number systems; binary counters; readout indicators and special counter tubes; decade counters; storage devices; logic circuits; computer applications; digital-to-analog and analog-to-digital conversion and many others. By explaining basic circuit configurations, DIGITAL COUNTERS AND COMPUTERS by E. Bukstein, quickly breaks down computer "mysteries" and starts you on a clear understanding of one of the "hottest" subjects in Electronics today! Fully illustrated. Price $8.75.

FCC Report

(*Continued from page* 8)

go ahead and make his own unit if he wants to, but it should be checked out thoroughly by someone who knows what he is doing before it is put to use.

Civil Defense. Of all the current uses of CB radio, the FCC is probably proudest of the way it is being used in civil defense activities. The agency has specifically included in the Citizens rules a provision that Class D stations may transmit messages relating to CD activities in connection with official tests or drills conducted by appropriate civil defense authorities.

Several cases have cropped up recently, however, which precipitated an observation by the Commission that, in such a CD drill, some other division or branch of the civil defense organization involved must be tested in addition to the radio group, so that there will be some actual test messages to transmit.

Any civil defense use of CB is limited to communications relating to official operations initiated and directed by the civil defense authority responsible for the particular locality, and "roll-calls" of CB stations, in the absence of official civil defense message traffic, the Commission says, are prohibited.

Check on Illegal Uses. As the second half of the current Congress gets under way early in January, Senator Karl E. Mundt (Republican, South Dakota) and his colleagues on the Senate Government Operations investigations subcommittee will have a chance to run a check on some advice Mr. Mundt issued to the FCC during anti-gambling hearings in the closing stages of Congress last fall.

Observing that two-way radio—including CB facilities—has been a boon to the underworld as well as to the more law-abiding elements of our society, the Senator said he feels that the FCC should direct more of its attention to monitoring and enforcement of various safety and special radio services, with a view to cracking down on illegal uses of the non-broadcast radio facilities.

Senator Mundt asked FCC Assistant General Counsel Dee W. Pincock to relay his concern to the full Commission with the request that the agency concentrate a little more in this area, and a little less on broadcast matters.

CB Measurements. For CB'ers with questions about the proper procedure for measuring the power of their transmitters, the FCC has come up with a one-paragraph explanation.

"The input power to those stages or circuits of a transmitter which contribute

FCC Report

(*Continued from page* 12)

radio frequency energy to the antenna system shall be measured with d.c. voltmeters and milliammeters of good accuracy. The sum of the d.c. voltage-current products thus measured shall not exceed 5 watts. Where the d.c. input power fluctuates with modulation, the power at the maximum voice peak shall not exceed 5 watts, as indicated by the meters. For this purpose, the maximum time constant of the meters shall not be greater than 0.25 of a second."

Application Trouble. One paramount difficulty the Commission is running into at the moment in processing CB applications results from the prospective CB'ers not specifying in their applications the uses to which the radio units are to be put. This one factor is causing more CB applications to be returned without FCC action than any other.

For the fastest possible processing of your application—and it's slow enough at best—please spell out in your application *exactly* what *each* CB unit mentioned on the application is going to be used for. —30—

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The young lady at left doesn't realize that she has just 'tripped' the POPULAR ELECTRONICS capacity-operated relay. Based on a very simple circuit using a minimum of parts, this sensitive detector has numerous uses around the house.

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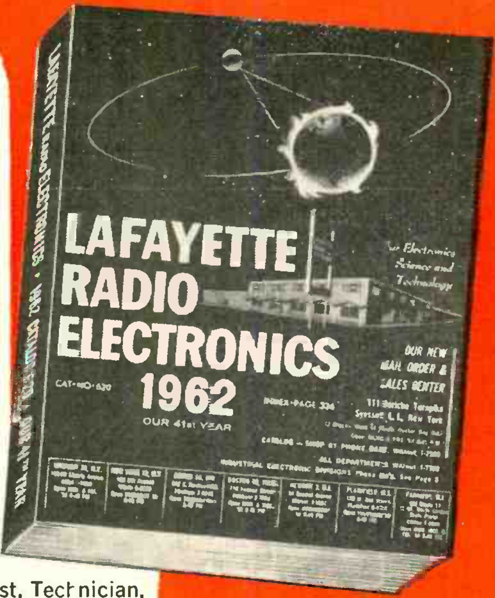

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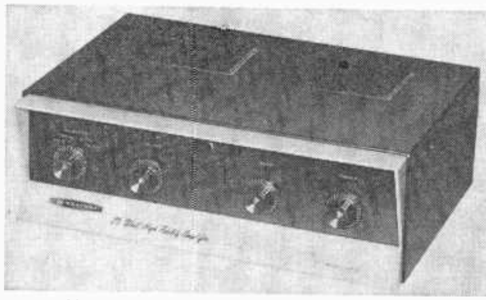
Hi-Fi Showcase

*A quick look at new products in the stereo/hi-fi field**

AFTER playing one "side" of a 4-track stereo tape from start to finish, the S505 tape recorder automatically reverses and plays the other half—it's the newest addition to the ***American Concertone*** line. Equipped with a hysteresis-synchronous capstan drive motor for timing accuracy, it operates at both 3¾ and 7½ inches per second; 7½- and 15-ips operation is available at slight extra cost. The S505 is supplied complete with record/playback preamplifiers, each with its own bias and equalization adjustments; and low-impedance, cathode-follower outputs provide a perfect means of matching to an existing stereo system. Prices range from $495.00 to $644.50, depending on type of case and whether 2- or 4-track record and the "Reverse-O-Matic" feature are desired. . . . From ***DuKane's*** Ionovac Division comes a de luxe columnar speaker system, the DuK-60. It employs four speakers: an Ionovac tweeter to handle frequencies from 3000 to 30,000 cycles and beyond; an 8" speaker for the mid-range; and another 8" and a 12" for the lows. In addition, two controls allow precise adjustment of the output above 3000 cycles and between 800 and 3000 cycles. Price, $246.00.

Find yourself in the market for an inexpensive monophonic amplifier? ***Heath's*** AA-181 preamp/amplifier kit, designed to



Heathkit AA-181 monophonic amplifier

match the new Heathkit AJ-21 and AJ-31 tuners, delivers a full 25 watts, ±1 db, 30 to 15,000 cycles. This attractive amplifier has inputs for microphone, magnetic phono,

**Write to the manufacturers listed at the end of this column for more data on products mentioned*

Showcase

(*Continued from page* 20)

crystal or ceramic phono, and "auxiliary;" in addition, it boasts separate bass and treble controls. Kit price (f.o.b. Benton Harbor, Mich.), $42.95. . . . Also available from Heath is the AS-51 series of speaker system kits. Suitable for either vertical or horizontal mounting on bookshelves, tables, etc., the AS-51 features a special tweeter mounting board which can be rotated so that the speaker maintains its proper position for wide-angle sound dispersion. Two Jensen speakers—an 8" woofer and a compression-type tweeter—provide smooth response from 50 to 12,000 cycles with the aid of a built-in 1600-cycle crossover network. Kit prices range from $39.95 to $46.95.

Kenwood Electronics' 60-watt stereo receiver consists of an AM/FM multiplex tuner and a 60-watt stereo amplifier in one cabinet. Manufactured in Japan, the KW-60 stereo receiver has inputs for magnetic phone cartridge, tape head, and auxiliary sources; an output jack for stereo headphones; and whistle, rumble, and scratch filters. Price, $299.95, complete with case. . . . Another product from Kenwood and another Japanese import is the KD-1 FM stereo adapter. Designed for use with almost any FM tuner, the KD-1 measures only 4¾" x 7⅞" x 7⅝", contains four tubes and consumes 25 watts. Price, $49.95.

Kenwood KW-60 stereo receiver

A new hi-fi offering from Allied Radio is the ***Knight-Kit*** KF-90 stereo FM/AM tuner, complete with built-in multiplex circuit. Designed to reproduce the full dynamic range of stereo FM, the KF-90 kit features a front-panel "dimension" control which allows the listener to vary channel separation on multiplex broadcasts. Separate tuning indicators simplify tuning on both AM and FM, and a built-in 10-kc. AM whistle filter eliminates annoying "squeals." Price, complete with case, sweep-aligned r.f. and i.f. transformers, and hardware,

(*Continued on page* 26)

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Here are the ABC's of 50 vacuum-tube circuits for electronics experimentation and project construction—all fully diagramed, complete with parts list.

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One hundred vacuum-tube schematics, plate-characteristic curves, simplified diagrams, test circuits and other selected illustrations supplement the informative text to make this book one of the most useful and invaluable manuals for your electronic experiments and hobby projects.

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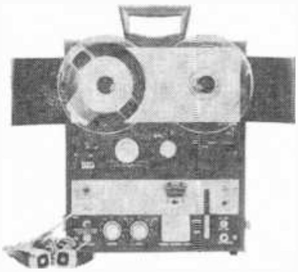
Showcase

(Continued from page 22)

$99.95. . . . Another tuner, the Realistic TM-214 by ***Radio Shack***, is expressly designed for FM multiplex reception. Available in either kit or factory-wired form, the TM-214 makes use of three i.f. and three limiting stages to provide constant output and high-gain bandwidth control without distortion. As for the 3-tube multiplex circuit, it features factory-set balance and separation controls for perfect performance at all times. Prices: $149.95 in kit form; $189.95, factory-wired.

Roberts Electronics has a new stereo tape recorder, complete with built-in stereo amplifiers and extended - range stereo speakers. Basically a 7½-ips unit, the 1040 can be readily adapted for either 3¾- or 15-ips operation by means of a conversion kit. Other features: dual microphone inputs, dual phono/radio inputs; automatic shut-off; push-button function switches; and automatic muting on rewind. Price, $299.50. . . .



Roberts 1040 tape recorder

Two new cartridges from ***Shure Brothers***—the M33 and the M77—possess exceptional performance characteristics: high output levels, effective hum shielding, and ease of stylus replacement. The M33 cartridge, recommended for turntable and record-changer arms tracking at 1 to 3 grams, offers a frequency response from 20 to 20,000 cycles and a channel separation that exceeds 22.5 db at 1000 cycles. The M77, on the other hand, is recommended for arms tracking at pressures in excess of 3 grams; frequency response is from 20 to 17,000 cycles, channel separation 20 db at 1000 cycles. As a bonus feature, either cartridge will accept Shure's new N78 diamond stylus, ideal for playing 78-rpm "collector's items." The M33 is priced at $36.50, the M77 at $27.50, and the N78 stylus at $8.55. —30—

Allied Radio Corp. (Knight-Kit), 100 N. Western Ave., Chicago 80, Ill.
American Concertone, Inc., 9449 W. Jefferson Blvd., Culver City, Calif.
DuKane Corp., Ionovac Div., St. Charles, Ill.
Heath Co., Benton Harbor, Mich.
Kenwood Electronics Div., American Commercial, Inc., 212 Fifth Ave., New York 10, N.Y.
Radio Shack Corp. (Realistic), 730 Commonwealth Ave., Boston 17, Mass.
Roberts Electronics, Inc., 5920 Bowcroft St., Los Angeles 16, Calif.
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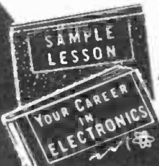

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Letters from our readers

BBC Far Eastern Station

■ In the October, 1961, "Short-Wave Report," I noticed with interest the statement that the transmitter of the BBC Far Eastern Station is located in Malaya, though the studios are in Singapore. This I can confirm with some authority, having supervised the installation of the equipment.

The station is remote-controlled and located at a place called Tebrau, in the State of Johore, about 14 miles from the causeway linking Singapore and Malaya. The site is in the middle of a rubber estate and, while the station was under construction, was attacked several times by Chinese Communist bandits.

If my memory serves me correctly, the station is equipped with two 100-kw. Marconi transmitters

and the first program transmitted (1950) was the Christmas speech of King George VI to the British troops serving in Korea. Though now a resident of the U.S.A., I'm still a British subject, and the report brought back very pleasant memories of an interesting and rewarding project.

SYDNEY A. BIGGS
La Puente, Calif.

Many thanks for your background material on the BBC Far Eastern Station, Mr. Biggs. We're sure that everyone will enjoy reading it as much as we did.

Cooking Up Blueprints

■ Thanks very much for the fine article entitled "Cooking Up Your Own Blueprints" which appeared in the September 1961 issue. I read it and, an hour later, made a highly successful first experiment. But there is an error in the text to which I'd like to draw your attention. The last sentence in the first column on page 96 reads, in part: ". . . place a piece of carbon paper with its coated

Letters

(*Continued from page 28*)

side against the back of the sensitized sheet." It should read ". . . place a piece of carbon paper with

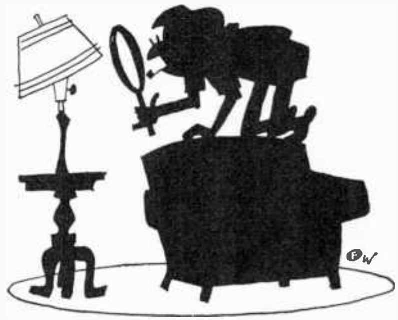
its coated side against the back of the typing paper." Don't you agree?

ARYEH ORGAHD
Jerusalem, Israel

Your correction is correct, Reader Orgahd. Thanks for telling us about it. And we're glad that the article gave you such a good start in making your own blueprints.

Spies Take Notice

■ The article titled "Mikes From Lamp Sockets" (October, 1961) was quite interesting. Mr. Trauffer, however, didn't mention one thing—the excellent "bugging" opportunity afforded by a lamp-socket mike. All you have to do is install it in place of one



of the normal sockets in a floor or table lamp! I think every spy should know about this excellent method for hiding a microphone.

KEN GREENBERG
Chicago, Ill.

All active spies—and many potential ones—have probably already drawn their own conclusions from Mr. Trauffer's article. We advise readers with anything to hide to take a close look at their lighting equipment.

Carl & Jerry in College

■ Being a student of electrical engineering myself, I'd like to congratulate Mr. Frye on having the foresight to send Carl and Jerry to college. After all, how many more years could the boys stay in

Letters

(Continued from page 30)

high school? I'm sure that I, and the many other readers of the column, will enjoy their further adventures.

ARTHUR H. RUDER
Brooklyn, N.Y.

Pen Pal Wanted

■ I'm a 26-year-old radio operator for Ferihegy Airport in Budapest, Hungary, and would like to

correspond—in English, French, or German—with an OM or YL about my own age.

PERGOVACZ LAJOS
Budapest 70Pf.73
Hungary

Compactron V.H.F. and FM Receivers

■ I plan to build the Compactron v.h.f. receiver which was described in the September 1961 issue. Can you tell me what changes in the hookup would be required to cover the FM band?

ERNEST PILE
Akron, Ohio

Apparently you missed the August 1961 issue, Mr. Pile. If you check, you'll find complete plans for a Compactron FM receiver in it. Why not become a subscriber?

■ I'm interested in building the Compactron v.h.f. receiver, but am having trouble finding the Merit P-3046 power transformer. Can you tell me where to locate one?

JOHNNY MANS
Riceville, Iowa

If you're having difficulty finding a dealer in your area who stocks Merit units, we suggest that you write Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N.Y. They'll be able to supply you with an equivalent model.

■ I've been reading the article on the Compactron FM tuner/receiver in the August 1961 issue. Upon checking my catalogs, I found that it was possible to obtain all of the parts except the 12-pin socket for the GE 6D10 Compactron. Would you please publish the address of a company that sells these sockets?

LEONARD M. HARDAWAY
Stockton, Calif.

Two of the many manufacturers producing 12-pin Compactron sockets are: Cinch Manufacturing Co., 1206 S. Homan Ave., Chicago, Ill. (Cat. No. SM-12-D-003) and I. H. Manufacturing Co., 121 Greene St., New York 12, N.Y. (Cat. No. CM-288). Write directly to these companies for a list of dealers in your area. —30—

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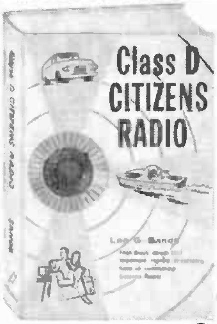

CLASS D CITIZENS RADIO — Leo G. Sands

Here is the first complete book on Citizens Radio Operation. Ever since the initial use of 2-way radiotelephone by police departments, this field has been growing in importance and application. Now, with more than a million vehicles equipped for its use, Citizens Radio is a major phase of the electronics field. This important new volume covers every aspect of the field—its history, rules, and everything about how it works—in seven big chapters with one hundred major sections. You'll learn exactly what Citizens Radio is, its applications, what equipment you need, the full story on receiver circuits and transmitters, antennas, installation, and maintenance, full FCC rulings, how to apply for licenses, etc. Many illustrations.

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COMPUTERS AND HOW THEY WORK
by James Fahnestock

Here is a fact-filled exciting guidebook to the wonderworld of electronic computers, with more than 120 illustrations and easy-to-follow tables in 10 big chapters. Step by step, you'll see and understand the workings of every type of computer ever used. This important new book illustrates the basic principles of computers in methods that require no knowledge of electronics. You'll learn all about computer memories, flip-flops and the binary counting system. You'll learn the mathematical language of computers where $1 + 1 = 10$. Other chapters show you how computers use tubes and transistors to make complex logical decisions in thousandths of a second. COMPUTERS AND HOW THEY WORK is must reading for career minded students and for electronics pros who want a more complete knowledge of this field.

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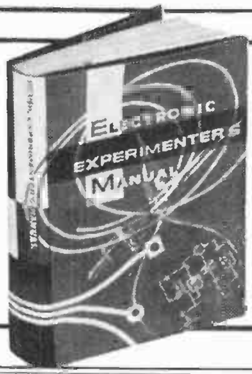

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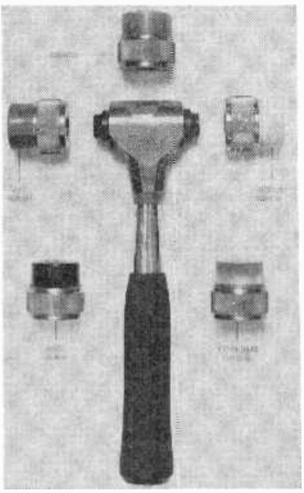
NEW products

ELECTRONIC ORGAN KIT

Now being manufactured by the *Schober Organ Corporation,* 43 West 61st St., New York, N. Y., is a "do-it-yourself" electric Spinet organ kit. No technical background is required to put the Spinet together, and its construction is simplified by the use of printed-circuit boards. The completed 88-key, 13-pedal instrument weighs less than 100 pounds. Price of the kit, about $500.00, considerably less than the cost of a comparable factory-built unit.

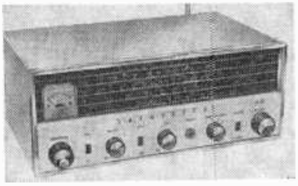
MULTI-FACED HAMMER

A multi-faced hammer made by Ramset is particularly well adapted to the electronic and electrical industries. The "Shure-Drive" can be fitted with any of five interchangeable tips. Color-coded to indicate degrees of hardness, the tips are available in soft, medium, hard, extra-hard, and rawhide types. Rebound is reduced by 40% by means of a steel striker "floating" within the head, and a contoured rubber grip is fitted to the handle. The hammer holder is priced at $10.50; tips run from $1.25 to $1.75 each. (*Ramset Fastening System,* New Haven, Conn.)



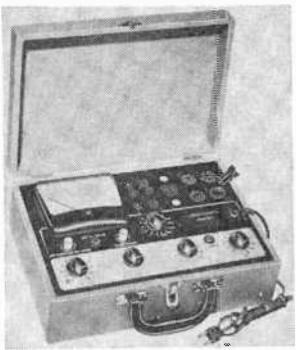
ECONOMY COMMUNICATIONS RECEIVER

The HE-40 receiver, available from *Lafayette Radio Electronics Corp.,* 111 Jericho Turnpike, Syosset, L.I., N.Y., covers 1600 kc. to 30 mc. and the standard AM broadcast frequencies in four bands. The main tuning dial has a 0-100 logging scale and a separate bandspread tuning capacitor is provided. Among the HE-40's other features are a calibrated "S"-meter, BFO/selectivity control, and built-in 5" speaker. The set has a ferrite loop antenna for the broadcast band, telescoping whip for short wave, and provision for connecting an external antenna. Price, $54.50.



VERSATILE TUBE TESTER

Besides testing all standard radio and TV tubes, Precision's Model 650 grid-circuit-type tester handles 10-pin miniatures, 12-pin Compactrons, 5- and 7-pin nuvistors, novar tubes, and a wide variety of voltage-regulating, industrial and foreign types. Gas currents as low as 1 microampere can be measured, and leakage sensitivity is over 100 megohms. An accessory adapter (Model PTA) permits checking TV picture tubes. The tester is priced at $69.95, the accessory adapter at $9.95. (*Precision Apparatus Co.,* 70-31 84th St., Glendale 27, L. I., N. Y.)



SIX-METER TRANSCEIVER

The WRL "TechCeiver-6," one of a new series of "Comet"-brand kits, is said to be among the smallest commercially available 6-meter transceivers. Its superhet receiver is tunable from 48 to 54 mc. and has a built-in noise limiter. The r.f. output of the plate-modulated transmitter is over

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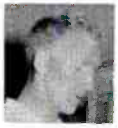
Edgar Wesatzke



As field director of Berean Mission Inc., I have complete charge of our radio work. With the expert advice and training I am receiving from you I can do my own repairs on our recorders and P.A. systems, besides keeping our radios going. My training from N.T.S. helps keep us on the air. I feel privileged to be a member of such a fine institution.

Rev. Enoch P. Sanford

Thanks to N.T.S. I have a business of my own right in my home. I am still in the Air Force but I have paid for all my equipment with money earned servicing TV sets. Yes, N.T.S. gave me my start in television.

Louis A. Tabat

I have a TV-Radio shop in Yorkville, Illinois, about 4 miles from my home, and it has been going real good. I started part-time but I got so much work that I am doing it full-time. Thanks to National Technical Schools.

Alvin Spera

SEE OTHER SIDE

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TELEVISION INCLUDING COLOR TV
90% of homes have at least one set. Color TV is becoming more popular daily. TV Stations grow in number, need technicians. Maintenance and repair offer big opportunities.

PHASE 2
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Radios in homes, cars, schools, all need expert upkeep. Stations expand as FM becomes popular. Now transistors boom entire field.

PHASE 3
ELECTRONICS
Computers, Data-Processing machines, Electronic Controls, Guided Missile Systems are new fields where Electronics play a vital role.

PHASE 4
SOUND SYSTEMS
New popularity of Hi-Fi-Stereo, as well as industrial sound systems and business intercoms make this a highly specialized and important field.

PHASE 5
FCC LICENSE PREPARATION
FCC License holders have a wide range of top jobs open to them. FCC License now a requirement for most Communication jobs.

PHASE 6
RADAR AND MICROWAVES
These are the communications systems of the future, already used in tracking and contacting satellites.

PHASE 7
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Automation and Computer electronics are the new tools of industry and commerce. Skilled Technicians in these fields are in great demand at top pay.

PHASE 8
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one watt. Transmitter tuning and power indicators are included as well as a push-to-talk relay, and separate power supplies are available for fixed or mobile operation. The transceiver uses standard 8-mc. crystals and sells for $39.95. (*World Radio Laboratories*, 34th and Broadway, Council Bluffs, Iowa)

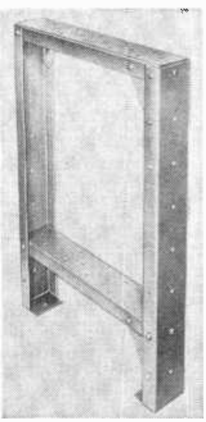
LICENSE-FREE "WALKIE-TALKIE"

The EICO #740 CB transceiver has a 100-milliwatt-input transmitter and a superheterodyne receiver—both crystal-controlled.

No license is required to operate the hand-held unit, which is powered by a nickel-cadmium battery; the battery provides 10-12 hours of intermittent use and can be recharged up to 500 times with the charger supplied. The communicating range between two #740's runs from a few blocks in heavily built-up areas to 10 miles in open country. A single transceiver, however, can cover substantially greater distances in cities when communicating with a conventional 5-watt input CB unit. Price: $54.95 in kit form; $79.95 wired. (*EICO Electronic Instrument Co., Inc.*, 33-00 Northern Blvd., L.I.C. 1, N. Y.)

WORKBENCH LEGS

No previous experience is needed to build your own workbench if you use "Pridecraft" workbench legs made by Pollard.



Free plans illustrate the six simple steps involved in the construction and list the hardware, lumber, and tools required. Following these plans and using two Pridecraft legs, anyone can set up a custom workbench in three hours or less. Furthermore, the easy-to-assemble legs are said to have all the rigidity and strength of industrial-type units. Available in green, silver, or gold, they cost $8.50 each and are shipped individually packed in 4" x 4" x 33" cartons. (*Pollard Bros. Manufacturing Co.*, 5504 Northwest Highway, Chicago 30, Ill.)

AUTOMATIC VTVM

Only one scale is visible at a time on the "Dynamatic 375" automatic VTVM; changing the range switch automatically inserts the proper direct-reading scale in the meter.

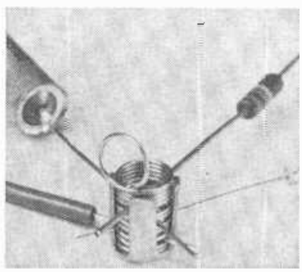
The instrument measures 0-1500 volts d.c., r.m.s a.c., or peak-to-peak a.c. (seven ranges for each). It also handles d.c. currents from 0 to 500 ma. in three ranges and ohms from 0 to 1000 megohms in seven ranges. Accuracy is ±3% (full-scale a.c. and d.c.), and a 100-microampere meter movement is used. Price, $89.95. (*B&K Manufacturing Co.*, 1801 Belle Plaine Ave., Chicago 13, Ill.)

AUTO ANTI-THEFT DEVICE

An automobile anti-theft device marketed by PECO discourages car thieves in two ways. When it is installed and turned on, the car's ignition, lights, and other electrical accessories are prevented from functioning. Furthermore, if any of this electrical equipment is switched on, the auto's horn will sound. Provision is made for normal operation of parking lights, electric clock, and any other electrical device ordinarily in use while the car is unattended. The anti-theft device sells for about $9.95 and comes with complete installation instructions. (*The Protection Equipment Co., Inc.*, Hopkins, Minn.)

SOLDERLESS CONNECTOR

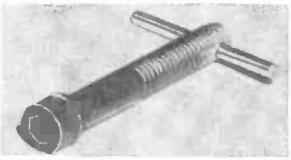
A unique solderless connector, the "Omni-Grip Type A," is being produced by *Cosmic Voice, Inc.*, Box 11, Jackson, Mich.



Designed for use in experimental hookups, it consists of a tension spring mounted in a forked cup. The cup is installed on a breadboard or panel with screws supplied. Connections are then made by expanding the spring (a looped handle is provided for this purpose) and sliding a lead through the coils. The connector will hold tightly as many as eight leads (up to #14 size) from any one direction. A package of one dozen "Omni-Grips" costs $1.20. —30—

Tips and Techniques

MINIATURE SOCKET WRENCHES



Allen-head cap screws can be easily made into convenient socket wrenches for popular sizes of miniature hex nuts. Select an assortment of 1" or 1½" screws whose heads fit the miniature hex-nut sizes you'll be most likely to encounter, and drill a hole through the end of the threaded portion of each one. Insert a 1" rod cut from a nail or brad in each hole and solder it in place to make a "T" handle.

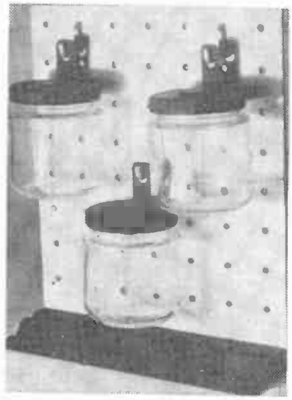
—*Charles W. Bittner*

SCREEN SORTS OUT KIT PARTS

One of the first steps in putting a kit together or constructing a project is to sort out the parts. You can make this job considerably easier by using a section of old window screen mounted over a shallow cardboard box. Just arrange capacitors, resistors, transistors, etc., on the screen by pushing their leads through the holes.

—*Bob Culter*

"HANG UP" STORAGE JARS

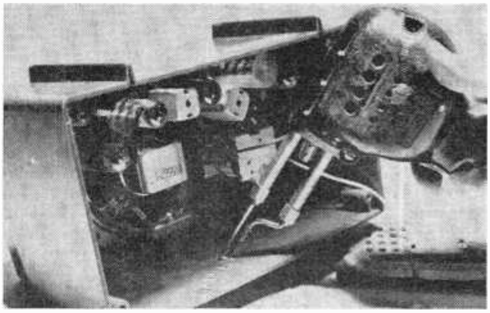


The glass jars in which baby food comes packed are very well suited for small-parts storage—and most families with small babies have an unlimited supply of such jars. Just attach a 1" angle bracket to the top of each jar and paint the assembly flat black. Related components can be grouped together and the jars hung on perforated panels using standard pegboard hardware. A glance will reveal the contents of any particular jar.

