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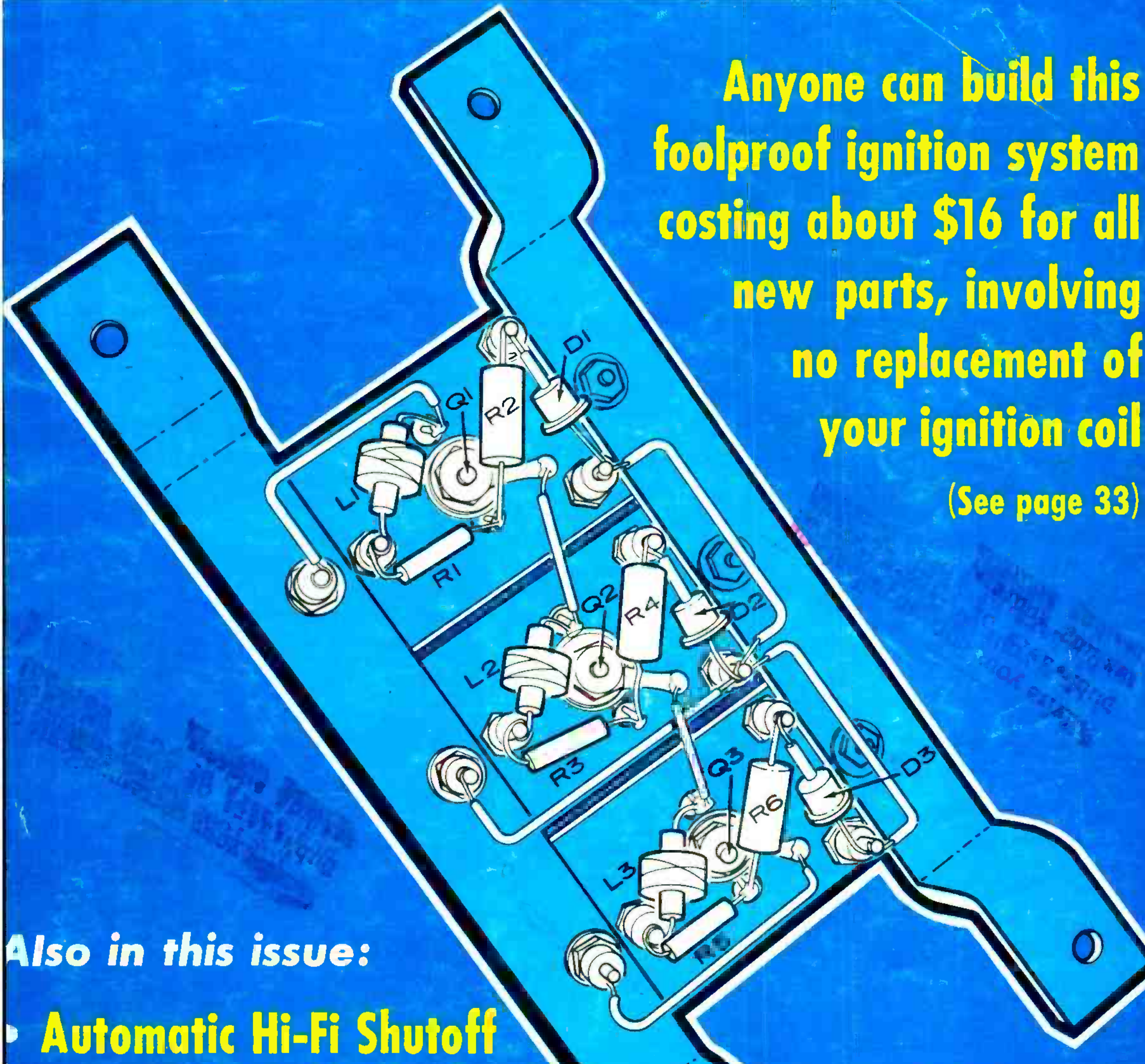

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(See page 33)

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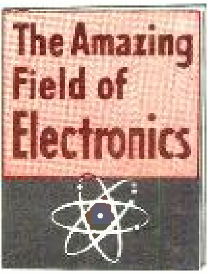

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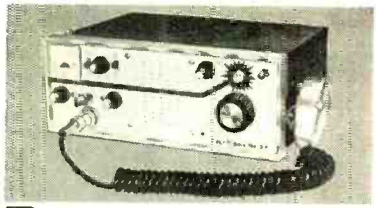

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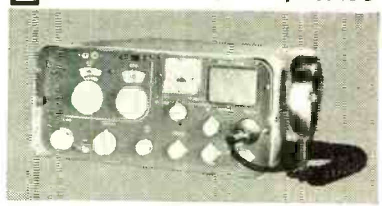

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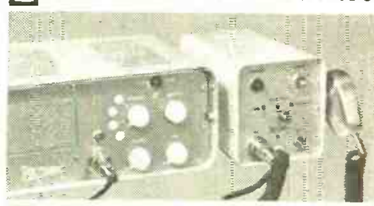