—*James A. Fred*

SOLDERING GUN REPAIRS CRACKS

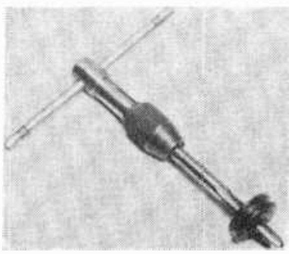
You can repair a cracked plastic radio cabinet in a jiffy by bonding the pieces together



with a soldering gun or iron. Working from the inside of the cabinet, melt small furrows across the crack in several places. If desired, these dents can later be covered with masking tape. *—Homer L. Davidson*

GROMMET LIMITS TAP TRAVEL

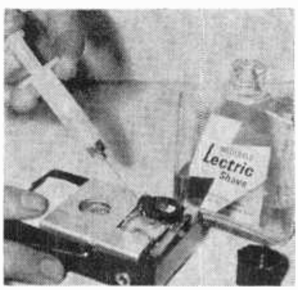
When threading holes in an electronic chassis, you can avoid damaging the delicate components mounted underneath the chassis by limiting the distance of tap travel. This is easily done by slipping a snug-fitting rubber grommet over the



end of the tap. Place the grommet just far enough in so that the tool can do its work properly. *—John A. Comstock*

SOLUTION FOR NOISY CONTROL

Next time you need some control cleaner in a hurry and all the radio shops are closed, try using some alcohol-base before-shave lotion. It'll do just about as good a job as the standard cleaner . . . and it smells nice, too. The best way to apply the solution to the noisy con-



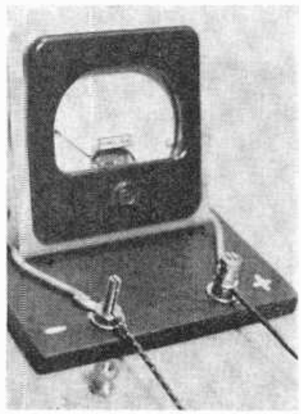
trol is with a small syringe but, if you don't have one, an old fountain pen can be used as a substitute. *—James Clifford*

"DIAL LIGHT" FOR PORTABLES

If you occasionally use your portable radio outside at night, you've probably wished that you had an illuminated dial. Pilot lights are difficult to build into today's compact sets and, even if installed, would be an excessive drain on the battery. The answer is to use the non-poisonous luminous paint now stocked at many hardware stores. Apply it to the set's dial pointer and numerals with a toothpick or a small brush. *—Konrad Axelrod*

QUICK-CHANGE BINDING POST

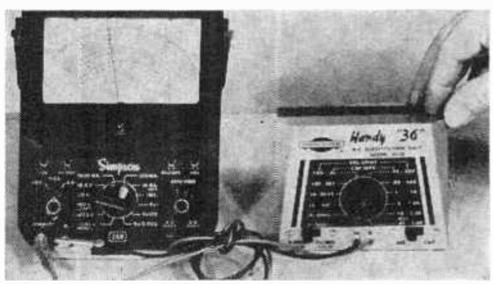
One fast saw-cut will convert a standard binding post to the quick-change type. Just slit the screw down the middle with a sharp hacksaw blade and you'll be able to slide in several leads without crimping their ends. A small washer should be inserted under the binding post head to prevent the wires from becoming jammed. If you



would like to increase the wire capacity of the binding post, try substituting a longer screw for the original one. *—Robert Micals*

QUICK CHECK FOR TEST INSTRUMENTS

The resistance section of an RC substitution unit can be used to make a fast check on your ohmmeter scales. In the case illus-

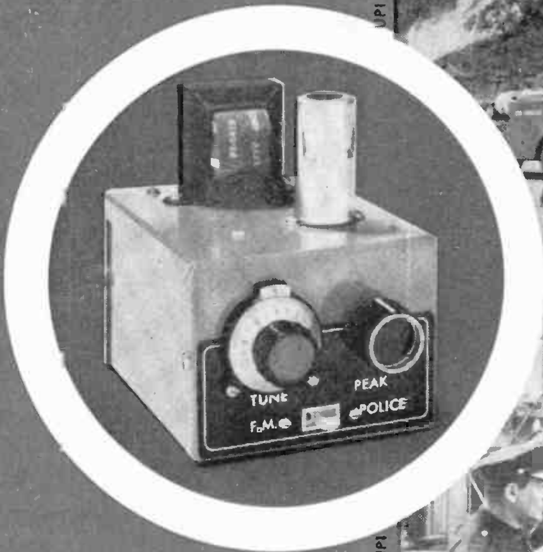


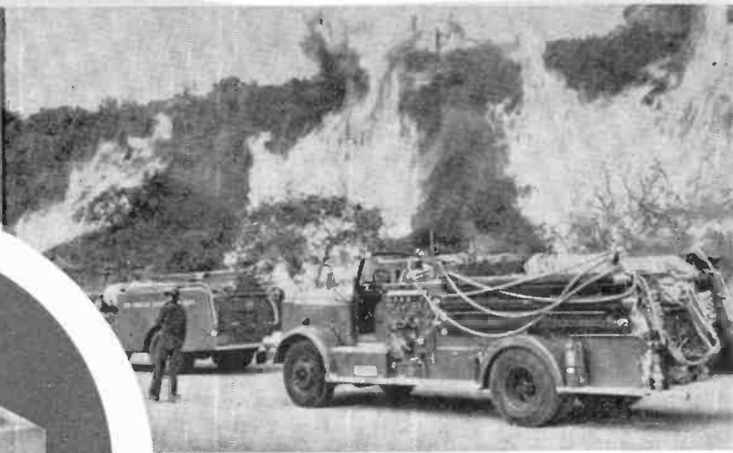
trated, the unit is set for 18 ohms—verifying (approximately) the accuracy of the R x 1 scale of the multimeter. Similarly, the capacitance section may be used to check out a capacitor tester.

—H. Leeper

Listen to the EICO Hour, WABC-FM, N. Y. 95.5 MC, Mon.-Fri., 7:15-8 P.M.

COVER STORY




UPI


UPI

By
HARTLAND B. SMITH
W8VVD

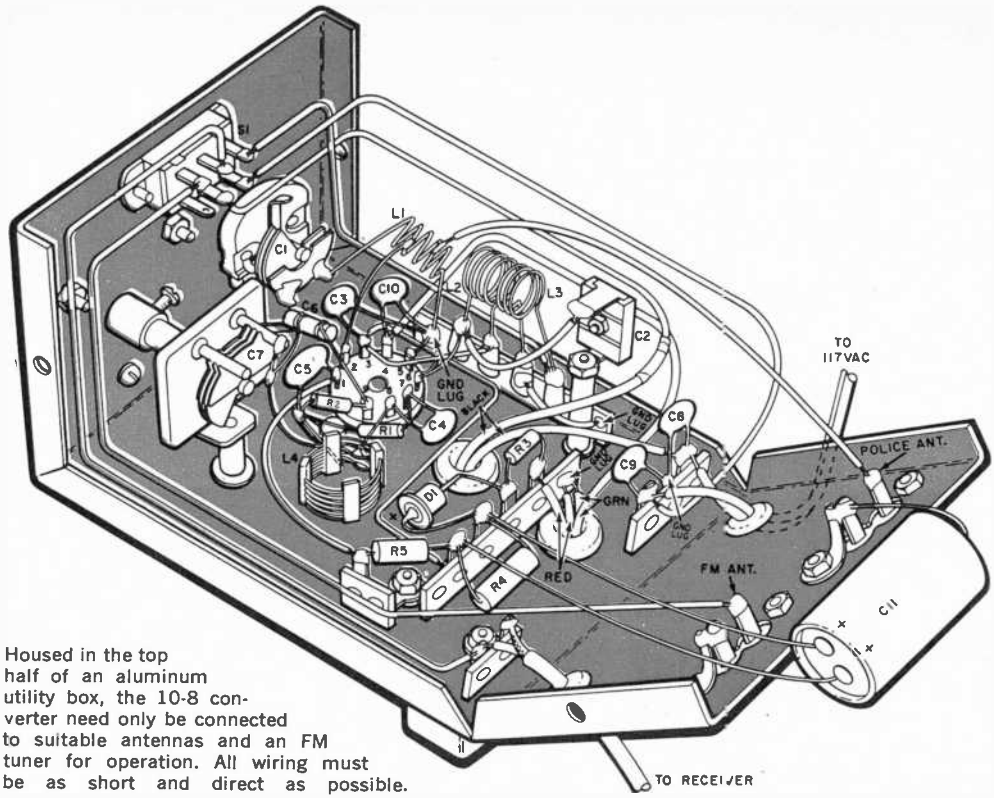
The "10-8" DE LUXE

Eavesdrop on the news while it's happening—with a converter that pulls in everything from police cruisers to cabs and fire engines

ALTHOUGH a good many SWL's are unaware of it, one of the busiest portions of the radio spectrum extends from 150.8 to 162 mc. This band is literally alive with police and fire calls, mobile telephone conversations, and the voices of taxicab dispatchers! Public utilities employ this segment of the ether to keep in touch with their repair crews. And, in coastal areas, even steamships can be heard on these frequencies.

Attached to a standard FM receiver or tuner, the *10-8* converter enables you to eavesdrop on all this exciting activity. If you're the kind of fellow who enjoys "keeping up with the news" *while it's happening,* you'll undoubtedly want to try your hand at building this little gadget. Costing less than $20.00, it can provide you with many hours of fascinating entertainment.

Why is the converter dubbed the *10-8*? Because "10-8" in the "10" system used by the police means "in service"—



Housed in the top half of an aluminum utility box, the 10-8 converter need only be connected to suitable antennas and an FM tuner for operation. All wiring must be as short and direct as possible.

which is just what your *10-8* will be most of the time.

Construction. The top half of a 5″ x 4″ x 3″ aluminum utility box supports all of the parts. Component placement should closely follow that of the original, since changes in layout may adversely affect the circuit's performance.

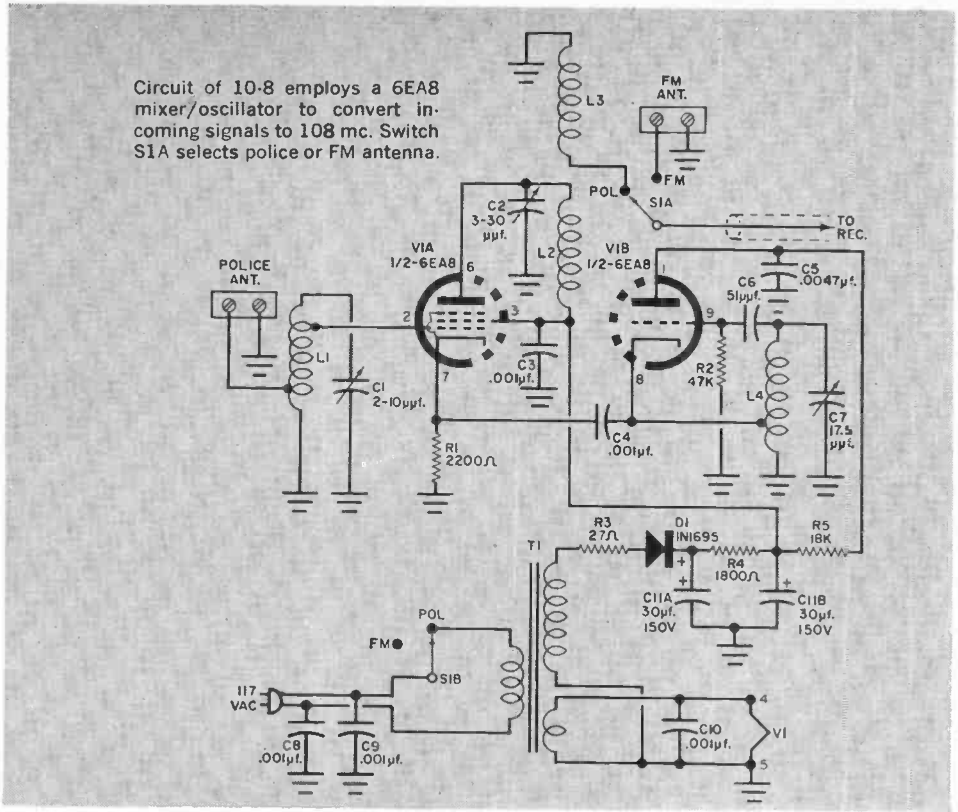
Capacitor *C7,* a Hammarlund HF-15 variable driven by a small vernier dial, is supported on a ½″ metal spacer held in place with a *6-32* machine screw. The dial should be set so that it reads *10* when the capacitor's plates are completely unmeshed.

The other tuning capacitor, *C1,* can be any small variable with a maximum capacity between 10 and 15 $\mu\mu$f. Mount it on the front panel and orient it so that the stator lugs are positioned as illustrated. A capacitor taken from the author's spare-parts box was used in the prototype. However, if you don't happen to have such a unit on hand, a second HF-15 can be used at this point.

The socket for *V1* should be mounted with pins 1 and 9 pointing toward the center of the chassis and pins 4 and 5 near the edge. One mounting lug of a four-lug terminal strip is held by the tube-socket mounting nut near pins 4 and 5. The other mounting lug on the terminal strip is fastened to the chassis with a 1¼″ *6-32* screw, and this same screw also holds *C2* atop a 1″ metal spacer. Make certain that the movable plate of this capacitor is the one which is grounded to the spacer.

Another four-lug terminal strip, held by *T1*'s mounting nuts, provides support for *D1, R3, R4,* and one end of *R5;* a single-lug tie point acts as a convenient terminal for the other end of *R5.* In addition, a couple of two-lug, screw-type terminal strips are mounted on the rear of the chassis and serve as antenna connectors. One terminal of each strip is grounded to the chassis.

Grommets should be placed in two holes in the top of the chassis through which the transformer leads pass. Two other grommets at the rear of the chassis



Circuit of 10-8 employs a 6EA8 mixer/oscillator to convert incoming signals to 108 mc. Switch S1A selects police or FM antenna.

PARTS LIST

C1—2 - 10 μμf. midget variable capacitor—see text
C2—3 - 30 μμf. mica trimmer capacitor
C3, C4, C8, C9, C10—0.001-μf., 600-volt disc capacitor
C5—0.0047-μf., 600-volt disc capacitor
C6—51-μμf. tubular ceramic capacitor, zero temperature coefficient
C7—2.8 - 17.5 μμf. midget variable capacitor (Hammarlund HF-15 or equivalent)
C11—30/30-μf., 150-volt electrolytic capacitor
D1—1N1695 diode
L1—Five turns of #20 tinned solid copper wire, 1/4" in diameter, spaced 4 times the diameter of the wire and tapped 1 1/2 turns from each end, with 3/8" leads—see text
L2—Four turns of #20 Nyclad wire, 3/8" in diameter, close-wound, with 3/8" leads—see text
L3—Three turns of #20 Nyclad wire, 3/8" in diameter, close-wound, with 3/4" leads—see text
L4—Six turns of #20 tinned solid copper wire, spaced the diameter of the wire, 5/8" in diameter, tapped 3 turns from the ground end, with 3/8" lead at ground end, 1" lead at grid end (Barker and Williamson 3007 Miniductor)
R1—2200-ohm, 1/2-watt resistor
R2—47,000-ohm, 1/2-watt resistor
R3—27-ohm, 1/2-watt resistor
R4—1800-ohm, 1-watt resistor
R5—18,000-ohm, 1-watt resistor
S1—D.p.d.t. slide switch
T1—Power transformer; primary, 117 volts a.c.; secondaries, 125 volts @ 15 ma. and 6.3 volts @ 0.6 amp. (Stancor PS-8415 or equivalent)
V1—6EA8 tube
1—Nine-pin miniature tube socket, shield base (Amphenol 59-407 or equivalent)
1—Miniature tube shield for above (Amphenol 5-408 or equivalent)
1—5" x 4" x 3" aluminum chassis box (Bud CU-2105A or equivalent)
1—36-mm. (1 1/2") vernier dial (Lafayette F-348 or equivalent)
1—15" length of RG-122/U coaxial cable
Misc.—Screws, grommets, knobs, terminal strips, ground lugs, etc.

protect the a.c. power cord and the coaxial lead which runs between the FM receiver and the *10-8*. Four more grommets, inserted in holes drilled at each corner of the bottom cover, serve as protective feet for the device. Additional holes include those for *C1* and *C7* as well as one in the side of the cover to provide access for adjusting *C2*.

Wind the coils exactly as specified in

THE "10" SIGNALS

The APCO "10" signals were developed by the Associated Police Communication Officers, Inc., to reduce the content of police messages to a codified form. Listed below are the "10" signals most often heard on the air, together with their meanings.

10-1	Receiving poorly—move to better location.
10-2	Receiving well.
10-3	Stop transmitting.
10-4	Acknowledgment (OK).
10-5	Relay.
10-6	Busy.
10-7	Out of service.
10-8	Repeat, conditions bad.
10-10	Out of service—subject to call.
10-11	Dispatching too rapidly.
10-12	Officials or visitors present.
10-13	Advise weather and road conditions.
10-14	Convoy or escort.
10-15	We have prisoner in custody.
10-16	Procure prisoner at ———.
10-17	Procure papers at ———.
10-18	Complete present assignment as quickly as possible.
10-19	Return to your station.
10-20	What is your location?
10-21	Call this station by telephone.
10-23	Stand by.
10-24	Trouble at station—unwelcome visitors—all units in vicinity report at once.
10-29	Check for wanted.
10-31	Is lie detector available?
10-32	Is drunkometer available?
10-33	Emergency traffic at this station.
10-34	Clear for local dispatch?
10-35	Confidential information.
10-36	Correct time?
10-37	Operator on duty?
10-38	Station report satisfactory.
10-40	Advise if Officer ——— is available for radio call.
10-60	What is next message number?
10-63	Net is directed.
10-64	Net clear.
10-67	Stations ——— carry this message.
10-68	Repeat dispatch.
10-70	Net message.
10-71	Proceed with traffic in sequence.
10-83	Have Officer number ——— call this station by telephone.
10-92	Your quality poor—transmitter apparently out of adjustment.
10-97	Arrived at scene.
10-98	Finished with last assignment.
10-99	Unable to receive your signals.

All municipal, county, and state police; special emergency; forestry; fire department; local government; and highway maintenance radio stations appear in the 200-page "Official Registry of Public Safety Radio Systems." Available from Communication Engineering, Box 629, Mineola, N. Y., for $4.00, the book lists frequencies, call-signs, locations, and number of mobile units.

the Parts List. Strip the insulation from a short length of No. 20 tinned solid hookup wire to make *L1*, and solder this coil between the terminal strip mounting lug near the tube socket and the closest stator terminal of *C1*. Next, run a bare 1" lead from pin 2 of *V1* to a point 1½ turns from the "capacitor" end of *L1*. Finally, solder a 5½"-long insulated wire between the ungrounded end of the police antenna terminal strip and a point 1½ turns from the opposite end of the coil.

Nyclad wire (No. 20), with its tough, chip-resistant coating, is recommended for both *L2* and *L3*; be certain to scrape the insulation carefully from the leads at the ends of these coils. Note that coil *L2* is supported by the 4-lug terminal strip's two insulated lugs nearest the tube socket. A ¾" length of bare wire runs from pin 6 of *V1* to the near end of *L2*; a 2½" wire is also soldered to this end of *L2* and then run to the fixed plate of *C2*. A wire soldered to tube pin 3 is connected to the opposite end of *L2*.

Coil *L3* is fastened to the two insulated lugs nearest *C2*. A short insulated wire runs from the end of *L3* next to *L2* to the grounded terminal strip mounting lug near *C2*. A 6¼"-long insulated wire is then run from the other end of *L3* to the "Police" terminal of *S1a*.

Before installing *L4*, solder a ¾" piece of bare wire to the third turn from the bottom end of the coil. More room will be available for making this tap if you bend the second and fourth turns inward by pushing on them with a screwdriver. Place the coil between the ground lug near pin 9 of *V1* and the adjacent stator lug of *C7*. The wire from the tap at turn 3 can now be soldered to tube pin 8.

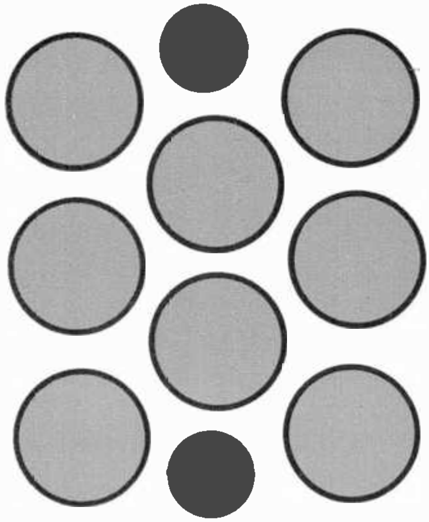
Finally, trim the leads of *C6* to ½". One end of this capacitor is soldered to pin 9 of the tube; the opposite end is wrapped around and soldered to the lead of *L4* which connects to *C7*.

Alignment. With power applied to the *10-8* and the bottom cover removed, there are a number of exposed high-voltage points in the converter which are apt to shock the unwary. Therefore, it's wise to "play it safe" and put on a pair of gloves before making the following adjustments.

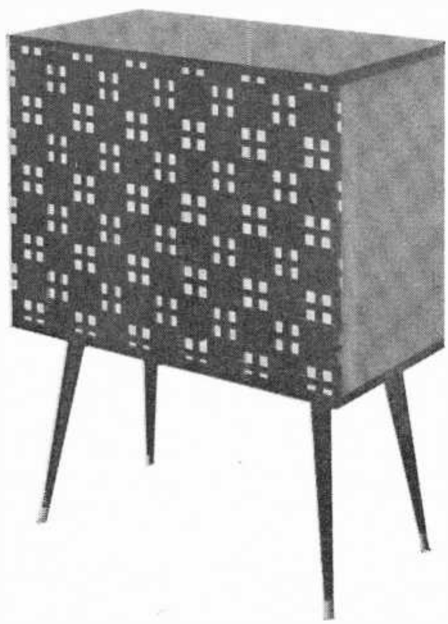
First, connect a 150-mc. antenna to the

(*Continued on page* 106)

STEREO SIXTEEN PLUS FOUR



Sixteen 5" speakers and four 2" tweeters deliver super-sweet stereo sound from a single enclosure

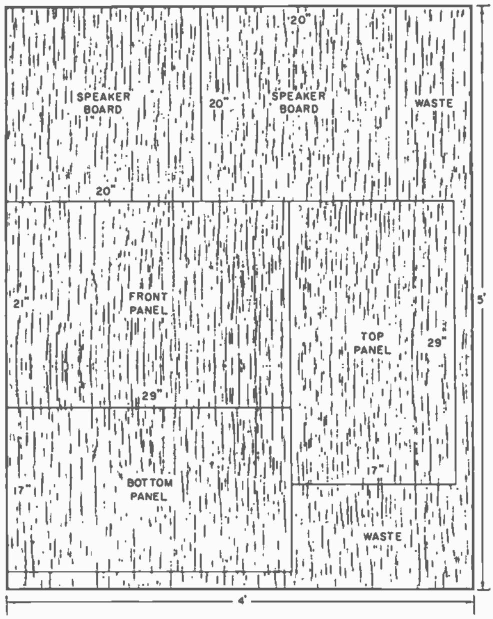


By JIM KYLE, K5JKX/6

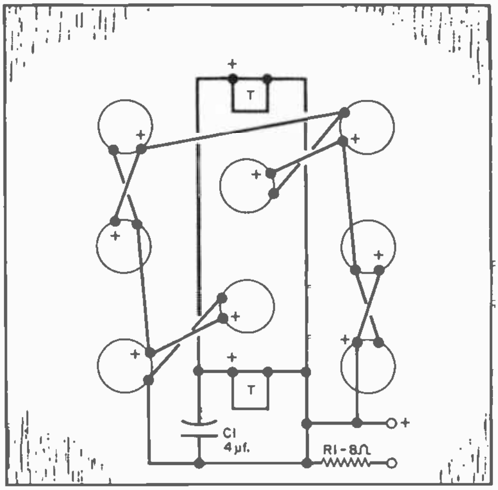
DO STEREO SPEAKERS pose a space problem for you? If so, here's a complete stereo speaker system, housed in a single enclosure measuring less than 2 feet deep and 3 feet wide, which you can build in a single weekend for less than $50.00. Based on the principles of the "Sweet Sixteen" (see January, 1961, POPULAR ELECTRONICS, p. 55), this speaker system, consisting of sixteen 5" units and four tweeters, reproduces the full audible range with outstanding clarity and definition. What's more, it effectively spreads the stereo effect over the entire room rather than along the conventional "line down the middle."

The only "drawback" (if it *is* a drawback) to the "Stereo Sixteen" is that it *must* be placed against a wall so that the sound will be reflected into the room. (Its stereo effect disappears when the sound is not reflected, due to the need for greater "spread" between the two "groups" of speakers.) When reflecting from a wall, however, this system has outperformed a hundred-dollar-plus, factory-assembled system hands down, both in response and separation!

Despite the outcome of this comparison, the "Stereo Sixteen" is admittedly a compromise, since it is designed for maximum performance in limited space. As a result, bass response drops fairly sharply below about 45 cycles, and the high end tapers off rapidly above 14,000 cycles. The reasons for this are that the



All major pieces are cut from a single sheet of 4′ x 5′ plywood, with a minimum of waste. Since the two speaker boards are identical (see dimensions at left), holes can be marked in both panels at once. Speaker system, wired as shown below, has impedance of 8-16 ohms.



Wire speakers as shown here, paying particular attention to polarities. An 8-ohm, 10-watt resistor in series with each speaker array decreases damping and improves bass response.

small size limits the bass, while the inexpensive tweeters limit the high end.

Total enclosure volume is less than optimum for even a "Sweet Sixteen" system, and individual speaker quality was deliberately held to the minimum which would produce acceptable results. The speakers themselves are very inexpensive—the 5″ units generally sell for approximately $1.70 each, and the cost of the tweeters is only about $2.50 each.

Ready to build it? Gather the necessary materials and let's begin.

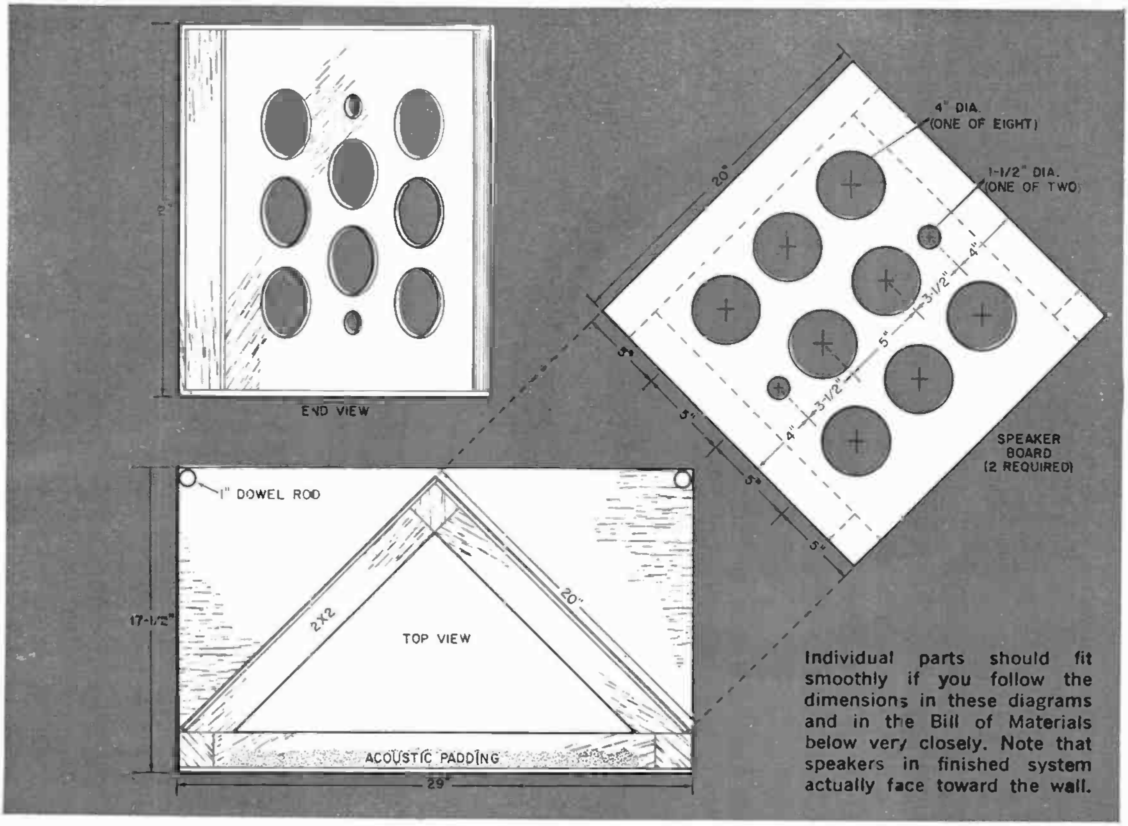
Getting Started. If you have complete confidence in your woodworking ability, you can begin by cutting all pieces to size as shown above. However, if your carpentry skills are no greater than the author's, it's best to measure each new item against the preceding pieces.

The place to start is with the speaker boards: cut them 20″ square, and sand the edges to eliminate splinters. Next, take eight 5″ speakers and two tweeters and position them on one of the boards, leaving a 2″ margin on all four edges to accommodate the 2″ x 2″ bracing which will be attached later. When you have all 10 speakers positioned on the board, carefully mark through each mounting hole with a soft lead pencil. Then remove the speakers and put them to one side.

Place the marked speaker board over the other one and drill through both boards at each mounting hole, using a $\frac{1}{16}$″ drill; this serves the dual purpose of providing screw-starting holes and marking both boards simultaneously. Next, draw lines to connect opposite mounting holes so as to locate the center of each individual speaker, and insure that each speaker will be concentric with its hole in the final board.

When all speaker centers have been marked, you're ready to mark and cut the speaker holes. A saber-saw or power jigsaw is best for cutting the large holes, while the 1½″ holes for the tweeters are best cut with either a hole saw or an adjustable circle cutter in a power drill.

After you have cut all 20 speaker holes, take one of the 20″ 2 x 2's and at-



Individual parts should fit smoothly if you follow the dimensions in these diagrams and in the Bill of Materials below very closely. Note that speakers in finished system actually face toward the wall.

tach it firmly to one edge of one speaker board, using at least three wood screws; this will be the back brace. Next, attach the other speaker board to the adjacent edge of the 2 x 2 to form a right-angled corner.

At this point, you're ready to mark the top and bottom panels for cutting. Place a length of 2 x 2 along what will be the 29" edge of one of the panels. Position the speaker-board assembly on the panel against this temporary spacer, and check to see that the 17" depth allows the panel to overhang approximately ½" beyond the back brace at this point; if it does not, make the panel deeper or shallower until it does. Mark the cutting lines square with the edges, and cut both the top and the bottom panels the same size. Then sand the cut edges lightly to remove splinters.

Wiring the Speakers. Remove the speaker boards from the back brace and attach all the speakers to them. (No. 6 x ½" sheet-metal screws are excellent for mounting the speakers, since they hold more firmly in the plywood than most other types.) After all the speakers are attached to the boards, wire them as shown on page 46.

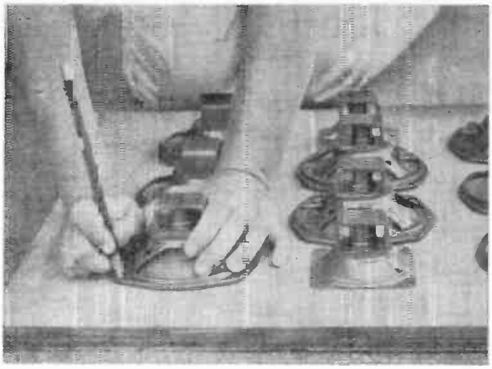
BILL OF MATERIALS

1—4' x 5' sheet of ½" plywood, cut into:
- *2—20" x 20" sheets (speaker boards)*
- *2—17" x 29" sheets (top and bottom panels)*
- *1—21" x 29" sheet (front panel)*

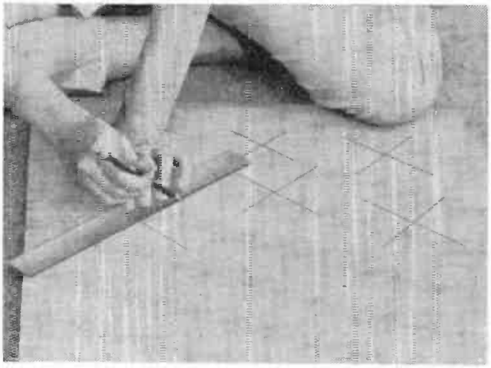
2—8' lengths of 2 x 2 framing stock, cut into:
- *4—18" lengths*
- *3—20" lengths*
- *2—25" lengths*

2—20" x 1"-diameter dowel rods
72—No. 8 x 1" flat-head wood screws
80—No. 6 x ½" sheet-metal screws
16—5" speakers (Oaktron 5B3, Lafayette SK-26, Olson S-336, or equivalent)
4—2" hard-cone tweeters (Oaktron 3C8T, Lafayette SK-122, Olson S-297, or equivalent)
2—4-µf. capacitors (non-polarized electrolytic or paper)
2—7.5-ohm, 10-watt resistors
1—Sq. yd. acoustic padding (or 6 papier-mache egg cartons—see text)
Misc.—Wire staples or thumbtacks, wire, solder

When wiring, make certain that the speakers are correctly phased—i.e., that they are so connected that the cones all move in the same direction at the same



Begin construction by placing speakers on speaker boards and marking through each mounting hole with a soft pencil.



After speaker mounting holes have been marked, the next step is to mark and cut holes for the speakers themselves.

time. If all the speakers are of identical make, simply connect right-hand to right-hand terminals and left-hand to left-hand terminals. Alternatively, if speakers of mixed manufacture are used, check each one with a flashlight cell and mark "+" on the terminal which makes the cone move *out* when it's positive.

Putting It Together. With the wiring completed, reattach the speaker boards to the back brace and add the upper and lower braces (18" 2 x 2's), using at least three wood screws per brace and ignoring the overhang at the front. Next, position the speaker-board assembly on the bottom panel as you did when marking the bottom panel for cutting. The overhang of the braces will prevent use of the 2 x 2 spacer, but it must be allowed for.

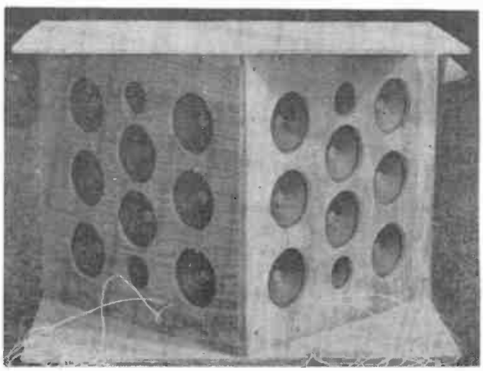
Now, at the top of the speaker-board assembly, align a straightedge with the front edges of the speaker boards. Mark the upper braces for cutting off the overhang, and cut along the markings. After cutting, turn the speaker-board assembly over on the panel and repeat the procedure for the lower braces. (With the upper overhang removed, the 2 x 2 spacer can be used when aligning the assembly on the bottom panel the second time.)

Take the remaining 29"-wide piece of plywood and attach a 20" 2 x 2 to one of the narrow edges, allowing the panel to overhang the lower edge of the 2 x 2 by

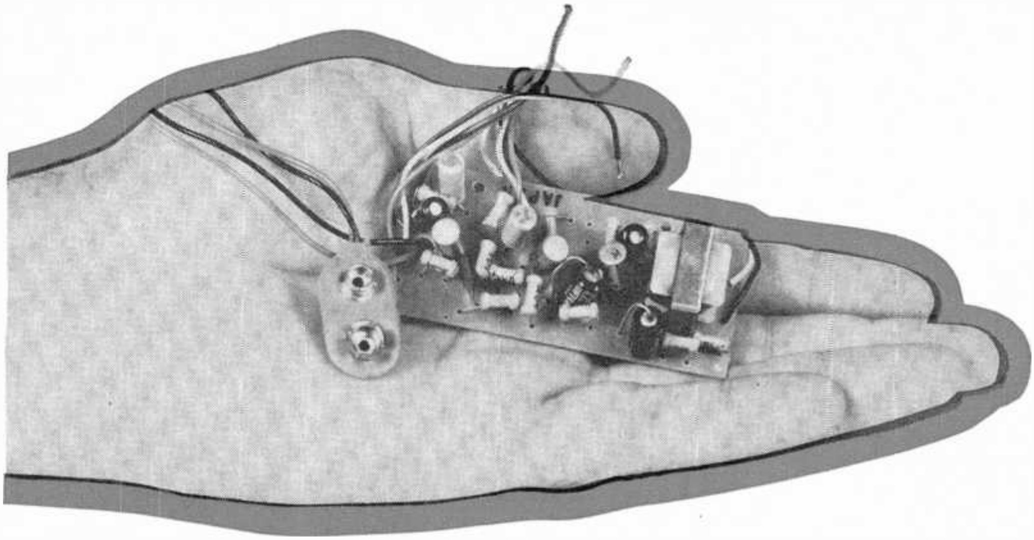
(*Continued on page* 99)

Speakers (left) are easy to wire—see diagram on page 46—but proper phasing is of utmost importance.

Rear view of basic unit, showing relative positions of speakers for each channel. Acoustic padding or an egg-carton "diffuser" should be attached to the inside front panel before it is screwed in place.



AUDIO BREADBOARD



Six uses for a ready-made transistorized amplifier which is ideal for experimenting "breadboard-style"

By ART TRAUFFER

THE three-transistor subminiature amplifier pictured above more than fills the bill for experimenters who want an economical, ready-made utility amplifier. Designated as the PK-522, this little amplifier measures only 1¼" x 2$\frac{13}{16}$", yet delivers an output of 100 milliwatts when used with a 9-volt battery. It's available from Lafayette Radio Electronics Corp., 111 Jericho Turnpike, Syosset, L.I., N.Y., for $3.75, plus postage.

To adapt the PK-522 for various experiments, the author mounted his unit on an 8" x 4" x ¾" wooden base or "breadboard" (see Fig. 1 on page 50). Leads from the PK-522 were soldered to Fahnestock clips, and the clips were numbered as shown in Fig. 2.

The author also made three simple additions to the PK-522 to improve its operation. A miniature volume control and switch were added, as well as a miniature input transformer which provides a better match for a crystal mike—this transformer can be cut in or out of the circuit by means of a wire jumper across clips 3 and 4. In addition, a pair of wire leads was soldered to the primary of the output transformer (at the bottom side of the panel) and then soldered to clips 8 and 9. Crystal earphones work fine when connected to clips 8 and 9 because the d.c. passes through the primary

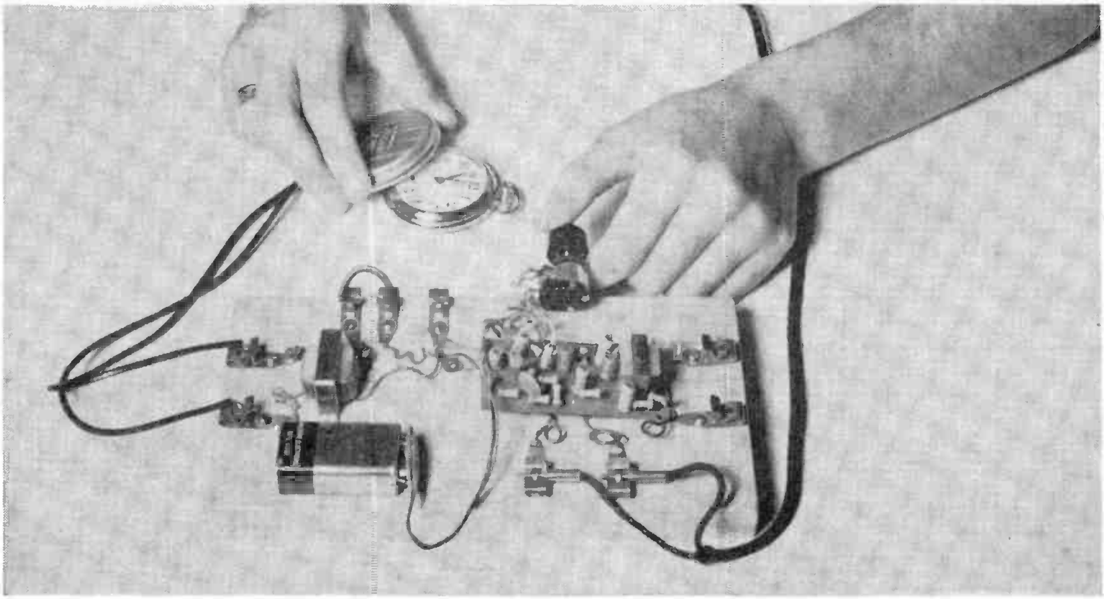


Fig. 1. Audio breadboard becomes an electronic "stethoscope" with addition of a crystal microphone and a pair of earphones. Circuit also functions as amplifier, signal tracer, or code-practice device.

BILL OF MATERIALS

1—Subminiature three-transistor audio amplifier (Lafayette PK-522 or equivalent)
1—9-volt transistor radio battery (B1) (Burgess 2U6 or equivalent)
1—Miniature input transformer; primary, 200,000 ohms; secondary, 1000 ohms (Argonne AR-100 or equivalent)
1—Miniature 5000-ohm volume control with s.p.s.t. switch (Lafayette VC-27 or equivalent)
1—Mounting bracket for volume control, 1¾" x ½" x 1/16"
1—Knob for volume control
9—Fahnestock clips, ¾" long x 5/16" wide
9—Soldering lugs (for Fahnestock clips)
12—Round-head wood screws, ½" long
1—Length of insulated hookup wire
1—Wooden base, 8" x 4" x ¾"
1—0.01-µf., 600-volt capacitor (C1)
1—1N54A diode (D1)
Misc.—Speaker, probe, alligator clip, etc.

of the output transformer; high-impedance magnetic phones also work better when connected to clips 8 and 9, since clips 6 and 7 are attached to the output transformer secondary and have an impedance of only 8 ohms.

Electronic Stethoscope. Figure 1 shows the PK-522 being used as an electronic "stethoscope" to listen to the ticking of a pocket watch. A crystal mike cartridge was connected to clips 1 and 2, a wire jumper across clips 3 and 4, and a pair of high-impedance magnetic earphones

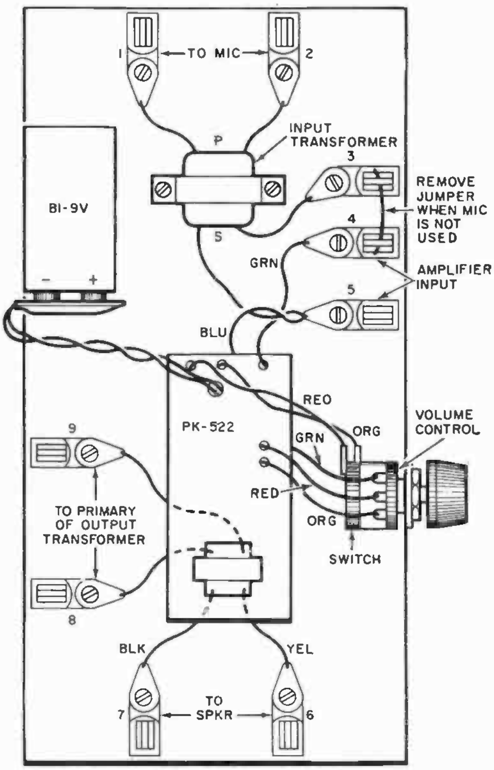


Fig. 2. Wooden base, 8" x 4" x ¾", serves as a "breadboard" in this easy-to-wire circuit. Volume control mounts on bracket fastened to edge of base.

across clips 8 and 9. If you want to use a PM speaker instead of the phones, simply connect its voice coil to clips 6 and 7.

"Big Ear." To use the PK-522 as a "big ear" for listening to birds, aircraft, etc., hook it up exactly as you did for the electronic stethoscope above. Make a large horn from a sheet of heavy paper or follow the instructions at right. High-impedance magnetic or crystal phones will be required for listening, since a speaker might cause acoustic feedback.

Phono Amplifier. Connect a crystal or ceramic phono pickup to clips 4 and 5, and a PM speaker (3- to 8-ohms impedance) to clips 6 and 7. Do not use a jumper across clips 3 and 4.

Amplifier for Crystal Radio. Disconnect the earphones from the crystal radio and run two leads to clips 4 and 5. The "ground" side of the crystal radio circuit

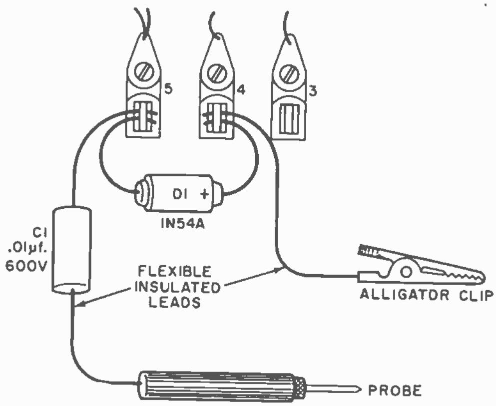


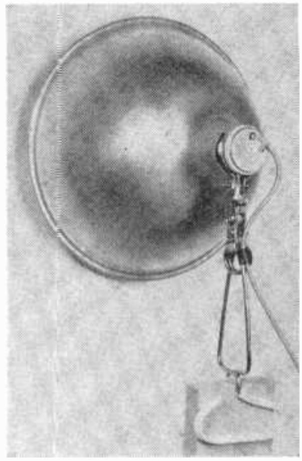
Fig. 3. Adding a few more components turns the breadboard into a signal tracer. Remove diode from Fahnestock clips 4 and 5 when tracing a.f. circuits.

goes to clip 4, and the "diode" side goes to clip 5.

Signal Tracer. Figure 3 shows how to use the PK-522 as an a.f. signal tracer. To trace a.c., simply disconnect the 1N54A diode from the circuit.

Code Practice Outfit. Connect a crystal mike to clips 1 and 2, a wire jumper across clips 3 and 4, and a PM speaker to clips 6 and 7. Place the mike and speaker near each other and turn up the volume control until you hear a loud "howl." Remove the wire jumper, connect a key to clips 3 and 4, and you're ready to practice code. —30—

MIKE FOR "BIG EAR"



HERE is a simple way to funnel more sound into a mike cartridge for a "big ear" or other experimental sound project. As shown in the photo, the secret is a clamp-on type photoflood reflector which "catches" the sound and feeds it into a crystal mike cartridge. The swivel clamp allows the mike to be clamped onto a variety of objects and tilted to any desired angle.

To assemble the mike, twist the reflector bowl off the lamp socket, then attach the clamp to the neck of the bowl, as shown. Using Duco cement, glue a 1½"-diameter crystal mike cartridge (an Argonne Type AR-52 or equivalent will do nicely) onto the opening in the neck of the bowl.

Any lightweight mike cable, such as Belden 8411, can be used between the mike and the amplifier—the shield of the cable should be soldered to the "ground" terminal on the rear of the cartridge, and the inside conductor soldered to the "hot" terminal. To finish off the mike assembly, the cable can be anchored to the clamp with plastic tape, and a standard mike cable connector soldered to the free end of the cable. —*Art Trauffer*

SHORT WAVE FOR

IF YOU'RE one of the many persons who are fascinated with short-wave radio but who have never known quite how to "get started," why not give English-language broadcasts a try? Even though you may not be a "dyed-in-the-wool" short-wave listener, such broadcasts are usually a sure bet, especially if you know when and where to listen.

Do you say that you don't have the desire to sit for hours on end, tuning patiently for stations? Do you complain that the "time element" doesn't ever seem to favor you? Then take a good look at the listings below—a country-by-country compilation of English-language broadcasts beamed from foreign countries to North America.

COUNTRY	CITY	TIME (EST)	FREQUENCIES (kc.)
Argentina	Buenos Aires	2200-2300[1]	9690
		0002-0102[2]	9690
Australia	Melbourne	0710-0815[1]	11,710
		1014-1115[2]	11,710
Austria	Moosbrunn	1900-2100	9540
	Deutsch-Altenburg	1800-2100	6155
		2100-2300	9540
Belgium	Brussels	1900-2000[3]	9745, 9705, 6140
Bulgaria	Sofia	1835-1900, 2000-2030, 2300-2330	9700
China	Peking	2000-2100,[1]	17,765, 15,115, 15,030
		2100-2200	11,975, 11,945, 11,730 9480, 7480
		2200-0000[2]	17,745, 15,250, 15,060 12,055, 11,820, 9785, 9457, 7350
Congo	Leopoldville	2130-2200[4,5]	11,755
Cuba	Havana	2200-2340,[4] 0000-0100	11,770
Czechoslovakia	Prague	2200-2300, 0000-0100	15,285, 11,990, 9795, 9550, 7345
Denmark	Copenhagen	2100-2130,[6] 2230-2300	9520
Ecuador	Quito	0900-1030, 1830-1900	17,890, 15,115
		2100-0000	15,115, 11,915, 9745
England	London	1030-1245	21,675
		1100-1300	17,810
		1615-1715	9825
		1615-2200	6195
Finland	Helsinki	0630-0700[7]	15,190, 11,805, 9555
Germany	Cologne	1715-1895[1]	9605, 6100
		0000-0020[2]	9640, 6100
Guatemala	Guatemala City	2200-2300[6]	9668
Hungary	Budapest	1900-2000, 2230-2330	11,910, 9833, 7220

BEGINNERS

By HANK BENNETT
W2PNA/WPE2FT

Bear in mind that there are many other English-language broadcasts which are not beamed to North America but which you may be able to hear with little or no difficulty. Remember, too, that although these listings were correct at time of compilation, short-wave stations change their frequencies and/or schedules with little notice. You're invited to send in any additions or corrections you may have—please address your letters to Hank Bennett, Short-Wave Editor, POPULAR ELECTRONICS, P. O. Box 254, Haddonfield, N. J.

The times given for all of these broadcasts are Eastern Standard, and the 24-hour system is used instead of "a.m." and "p.m." designations. —30—

COUNTRY	CITY	TIME (EST)	FREQUENCIES (kc.)
Italy	Rome	1930-1950[1]	11,905, 9575
		2205-2225[2]	11,905, 9575
Japan	Tokyo	1930-2020	21,520, 17,725, 15,135
Jordan	Amman	2015-2045	7155
Katanga	Brazzaville	2015-2100[4]	11,725
		0015-0030	9730
Liberia	Monrovia	2000-2230[8]	11,980
Netherlands	Hilversum	1630-1720[6]	11,730, 9590, 6020
		2030-2120[6]	9590, 6020, 5980
		2100-2230[9]	9590, 6020, 5980
Norway	Oslo	2100-2125[1,9]	11,850, 9610, 6130
		0000-0025[2,10]	11,850, 9610, 6130
Rumania	Bucharest	2030-2130	11,810, 9570, 7225, 7195, 6190, 5980
		2200-0000	15,380 11,810, 9570 9510, 7225, 7195, 6190
Spain	Madrid	2215-2300, 2315-0000	9363, 6130
		0015-0100	9363, 6130
Sweden	Stockholm	0900-0930[1]	17,840, 9725
		2045-2115[1]	
		1915-1945[2]	
Switzerland	Berne	2030-2215	11,865, 9535, 6165
		2315-0000	
Thailand	Bangkok	2315-0015	11,910
Turkey	Ankara	1815-1900	9515
U.S.S.R.	Moscow	1800-0100	[11]
Venezuela	Caracas	2130-2245[9]	6170[12]

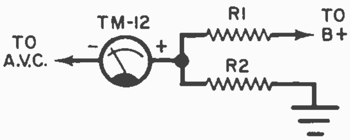
NOTES:

1. *Beamed to East coast.*
2. *Beamed to West coast.*
3. *1900-1915, Monday and Friday.*
4. *Beamed to the Americas.*
5. *Monday through Saturday.*
6. *Monday through Friday.*
7. *Tuesday and Saturday only.*
8. *Tuesday only.*
9. *Sunday only.*
10. *Monday only.*
11. *Frequencies of U.S.S.R. stations are subject to frequent change. The latest list, based on published schedules and listening observations includes: 12,010; 11,960; 11,860; 11,820; 11,690; 9760; 9680; 9660; 9650; 9620; 9600; and 9570 kc.*
12. *Latest observations indicate an English program on Saturday at 1630-1800. In addition, the Sunday program may have been changed to 2230-0000.*

WHY TUNE BY EAR?

By ROCCO J. CARLUCCI

Tricky tuning, says this author, is strictly a matter for meters



MOST EXPERIMENTERS are well aware that the eye is far more "sensitive" than the ear, but a good many fail to put this observation into practice. Take the matter of receiver tuning, for instance—a simple tuning meter can easily be added to almost any AM receiver to make accurate tuning as simple as 1, 2, 3.

Two of the less expensive tuning meters on the market are the Lafayette TM-12 ($2.95) and the Radio Shack R94L106 ($2.88). Instructions furnished with the Lafayette meter explain that it should be installed in the cathode circuit of the receiver's last i.f. stage. However, the author installed this meter in a Heath XR-1-P transistor portable, only to discover that the variations in current were so small that the meter was insensitive even on the strongest stations.

To remedy this situation, the author connected the meter between the a.v.c. line and a positive reference point provided by the junction of a 100,000- and a 1000-ohm resistor (*R1* and *R2*, respectively, in the diagram above) across the battery. When the receiver is mis-tuned, there is little or no a.v.c. voltage, so the difference in potential across the meter is very small. However, when a station is tuned in, the a.v.c. voltage is greatest, and the difference of potential across the meter is also at a maximum. Naturally, the amount of deflection will vary with the receiver circuit and the value of the divider resistors used, so some juggling of values may be necessary for optimum operation. -30-

Whether you buy a converter or revamp a standard tuner, it's

In-car FM for MPL*

*Mighty Pleasurable Listening

By WALTER ROBSON

DOES FM in your car sound like a worthwhile proposition? Sure it does! And one easy way to put it there is to purchase one of the FM converters now on the market (Granco's Model ARC 60, for example, sells for $42.95). Or, if you already have an FM tuner or two around the house, you may decide to do just what the author did—modify your present FM tuner for in-car use.

Fortunately, the sensitivity and readily satisfied voltage requirements of many ordinary FM tuners make them a "natural" for this modification. The author's tuner has provided flawless, static-free performance for over a year at distances up to 100 miles from broadcast stations. And while the author uses only an ordinary folded dipole, an antenna specifically designed for mobile FM reception would naturally produce even more spectacular results.

The easiest modification involves a.c.-operated tuners with common 6.3-volt tubes such as the 6AU6, 6AL5, etc. If your tuner is one of these, and if your auto electrical system is of the 6-volt variety, you can perform the modification in a matter of minutes.

If your car has a 12-volt electrical system, you can usually replace the tuner's tubes with 12.6-volt equivalents (i.e., a 12AL5 for a 6AL5, and so on); alternatively, a suitable dropping resistor could be inserted into the heater circuit. Such tube substitutions can also pave the way for using an a.c./d.c. tuner with a 6- or 12-volt car battery; naturally, the tube heaters would have to be rewired so that they are in parallel or perhaps series/parallel rather than in series.

The Power Supply. One of the simplest ways to handle the power supply problem, of course, is to purchase a d.c.-to-a.c. inverter—ATR makes a portable, plug-in type unit for 6-volt operation which sells for $16.30 and a 6/12-volt model priced at $18.91 while the Electric Storage Battery Company's Model I-152 inverter operates from 12-volt batteries only and sells for $59.95. Such units pack enough punch to power almost any small FM tuner, and obviate the need to revamp the tuner's circuitry.

A less expensive solution is to purchase a small d.c. power supply for the B+ requirements and run the heaters directly off the car battery. The Heathkit VP-1-6 vibrator power supply, designed for 6-volt operation, or its 12-volt equivalent, the VP-1-12, are especially well suited for the purpose; each is priced at $8.95 in kit form.

As a third possibility, you may decide to follow the author's lead and tap the necessary B+ from your auto radio. In this case, you'll have to arrange some means to switch off the auto radio's r.f. and i.f. stages when using the FM tuner to reduce drain on the vibrator. The author solved this problem with a d.p.s.t. selector switch.

Regardless of the voltage source you select, its d.c. output should equal or exceed that at the input to the filter section of your FM tuner. If the voltage source is too high—and this is likely to be the case, a suitable dropping resistor can be added.

AM/FM Selector Switch. Even if you decide not to use your AM radio as a source of B+ voltage, an AM/FM selector switch is almost a necessity, since the car radio will be called upon to furnish the audio stages. In the author's case, this switch serves to turn off all tubes in the AM receiver except the audio and rectifier tubes and thus provide B+ for the FM tuner when switched to FM.

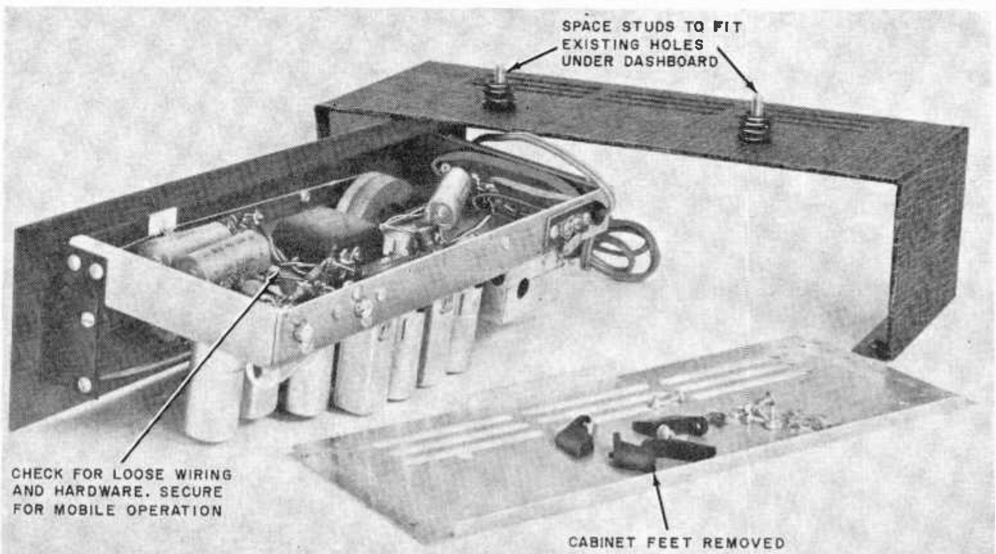
In addition, the FM audio output is switched to the AM receiver's audio amplifier in the FM position and removed in the AM position in order to prevent the low output impedance of the FM tuner from lowering the AM volume level. Still another function of the selector is to switch the antenna from the AM receiver to the FM tuner.

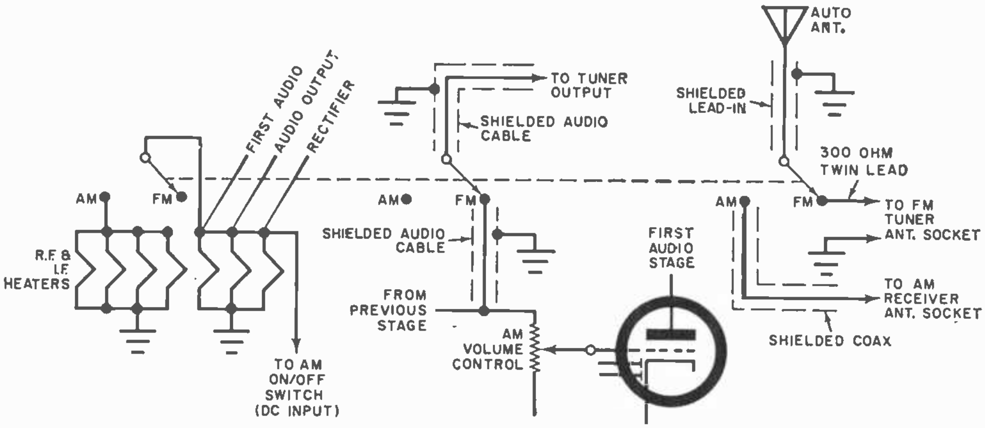
The AM/FM selector switch can be mounted anywhere within reach of the driver, but for simplicity of wiring it should be installed so that the AM antenna lead will reach it without splicing. A small chassis box might be used to mount the switch and antenna connector.

To feed the output from the tuner to the AM receiver's audio section, first locate the AM volume control. Connect the inner conductor of a length of shielded cable to this control's "hot" terminal, and connect the shield to some convenient chassis ground point. Connect the opposite end of this shielded cable to the AM/FM selector switch. A short length of shielded audio cable and an RCA phono plug connects the FM audio output to this switch section.

The FM position of the AM/FM selector switch also connects the AM whip or a whip-connected auto FM antenna to a length of 300-ohm twin lead attached to the FM tuner's antenna input terminals by means of twin-lead connectors. Naturally, this switch section can be eliminated if a dipole is used in addition to the AM whip—a dipole would be con-

Actual method of mounting will vary with the type of tuner you decide to install as well as where you mount it. Here's how one experimenter went about mounting his Heathkit FM-4 under the dashboard.





Typical circuit showing how AM/FM selector switch is wired. Switch will be required in most cases; exact circuitry will vary with each installation.

nected directly to the FM antenna input terminals via standard 300-ohm twin-lead of the type used for television lead-in.

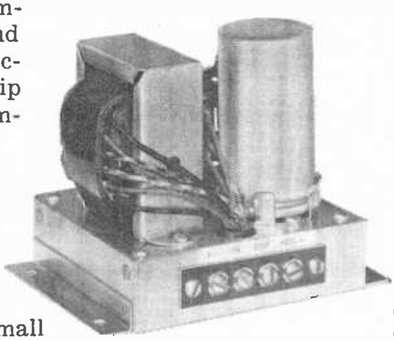
The antenna itself can consist simply of the auto's ordinary AM whip, or a halo antenna designed for FM auto operation can be slipped over the AM whip for better reception. An ordinary dipole clamped to the AM auto antenna should provide improved performance over whip operation, and it will be only slightly directional. The halo and whip antenna, of course, are completely non-directional.

Installation. Where and how you mount your FM tuner will vary according to its size and shape as well as with the physical features of your car. It might be mounted on a small shelf under the dashboard. Or your glove compartment, if it is large enough, might be a convenient spot for it.

Since the tuner will be subject to all the bumps and jolts encountered in day-to-day driving, it's wise to employ some sort of shock-mounting. Rubber or felt padding, springs, or other shock-absorbers will suggest themselves, depending on your particular installation.

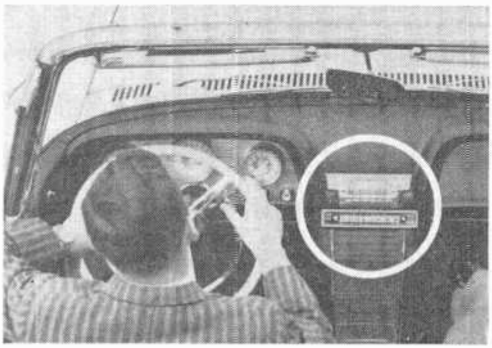
Next time you go for a drive, arrange to take your FM with you. On the road, just as in the home, FM equals MPL—Mighty Pleasurable Listening! -30-

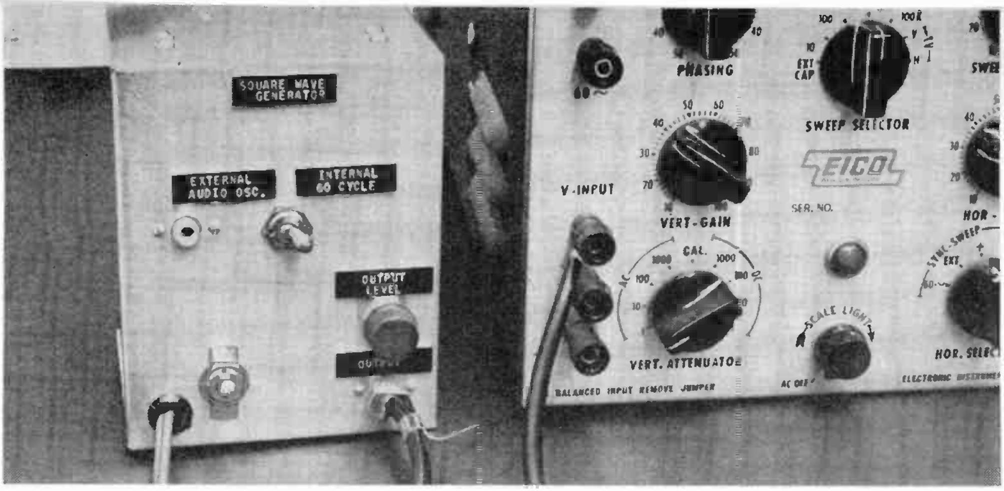
A d.c.-to-a.c. inverter, such as the ESB Model I-152 shown above, can be used to provide the power for your FM tuner.



Another possibility for powering the tuner without tapping into the AM radio's circuitry lies in a d.c. power supply, such as the Heathkit at left.

You may be able to mount one of the new FM converters below your AM radio, as in the "Thunderbird" below.

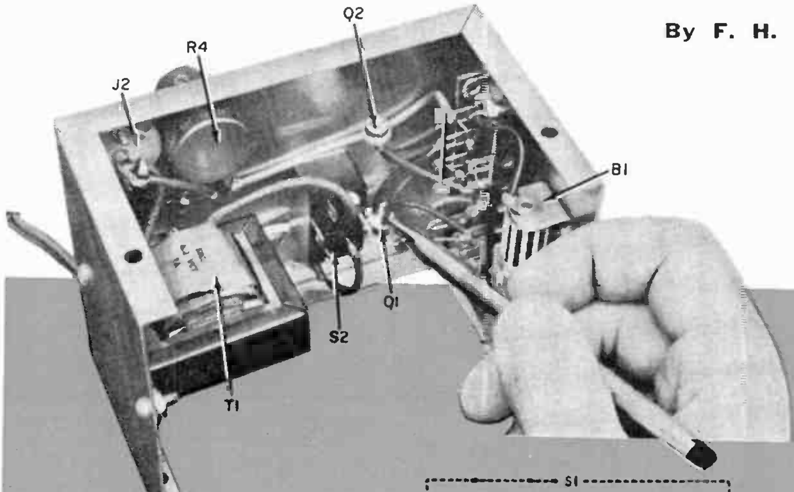




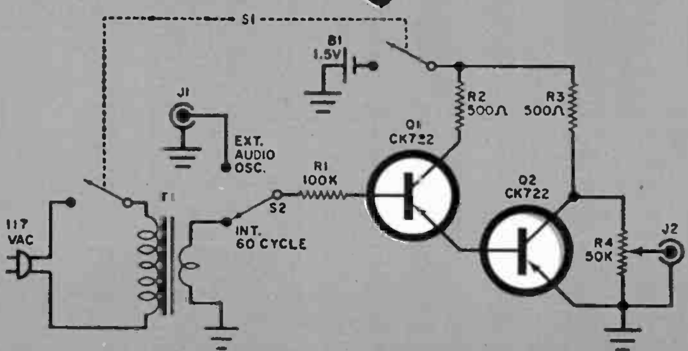
The SQUARE

Simplify your hi-fi testing procedures with this low-cost square-wave generator

By F. H. CALVERT, W9JCV



Transistors (pencil points to Q1) are soldered into circuit without sockets. Be careful not to apply too much heat.



The circuit is essentially an overdriven transistorized amplifier. Transformer T1 acts as internal 60-cycle source.

OVER the past several years, square-wave testing of hi-fi amplifiers (see "The Square Wave Generator," February, 1961, page 68) has become increasingly popular. Testing with square waves is an efficient way to get a good idea of an amplifier's phase shift, "ringing" characteristics, and response to transients. In addition, because of the square wave's rich harmonic content, the frequency response of an amplifier throughout the complete range of hearing can be judged by using only three fundamental test frequencies.

The current models of audio signal generators generally have a square-wave—as well as a sine-wave—output. If your generator is an older model, however, you can modernize it with the "Squarer." This simple device will convert to square waves the output of any sine-wave generator capable of delivering about 6 volts r.m.s. The output of the Squarer is about 1 volt, and the unit will provide a 60-cycle square-wave signal without an external generator.

PARTS LIST

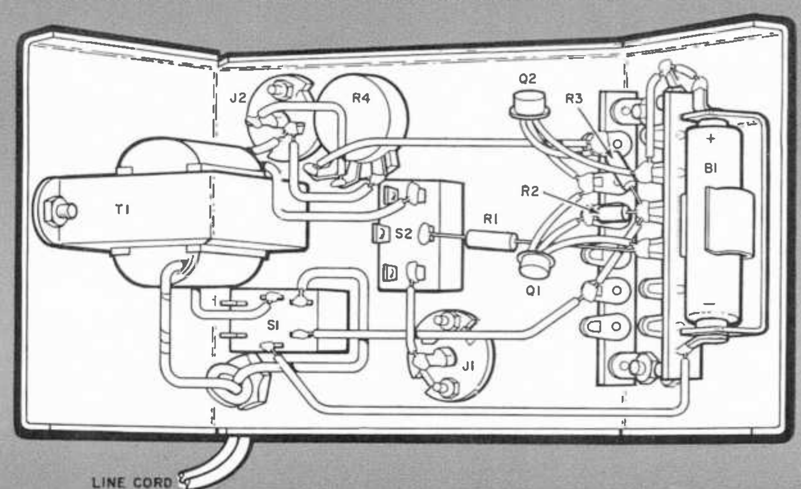
B1—1.5-volt penlight cell (Burgess Type Z or equivalent)
J1, J2—Phono jack
Q1, Q2—CK722 transistor
R1—100,000-ohm, ½-watt resistor
R2, R3—500-ohm, ½-watt resistor
R4—50,000-ohm potentiometer
S1—D.p.s.t. switch
S2—S.p.d.t. switch
T1—Filament transformer; primary, 117 volts; secondary, 6.3 volts—current not critical (Thordarson 21F08, secondary center tap not used—or Stancor P6465)
1—5" x 4" x 3" aluminum utility box (Bud CU-3005-A or equivalent)
Misc.—Battery holder, terminal strips, hardware, line cord and plug, etc.

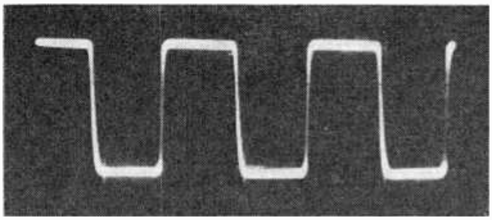
About the Circuit. The Squarer is basically nothing more than an overdriven transistorized amplifier. The input signal originates either from the secondary of *T1* or from a sine-wave generator connected to external-input jack *J1* (depending on the setting of switch *S2*). After passing through *S2*, the signal is applied to the base of transistor *Q1* through resistor *R1*.

Resistor *R2* serves as the collector load for *Q1*, and this transistor is directly coupled to *Q2*. Resistor *R3* loads the collector circuit of *Q2*, and the amplifier output is tapped off by *R4* and fed to jack *J2*. Power for the circuit is supplied by battery *B1*. Switch *S1* simultaneously controls both the battery and transformer primary voltages.

The transistors conduct only on the negative half-cycles of the sine-wave input signal. Saturation occurs when the input reaches a few millivolts, steepening the sides and flattening the top of

Pictorial diagram shows simplicity of the parts layout and wiring.





Oscilloscope trace of Squarer's output when operated with a 1000-cycle, sine-wave input. Notice the sharp rise time and the flat tops of the waveform.

the signal's waveshape. The resulting output is essentially a square wave.

Construction. The parts are housed in a 5″ x 4″ x 3″ aluminum utility box, and there's plenty of room to spare. Switches *S1* and *S2,* jacks *J1* and *J2,* potentiometer *R4,* and the line cord grommet are mounted behind the top of the box. Transformer *T1* is mounted on one of the box sides, the battery holder and two 6-lug terminal strips on the other.

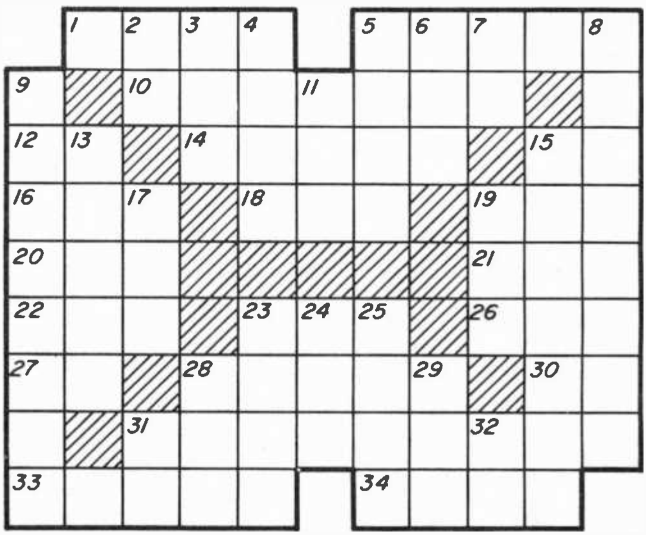
The wiring is quite simple and can be completed very quickly. No transistor sockets are used and both *Q1* and *Q2,* together with load resistors *R2* and *R3,* are wired directly to the two terminal strips (see pictorial diagram). Be careful not to apply too much heat when soldering in transistors *Q1* and *Q2,* and be sure to install battery *B1* with the correct polarity.

Using the Squarer. If the device is to be used with an external signal generator, it's not necessary to plug in the line cord. Just plug the output of the generator into *J1* and the input of your test circuit into *J2.* Then flip on *S1,* switch *S2* to *External Audio Osc.,* and you're ready to go. To use the internal 60-cycle signal, the procedure is the same, but the line cord must be plugged in and *S2* switched to *Internal 60 Cycle.* In either case, the output level of the Squarer is controlled with potentiometer *R4.*

Once you've added the Squarer to your stock of test equipment, you'll wonder how you ever got along without it. The POPULAR ELECTRONICS article mentioned earlier will give you a good start toward understanding the theory of square wave testing, and some practical work with the Squarer will do the rest. —30—

CROSSWORD PUZZLE

By Thomas Windser



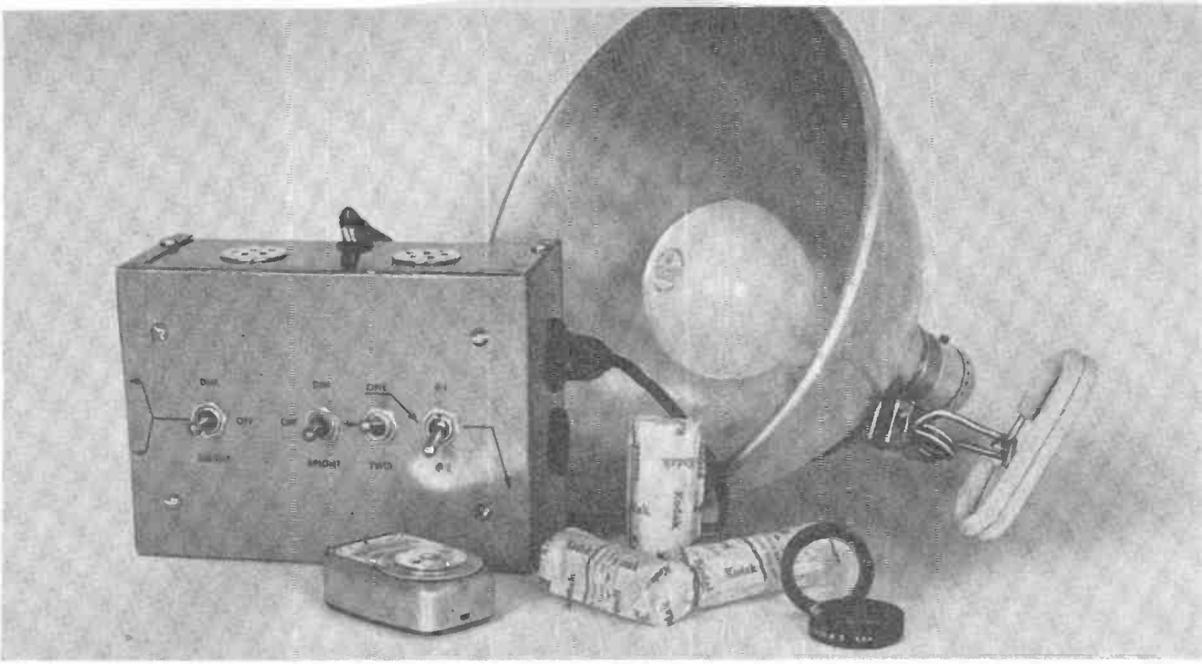
ACROSS

1 An electron microscope uses a magnetic ———.
5 Tube type.
10 Discoloration on a TV picture tube: two words.
12 There's at least one such stage in every superheterodyne.
14 Lassos.
15 Amplitude modulation: abbrev.
16 Raced.
18 Pale.
19 Mischievous child.
20 Cathode-ray oscilloscope: abbrev.
21 G.I. aspirin.
22 United Arab Republic: abbrev.
23 Grow old.
26 New: combining form.
27 Inside diameter: abbrev.
28 Trigonometric function: plural.
30 Railroad: abbrev.
31 Varied the amplitude.
33 Type of lug.
34 Stations: abbrev.

DOWN

2 Its product is usually expressed in watts.
3 Neither . . . ———.
4 Noise visible on a TV picture tube.
5 A blown fuse is an ——— circuit.
6 Commanding officers: abbrev.
7 Telephone and Telegraph: abbrev.
8 Zip cord: two words
9 Electric current paths.
11 Mineral spring.
13 Unit of capacitance.
15 Units of current.
17 Norway: abbrev.
19 Man's name.
23 Assistant.
24 African antelope.
25 Teleost fishes.
28 Soil.
29 Occupied a chair.
31 Milliampere: abbrev.
32 Symbol for tantalum.

(Answers on page 98)



FLOOD LIFE STRETCHER

Spare the voltage and save those photofloods with this easy-to-build light control center

By W. F. GEPHART

EVERY PHOTOGRAPHER appreciates the value of a photoflood "dimmer." With the lights on "dim," his subjects are much more comfortable during the setting-up and focusing ritual. Even more important, the life of the floods is appreciably extended.

When two lights of the same type are used, only a simple switch is necessary to connect them in series and dim them equally. But suppose you want to use a No. 1 bulb with a No. 2 bulb, or that you need three bulbs? While two mismatched bulbs *can* be used with a simple series switch, they won't dim equally, and the lighting can't be balanced properly when they are on "dim." The situation is even worse when three bulbs are used, since the two "paired" ones will ordinarily

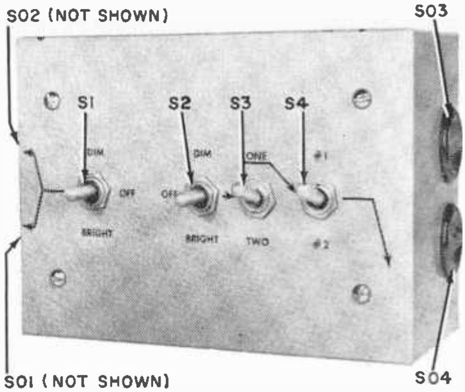


Fig. 1. Front view of switchbox. Author placed arrows on front panel to indicate which switches relate to which sockets; decals next to switches identify switch functions.

be connected through the switch, while the third will be connected directly to the 117-volt a.c. line.

The photoflood switchbox shown here is a very practical solution to the "dimming" problem. Not only will it handle up to four bulbs in almost any combination, but it will also permit dimming odd or unmatched bulbs equally so that the lights can be positioned and balanced with the bulbs on "dim." Construction is simple—you should be able to build the entire unit in a few hours' time.

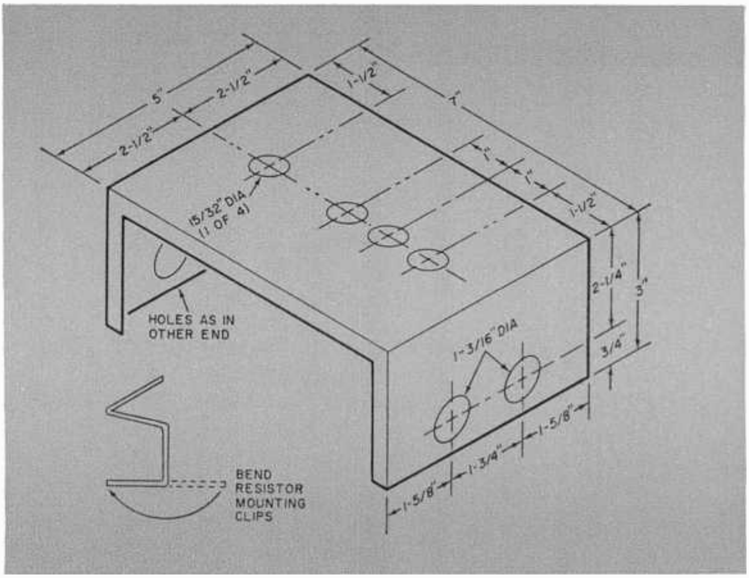


Fig. 2. Switchbox consists essentially of four receptacles, four switches, and two resistors. Note that switch positions shown below correspond to decals in photo above.

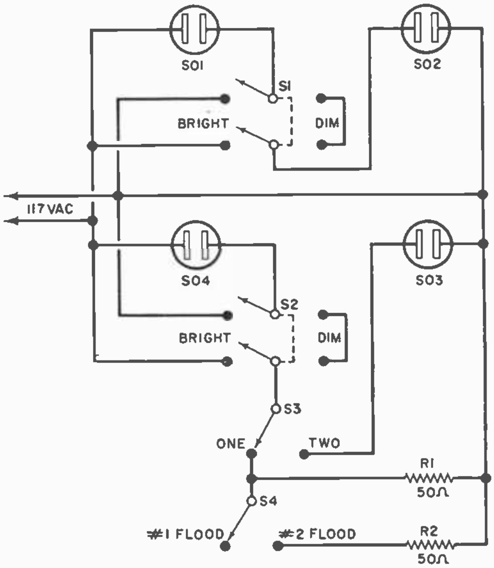


Fig. 3. Chassis box should be easy to punch and drill if you follow the dimensions shown above. Clips for power resistors R1 and R2 must be bent as indicated if resistors are to fit within box.

About the Circuit. The circuitry of the switchbox is extremely simple: as you can see from the schematic diagram at left, it consists of only four switches, two resistors, and four sockets.

Switch *S1*, which controls sockets *SO1* and *SO2*, is the conventional series/parallel control for use with two paired bulbs. Either two No. 1 or two No. 2 bulbs can be plugged into these sockets.

Switch *S2*, in conjunction with switches *S3* and *S4*, controls sockets *SO3* and *SO4*. If two paired bulbs are being used in these sockets, switch *S3* is set to "Two,"

PARTS LIST

R1, R2—50-ohm, 100-watt, wire-wound resistor (IRC 6½E or equivalent)
S1, S2—D.p.d.t. toggle switch with center "off" position, 15 amp. @ 125 volts (Carling 2GM53-73 or equivalent)
S3, S4—S.p.d.t. toggle switch, 15 amp. @ 125 volts (Carling 2FB53-73 or equivalent)
SO1, SO2, SO3, SO4—2-pole, female a.c. receptacle (Amphenol 61-F1 or equivalent)
1—7" x 5" x 3" aluminum chassis box (Bud CU-2108A or equivalent)
Misc.—Heavy-duty appliance cord with plug, 1" screen-type plug buttons (optional), wire, solder, etc

lighting can be balanced with three bulbs on "dim."

Construction Hints. The unit is built in a 7″ x 5″ x 3″ aluminum chassis box, with sockets at each end—see Fig. 1. The schematic diagram appears in Fig. 2, drilling layout in Fig. 3, and wiring details in Fig. 4. Decal letters and arrows on the front panel show the functions of the various switches and sockets.

The mounting brackets supplied with the resistors must be bent as shown in Fig. 3. No mounting holes are indicated

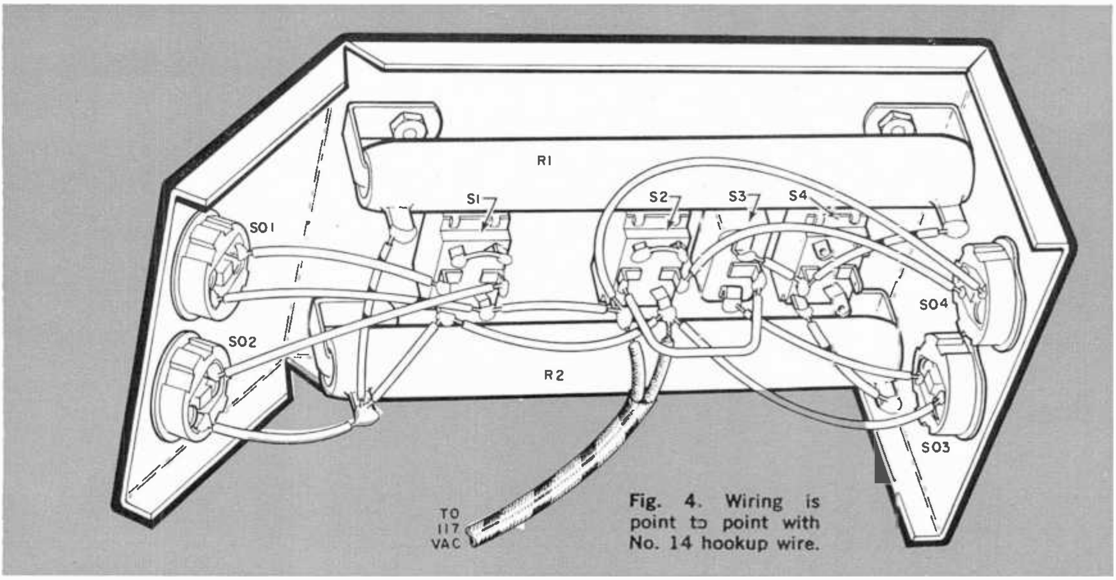


Fig. 4. Wiring is point to point with No. 14 hookup wire.

and switch *S4* is not used. If only one bulb is to be used, it is plugged into *SO4*, switch *S3* is set to "One," and switch *S4* is set to the size bulb being used.

When a single No. 1 bulb is plugged into *SO4* and switch *S4* is on "#1," resistor *R1* is in the circuit and takes the place of a second bulb for dimming purposes. With a No. 2 bulb plugged into *SO4*, switch *S4* is set on "#2," resistor *R2* is connected in parallel with *R1*, and the *R1/R2* combination acts as a second "bulb."

The value of these resistors is such that they enable the single bulb to dim to half its normal intensity, just as though two bulbs were connected in series. The light value of the single bulb is then in proportion to the dimmed effect of the paired bulbs in *SO1* and *SO2*, so overall

for these brackets, since their exact position will depend on how the brackets are bent.

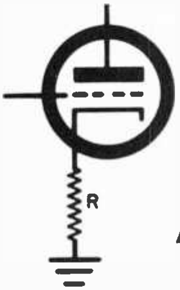
All wiring should be done with No. 14 wire, and the line cord should be an asbestos-insulated, heavy-duty type. Two 1″ vent plugs can be placed on each of the sides of the bottom half of the box to provide ventilation for the resistors.

Operation. When using the switchbox, keep in mind that each No. 1 photoflood draws about 2.2 amperes and each No. 2 photoflood draws about 4.4 amperes on "bright." Since the average household outlet is designed to handle a maximum current of about 15 amperes, an absolute maximum of three No. 2 bulbs and one No. 1 bulb can be used at one time, assuming there is nothing else connected to that particular circuit. —30—

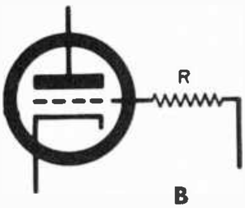
RESISTOR FUNCTION QUIZ

By ROBERT P. BALIN

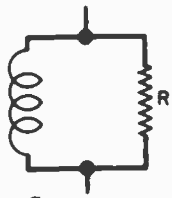
Resistors find more uses in electronic equipment than any other component. See if you can match the functions of the resistors listed at right with the letters (A through I) representing their applications in the diagrams at left.



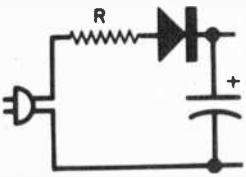
A



B



C



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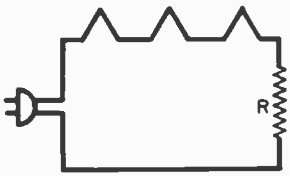

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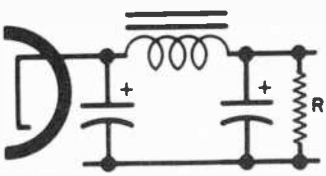

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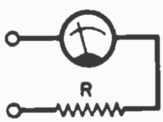

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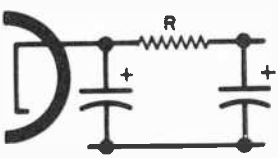
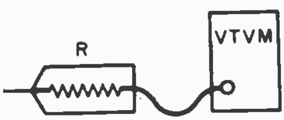


H



I

1 Current limiting resistor ______

2 Damping resistor ______

3 Ballast resistor ______

4 Filter resistor ______

5 Self-bias resistor ______

6 Isolation resistor ______

7 Range resistor ______

8 Parasitic suppressor ______

9 Bleeder resistor ______

(Answers appear on page 111)

ADVANCED EXPERIMENTERS CORNER

TAKING YOUR TRANSISTOR'S TEMPERATURE

By FRANKLIN C. FITCHEN

ABOUT THE AUTHOR

FRANKLIN C. FITCHEN calls on his broad knowledge of semiconductor theory in this, his first article for POPULAR ELECTRONICS. *An associate professor of electrical engineering at his own alma mater (the University of Rhode Island), Mr. Fitchen is also the author of* Transistor Circuit Analysis and Design, *recently published by the D. Van Nostrand Company.*

MOST EXPERIMENTERS know only too well that transistors don't like heat. The simple truth of the matter: any transistor will be permanently damaged if subjected to temperatures high enough to break down its crystalline structure. In practice, the upper temperature limit for high-quality germanium transistors is about 200°F, while silicon devices can withstand temperatures up to about 300°F.

Not so well known is the fact that the sources of heat may be internal as well as external. High temperatures from such external sources as soldering irons and nearby electronic parts can be minimized by careful soldering techniques and intelligent parts placement. Heat from internal sources, on the other hand, is far less easy to deal with. Let's see precisely how much heat is generated inside a transistor under operating conditions, and how we can measure this heat to insure that the transistor is operating within its temperature range.

Thermal Resistance. Suppose we begin by examining the manufacturer's specification sheet on any transistor for a statement about *thermal resistance*. You will find that this characteristic is usually expressed in units of *degrees Centigrade per milliwatt* (°C/mw). To determine the transistor's internal temperature under no-signal conditions, all you have to do is multiply the *thermal resistance* by the power (in milliwatts) being converted to heat at the transistor's collector-base junction. The result is the transistor's internal temperature rise in degrees Centigrade, and adding this amount to the room or air temperature (also in degrees Centigrade) will give you the transistor's calculated internal temperature.

This may sound easy to do, but the average experimenter is faced with two problems. First of all, how does one find the power being converted to heat at the collector-base junction? And secondly, how are degrees Centigrade converted to degrees Fahrenheit and vice-versa? Let's tackle each problem separately.

Fig. 1. Power converted into heat at the collector-base junction is determined by finding the product of the voltage and current at the junction.

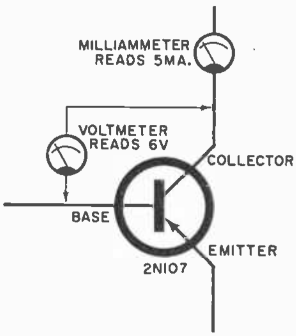


Figure 1 shows the typical no-signal current and voltage conditions for a 2N107 transistor—a type commonly used in experimenters' circuits. The voltage drop across the collector-base junction is 6 volts, and the current leaving the collector (hence, the current that must pass through the collector-base junction) is 5 milliamperes. To determine the power being converted into heat in the transistor, simply multiply 6 volts by 5 milliamperes. The answer, of course, is 30 milliwatts.

The manufacturer's specification sheet states that the thermal resistance for the 2N107 is 0.5°C/mw. Multiply this constant by the computed 30 mw., and the temperature rise in the transistor can be predicted to be 15°C. Now, to find the transistor's calculated internal temperature, all you have to do is add this temperature rise to the room temperature, having first insured that both temperatures are in degrees Centigrade.

To convert a temperature in degrees Centigrade to degrees Fahrenheit, you just multiply the Centigrade temperature by 9/5 and then add 32. Stated in equation form,

$$°F=\frac{9}{5}°C+32$$

(*equation 1*)

Working the other way—i.e., converting °F to °C, you subtract 32 from the temperature in degrees Fahrenheit and multiply by 5/9. Again, this can be reduced to a simple equation,

$$°C=\frac{5}{9}(°F-32)$$

(*equation 2*)

If you have no head for equations or computations, you can find the desired Fahrenheit or Centigrade temperature very easily on the conversion chart in Fig. 2.

Earlier, we saw that the temperature rise in the 2N107 was 15°C. Let's assume the room temperature is 77°F. Using *equation 2*, we find that the room

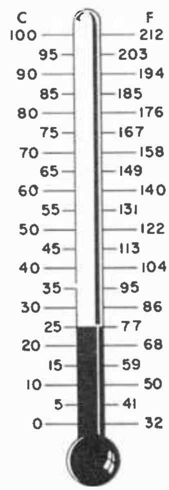


Fig. 2. The thermometer-type graph permits rapid conversion of temperature between the Fahrenheit and Centigrade systems.

temperature in degrees Centigrade is 25. So, we add 15°C to 25°C and find that the temperature at the collector-base junction is 40°C. Since the manufacturer's specifications for the 2N107 specify a 60°C maximum temperature at the collector-base junction, the transistor is operating well within its maximum temperature rating.

When you predict the internal temperature of a transistor using the thermal resistance calculations just described, you assume that the transistor is one which just meets manufacturer's specifications. In an actual production run, the thermal resistance of the transistors passed by quality inspection is usually less than the published specifications. This means that the temperature of the 2N107 collector-base junction will not be more than the 40°C just calculated. In fact, it will usually be less.

Leakage Current. To obtain a true measure of a transistor's collector-base junction temperature, we can make use of a known relationship that exists between the collector-base junction leakage current, I_{co}, and temperature. This leak-

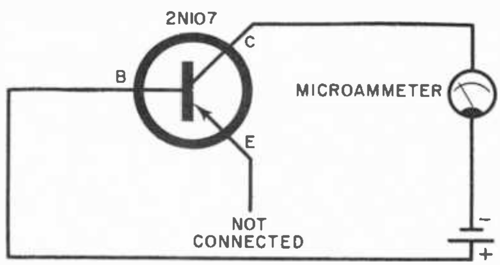


Fig. 3. Test circuit for measuring collector-base junction leakage current, I_{co}, of pnp transistors; reverse battery polarity to test npn types.

age or reverse current at the collector-base junction can be measured as shown in Fig. 3.

A dry cell is connected in series with the base and collector, with the positive terminal of the battery connected to the *n*-type terminal, and the negative battery terminal to the *p*-type terminal; the emitter is left disconnected. A microammeter inserted into the circuit measures the current flow, which, for low-power germanium transistors, is on the order of 1 to 20 microamperes.

The curve of the variation in I_{co} versus

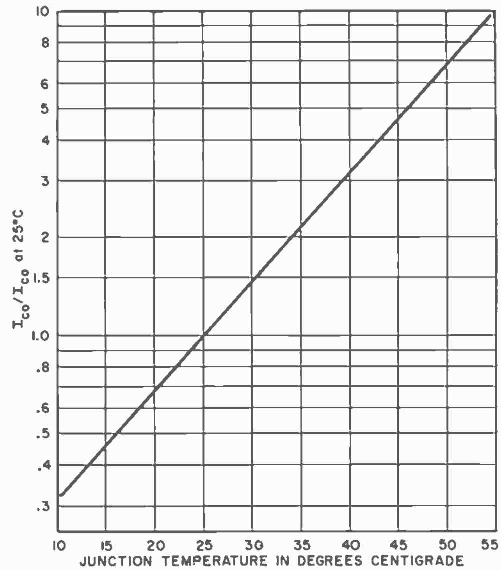


Fig. 4. Variation of I_{co} with temperature for the 2N107 pnp transistor. Refer to specification sheets for junction temperature curves of other transistors.

collector-base junction temperature is shown in Fig. 4. Similar graphs for most low-power (below 200 mw.) germanium transistors usually appear on the transistor's specification sheet.

Five steps are required to determine the ratio I_{co}/I_{co} at 25°C:

(1) Disconnect the transistor from its circuit and put it aside for a few minutes. This will insure that the transistor is at room temperature.

(2) Insert the transistor into the test circuit shown in Fig. 3 and measure the I_{co} at 25°C. Record this reading.

(3) Return the transistor to its original circuit, turn on the power, and allow a few minutes for the transistor to heat to a stable temperature; five minutes should be enough time.

(4) Remove the transistor from its circuit and quickly reinsert it in the test circuit shown in Fig. 3. Record the value of I_{co} before the transistor temperature has a chance to fall.

(5) Divide the value recorded in Step 4 by the value of I_{co} recorded in Step 2. The result will be the ratio of I_{co}/I_{co} at 25°C.

Now, to find the transistor's operating temperature in the circuit in which it will be used, all you have to do is mark the value determined in Step 5 on the vertical axis of the graph shown in Fig. 4. Then, draw a horizontal line from this point across to the sloping line, and draw a vertical line from the point of intersection to the horizontal axis of the graph.

The point of intersection with the horizontal axis will indicate the transistor's operating temperature in degrees Centigrade. As long as this operating temperature is below the manufacturer's stated maximum operating junction temperature, you can be sure that heat will not destroy the transistor.

Using a Switch. The author inserted a switch into an a.f. amplifier circuit (Fig. 5) to permit the transistor to heat up to actual operating temperature. Then, at a flip of the switch, the transistor was taken out of the circuit and placed in the test circuit. The switch enables the I_{co} reading to be made at almost the same instant, giving the transistor no time to cool off. In Fig. 5, the switch is shown in its normal position, i.e., with the transistor connected in the amplifier circuit.

It is important that the switch open the lead to the emitter before closing the line to the microammeter; otherwise the meter might be damaged if the collector current is too large. The switch used is commonly called a telephone key (Fig. 6) and has the advantage that all of its contacts do not "make" at the same instant. Therefore, a "slow" one was used for the microammeter connection.

In operation, the circuit must be allowed to stabilize for several minutes at its normal operating point. Then the switch is thrown to its other position and the microammeter read as soon as the needle stops moving—it is important to take this reading immediately, before the transistor begins to cool off. After the "hot" reading is taken, the transistor is allowed to cool for a few minutes to room temperature, then the microammeter is read again. The second reading is divided into the first for the I_{co}/I_{co} at 25°C. This ratio is entered on the graph (Fig. 4) and the collector-base junction temperature found as before.

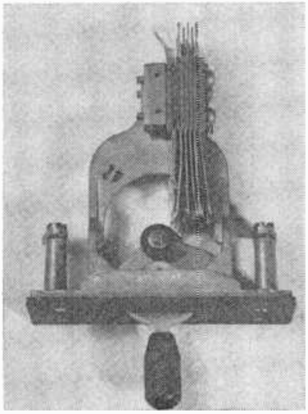


Fig. 6. Telephone-type key switches test circuit in Fig. 5. It is important that slow-make contacts be used to switch the 0-25 microampere ammeter.

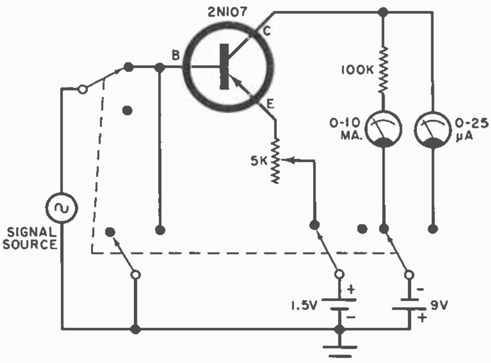


Fig. 5. Test circuit used by author to check collector-base junction temperature rise in a 2N107 pnp transistor under normal operating conditions.

Under "standby" or no-signal conditions, the transistor in Fig. 5 draws a collector current of 5 ma. with a collector-to-emitter voltage of 7 volts. Thus, the power dissipation at the junction is 35 mw. The I_{co} measures 14μa., and the I_{co} at room temperature is 6.5 μa., resulting in a ratio of 2.15. From the graph in Fig. 4, the internal temperature under these operating conditions is 35°C or 95°F. Since the manufacturer's specified maximum junction temperature for the 2N107 is 60° (140°F), the transistor is operating at a safe temperature in the designed circuit. -30-

On the Citizens Band

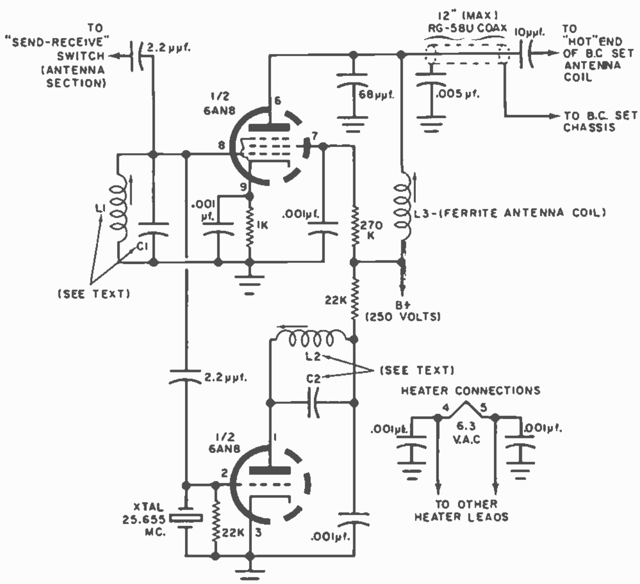
By DICK STRIPPEL, 2W1452

GUESS WHAT? It's 1962, and the Citizens Band is a little more than three years old. A lot has happened during those three years—the quality of equipment has improved greatly, and probably more than a half-million CB transmitters have gone on the air. (Since about 250,000 licenses have been issued, this estimate assumes an average of two transmitters per license.)

However, in this writer's opinion, CB'ers have not quite "come of age" yet. Too often there are still discourteous and even downright illegal operations on the band. So we have drawn up a set of New Year's resolutions which, if followed, should make our band a better place to operate.

- Never initiate a transmission without first checking the channel to see if it is in use.
- Keep down the number of "breaks." You wouldn't just charge into a private, face-to-face conversation, so why do it on the air?
- When requested to stand by while traffic is being passed, do so with a minimum of chatter—a simple "11-4" will suffice.
- Monitor your channel for a few moments after you sign off. Someone may have an important message for you, or even emergency traffic.
- Keep the "rat pack" "round robins" down. Nothing breeds chaos more quickly than five or six stations all trying to get their "nickel's worth" in during the same five minutes.
- Courteously assist CB visitors in your area when they request travel information.
- Last, and certainly not least, simply obey all FCC rules and regulations.

Tech Notes. Our mail has indicated that a number of CB'ers are interested in a simple converter to make a broadcast-band receiver into a double-conversion CB superhet. The schematic diagram at left shows a circuit for such a device which uses a 6AN8 tube.



If you presently use a superregenerative receiver employing a 6AN8, you'll be able to modify it slightly and thus keep the converter in your transceiver cabinet. If you decide to do this, you can use the coils (*L1* and *L2* in the diagram) which are already in the receiver section. If not, you can order replacement-type coils from the manufacturers of such units. The major electronic supply houses also stock coils suitable for use in this converter. Naturally, you'll also have to pick up suitable capacitors (*C1* and *C2*) to match the coils.

Caution: note that both the

inner and outer conductors of the coaxial cable are connected to the transceiver through capacitors. These capacitors are important, since without them the case of your transceiver could be carrying the full line voltage, making operation extremely dangerous.

The 25.655-mc. crystal shown in the diagram should be of the "third overtone" type, and it can be obtained from any one of a number of manufacturers. Also note that the converter should be connected to the broadcast set through not more than one foot of coaxial cable.

After connecting the converter to the BC set, adjust the trimmer on the large (r.f.) section of the BC set's tuning capacitor for maximum volume. You'll be able to receive CB signals from about 1300 kc. through 1600 kc. on the dial.

To align the converter, simply adjust the slugs in *L1*, *L2*, and *L3* for maximum noise output from the BC set.

TVI and You. We recently received a telephone call from a somewhat distraught CB'er who had been told that he was causing interference on a neighbor's TV set. Unfortunately, the complainer—who was quite angry—refused to give his name, and the distressed CB'er wanted to know what he should do.

Every now and then we hear about similar cases of TVI (television interference), and only a few days ago we came across a newspaper clipping which told of CB interference to a public address system in a church. Of course, the people interfered with are understandably annoyed, and the complaints must be handled with diplomacy.

Interference to TV, radio, or other electronic devices is caused by two factors. The first is harmonic radiation. This is usually only picked up on TV Channel 2, since the second harmonic of CB transmissions falls within this channel. The FCC has set down rules covering harmonic radiation, and if your rig is causing Channel 2 interference, it's a safe bet that your transmitter is not operating properly.

Most commercial CB rigs do not produce enough Channel 2 interference to bother a TV set in the same room. If your set does, it's almost certain that either your output or TVI trap is improperly adjusted. Check your instruction book and make necessary changes.

The diplomacy part comes in when someone must tell the person suffering the interference that his trouble may be due to poor design in his TV, radio, or p.a. system. The best thing to do is enlist the support of a good local radio and TV repairman.

The second, and far more common type of interference, is caused by improper design or malfunction of the set which is being interfered with. In the case of a public address amplifier, certain leads could be just the right lengths to act as coils tuning the CB band. Again, a corroded or poor solder joint could be acting like a simple crystal detector.

Many older TV sets use an intermediate frequency in the 27-mc. band, and poor circuit design can cause a CB signal to be picked up in the 27-mc. section of the set. This type of TVI is easily identified because it is received on all channels. The only cure is for the person owning the set to have a "high-pass filter" installed at the TV set's antenna terminals.

Club Notes. We have finally received some word about club participation during hurricanes "Carla" and "Esther" last September. . . . In Lubbock, Tex., members of the Lubbock Citizens Band Radio Club joined forces with the Salvation Army and the Red Cross in providing communications for relief work, such as distributing food and clothing. . . . Up Rhode Island way, the Bristol County CB'ers volunteered their services to local Civilian Defense officials when "Esther" came along. They set up a base station in the Bristol police station to control 15 mobile units. Fortunately, damage was light, but the CB'ers gave a good account of themselves and won the respect of local officials.

The 10/99 Club of Anaheim, Calif., plans events every Monday and Friday night to keep up club interest. Most of these activities are simply "coffee breaks" when members can get together to discuss CB, or whatever. Guest speaker at their October meeting was Mr. Bernard "Pop" Linden, recently retired engineer in charge of the 11th FCC District.

In closing, here's a bid for you to keep that club news coming in. If your club participates in a local emergency or activity, let us know about it as soon as it's over. —30—

"LINE BLENDER" for TV Screens

Plastic filter optically "removes" scanning lines from picture tubes

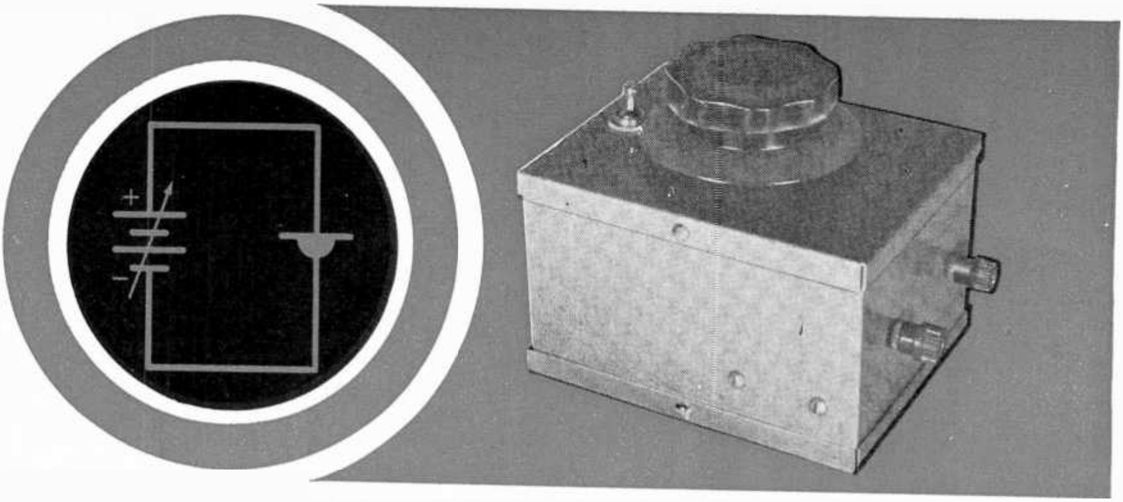
Photo at top shows effect of scanning lines on TV screen; photo at right shows identical screen with lines "removed." Note that difference has been exaggerated here for emphasis.

RECENTLY introduced in Germany by the giant Saba Works, a unique television "filter" will soon be available for American scanning systems.

As you probably know, the "picture" on your television set is actually comprised of a succession of individual lines which sweep at a slight angle from left to right across the screen. In the United States, the "525-line" system is standard. Even so, less than 480 lines actually appear on the screen, since some are lost in the interval it takes the electron beam to travel from the bottom of the picture back to the top to start its "trip" all over again.

As TV screens have gotten larger and larger, the scanning lines have become more and more noticeable, especially at short viewing distances. Now, by placing Saba's specially designed plastic filter in front of the picture tube, the individual lines can be blended into one smooth picture. The result is an image which appears to be "lineless" at any distance and which looks very much like the picture you see on the screen of your neighborhood movie theatre. —30—

Unlike electronic systems (the "wobbulator," for example), Saba's new filter is optical in nature. Its effect is to blend individual lines into a single, "lineless" picture.



For Experimenters ...

TD POWER SUPPLY

By RUFUS P. TURNER

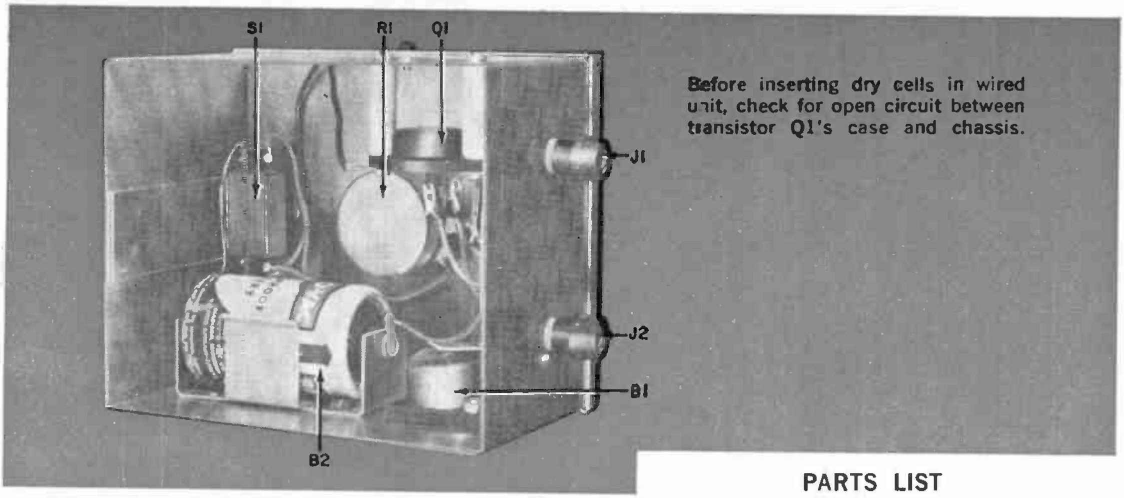
ONE of the annoying drawbacks in experimenting with tunnel diodes* is that an adequate power supply is usually not available on the experimenter's bench. The easy-to-assemble TD power supply described in this article fulfills the three basic specifications a tunnel diode power supply should have. They are: (1) an internal resistance of 10 ohms or less, (2) a d.c. output continuously variable from 10 to 500 millivolts, and (3) good regulation—since tunnel diodes operate best when their supply voltage "stands still."

The simplest kind of variable power supply for powering tunnel diode circuits, shown in Fig. 1, consists of a 1.5-volt dry cell (*B1*) and a voltage divider consisting of a potentiometer (*R1*) and two fixed resistors (*R2* and *R3*) in series. The current through the divider ranges from 1.5 ma. when *R1* is set at 1000 ohms to 50 ma. when *R1* is set at zero. Accordingly, the d.c. output voltage varies from 15 to 500 millivolts. The output resistance is a bit less than 10 ohms (determined primarily by the value of *R3*). But this simple supply has two disadvantages: (1) a large current flows through the potentiometer when the latter is set near its low-resistance end, and (2) fluctuations in battery voltage cause the output voltage to fluctuate.

Transistorizing. The disadvantages of the circuit in Fig. 1 can be overcome by substituting a low-priced power transistor for the potentiometer. The transistor can safely carry much higher currents and, if it is operated as a common-emitter d.c. amplifier, a small control current (safe to vary with a small potentiometer) will vary the high current through the output resistor. A further advantage results from the almost flat collector current-voltage curve; the battery voltage can fluctuate without causing very much of a change in the output voltage.

Figure 2 shows the complete circuit of the transistorized TD power supply. The 2N255 power transistor (*Q1*) operates as a common-emitter amplifier. The base input current (I1) can be varied between 0.13 and 2 ma. by adjusting potentiometer *R1*, causing the collector current (I2) to vary between zero (ap-

**For detailed information on how the tunnel diode works, see* POPULAR ELECTRONICS, *September, 1960, page 52.*



Before inserting dry cells in wired unit, check for open circuit between transistor Q1's case and chassis.

To test tunnel diode circuits, you will need a continuously variable, well-regulated low voltage

PARTS LIST

B1—1.35-volt mercury cell (Mallory RM3R)
B2—1.5-volt size "D" dry cell (Burgess #2 or equivalent)
J1—Insulated binding post, red (E. F. Johnson 111-102 or equivalent)
J2—Insulated binding post, black (E.F. Johnson 111-103 or equivalent)
Q1—2N255 transistor
R1—10,000-ohm potentiometer
R2—300-ohm, 1-watt resistor
R3—10-ohm, 1-watt resistor
S1—D.p.s.t. toggle switch
1—5" x 4" x 3" aluminum utility box (Bud CU-2105A or equivalent)
1—Battery holder for B1 (Keystone 104 or equivalent)
1—Battery holder for B2 (Keystone 175 or equivalent)
1—Transistor mounting kit—optional (Motorola MK-15)

proximately) and 50 ma. The collector current flows through the 10-ohm resistor (*R3*) and produces an output voltage drop that varies from 10.0 to 500 millivolts.

The output voltage does not drop to zero because the 1-ma. static collector current of the transistor used in the author's model produces a voltage drop of 10 mv. across *R3*. This minimum voltage will vary with the make of transistor. In the event that the output voltage of the power supply you assemble exceeds 500 millivolts, it will be necessary to increase the value of *R2* by 50 to 100 ohms—as required—by a trial-and-test technique.

Collector voltage is provided by a 1.5-volt size "D" flashlight dry cell (*B2*), while base input (control) voltage is provided by *B1*. To insure a steady input voltage, a 1.35-volt mercury cell is used for *B1*. A mercury cell maintains a relatively constant voltage throughout its useful life.

Because of the amplification provided by the transistor, the base input (control) current, I1, should be limited to

(*Continued on page* 116)

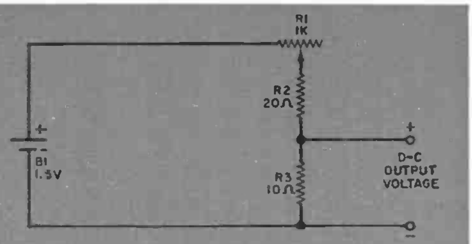
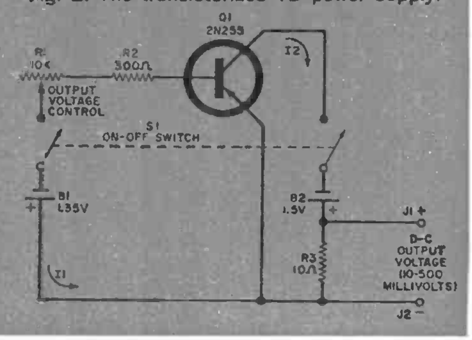


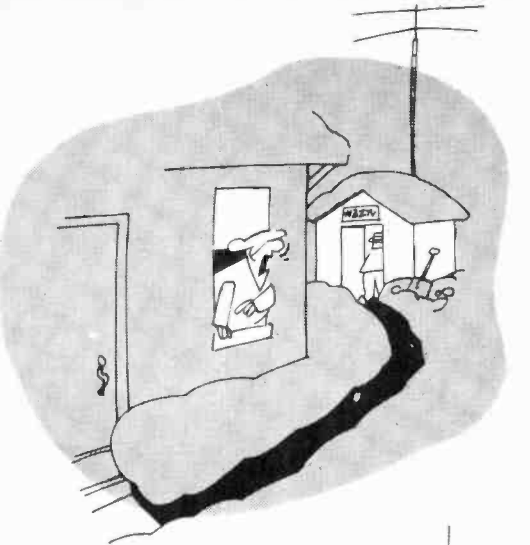
Fig. 1. Simplest tunnel diode power supply.

Fig. 2. The transistorized TD power supply.



Hobnobbing with Harbaugh

Just Plain QRM



"I said the front walk!!"

"I forgot to tell you, I was dusting in here and pulled the cord out."

"I'd like to see something with an early American antenna."

"The TV man left it here by mistake . . . all I can get on it is a wiggly line."

Across the Ham Bands

By
HERB S. BRIER
W9EGQ

ARRL "NOVICE ROUNDUP"

WANT TO WORK a bunch of new states and receive a batch of new QSL cards? A golden opportunity for you to do both is presented by the Eleventh Annual ARRL "Novice Roundup" contest which starts February 3 at 6:00 p.m., local time, and continues until February 18 at 9:00 p.m., local time. The rules are simple: each operator works as many stations as possible over a total of 40 hours or less in the contest period, using any or all of the Novice bands. Contacts are made by calling "CQ NR" or answering such calls by other stations.

To complete a contact, each operator sends the other a contest number (beginning with Nr. 1 for his first contact) and the name of his section. The ARRL sections correspond to the U. S. states, the Canadian provinces, the West Indies (Puerto Rico, Cuba, etc.), and the Canal Zone. California, however, is divided into eight sections; New York into three; Florida, Massachusetts, New Jersey, Pennsylvania, and Texas into two each.

One point is earned for each completed contact, and your final score is the number of contact points multiplied by the number of different sections worked—with a bonus. If you have an ARRL Code-Proficiency Certificate, you can add the code speed shown on the certificate to your contact points. For example, if you work 15 stations in eight sections, and have a 10-wpm certificate, your total score will be: $(15 + 10) \times 8 = 200$ points.

The scores are sent to the American Radio Relay League, Inc., 38 La Salle Rd.,

Novice Station of the Month

Lou Waters, WV2TCW, 356 2nd Ave., Troy, N. Y., sent in the winning entry in the photo contest this month. WV2TCW uses an EICO 720 transmitter, a National 270 receiver, a 15-meter dipole, and an "all-band" antenna. In three months, he has made over 500 contacts in 31 states, Canada, Belgium, and other countries. Incidentally, his log includes contacts with nine YL's.

Lou will receive a 1-year free subscription to P.E. for his photo. If you'd like to try for a similar award, send us a picture of your station—preferably with you at the controls, and include some information about yourself, your equipment, and your activities. Maybe you'll be one of the lucky winners. All photo entries should be sent to Herb S. Brier, c/o POPULAR ELECTRONICS, Box 678, Gary, Indiana.

High stability of Mosley CM-1 ham receiver belies its low price tag. Set uses six tubes, two diodes.

West Hartford, Conn., and the winning Novice in each section receives a certificate. (A prior request to the same address will promote some contest log sheets and an ARRL section map to help you tabulate your score.)

While General Class and Canadian hams are not eligible for an award, they are nevertheless invited to participate in the Novice Roundup and help Novices add points to their scores.

Reciprocal Licensing. Many countries extend the courtesy of reciprocal licensing privileges to each other's amateurs. But a provision of the United States radio laws—not originally aimed at hams—prevents amateurs from other countries (except Canada) from operating in the United States. This is a source of resentment against the United States for many foreign amateurs, and it also prevents U.S. hams from operating in countries with reciprocal licensing laws.

As mentioned in the *FCC Report* (November, 1961, POPULAR ELECTRONICS), Senators Barry Goldwater (ex-6BPI), Arizona, and Andrew F. Schoeppel, Kansas, are trying to do something about this situation. They introduced a bill (S.2361) in the United States Senate on August 1, 1961, to amend the Communications Act of 1934 so that foreign amateurs would be permitted to operate in the United States under proper safeguards. The bill is now being considered by the Senate's Interstate and Foreign Commerce Committee, and you can help get it enacted into law by writing to your two U. S. senators and telling them that you favor it. Ask your friends to write to their senators, too.

Receiver Breakthrough. Judging from the specs of the new CM-1 10- to 80-meter ham receiver, Mosley Electronics, Inc., 4610 North Lindbergh Blvd., Bridgeton, Mo., may have achieved a real breakthrough in ham receivers by producing a rock-stable set for $169.95. (An accessory matching speaker is priced at $16.95.)

The crystal-controlled h.f. oscillator, variable first i.f., voltage regulation, and temperature compensation account for the CM-1's high stability. Include 2.5-kc. selectivity, ½-microvolt sensitivity, an S-meter, and a noise limiter, and you have a lot of performance from six tubes and two semiconductor diodes.

You can write to Mosley for more information or see the CM-1 at most ham supply houses.

HIGH-PERFORMANCE TRANSMITTER

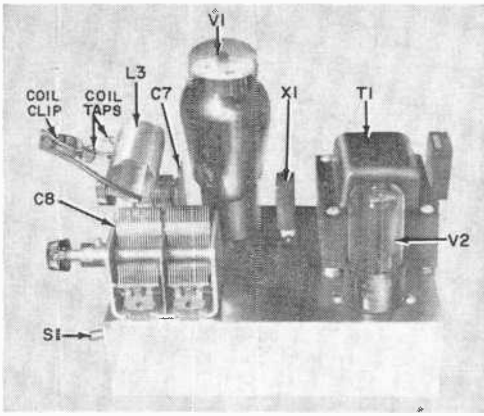
Though simple to build, this 25- to 30-watt, crystal-controlled c.w. transmitter will, under the same conditions, produce a signal within one "S" unit of that emitted by a transmitter running the full Novice power of 75 watts. Especially designed for the 80- and 40-meter ham bands, the rig also works well on 20 meters. The power supply is built-in, the signal is ripple-free, and keying characteristics are good.

Construction. A 5″ x 7″ x 2″ aluminum chassis comfortably accommodates the transmitter and its power supply. The key jack and power switch are at the front of the chassis and the output connector and power cord are at the rear. The fixed capacitors, r.f. chokes, and resistors are supported by their leads; wiring is point to point; and ground connections are made to solder lugs placed under strategically located mounting screws.

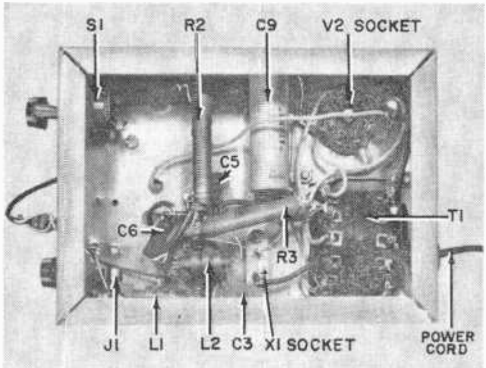
The stator terminals of dual variable capacitor *C8* are connected together, placing the two sections in parallel. For extra rigidity, each lead of coil *L3* is doubled back upon itself and wrapped once around the plastic coil-form strip where it terminates. Coil *L3* is then mounted between the stator terminals of capacitors *C7* and *C8*. Taps made of looped wire are soldered to *L3* at 6 and 14 turns from the *C7* end. A 3″ length of insulated wire is connected to the *C8* side of *L3* and a small battery clip soldered to its free end.

PARTS LIST

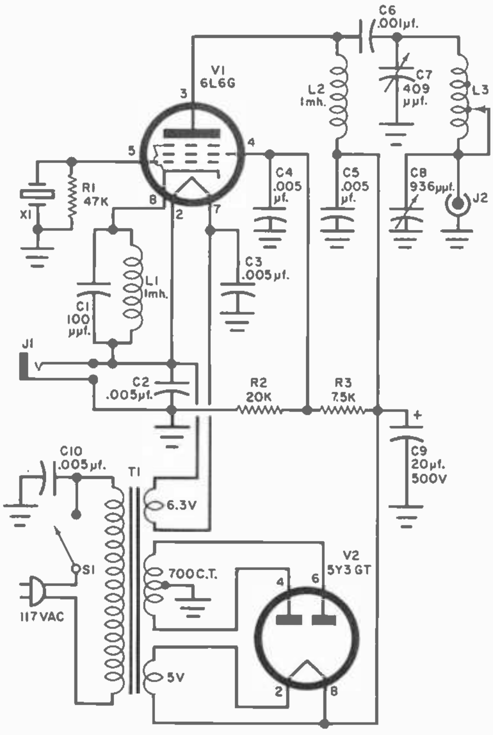
C1—100-μμf. mica capacitor
C2, C3, C4, C5, C10—0.005-μf. ceramic capacitor
C6—0.001-μf., 1000-volt mica capacitor
C7—409-μμf. variable capacitor (Allied 61 H 009 or equivalent)
C8—Dual 468-μμf. variable capacitor (Allied 61 H 059 or equivalent) with both sections in parallel
C9—20-μf., 500-volt electrolytic capacitor
J1—Open-circuit phone jack
J2—Chassis-type coaxial connector (Amphenol 83-1R or equivalent)
L1, L2—1-mh. r.f. choke
L3—29 turns of #20 wire, 1" diameter, 1 13/16" long, tapped 6 and 14 turns from output end (cut from B&W 3015 Miniductor or equivalent)
R1—47,000-ohm, ½-watt resistor
R2—20,000-ohm, 10-watt resistor
R3—7500-ohm, 5-watt resistor
S1—S.p.s.t. switch
T1—Power transformer; primary, 117 volts; secondaries, 700 volts CT @ 90 ma., 5 volts @ 2 amperes, 6.3 volts @ 3 amperes (Stancor PM-8409 with filament CT unused, or equivalent)
V1—6L6-G tube
V2—5Y3-GT tube
X1—Transmitting crystal—see text
1—5" x 7" x 2" aluminum chassis (Bud AC-402 or equivalent)
Misc.—Insulated tie points, tube sockets, solder lugs, power cord and plug, crystal socket, etc.



There's not much wasted space on the transmitter chassis, as can be seen in these top and bottom views. Top view (above) shows that the power supply components take up one third of the area.



Schematic of high-performance c.w. transmitter shows simplicity of circuit. Only two tubes are needed, including power-supply rectifier.



Tuning and Operation. On 80 meters, all of coil *L3* should be in the circuit—so the coil-shorting clip is not used; to get it out of the way, clip it to one of the *C8* stator terminals. For 40-meter operation, attach the clip to the 14-turn tap; on 20 meters, use the 6-turn tap.

With the coil adjustment made, plug in a crystal for the band you will be using. Eighty-meter crystals are normally used on "80," 40-meter crystals on "40." It's possible, however, to use an 80-meter crystal whose second harmonic falls in the 40-meter band for 40-meter operation. Forty-meter crystals with second harmonics on the 20-meter band are always used on "20."

Now connect a No. 45 pilot lamp or a 100- to 150-ma. d.c. meter in series with the ungrounded key lead. With the antenna connected and both variable ca-

(*Continued on page* 108)

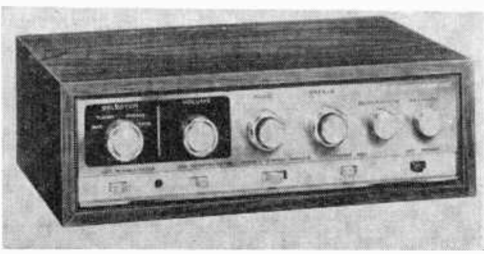
Transistor Topics

By LOU GARNER

With the beginning of a new year, it is once again time to open our "secret chest" and drag out our dusty crystal ball, cleaning and polishing it in anticipation of successful predictions for the coming year.

This annual guessing game with the semiconductor industry is a lot of fun, even if embarrassing at times. Nearly all of our predictions come to pass, but the timing is often a wee bit off. In some cases, the industry moves so fast that the "prediction" actually comes true *before* the January issue rolls off the presses. In other cases, however, manufacturers are several months late in offering the products anticipated by yours truly.

For example, in January of 1960 we predicted that a "two-bit" transistor would be offered that year. The prediction came true—*but not until mid-1961,* when Radio Shack, Lafayette Radio and other distributors offered "packs" of four transistors at slightly under one dollar. Perhaps we should check out the printed circuits in our crystal ball—with special reference to the time constants!!



Among the latest in hi-fi equipment is this all-transistor stereo amplifier kit from Allied Radio.

Before turning to the coming year and sticking our neck out again, let's review the box-score of "guesstimates" for last year. In our January 1961 column, we predicted:

✓ A race towards transistors among CB equipment manufacturers—*double-check*—look at the types and models offered in current ads!

✓ A medium-power transistorized CB transmitter—*double-check*—Cadre Industries offers such equipment, and rechargeable batteries can be installed, just as predicted.

✓ Increasing use of transistors in amateur radio gear—*check*—but, as of this date, no manufacturer is offering a transistorized SSB transmitter, so we struck out on this part of our forecast.

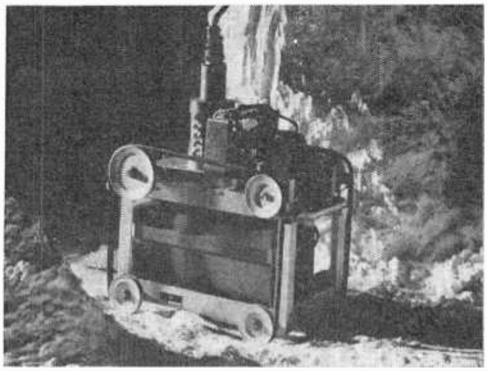
✓ Medium-power r.f. transistors at under three dollars—*struck out* again—but, as the old saying goes, "Wait 'til next year!"

✓ A swing to transistors for R/C work—*double-check.*

✓ Increased use of transistors in hi-fi equipment—*triple-check*—see our October 1961 column, and refer to current catalogs!

Things To Come. Even after double-checking the circuits in our crystal ball, we're still a little dubious about the time constants . . . but here goes!!

In 1962, watch for . . . "experimenters'" tunnel diodes at tube prices or less . . . *transistorized CD gear for fall-out shelters and personal use* . . . a transistorized stereostethoscope for doctors . . . *high-frequency medium-power transistors for under $5.00* . . . silicon transistors for hobbyists for under $2.00 . . . *a medium-priced (under $350.00) transistorized oscilloscope* . . . a new type of



First U.S. "moon-shot" will undoubtedly call on a battery of transistorized equipment. Lunar vehicle shown above will collect data on moon, yet be controlled from earth. Cutler-Hammer is the designer.

transistor or semiconductor device based on the use of crystalline carbon (diamond) . . . *an increase in the use of transistors in hi-fi equipment, coupled with a drop in the number of firms offering transistorized CB "walkie-talkies"* . . . the introduction of a transistorized personal small-arms detector . . . *and, finally, a U.S.-sponsored "moon-shot" carrying a transistorized TV camera.*

Reader's Circuit. Assuming that a transistor is neither excessively leaky nor "open," its most important parameter as far as general experimental work is concerned is its gain or *beta*. This value may range from as low as 5 to well over 100, depending on the type of transistor and the conditions under which it is checked. In many switching and control circuits, low-*beta* transistors will give quite satisfactory results. In preamplifiers, receivers, and similar projects, on the other hand, high-*beta* units are required for optimum performance. Finally, in some cases—push-pull circuits, for example—the exact value of *beta* is not overly important, provided a pair of transistors with identical gain characteristics can be found.

Unfortunately, a transistor's *beta* is seldom given as an exact value, even under specified test conditions. Rather, semiconductor manufacturers will list "minimum," "average," and "maximum" values. Better-quality transistors generally have a specified *beta* spread of three to one; typically, from 25 to 75. Inexpensive transistors can have a *beta* range as high as 10 or 20 to 1, and a unit will be considered "good" if its *beta* falls anywhere between 10 and 100.

With these facts in mind, and realizing that most hobbyists prefer to use low-cost transistors, a number of readers have suggested designs for inexpensive d.c. *beta* checkers. One of the more interesting circuits is illustrated in Fig. 1. It was designed by P. L. Conant.

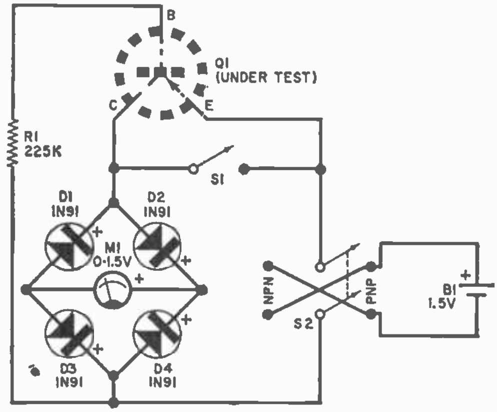
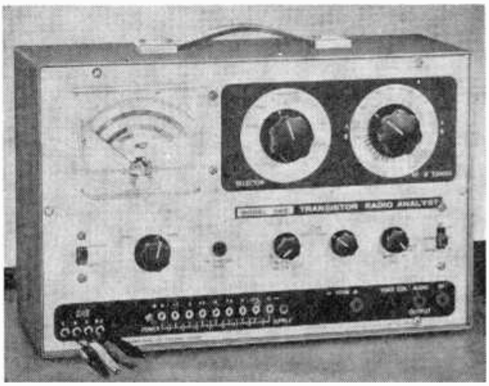


Fig. 1. Inexpensive beta tester designed by reader P. L. Conant will check either npn or pnp transistors, depending upon position of d.p.d.t. switch S2.

Referring to the schematic diagram, and ignoring the diodes and switches for the moment, *beta* is checked by using the transistor, *Q1,* as a d.c. amplifier in the common-emitter arrangement, applying a fixed base bias, and measuring the resulting collector current. In this case, the base bias is determined by series base resistor *R1* and the supply voltage *B1,* with the collector current directly proportional to *Q1*'s *beta.* In practice, *R1*'s value is chosen so that *beta* can be read directly on the 1.5-volt d.c. voltmeter *(M1)* used as *Q1*'s collector load. Meter readings are multiplied by 100, permitting *beta* readings of up to 150.

The circuit has several interesting features. Either *npn* or *pnp* transistors can be checked simply by reversing the polarity of the supply voltage; a cross-connected d.p.d.t. switch, *S2,* is used for this purpose. A diode bridge circuit *(D1, D2, D3,* and *D4)* insures correct meter polarity and an "up-scale" reading regardless of supply voltage polarity. A s.p.s.t. push-button switch, *S1,* connects the battery directly across the diode/meter circuit, permitting a built-in test of battery condition. Operating power is supplied by a single flashlight cell *(B1)* rather than a more expensive 9-volt battery.

All the components are standard and readily available through regular parts distributors. The only critical items are the bias resistor, *R1,* and the meter *(M1)*. A 225,000-ohm, 1% unit should be



The Model 960 tester made by B & K Manufacturing Co. is designed for servicing transistor radios.

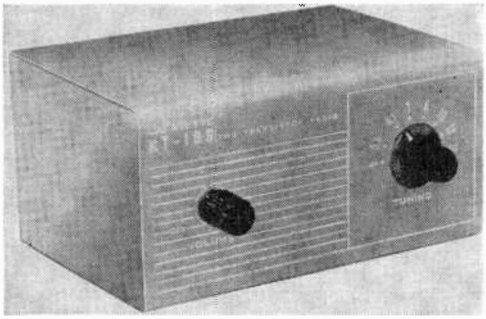
used for *R1,* and a standard 0-1.5 volt d.c. voltmeter with a sensitivity of 1000 ohms/volt for *M1*. Although type 1N91 diodes are specified, other general-purpose units should give satisfactory results. Switch *S1* can be a push-button or spring-return slide or rotary switch; a toggle, slide, rotary, or lever switch may be used for *S2,* depending on individual preferences.

The *beta* checker can be assembled in a single evening without difficulty, even allowing time for a coffee or "Coke" break. A sloping-front meter cabinet, a Minibox, or a small plastic box can be used as a case, with a standard transistor socket and/or flexible test leads and miniature alligator clips provided for the transistor. Neither layout nor lead dress is critical, but the usual precautions should be observed when soldering the diodes in place to avoid heat damage.

In operation, the condition of the battery is checked first by throwing on *S1;* a full-scale reading should be obtained. Afterwards, *S2* is thrown to the proper position for the type of transistor to be checked and the transistor is inserted in the test socket. If flexible leads are used for connecting the transistor, the *emitter* and *collector* terminals should be connected first, the *base* terminal last. Finally, the meter reading (0 to 1.5 volts) should be multiplied by 100 to arrive at the *beta* figure.

This test assumes that the transistor has negligible leakage—as will be the case for most units in good condition. If collector leakage is high (as determined by a check with the base lead disconnected), this value must be subtracted from the final meter reading.

Product News. An interesting test instrument has been announced by the B & K Manufacturing Co. (1801 W. Belle Plaine, Chicago 13, Ill.) Known as the Model 960 Transistor Radio Analyst, this



Low-cost transistorized AM radio kit by Lafayette Radio is battery-operated and requires no soldering.

instrument sells for $99.95 and is intended to simplify transistor radio servicing. It combines, in one unit, the features of a signal generator, d.c. power supply, VTVM, milliammeter, ohmmeter, and transistor checker. As a signal generator, the "960" supplies modulated r.f. signals for signal injection tests of r.f., i.f., converter, and detector stages, as well as an audio signal for checking audio stages and speakers. As a substitute power source, the unit can supply from 1.5 to 12.0 volts, d.c., in 1.5-volt steps. Both in-circuit and out-of-circuit transistor test provisions are included.

Featuring a unique type of construction, a transistor radio kit recently introduced by Lafayette Radio (165-08 Liberty Ave., Jamaica 33, N. Y.) is intended for the hobbyist with limited

(Continued on page 100)

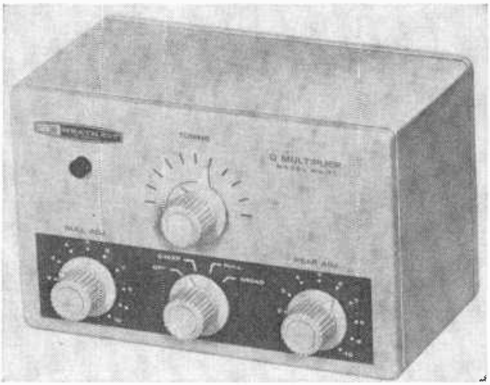
Short-Wave Report

By **HANK BENNETT**
W2PNA/WPE2FT

Q-MULTIPLIER AND RECEIVER KITS

THERE ARE two new kits available from the Heath Company which will be of interest to SWL's: the HD-11 Q-multiplier and the GR-91 receiver. Both are easy to build with the instructions provided and both should help furnish many hours of listening pleasure.

The *HD-11 Q-multiplier* can be used with any communications receiver having an i.f. between 450-460 kc., and with either a.c./d.c. or transformer-operated receivers. This "electronic filter" greatly increases receiver i.f. selectivity (it has an effective *Q* of approximately 4000) for peaking or rejecting a signal on AM, c.w., or SSB. It can be used to produce a sharply peaked i.f. curve for c.w. reception, broad peaked i.f. for phone operation, or a deep rejection notch to eliminate a closely interfering heterodyne; both peak and notch positions are tunable to any point in the receiver's i.f. bandpass.



Weighing only two pounds (net), the HD-11 has a built-in power supply and comes complete with connecting i.f. cable, plug and socket for receiver attachment. It's priced at $14.95, f.o.b., Benton Harbor, Mich.

The *GR-91 receiver* covers 500 kc. to 30,000 kc. in four bands which are clearly marked on an illuminated 7″ slide-rule dial. High sensitivity and good stability are insured by the modern four-tube plus silicon rectifier superheterodyne circuit, the tubes being a 12BE6 oscillator/mixer; a 12BA6 i.f. amplifier and BFO; a 12AV6 second detector, a.v.c., and first audio amplifier; and a 50C5 beam power output tube.

Among the special features of the GR-91 is an all-new illuminated tuning meter that shows relative signal strength of each station; front-panel controls include audio gain, electrical bandspread, AM/standby/c.w. switch, bandswitch, BFO, main tuning, and antenna trimmer. On the rear of the chassis is a noise limiter switch, a headphone jack, a Q-multiplier jack, and an antenna jack with provisions for both balanced (300-ohm) or unbalanced (75-ohm) inputs. A built-in 3″ x 5″ speaker is also included.

Furnished in an all-steel cabinet, the GR-91 weighs nine pounds and is priced at $42.50, f.o.b., Benton Harbor, Mich.

(*Continued on page 110*)

By
JOHN T. FRYE
W9EGV

Carl and Jerry

Wired Wireless

"MIND telling me why we're climbing to the sixth floor of Gary Hall?" Jerry puffed as he followed his athletic chum, Carl, up the stairs.

"Jimmy Young, chief technical and maintenance engineer of WCCR, master station of the carrier-current campus radio network, wants to see us. And we've been itching to see the station. Need I say more?" Carl asked as he pushed open the door at the top of the stairs.

A stocky, dark-complexioned young man rose from a chair across the large room and came to meet them. "You must be Jerry Bishop; and you, Carl Anderson," he said, holding out his hand. "I'm Jimmy Young. Thanks for coming. Want to take a quick look around the station before we get down to the little matter I have in mind?"

"Yeah!" Carl and Jerry chorused.

A grin spread over Jimmy's face as he brushed back his dark hair with his hand. "Okay, but first you gotta suffer through my two-dollar lecture," he warned.

"You're now standing in the office and lounge of WCCR, master station of what we think is the oldest and largest carrier-current campus radio network in the world. There are four other stations in the net: WMRH in H1 Residence Hall, WHRC in H2, KMRX in H3, and WCTS in the State Street Courts. As soon as it's completed, we expect to add a sixth station, WGRC, in the Women's Residence Hall.

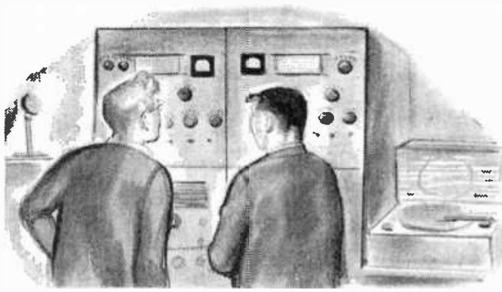
"Each station," he continued, "operates on a selected crystal-controlled frequency somewhere between 570 and 660 kilocycles. The r.f. from the transmitter is fed into the power circuits of the particular residence unit so that any radio inside the building can pick up the program but no signal can be heard outside. Each station is self-sufficient; it's constructed, maintained, and operated by students housed in that building, and it furnishes programs for the residents of that one housing unit.

"At the same time, each satellite station is connected to the patch board of this master control station by a closed telephone loop so we can feed programs to it or it can furnish programs for the network. All five stations take turns furnishing network programs. A simplex telephone circuit in connection with each telephone loop permits exchanging information about programing, etc.

"Now, let's go into Studio A, our master control room."

THE BOYS followed him through the door, and the first thing that caught their eyes was a couple of standard six-foot racks filled with electronic equipment. A control console, two turntables, tape recorders, an AM-FM tuner, and other assorted pieces of equipment were arranged for maximum convenience.

"I'll talk about WCCR," Jimmy announced, "for it's the oldest and most sophisticated station, and it's the one I know the most about; but the basic transmitters of the other stations are similar. This is the station for Gary



Carl and Jerry

(*Continued from page* 82)

Hall, often called the Men's Quadrangle because it actually consists of six residence halls arranged in a rectangle. Power circuits for the Quadrangle are fed from six different power boxes furnishing 220 volts single phase a.c.; so we have to feed our r.f. into each of these boxes."

"Must take lots of r.f.," Carl said. "How many kilowatts do you run?"

"We use two separate transmitters here at WCCR so we can transmit the same program on two different frequencies and provide stereo reception, but each transmitter inputs only about 30 watts! In fact, the transmitters are revamped Heathkit DX-35's. We put in new oscillator coils and plate-tank pi-networks designed to have a satisfactory *Q* at a low, broadcast-band frequency, and to feed a 72-ohm coax line. These transmitters are plate-modulated in each case by a pair of 5881's in Class AB_1 driven by a 12AX7 as a combination amplifier and phase-inverter."

"Then what's the rest of that stuff?" Carl asked, waving at the big racks.

"Preamplifiers, monitor amplifiers, cue amplifiers, limiter amplifiers, patch board, power supplies, and other little goodies needed to transmit really high quality programs and to serve as a master control station. Our preamps and line amps are flat from 10 cycles to 25,000 cycles, but we restrict the high end to 9000 cycles and boost the bass before feeding the signal to the modulator. We do this to prevent splatter and to compensate for the poor low-frequency response of the small radios used to receive us."

"You say you run two different r.f. signals into your single 'antenna,' the power lines, when you're operating stereo," Jerry commented. "How do you prevent interaction between the two transmitters?"

"We use what we call a hybrid junction. This is similar to the diplexer unit a TV station employs to feed both the audio and video transmitters into the same antenna. Actually, it's a form of r.f. bridge that permits each transmitter to feed the line but prevents r.f. from backing up into the other transmitter."

"How do you actually couple into the power boxes?" Carl wanted to know at this point.

"We use an r.f. transformer for each box. The primary is tapped so we can hook several in parallel and still get a proper impedance for our 72-ohm line. Each side of the secondary goes through an 0.0005 blocking capacitor and a 10-ohm, 5-watt resistor to one side of the 220-volt line. The capacitor, of course, keeps the 60-cycle a.c. out of the transformer winding.

"We've found that the impedance from one side of the power line to ground varies between 1/4 and 1/2 ohm at our carrier frequency as different devices in the building are switched on or off. Naturally a two-to-one change in load impedance would badly upset any established match; but when the resistor is inserted, the impedance seen by half the transformer secondary can only vary between 5 1/4 and 5 1/2 ohms, and that can be tolerated. Lots of power is lost in the resistors, but we've enough left."

"Can you pick up the program on a transistor radio in one of the rooms, or does the radio have to be plugged into the line?" Carl asked.

"You know you can pick it up on any kind of radio; so stop pulling my leg! In fact, you can receive it with only a pair of earphones clipped across a 1N34 diode. Remember, you're practically sitting on the antenna, for every wire in the building is radiating r.f. for a short distance."

"What hours do you operate?" Jerry questioned.

"We're on twenty-four hours a day, seven days a week. We start with some rock-and-roll wake-up music around 7:30 a.m. During the rest of the morning we feature good-to-study-by music, not too distracting, and a special lunch program of music is on during the noon hour. In the afternoon we play 20 or 30 of the top records. Dinner music is on from 5:30 to 6:30, and after dinner we have more pop tunes—but no rock-and-roll. From 9 until 11 it's semi-classical; from 11 to 12 we have an hour of the very best classical music. Then we switch over to the tuner bringing in one of the clear channel broadcast stations that operate all night, and we ride that until morning."

(*Continued on page* 87)

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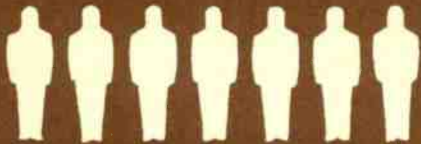

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Carl and Jerry

(*Continued from page* 84)

"Do you get permission to rebroadcast their programs?"

"Yes, although strictly speaking we wouldn't have to. We're not rebroadcasting. Our wired-wireless is actually just a big p.a. system."

"Do you do any live shows?" Jerry asked.

"Oh, sure. We do interviews in our studios here, and we do remote pickups from all over the campus. We may do a poolside program from the Co-Rec Gym during a swimming meet; we may broadcast a baseball game; or we may work remote from a record hop, or dance, or any other spot calculated to stir up interest among our listeners. Our patch board is connected to that of the university broadcast station by a permanent loop, and sometimes they let us use their remote lines when we're doing a remote show. But let's take a look at the rest of the station.

"Here, next door, is Studio C, which is just an announcing studio. Studio B, over there to the left, has a console and turntables, and is set up as a control room for monophonic work. On down the hall is our record library—we have 5000 45's and about 2000 LP's in there, and among the latter are many of the finest classical records. We're starting to stock up on stereophonic records and tapes now, for the fellows seem to like our stereo programs."

"Where do you get the money for all this?" Carl asked bluntly.

"As you know," Jimmy replied, "each residence hall has its own social organization or club. You automatically join this club when you take up residence and are charged a membership fee of $15 a year to pay for social activities, music groups, camera club, residence-hall radio station, etc. Each station prepares a budget each year and receives a certain amount of the club dues to pay for records, maintenance, and new equipment."

"Those studios must be soundproofed," Carl remarked as he watched the lips of an announcer in Studio C moving but heard no sound.

"They are. The walls are double-studded, and each wall contains two layers of acoustical wall tile, two layers of Celotex, and two 2″ layers of star foam. The glass partition windows have double panes set in rubber so they can't conduct sound. Over here, next to the stairs, is our lab and workshop where we build and test our equipment. You see we have the usual meters, signal generators, and 'scope . . .

"Say, fellows, I'd like to go into more detail, but I'm running out of time. Suppose we go over to the desk and I tell you why I had you come up."

THEY SAT DOWN at the desk, and Jimmy peered at them from beneath his heavy brows as he toyed with a set of keys fastened to his belt with a silver chain.

"Some joker always tries to get into the act, and we have one here at Gary Hall," he said with a sigh. "For the past week someone in the southwest wing has been jamming our programs. He sits on the frequency, plays records, makes sarcastic remarks about our programs, and tries to get the listeners to tune to another frequency where he says he is going to put on a *real* program.

"We thought he'd soon get tired and quit this foolishness, but apparently he's not going to; so we've got to find him and put a stop to it. Too many students are complaining that they're not getting much satisfaction out of the money they've paid for carrier-current entertainment."

"How do you know the guy is in the southwest wing?" Carl quizzed.

"That's the only place his signal is heard. Signals won't feed back through the r.f. transformers from one power box to the others."

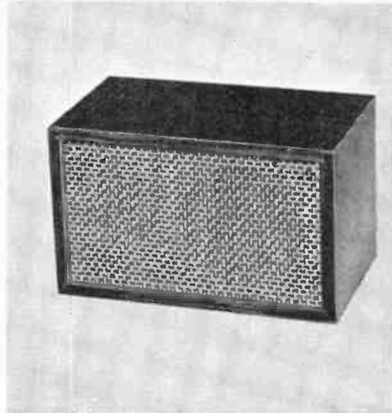
"Where do we come in?" Jerry asked.

"We need some outsiders to help track the wildcatter down. Members of the WCCR staff are too well known here at Gary Hall; as soon as one of us steps into that southwest wing, the station goes off the air. But I hear you two are pretty good electronic technicians. Will you help?"

"Sure, but how can we?" Carl wanted to know.

Jimmy opened a drawer and took out a small transistorized tape recorder. A shielded cord ran from the microphone

(*Continued on page* 90)



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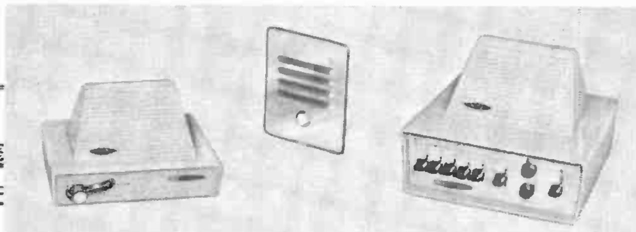

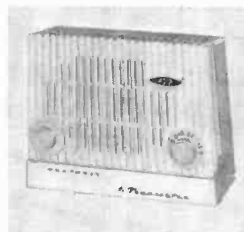

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Carl and Jerry

(*Continued from page* 87)

jack to a little black metal box with a small coil sticking out one end.

"This is a ferrite-rod antenna coil tuned to the frequency of the wildcat station," Jimmy explained. "A crystal diode inside the box detects the signal picked up by the coil and feeds it to the recorder amplifier. With the monitoring earphone of the recorder, you can hear anything picked up by this r.f. probe and being recorded.

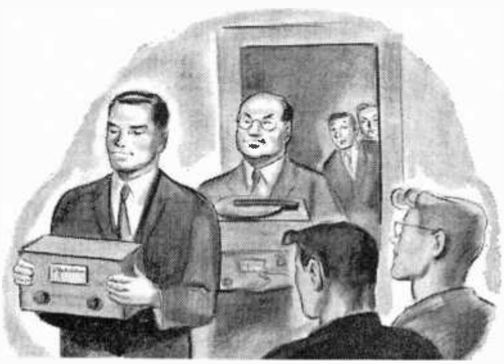
"The wildcatter can't be running much power; so his signal should fall off rapidly on this insensitive detector as the distance from the room where he is feeding the signal into the line increases. I want you two to use this to spot his room; then call me, and the hall counselor and I will take it from there."

"When?" Carl asked.

"In about ten minutes, if you will. He comes on every evening at four, and it's nearly that now. We'll play piano music from four until four-fifteen so you can tell his station from ours. Then I'll fake a station breakdown so you'll have his signal in the clear. Okay?"

Before they quite knew what they were doing, Carl and Jerry found themselves walking down the hall on the second floor of the west wing of the Quadrangle. They tried to saunter along very nonchalantly, but they felt as conspicuous as a couple of skunks at a perfume manufacturers' convention. The recorder was humming away in Jerry's overcoat pocket, and his turned-up coat collar concealed the earphone.

"I'm hearing both stations," he muttered to Carl. "The joker's rock-and-roll is beginning to drown out the piano. We must be getting close. He's stronger on this side of the hall. Oh, oh! There goes the piano music off. The wildcat station is really getting loud now, but keep walking. Now it's beginning to fall off. Let's turn around.



"Right here it's the loudest. He's talking now. Pretend to show me something in that math book while I take this earphone out of my ear. Say! I can hear him talking through the ventilator at the same time I hear him on the earphone. This is the room. Call Jimmy while I keep the recorder going."

Carl called from a telephone booth in the hall, and in only a few minutes Jimmy came dashing up with another young man. They took the tape recorder, listened to the sounds coming from the ventilator, and then knocked at the door. Carl and Jerry walked on down the hall as the door finally opened and two flustered-looking youths let Jimmy and the counselor in.

Fifteen minutes later, the door opened again, and Jimmy and the counselor emerged. They were carrying a small 45-rpm record player and what the two boys recognized as being a wireless phono-oscillator.

"Well, fellows, there goes our wildcat radio station," Jimmy said as he joined them and the three started for the stairs. "When they heard the tape recording, they broke down and confessed. The equipment has been confiscated, and I'm pretty sure we won't have any more of that sort of thing. And I certainly want to thank you for helping. I've got to scamper back and put the station on the air again now, but I'll see you around."

BIG lazy snowflakes started drifting down as Carl and Jerry walked briskly toward H3 in the gathering darkness. The patterns of lighted windows in the residence halls looked warm and friendly.

"Say, Carl," Jerry suddenly exclaimed, "I *like* being part of a school where the students can design and build and maintain and operate an elaborate radio network like that in their spare time—especially when we both know how precious little spare time they have."

"Yeah, me too," Carl agreed. "I think we're in the right place." —30—

Getting to know the. . .

$$X_c = \frac{1}{2\pi fC}$$

BYPASS CAPACITOR

By JOHN M. DOYLE Technical Editor National Radio Institute

CAPACITORS are used in modern electronic circuitry for such purposes as blocking, filtering, timing, and bypassing. The last-mentioned application—bypassing—is by far the most common. It's also much more critical than many people suspect, since the selection of a wrong-value bypass capacitor can result in poor frequency response, phase distortion, circuit instability, or even outright oscillation.

Now, you may feel that this problem is no concern of yours, but is rather one for the design engineer. "Shucks," you say. "If a capacitor—bypass or otherwise—goes bad, I'll replace it."

This approach works fine in most cases. But how many times have you wished you could help fix a piece of equipment after a well-intentioned, but poorly instructed, do-it-yourself fan has been hard at work with his trusty soldering gun? Or how many times have you felt like throwing that cheap "screech-box" receiver out of the window, when a 15¢ bypass capacitor would do much to quiet the demon of temptation? Finally, remember that despite our ultra-modern manufacturing methods, "goofs" are still made by people who do the physical wiring and inspection but who know nothing about the workings of the circuit.

If you're now convinced of the importance of knowing a little more about bypassing (and shame on you if you aren't), let's get on with the job.

Reactance. When a capacitor is used as a bypass, it must provide a low-impedance path for electrical currents of certain frequencies and a high-impedance path for those of other frequencies. The property which permits it to operate in this manner is called *reactance.* The value of reactance for a given frequency is determined by the basic formula:

$$X_c = \frac{1}{2\pi f C}$$

where X_c is the capacitive reactance in ohms, 2π is a constant (approximately 6.28), f is the operating frequency in cycles per second, and C is the capacitance in farads.

This relationship tells us that the reactance of a given capacitor decreases as frequency increases. For example, the value of X_c for a 0.01-μf. capacitor at a frequency of 500 cycles is about 31,800 ohms. But at a frequency of 5000 cycles, the reactance has decreased to about 3180 ohms.

Not only must we be able to calculate X_c, but we must also know how to determine what value capacitor is needed to obtain a certain reactance at some specified frequency. All that we have to do is rearrange the above equation as:

$$C = \frac{1}{2\pi f X_c}$$

where all symbols have the same meaning as before. For example, if we want to know what value capacitor will provide a reactance of 18 ohms or less at a frequency of 500 cycles, we just substitute known values in the above formula. The calculated answer is 17.7 μf., approximately, but the next highest standard capacitance value available will be okay for most applications.

Audio-Frequency Amplifiers. In a typical audio-frequency amplifier, such as that shown in Fig. 1, a capacitor, *C1*, is used

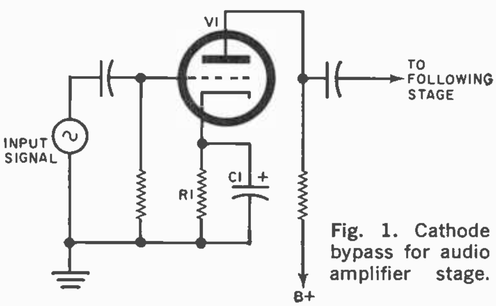


Fig. 1. Cathode bypass for audio amplifier stage.

to bypass audio frequencies around the cathode resistor, *R1*. If capacitor *C1* is omitted or if it does not operate properly, the a.c. plate current component develops a voltage drop across *R1* which opposes the input signal applied to the grid. This effectively reduces stage gain and results in inverse feedback or "degeneration."

Now, let's see what requirements are placed on the capacitor if it is to prevent degeneration. Suppose the amplifier is to pass all frequencies between 100 and 5000 cycles, and the value of cathode resistor recommended by the manufacturer for class A operation is 1500 ohms. Because the reactance of the capacitor decreases as frequency increases, a capacitor that satisfactorily bypasses the resistor at the lowest frequency will work quite nicely over the entire range.

A rule-of-thumb used by circuit designers is that *the reactance of the capacitor at the lowest frequency to be passed should not exceed one-tenth the value of the resistor it bypasses.* Using this rule, we substitute known values in the equation developed for finding *C*:

$$\begin{aligned} C &= 1/(6.28 \times 100 \times 150) \\ &= 11\ \mu\text{f.} \end{aligned}$$

An electrolytic capacitor is suitable for this purpose because its leakage resistance is not important and high capacitance is obtained in a compact size.

In some applications, such as high-quality audio amplifiers, the ratio of resistance to reactance at the lowest frequency passed is made 20 to 1 or even higher, but the ratio used in our example is adequate for most cases. Needless to say, the working voltage of the capacitor selected for any bypassing applications must be larger than the maximum voltage present.

Bypassing in the case of a transistorized audio-frequency amplifier is very similar. A typical *pnp* transistor amplifier, using the common-emitter arrangement, is shown in Fig. 2. Base bias is obtained from the voltage-divider network, consisting of *R1* and *R2*, and the emitter is forward-biased (negative in the case of a *pnp* transistor, and positive for the *npn* type). To prevent signal degeneration, the emitter-bias resistor (*R3*) is bypassed with a high-value electrolytic capacitor (*C1*).

In either type amplifier discussed above, a certain amount of degeneration is sometimes intentionally used. Therefore, before jumping to any wrong conclusion, always make sure that degeneration is in fact undesirable before attempting to correct a case of "faulty" design. If bypassing is improved where degeneration is needed, the circuit will not operate properly.

Other Applications. When a pentode-type tube is used, additional bypassing is needed in the screen grid which must operate at ground potential, *as far as all signal voltages are concerned*, if degeneration is to be avoided. A typical case is the television i.f. amplifier shown in Fig. 3.

In this circuit, screen potential is obtained from the plate-supply source through the screen-dropping resistor, *R2*. If bypass capacitor *C1* fails to operate properly at any frequency, the gain of the amplifier falls off at that frequency. The value of *C1* is again determined by the rule-of-thumb that its capacitive reactance at the lowest frequency passed *should not exceed* one tenth the value of the resistor it bypasses.

Generally, mica or ceramic capacitors, ranging in value from about 50 $\mu\mu$f. to 0.01 μf., are used for r.f. bypassing arrangements of this type. If the pentode is employed as an audio-frequency amplifier, high-quality paper or electrolytic capacitors are used. Their proper value can be determined in the same way.

Sometimes it is necessary to bypass radio but not audio frequencies. A typical case is in the detector circuit of an AM receiver, as shown in Fig. 4. Assuming that the r.f. carrier frequency is 455 kc., if the reactance of *C1* is to be one-tenth the value of *R1* at this frequency, its value—using the formula previously

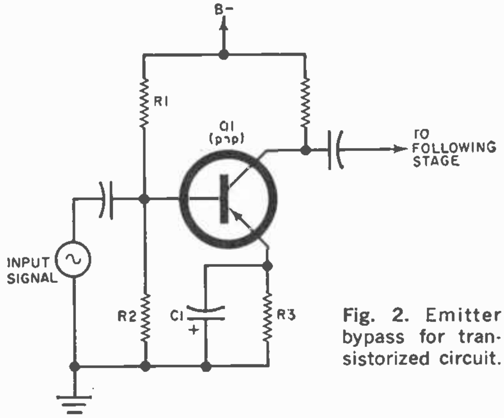


Fig. 2. Emitter bypass for transistorized circuit.

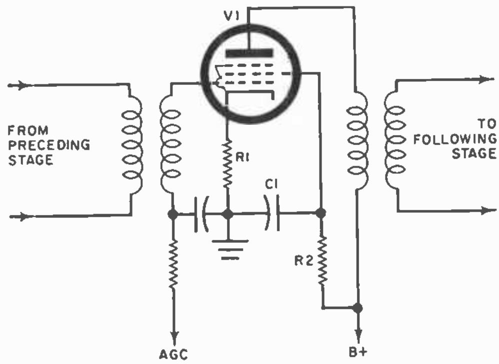


Fig. 3. Screen bypass for typical i.f. amplifier in a television set.

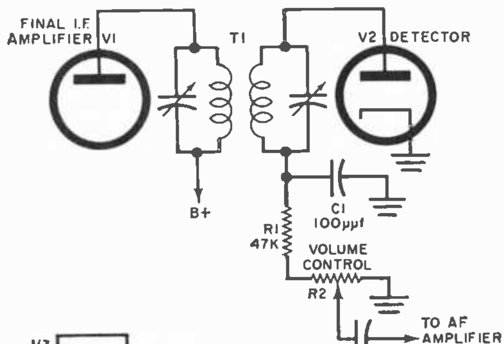


Fig. 4. R.f. bypass for diode detector stage.

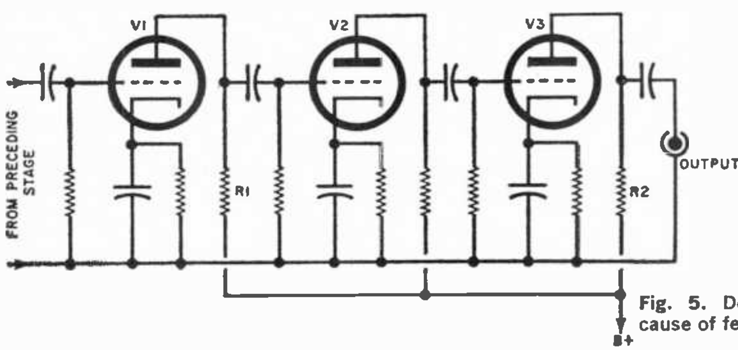


Fig. 5. Decoupling is required because of feedback through R1 and R2.

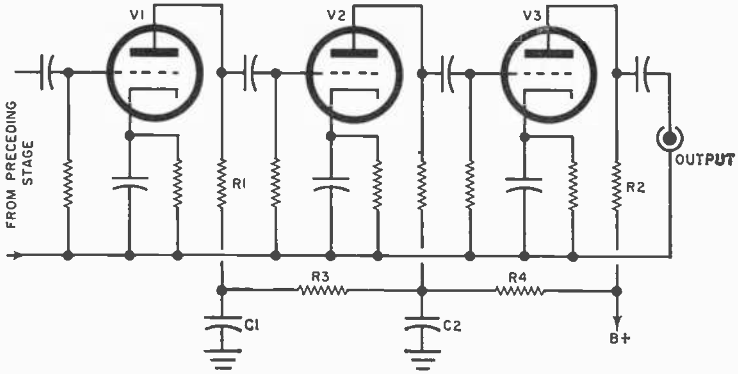


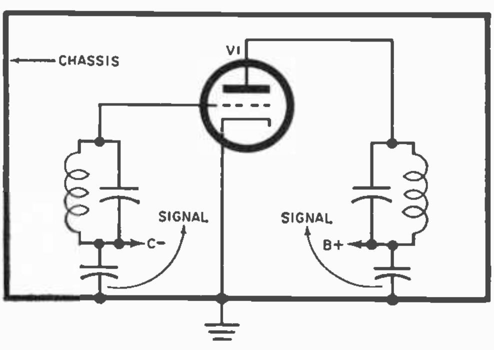
Fig. 6. Networks R4/C2 and R3/C1 prevent undesired feedback between stages.

given—is approximately 75 $\mu\mu$f. We would use a standard 100-$\mu\mu$f. mica or ceramic capacitor. If the highest audio frequency to be passed is 5000 cycles, the reactance of the capacitor at this frequency is better than 300,000 ohms.

Another circuit in which bypassing is important is illustrated in Fig. 5, where three amplifier stages are fed from a common plate-voltage supply. Since most power supplies possess a finite impedance, the output of *V3* will be returned to the plate circuit of *V1* through load resistors *R2* and *R1*. This effective signal voltage is then fed to the grid circuit of *V2* and then into *V3*. Naturally, if the gain of these stages is high enough, oscillation occurs.

To prevent instability of this type, decoupling networks are used, a typical example of which is shown in Fig. 6. The reactance of *C1* and *C2* at the lowest operating frequency is made very small compared to the resistance of *R3* and *R4*. Because *R3/C1* and *R4/C2* form voltage dividers, almost the entire voltage developed across the common impedance is dropped by *R3* and *R4*. Essentially, no feedback voltage is then coupled into the plate circuit of *V1* or *V2*.

Fig. 7. Decoupling capacitors should be grounded at one point for best results at high frequencies.



The values of *R3* and *R4* should be kept as low as possible to accomplish the job without dropping a prohibitive amount of the d.c. plate voltage for *V1* and *V2*. In cases where a very small drop in this voltage is all that can be tolerated, *R3* and *R4* can be replaced by an inductance of low d.c. resistance. The value of inductance needed for a given reactance at a specified frequency is determined by the formula:

$$L = X_L / 2\pi f$$

where X_L is the inductive reactance in ohms, and f is the operating frequency in cycles per second.

Chassis Grounds. Here's a final word about connecting bypass capacitors. At frequencies of 30 mc. and below, the dimensions of the chassis are usually only a fraction of a wavelength, and it can be considered a fixed reference. Above 30 mc., however, the chassis is essentially a conducting sheet on which points of maximum current and voltage appear.

In the circuit of Fig. 7, grid and plate "ground" currents pass through the chassis to the cathode of the stage. A good practice, generally, is to separate these ground currents from the chassis by returning all leads to the cathode or a bus bar. Just be sure, however, that the leads are kept as short as possible to prevent cross-coupling and undesirable feedback. —30—

QUICK-CHECK AUDIOMETER

A new medical instrument which may soon be as common in doctors' offices as the stethoscope or blood-pressure gauge is known as the "Quick-Check Audiometer." Designed to give the physician a quick summary of his patients' hearing losses, the instrument is not meant to replace the standard clinical audiometer. It does, however, check hearing at the three most important frequencies (250, 1000, and 4000 cycles) and at three key volume levels. In use, the audiometer is held to the patient's ear and the patient instructed to signal when he hears a tone. The frequency control, level control, and on-off key are placed so that they can be manipulated by one hand.

Battery-operated, the audiometer employs standard mercury cells which need be changed only once a year. The normal voltage drop after one year's use causes no frequency deviation and not more than 1 db variation in level. Manufactured by Danavox, Copenhagen, Denmark, the unit is available with ASA (10, 30, and 50 db above threshold) or BSI (20, 40, and 60 db above threshold) calibrations.

—*Hans F. Kutschbach*

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TUBE SUBSTITUTION HANDBOOK, Volume 2 *by the Howard W. Sams Engineering Staff*

Revised to take into consideration the hundreds of new tube types which have been introduced since its original publication (as Volume 1), this handbook now contains over 4450 recommended substitutions. It's divided into five sections, the largest of which is a directory of over 2500 interchangeable receiving tubes. The remaining sections list industrial tubes which substitute for receiving tubes, European replacements for American receiving tubes and vice versa, and interchangeable television picture tubes.

Published by Howard W. Sams & Co., Inc., 1720 E. 38th St., Indianapolis 6, Ind. Soft cover. 96 pages. $1.50.

NEW SHORTCUTS TO TV SERVICING (in two volumes) *by Leonard C. Lane*

Based on a home-study course prepared for a prominent TV manufacturer, this two-volume set is written in a simple style—yet is complete and accurate. The books are not concerned with theory or mathematics, but devote themselves solely to defects appearing in basic circuits of TV receivers and their cures. Bench-tested techniques for finding troubles in the front end, r.f., i.f., a.g.c., sync., picture tube, detector, low voltage, audio, and other circuits are given.

Published by Gernsback Library, Inc., 154 West 14th St., New York 11, N.Y. 160 pages per volume. Soft cover edition, $5.90. Hard cover edition, $9.90.

BASIC MATHEMATICS, Vol. 2, *by Norman H. Crowhurst*

In the second volume of a planned four-volume course in basic mathematics, the author builds on the foundation laid in Volume I. He takes the reader through simple, simultaneous, and quadratic equations; powers and roots; imaginary numbers; simple mechanics, including resonance; proportion and ratio; simple trigonometry calculations; and properties of triangles and circles. The step-by-step "pictured text" presentation poses a problem, then discusses it and explains one or more methods of solution.

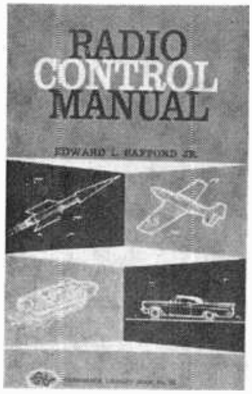
Published by John F. Rider Publisher, Inc., 116 West 14th St., New York, N.Y. 144 pages. Soft cover. $3.90.

INDUSTRIAL TRANSISTOR AND SEMICONDUCTOR HANDBOOK *by Robert B. Tomer*

A modern sourcebook for industrial semiconductor data, this volume contains information on all types of transistors and diodes. Operating characteristics, circuit-design procedures, and typical applications are fully discussed, enabling the reader to select those units best suited to his requirements. The newer semiconductor areas, such as thermoelectricity, energy conversion, micromodules, integrated circuits, etc., are also covered.

Published by Howard W. Sams & Co., Inc., 1720 East 38th St., Indianapolis 6, Ind. 256 pages. Soft cover. $4.95.

RADIO CONTROL MANUAL *by Edward L. Safford, Jr.*



Written by a guided missile expert and winner of many model plane competitions, this book minimizes theory and tells, in a simple step-by-step way, how to acquire "the ultimate" in radio control systems. It starts with a simple basic system and shows how, by adding and modifying components, the R/C fan can develop a highly efficient multi-channel design. Realizing that not all R/C

Bookshelf

(*Continued from page* 97)

fans are do-it-yourself'ers, the author also explains where and how commercial components may be used.

Published by Gernsback Library, Inc., 154 West 14th St., New York 11, N.Y. 192 pages. Soft cover. $3.20.

New Literature

Harman-Kardon has released an illustrated catalog describing the new "Commander" series of public-address amplifiers and systems. It details the features, prices, and applications of 12-, 35-, and 100-watt amplifiers; a phonograph top which may be used with all units; locking panel covers; and a combination mixer/preamplifier. Write to Commercial Sound Division, Harman-Kardon, Inc., Plainview, N.Y., for your free copy.

A completely revised edition of the Bendix Radio Station Guide can be obtained from Bendix Marine dealers or from Bendix Marine Department, North Hollywood, Calif. It lists the exact locations of broadcast and airways beacon stations by latitude and longitude—as well as their frequencies and call-signs—on the Atlantic, Gulf, and Pacific coasts and in the Great Lakes area.

Copies of a new replacement chart of oscilloscope cathode-ray tubes are now available from Sylvania Electric Products Inc. (1100 Main St., Buffalo 9, N.Y.) or from Sylvania industrial tube distributors. The chart lists the scopes of 78 different manufacturers by name and model number, indicating the proper replacement CRT for each one. —30—

Solution to Crossword Puzzle

(*Puzzle appears on page* 60)

	L	E	N	S		O	C	T	A	L
C	■	I	O	N	S	P	O	T	■	A
I	F	■	R	O	P	E	S	■	A	M
R	A	N	■	W	A	N	■	I	M	P
C	R	O	■	■	■	■	■	A	P	C
U	A	R	■	A	G	E	■	N	E	O
I	D	■	S	I	N	E	S	■	R	R
T	■	M	O	D	U	L	A	T	E	D
S	P	A	D	E		S	T	A	S	

Stereo Sixteen Plus Four

(*Continued from page* 48)

the thickness of the bottom panel. Position the panel at the front of the enclosure, with the bottom edge flush with the surface of the bottom panel, and mark the other edges for cutting. After the front panel is cut and edge-sanded, attach the remaining 20″ 2 x 2 to the other narrow edge and the two 25″ 2 x 2's to the top and bottom edges.

Pad or Diffuse. The acoustic padding is attached to the inside of the front panel with either thumbtacks or a staple gun; if desired, an inexpensive substitute for acoustic padding can be made from six egg cartons of the *papier-mache* variety. Simply tack the bottom halves of the egg cartons to the inside of the panel; they will absorb and diffuse all sound waves reaching them, preventing reflections.

To attach the front panel to the enclosure, position it in place and drill through the front edges of the speaker-board panels for a No. 8 x 1″ wood screw (three screws per panel), drilling through the panel at an angle so as to go into the front-corner-brace 2 x 2 straight. In addition, attach the top and bottom panels to the front-edge braces with four screws per panel, and, if you haven't already done so, tie the top and bottom down to the upper and lower speaker-board braces with two screws per brace.

The rear corner supports are attached by a single wood screw run into each end of each dowel, through the top and bottom panels, and pulled up tight. This done, the electro-acoustical part of the system is now complete, and you can give it its test run.

Finishing the System. If you keep in mind that both sides and the back must be acoustically open to let the sound out without restriction, the "sky's the limit" on finishing.

The original system was finished in an Oriental motif, with solid gloss black top, ebony and brass legs, and a mosaic Masonite front-panel overlay. This results in a striking piece of furniture, but a simple "wrap-around" of grille cloth (hard-weave drapery fabric does as well and is less expensive) will also look extremely professional. —30—

Transistor Topics

(*Continued from page* 80)

experience in circuit wiring. Designed around a transistors-and-diode reflex circuit, the receiver is powered by a single 9-volt battery and tunes the standard AM broadcast band (550-1600 kc.). A pre-punched etched-circuit board is utilized in conjunction with Fahnestock clips; since all components are connected to these clips, no soldering is required. Designated as Catalog No. KT-199, the kit sells for $9.95 net, less earphones and battery.

The Milton Ross Metals Co. (237 Jacksonville Rd., Hatboro, Pa.) is now pro-

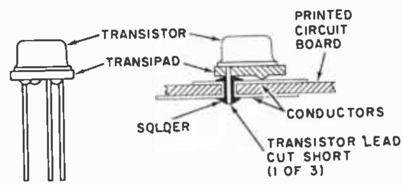


Fig. 2. Plastic spacers by Milton Ross Metals Co. serve to cushion transistors.

ducing an extensive line of small plastic spacers dubbed "Transipads" (see Fig. 2). These are used when mounting transistors on etched-circuit boards and serve to cushion the transistor, to reduce lead stresses, and to protect against heat damage.

A well-known semiconductor manufacturer, the U.S. Transistor Corp. (Syosset, N. Y.) is developing a transistorized remote control unit for use in a new line of toys to be manufactured by the Ideal Toy Corp. (Hollis, L. I., N. Y.) Designated as a "Remotrol" unit, the device employs three germanium *pnp* transistors and will enable youngsters to activate and stop toy tanks, airplanes, submarines, animals, and rockets by remote control at distances up to 30 feet. The new line of toys using the "Remotrol" device will probably be introduced by Ideal at the New York Toy Show next spring.

That does it for now. To paraphrase good old Omar: *The Moving Finger Writes, and having writ . . . will be back next month.*

—*Lou*

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Make .... | Model ....

Principal SW Bands Monitored | Number of QSL Cards Received

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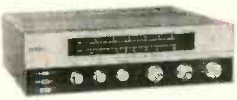

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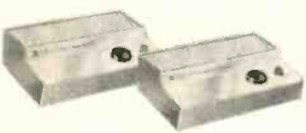

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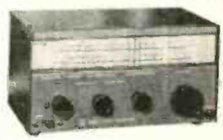

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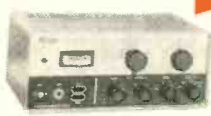

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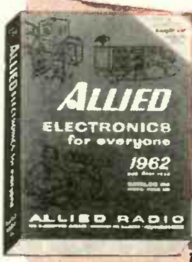

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The "10-8" De Luxe

(*Continued from page* 44)

"police" antenna terminal strip and an FM antenna to the FM antenna strip. Run the output cable from the *10-8* to the antenna terminals of the FM set, and temporarily solder a 1" wire between pins 5 and 7 of *V1*.

Next, set the FM receiver dial at 108 mc. and *C7* at maximum capacity, then adjust *C2* for the loudest hiss in the receiver's speaker. Spread the turns of *L2* slightly if maximum noise occurs with *C2* wide open. Bend *L3* back and forth with respect to *L2* until you determine the position which results in the greatest background noise.

Remove and discard the wire between pins 5 and 7, then tune *C7* from maximum to minimum capacity. As you do this, you should hear several signals which are harmonics of the variable oscillator. If no signals are evident, *V1b* is not oscillating—try increasing the plate voltage by reducing *R5* to approximately 4000 ohms. If this fails to start the oscillator, look for a defective component or a wrong connection.

Once you have the oscillator perking, tune the vernier dial back and forth in search of police calls and other v.h.f. transmissions. When you come across a signal, peak *C1* for maximum volume. Since this particular adjustment is rather broad, a slight touch-up will suffice when tuning from one end of the band to the other. If *C1* must be fully meshed for best reception, squeeze the turns of *L1* closer together. If optimum results are obtained with *C1* at minimum capacity, open up the coil a bit.

Mobile telephone and taxicab dispatcher signals should be picked up with the vernier dial set somewhere between *3* and *5*. Likewise, police calls should come in between *5* and *7*. If you can receive no mobile phones, but police calls are found between *1* and *3* on the dial, add a turn to the top of *L4*. On the other hand, if mobile phones are heard around *7* or *8*, remove a turn from the coil.

Performance. Naturally, the performance of the converter depends to a large extent on the quality of the antenna installation. At an average location, mobile stations will come through at distances up to about five miles. Base stations, especially the higher powered ones, will be audible for at least 20 miles.

Be sure to log the dial settings of the various services you hear so that you can retune to them in the future. And always set the FM dial to exactly 108 mc. when using the *10-8*—failure to do so will nullify your loggings.

Readers who live close to a TV transmitter on Channel 2 may pick up its audio signal in the middle of the band and its raw a.c. video carrier at *8* or *9* on the dial. Two or three unmodulated carriers may also be noted as you tune across the band. In the unlikely event that one of these signals falls on the frequency of a desired station, simply shift the FM dial to 107.5 mc.; this will "move" the offending carrier so that it will no longer be troublesome. —30—

HOW IT WORKS

Many police, fire, public utility, and maritime mobile stations operate between 150.8 and 162 mc. The *10-8* makes it possible to tune in these signals on an ordinary FM radio.

A 155-mc. police call, for example, arrives at the antenna, drops down the feedline, and finally reaches coil *L1*. Since *L1* and capacitor *C1* form a resonant circuit that can be tuned to 155 mc., a 155-mc. voltage can be built up across this *LC* combination and applied to the grid of *V1a*.

Tube *V1a* is a variable-frequency oscillator which, in this case, is tuned to 47 mc. The 47-mc. output of *V1b* is fed to the cathode of *V1a* via capacitor *C4*. Because *V1a* is a non-linear device, the 47-mc. energy combines in the tube with the 155-mc. police signal to produce two new frequencies. These new frequencies, or "beats," are equal to the sum of and the difference between 47 and 155 mc.

The sum (202 mc.) and the difference (108 mc.), as well as the 47- and 155-mc. signals, are all present at the plate of *V1a*. Only one of these, the 108-mc. signal, is desired. Consequently, coil *L2* and capacitor *C2* are resonated to this particular frequency. Coil *L3*, which is inductively coupled to *L2*, picks up 108-mc. energy and feeds it, via switch *S1a* and the coaxial cable, to the input of the FM receiver. The 155-mc. police signal will now be heard when the FM set is tuned to 108 mc.

To eavesdrop on a mobile telephone conversation at 152 mc., *C1* is peaked to this new frequency and capacitor *C7* reset for an oscillator frequency of 44 mc. The FM set need not be retuned, because the difference between 152 and 44 is again 108.

Power to operate the *10-8* is supplied by a small isolation transformer, *T1*, and a silicon rectifier, *D1*. When normal broadcast reception is desired, *S1* is thrown to the FM position. This action shuts down the power supply, disconnects the converter from the FM set, and connects an FM antenna to the input of the receiver.

Across the Ham Bands

(Continued from page 77)

pacitors at maximum capacitance, turn on the transmitter and wait a minute for the tubes to reach operating temperature. Press the key and adjust capacitor *C7* for minimum glow of the pilot bulb (it may go out completely) or minimum meter reading. Then decrease the capacitance of *C8* a small amount—say 10%—and readjust *C7* for minimum glow or meter indication. This minimum reading will be higher than before.

Continue adjusting the two capacitors as above until you reach the highest "minimum" that still allows good transmitter keying. Check the keying by listening to the transmitter signal in your receiver; for best results, it may be necessary to detune capacitor *C7* slightly to the low-capacitance side of the minimum point. When properly tuned, the transmitter plate current will be in the region of 60 to 75 ma. (dull red glow of the pilot bulb), representing a power of 25 to 30 watts input.

After tuning, capacitor *C7* should be approximately ½-meshed on 80 meters, 1/3-meshed on 40 meters, and ⅕-meshed on 20 meters. Settings far different from these may produce an output on out-of-the-band harmonics of the crystal frequency.

News and Views

Dick Gray, WV6RVM, 5833 Sherwood Dr., El Sobrante, Calif., is a versatile ham. During the school year, he is a high-school music teacher; in the summer, he is a Ranger in Yosemite National Park. Dick built his operating desk from an old door and some plastic-covered plywood; his home-brew transmitter is based on the plans of the 6DQ5 rig in the ARRL handbook. In his "spare time," Dick gets on the air. . . . **Walt "Bud" Simciak, K9QXS,** Room A-302, 71 E. 32nd St., Chicago 16, Ill., lives at that address while attending the Illinois Institute of Technology. But he does his operating from a suburb of Gary, Indiana. In his six months as a Novice, Bud's 2-meter Gonset Communicator (running about 10 watts) racked up over 200 contacts in six states. His 22-element beam (two stacked 11-element beams) is 50' high and helps give his signal the "voice of authority." . . . Incidentally, it's remarkable how many hams are working surprisingly long distances on two meters with inexpensive, low-power transceivers such as the Heathkit "Two'er," etc. **Ralph Roales, W9RVM,** Vincennes, Ind., for example, thinks nothing of working 100 miles with his "Two-er" feeding a 9-element, home-brew beam. Not bad for a power of 0.005 kilowatt, as Ralph puts it.

Jim Hegedus, WV2PHY, 202 Route 156, Trenton 20, N.J., transmits with a Heathkit DX-40 and receives on a Lafayette HE-10. A 40-meter dipole and a 15-meter dipole also do their parts. In six months, Jim has logged 42 states and 16 countries: he rates Pakistan and Latvia as his best DX (who wouldn't?). . . . **Kenneth Stoddard, KN5MQV,** Box 323, Perry, Okla., proves that "you never know whether it will work until you try it" by using a 6BQ6 and a 2E26 in parallel running 40 watts in his home-built transmitter. Feeding a long-wire antenna and receiving on a Hallicrafters S-38, Ken has knocked off 37 states and four Canadians in six weeks—all on 80 meters. . . . **Harry Peterson, KN7PSG,** 1825 Northview, Phoenix 21, Ariz., reports that his first contact was with KN7PRQ. Guess who was KN7PRQ's first contact? You're right, KN7PSG. Harry transmits with a DX-40 and receives with a Hallicrafters S-76. The T/R switch described in our August, 1960, column connects the receiver and transmitter to a 40-meter dipole antenna. Harry has had good luck with several of our other construction projects, too.

William L. Kern, KN3PLW, 605 Edna St., Connellsville, Pa., really is tied up in communications. During the day he works for the telephone company; at night, he "pounds brass" on 40 meters. A Knight-Kit T-50 transmitter and a Knight-Kit R-55 receiver have put 27 states and a Canadian in Bill's log. . . . **Tom Becker, KN8BQX,** 915 Golfview Dr., Dayton 6, Ohio, didn't mention what kind of an antenna he is using, but it must be a pretty good one. In only a few weeks, Tom's AMECO AC-15 transmitter, running 15 watts, and his National NC-57 receiver have exchanged signals with 10 states. . . . One of the claims to fame of **Mike Gallo, WA2LSK,** 1 Jay St., Binghamton, N.Y., is that he QSL's 150%. I hope the message gets through to some of the non-QSL'ers. Mike has worked 14 states on 6 meters with a home-brew, 50-watt transmitter feeding a 10-element Taco beam, 55' high. For receiving, he put together a converter which makes his rebuilt 1938 Philco broadcast set think it is a short-wave radio.

Vant Morrell, WN4CTC, 659 Cardinal Lane, Lexington, Ky., really kept his Johnson Adventurer transmitter and Hallicrafters S-120 receiver hot his first week on the air. Fifty-eight contacts in 23 states (all on 40 meters) are the evidence. His antenna is a folded dipole 25' high, and his receiver is abetted by a home-built signal booster and a Heathkit QF-1 Q-Multiplier. . . . **Ralph "Lucky" King, K1KOB,** Jones Ave., Portsmouth, N.H., is doing his part to keep New Hampshire on 6 meters. In 10 months, his Lafayette 6'er (a 7-watt powerhouse) driving a Cush Craft 3-element beam has worked over 300 different stations. Exactly how many states Lucky has worked is a bit of a mystery, but he has QSL cards from 20 of them.

Until next month, 73,

Herb, W9EGQ

Short-Wave Report

(*Continued from page* 81)

The following is a resume of current reports. At time of compilation all reports are as accurate as possible, but stations may change frequency and/or schedule with little or no advance notice. All times shown are Eastern Standard and the 24-hour system is used. Please send reports to P. O. Box 254, Haddonfield, N. J., in time to reach your Short-Wave Editor by the eighth of each month—be sure to include your WPE call.

Antigua—DX'ers who would like to log this British West Indies country (although it no longer counts as a separate country) should try for the Antigua Broadcasting Service on 644 kc., 1000 watts. The schedule is 0630-0900, 1130-1300, and 1800-2100 daily, and reports will be verified. Send your reports to Mr. Campbell Matthew, VP2AR, Hood Street, St. John's, Antigua, B.W.I. According to Mr. Matthew, this station receives only about a half dozen reports yearly, mostly from New Zealand, Australia, and Sweden. (*DC*)

Argentina—*Radiodifusion Argentina al Exterior*, Buenos Aires, operates weekdays as follows: to Central Europe at 1400-2000 in Spanish, German, Italian, French, Eng., and Port. on 11,730 kc.; to Eastern N.A. at 2100-2300 and to Western N.A. at 2302-0102 in Eng. and Spanish on 9690 kc. (*WPE1BD, WPE3BIK, WPE8BBL, WPE8CKW, WPE8MS, WPE8OG*)

Australia—*R. Australia* has placed a new xmtr in use on 9570 kc. at 0458-1230 to S.E. Asia, replacing the former outlet on 9565 kc. The VL- call-signs have been dropped. A new QSL card has been printed and will be issued when the supply of old cards is exhausted. (*WPE6BPN, WPE8MS*)

Austria—A portion of the schedule for *Oesterreichischer Rundfunk*, P. O. Box 700, Vienna 50, Austria, reads: 1800-2100 on 6155 kc.; 1900-2300 on 9540 kc.; 2100-0000 on 15,255 kc.; 1200-1300 on 17,800 kc.; 0900-1000 on 17,850 kc.; and 0500-0645 on 21,570 kc. The latter channel replaces 21,705 kc. (*WPE2CRX, WPE2FHU, WPE3RB, WPE4FI, WPEØVB, VE3PE1KC*)

Belgium—Brussels operates at 0715-0800 on 15,140 kc., replacing 15,435 kc. The 1945-2000 program on Mondays and Fridays has been switched to 1900-1915 on 9765 kc.—replacing 11,805 kc.—and on 9745 kc., and to Europe on 6000 kc. (*WPE2FHU, WPE4FI, WPE8DCG*)

Brazil—A rarely heard station is *R. Tabajaras*, Joao Pessoa, Brazil, on 4795 kc. It has been logged at 1830-1900 with L.A. music and Port. announcements. (*WPE1HC*)

ZYH21, *R. Iracema de Fortaleza*, was logged on 4815 kc. at 0315 with an excellent signal. Their s/on time is listed as 0300. (*WPEØJJ*)

R. Relogio, Rio de Janeiro, 4905 kc., was heard around 1700 with time checks each minute, commercials, and irregular ID's; all Portuguese. *R. Difusora de Petropolis*, 5042 kc., was heard with "Agencia Nacional," a government program, in Port., ending at 1800. (*PY2PE1C/W2*)

British Guiana—ZFY, Georgetown, has moved from 3255 kc. to 3265 kc. and is tuned at 0000 with classical music. (*WPE2MI*)

Colombia—HJGF, *R. Bucaramanga*, 4845 kc., has an Eng. period scheduled on Wednesdays at 2200-2300. Has anyone heard it? (*VE7PE1R*)

A station being heard on 14,605 kc. is a third harmonic of *R. Neiva* on 4868 kc., which, in turn, is a change from 4855 kc. Their s/off is listed as 0000. They frequently play the opening of "The William Tell Overture." (*WPE6BPN*)

Congo Republic—Leopoldville, 11,755 kc., operates with 50 kw. daily except Sundays as follows: to Africa in French and Port. at 1200-1500; to Europe, Asia, and Oceania in German, Eng. (1630), French, Spanish, and Italian at 1530-1830; to the Western Hemisphere in Spanish (2000), French (2045), and Eng. (2130). The latter xmsn is not listed for Saturdays. Newscasts are aired in French at 1330, 1715, 2045; in Port. at 1430; in German at 1545; in Eng. at 1630, 2130; in Spanish at 1745, 2000; and in Italian at 1800. (*WPE2DTO, WPE4DMF, WPE4JO, WPE8MS, WPE9BTA, WPE9CGQ, WPEØBTN, WPEØBXN, FA*)

Cuba—*R. Habana* is observed as follows: in Eng. on 11,770 kc. at 2200-2340 and 0000-0100; in Port. on 11,875 and 11,770 kc. at 2030-2100 and on 11,875 and 11,760 kc. at 2300-2330; in French on 11,770 kc. at 2340-0000; in Spanish on 11,875 and 11,770 kc. at 1500, 1830, and 2100, and on 11,875 and 11,760 kc. at 0300 and 0530. The European xmsn at 1200-1400 in Spanish, Eng., and French is noted irregularly on 15,300 kc. The 11,875- and 11,760-kc. outlets are directed to South America, the 11,770-kc. broadcasts to N.A. (*WPE6BPN, WPE8MS*)

Ecuador—New stations and frequency changes: *R. Mercurio,* Cuenca, is on 6350 kc. at 1900-2300; *Centro Radiofonico de Imbabura,* Ibarra, is now on 5070 kc. and noted at 1900-2000; *R. Once de Noviembre,* Latacunga, on 6272 kc., is tuned at 1900-2300; *R. Nacional Espejo,* Quito, has moved from 4680 kc. to 4633 kc. and is heard at 1900-0000. (*WPE4FI*)

Finland—Helsinki operates to N.A. at 0630-0900 with Eng. on Tuesdays and Saturdays at 0630-0900 on 15,190, 11,805, and 9555 kc.; and to Europe with Eng. on Mondays and Fridays at 1100-1130 on the same channels as well as at 1600-1630 Fridays on 6120 kc. (*WPE4FI, WPE8CYR, WPE8DCG, WPE8MS, WPE9DPU*)

Formosa—Taipei was heard weak to fair

Resistor Quiz Answers

(*Quiz on page* 64)

1	D	4	H	7	G
2	C	5	A	8	B
3	E	6	I	9	F

on 17,785 kc., dual to 15,345 kc., with the N.A. xmsn at the new time of 2110-2140. (*WPE4FI*)

Greece—*R. Athens* operates to France and England at 1215-1245 and to N.W. Europe at 1400-1445 on 17,745 and 15,345 kc.; and to mariners at 1700-1730 and 1800-1830 on 15,345 and 11,720 kc. Reports go to: Hellenic National B/C Institute, Technical Services Directorate, 16 Mourousi Street, Athens, Greece. (*WPE3BOC, WPE4DSZ*)

Guinea—Conakry has a new 100-kw. xmtr in service on 4910 kc. and is noted with a fair signal at 1600-1700. (*WPE4FI*)

Haiti—4VU, *R. Lumiere,* Cayes, 2410 kc., was noted at 2021 during a French religious period. An ID was given at 2044. This one is weak and may be difficult to hear. (*PY2PE1C/W3*)

Israel—There has been some doubt regarding the use of 11,920 kc. by the Israel B/C Service. *WPE2DTO* wrote them and the following is a portion of the reply that he received. "It happens that the information in POPULAR ELECTRONICS was correct: *Kol Israel* does use the 11,920-kc. outlet although we believe 9009 kc. to be the most clearly received in most parts of the world." The letter was signed by Eileen Hyman, Assistant to the Director, Overseas Department, Israel B/C Service. (*Ed.*)

Ivory Coast — *Radiodiffusion Cote Ivoire,* Abidjan, was noted on 11,820 kc. from 1345 to 1430/fade-out with Eng. and French programs of news, jazz, and dance music. (*WPE8AGY*)

Jordan—Amman was noted on a new frequency of 15,345 kc., replacing 15,170 kc., at 1800-2000 to L.A. (*WPE4FI*)

Luxembourg—*R. Luxembourg,* 6090 kc., is heard in Europe at 1300-1830 and in Eastern U.S.A. at 1545-1615 with American pop tunes. Reports go to 38 Hertford St., London, W1, England. (*WPE2CRX, JH*)

Martinique — Fort de France has been logged on 4895 kc. at 2005 with operatic music and in French; on 3315 kc. at 1930-1940 with a French newscast; on 2420 kc. with a Hindi religious program at 2010-2030 and records to 2040. (*WPE1HC, WPEØVB*)

Mexico—XESC, Mexico City, formerly on 15,205 kc. and now on 15,200 kc., has become active again after a year's absence and is being noted at 1700-2100; XEWW, Mexico City, has moved to 9515 kc. from the 9500-kc. band-edge channel used for the past 20 years; XEHH, 11,880 kc., Mexico City, is tuned at 1200-2030 with Mexican music, many commercials and frequent ID's, all Spanish. (*WPE2ENZ, WPE4FI, WPE8CKW*)

The following up-to-date listing of the Mexican s.w. broadcasting stations was received from the Mexican Government by Thomas Mount, WPE2AJR, Red Bank, N. J. Call-sign, frequency, power, and mailing address for each station are given, in that order. The two asterisked items represent frequency shifts as reported by Roger Legge, WPE4FI, and the last five stations listed are Mexican cultural stations.

XEBR, 11,820 kc., 150 watts; Carlos Balderrama, Rosales y Vildosola, Edificio San Alberto, Hermosillo, Son.

XEBT, 9625 kc., 10,000 watts; Radio Satelite, S.A., Dr. Rio de la Loza 182, 2° piso, Mexico, D. F.

XECMT, 6090 kc., 1000 watts; Ricardo Lopez Mendez, Km. 560 Carretera Mexico-Laredo, Ciudad Mante, Tams.

XEFT, 9545 kc., 250 watts; Sucrs. de Jose Rodrigues Lopez, Independencia num. 74, Veracruz, Ver.

XEHH, 11,880 kc., 5000 watts; ARSE, S.A., Quemada num. 40, Mexico, D. F.

XEKW, 6030 kc., 500 watts; Jose Martinez Ramirez, Casco de Quiroga y Mariano Elizaga, Morelia, Mich.

XEMZ, 11,860 kc., 1000 watts; Manuel Zetina Gonzalez, Rio Poo num. 48, Mexico, D. F.

XENN, 11,780 kc., 500 watts; Salvador del Conde, Zacatecas 229 "Condominio Yucatan," Mexico, D. F.

XEOI, 6010 kc., 2500 watts; Fomento de Radio, S.A., Ayuntamiento num. 101, Mexico, D. F.

XEQM, 6105 kc., 250 watts; Lazaro Achurra Suarez, Calle 60 num. 735-D, Merida, Yuc.

XEQQ, 9680 kc., 1000 watts; Radio Mexicana del Centro, S. A., Jose Maria Marroqui num. 11, Mexico, D. F.

XERCM, 6130 kc., 100 watts; Radio Central de Mexico, S.A., Vallarta num. 1, 6° piso, Mexico, D. F.

XESC, 15,200 kc.*, 5000 watts; Dolores G. Estrada de Ferreiro, Calz. Mexico a Xochimilco Km. 17, Parada Rio Blanco, Mexico, D. F.

SHORT-WAVE ABBREVIATIONS

B/C—Broadcasting	Port.—Portuguese
Eng.—English	QSL—Verification
ID—Identification	R.—Radio
kc.—Kilocycles	s/off—Sign-off
kw.—Kilowatts	s/on—Sign-on
L.A.—Latin American	xmsn—Transmission
N.A.—North America(n)	xmtr—Transmitter

XETT, 9555 kc., 500 watts; Guillermo Morales B., Dolores num. 10, Primer Piso, Mexico, D. F.

XEUW, 6020 kc., 250 watts; Fernado Pazos Sosa, Independencia num. 230, Veracruz, Ver.

XEWW, 9515 kc.*, 10,000 watts; Cadena Radiodifusora Mexicana, S.A., Ayuntamiento num. 54, Mexico, D. F.

XEXE, 11,900 kc., 1000 watts; Radiodifusora Mexico, S.A., Jose Maria Marroqui num. 11, Mexico, D. F.

XEXG, 6065 kc., 5000 watts; Radiodifusora Mexico, S.A., Jose Maria Marroqui num. 11, Mexico, D. F.

XEJG, 4820 kc., 250 watts; Gobierno del Estado de Jalisco, Palacio de Gobierno, Guadalajara, Jal.

XERUU, 15,300 kc., 250 watts; Universidad de Chihuahua, Domicilio Conocido, Chihuahua, Chih.

XESE, 2380 kc., 350 watts; Secretaria de Educacion Publica, Direccion de Asuntos, Indigenas, Seccion Administrativa, Mexico, D. F. (Station location is Samachique, Chih.)

XEXA, 6175 kc., 100 watts; Radio Gobernacion, Calle de Bucareli, Mexico, D. F.

XEYU, 9600 kc., 250 watts; Universidad Nacional Autonoma de Mexico, Ciudad Universitaria, Mexico, D. F.

New Hebrides—*R. Vila,* 3955 kc., is noted in New Zealand at 0200-0400 in Eng. and French. They would like to receive reports comparing their signal to those of Fiji, Noumea, and others in the general area. *(WPEØJJ)*

Norway—*R. Norway* has "Norway This Week" in Eng. to N.A., the North Atlantic, and Caribbean areas at 2100-2125 on Sundays on 6130, 9610 and 11,850 kc. Norwegian is carried to the same areas on Sundays at 2000-2120 and daily at 2300-0020 on 11,850 and 9610 kc., and daily at 0000-0025 on 6130 kc. They request questions of common interest which they can answer on their Sunday Eng. program. All correct reports are acknowledged; return postage is not required. The address: Norsk Rikskringkasting, Bj. Bjornsonsplass 1, Oslo. *(WPE2EIW, WPE8BBL, WPE8MS, WPEØTA, R. Norway)*

Portugal—The latest complete schedule for *Emissora Nacional,* Lisbon, reads as follows: to U.S.A. and Canada at 1900-2300 on 9740 and 6025 kc.; to Macau at 0400-0815 on 17,880 kc.; to Timor at 0400-0800 on 21,495 kc.; to S. W. Asia (Eng.) at 0815-0900 on 21,495 kc.; to Portuguese India at 0900-1215

SHORT-WAVE CONTRIBUTORS

Anson Boice *(WPE1BD)*, New Britain, Conn.
Bud Barto *(WPE1HC)*, Naugatuck, Conn.
Joseph Russo *(WPE2CRX)*, Toms River, N. J.
Ronnie Breiger *(WPE2DTO)*, Englewood, N. J.
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Henry Marbach *(WPE2FHU)*, White Plains, N. Y.
Robin Martin *(WPE2GEH)*, Glen Head, N. Y.
Douglas Benson *(WPE2MI)*, Schenectady, N. Y.
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Uwe Koops *(WPE3RB)*, Cliffside Park, N. J.
Grady Ferguson *(WPE4BC)*, Charlotte, N. C.
John Sedmera, III *(WPE4DMF)*, Lakeland, Fla.
William Moshos *(WPE4DSZ)*, Virginia Beach, Va.
Roger Legge *(WPE4FI)*, McLean, Va.
W. E. Brodie *(WPE4JO)*, Brandon, Fla.
Shaler Hanisch *(WPE6BPN)*, Pasadena, Calif.
Don Beebe *(WPE7AT)*, Seattle, Wash.
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Joseph Bove *(WPE8CKW)*, Norwood, Ohio
L. Richard Gruber *(WPE8CXT)*, Deer Park, Ohio
Charles Crehore *(WPE8CYR)*, Lorain, Ohio
Larry Bassett *(WPE8DCG)*, Royal Oak, Mich.
Richard England *(WPE8FV)*, Columbus, Ohio
Mike Kander *(WPE8MS)*, Dayton, Ohio
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Craig Anderson *(WPE9BTA)*, Woodhull, Ill.
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Scott Zucker *(WPEØBTN)*, University City, Mo.
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Gerry Dexter *(WPEØJJ)*, Waverly, Iowa
Gerhardt Martens *(WPEØTA)*, Frazee, Minn.
George Buchanan *(WPEØVB)*, Webster Groves, Mo.
Giacomo Perolo *(PY2PE1C/W2)*, Boonton, N. J.
Giacomo Perolo *(PY2PE1C/W3)*, New Castle, Del.
Adolf Lugmayr *(VE3PE1KC)*, Toronto, Ont.
Frank Mohan *(VE3PE1LT)*, Toronto, Ont.
David Bennett *(VE7PE1R)*, Richmond, B. C.
Fred Allgaier, III *(FA)*, Pasadena, Texas
Drayton Cooper *(DC)*, Southport, N. C.
Jean Howard *(JH)*, APO, New York, N. Y.
James J. Hart *(JJH)*, Irvington, N. J.
Radio Norway, Oslo, Norway

on 21,495 kc. (also on 17,880 kc. at 0900-1200 except Sundays and holidays); to East and South Africa (Eng.) at 1315-1430 on 15,380 kc.; to W. Africa (Eng.) at 1430-1840 on 15,-380 kc., and at 1645-1840 on 12,080 kc. (also on Sundays and holidays at 0400-0815 on 17,-880 and 21,700 kc., and at 1215-1630 on 17,880 kc.); to Guinea, Cape Verde Islands, and Brazil, at 0900-1200 on 17,880 kc. (also on 15,125 kc. except Sundays and Holidays), at 1430-1600 on 17,895 kc., and at 1430-2100 on 11,915 kc.; to the fishing fleet at 1600-1930 on 11,840 kc.; to adjacent islands at 0400-1300 on 11,875 kc. (also Saturdays at 1440-1800 on 6025 kc.); and to Europe (Eng.) at 1315-1430 on 6025 kc. (*WPE2EIW, WPE2GEH, WPEØTA, VE3PE1LT, VE7PE1R*)

Syria—Damascus has moved from 5805 kc. to 5794 kc., where it is noted at 0035-0045 with Arabic music; this is dual to 11,750 and 7398 kc. (*WPE1HC*)

Trinidad—A radiotelephone station, ZBD85, Port of Spain, 18,075 kc., has been working Miami mornings and afternoons. They verify by letter. (*WPE8CXT*)

Turks Island—The British Cable and Wireless Station, VSI, operates daily except Sundays at 1100 on 4560 kc. with local news, shipping information, and a few items of general traffic—usually running no longer than 10 minutes. They are *NOT* looking for reports although they will be welcome; return postage is mandatory. The address: Mr. Hyatt, Superintendent, Radio Station VSI, British Cable and Wireless, Grand Turk, Turks Island, British West Indies. (*DC*)

Venezuela—*R. Junin,* San Cristobal, 4930 kc., is heard well at 1900-2230. The s/off time is scheduled as 2330. This station does not seem to use call-signs although the assigned call may be YVOT. (*WPE4FI, WPE6BPN, WPE8FV*)

Radiodifusora Nacional, Caracas, 6170 kc., announces Eng. for 1630-1800 on Saturdays and 2230-0000 on Sundays to N.A. and Europe. (*WPE4BC, WPE6BPN, WPE7AT, WPE8MS*)

A new station, *R. Tropical,* Caracas, 4870 kc., is being heard with "Cavalcada Musical de Medianoche" until 0130. Announcements give the call as YVKT, with YVRT on 1050 kc., and YVKQ on 6110 kc. The latter has not yet been heard. (*WPE6BPN*)

Zanzibar—According to a schedule received from the station through a friend, the *Voice of Zanzibar* now seems to be using 6005 kc. at 0525-0630 and 0830-1130. Programs all appear to be in Swahili or a related language. Has anyone heard these broadcasts? (*WPE8AGY*)

Clandestine—A station has been noted at 1330 with a Congolese newscast. The ID seems to be *Voice of Free Katanga.* Before the start of each program a series of chimes are sounded; a musical program begins at 1344 and is still on after 1415. This channel is in the middle of the DX portion of the 15-meter amateur band. (*JJH*) —30—

POPULAR ELECTRONICS

January 1962 Advertisers' Index

TD Power Supply

(*Continued from page* 73)

a maximum of 2 ma. by inserting a 300-ohm current-limiting resistor (*R2*) in series with *R1*. Resistor *R2* holds the base current at a safe value when *R1* is set at zero; this prevents the output voltage from increasing to a value which would be high enough to damage a tunnel diode.

Construction. Figure 2 and the photographs on pages 72 and 73 give the necessary details for assembling the TD power supply. It's housed in a 5" x 4" x 3" aluminum box, and neither its layout nor wiring is critical. Potentiometer *R1* and switch *S1* are mounted on the top lid of the box; all other components are mounted on the side walls. Dry cell *B2* is held by a Keystone 175 battery holder, and mercury cell *B1* by a Keystone 104; both of these holders are fastened to the same chassis wall.

Power transistor *Q1* does not need a heat sink; but do not fasten it directly to the metal box, because its collector is connected internally to the metal envelope. Instead, mount the transistor upside down on two ceramic or plastic studs. If you wish, a Motorola transistor mounting kit can be used.

Resistor *R2* is held by a 2-lug tie-point, and resistor *R3* by the solder lugs of the two insulated binding posts (*J1, J2*) which serve as the plus and minus d.c. output voltage terminals. For safety's sake, use a red binding post for the positive terminal and a black one for the negative terminal. A 3" finger-grip knob allows smooth, comfortable adjustment of *R1*.

Using the Supply. It is a good practice, in experimenting with tunnel diodes, to start with switch *S1* open and with potentiometer *R1* set to its maximum resistance (for zero output voltage). Then snap *S1* to "on" and increase the voltage slowly until the tunnel diode circuit begins to operate.

The output terminals of the TD power supply are unbypassed. Due to the high radio frequencies on which most tunnel diode circuits operate, it is wiser to insert bypass capacitors in the tunnel diode circuit itself rather than at the output of the power supply. —30—

ELECTRONICS MARKET PLACE

RATE: 60¢ per word. Minimum 10 words prepaid. March issue closes January 6th. Send order and remittance to Martin Lincoln, POPULAR ELECTRONICS, 1 Park Ave., New York 16, N. Y.

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TV Tuners—Rebuilt or Exchanged $9.95 complete—all types—fast, guaranteed service. Send tuner with all parts to: L.A. Tuner Exchange, 4611 West Jefferson Blvd., Los Angeles 16, California.

GOVERNMENT Surplus Receivers, Transmitters, Snooperscopes, Parabolic Reflectors, Picture Catalog 10¢. Meshna, Malden 48, Mass.

WPE-SWL-CB-QSL Cards — Samples 10¢ — "Brownie" W3CJ1, 3110A Lehigh, Allentown, Penna.

DIAGRAMS for repairing Radios $1.00, Television $2.00. Give make, model. Diagram Service, Box 672-PE, Hartford 1, Conn.

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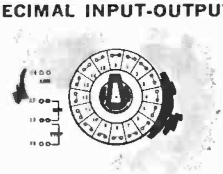

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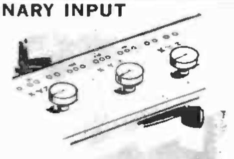

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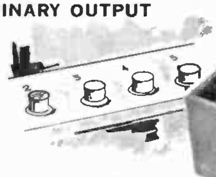

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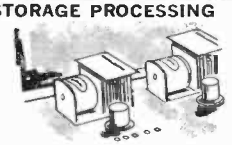

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