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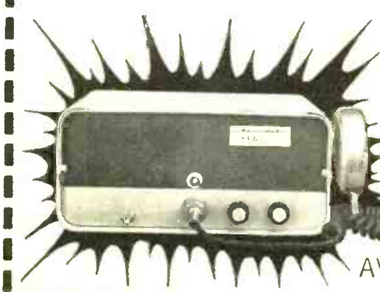

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FCC Report

By **ROBERT E. TALL**
Washington Correspondent

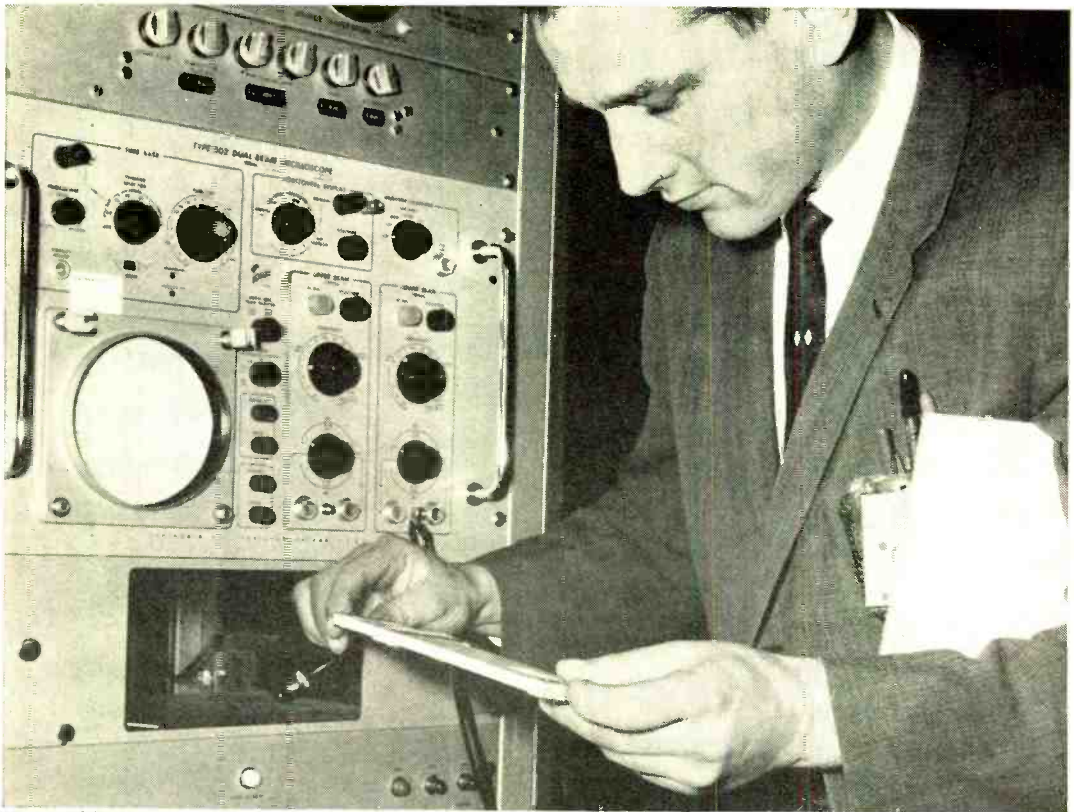
"Small Forfeitures" Enforcement

THE Citizens Radio Service was the first to feel the impact of the Federal Communications Commission's new authority to impose monetary "forfeitures" against non-broadcast radio licensees charged with repeated or willful violations of its rules. By fining a Florida CB'er $300.00 for three violations, the agency has launched its program to make use of this latest addition to its arsenal of rule enforcement methods. The "small forfeitures" provision became law last June after President Kennedy endorsed changes in the Communications Act to be made by Congress.

In asking Congress for the authority to impose these forfeitures, the FCC gave the new legislation a high priority rating in order to arm itself with a "punishment to fit the crime" and bring about more widespread compliance with its nonbroadcast radio rules. The agency managed to convince Congress that the marked increase in the number of relatively minor violations of its rules in some of the newer radio services, including CB, represented a "very real menace" to the orderly use of the radio spectrum, and to efficient regulation. It was pointed out that the established enforcement techniques, such as "criminal penalties, revocation of license, and issuance of cease and desist orders" were "normally too drastic for the relatively minor types of offenses involved" in the nonbroadcast services, and "too cumbersome and time-consuming considering the multitude of violations that occur."

Specific Violations. New rules adopted by the FCC, after Congress and the President gave the agency the authority for the program, list 12 specific rule violations which, if repeatedly or willfully committed by a nonbroadcast radio station, subject the offender to fines ranging from $100.00 to $500.00.

Categories of offenses which apply to *both* the station licensee and the operator of the station, whether the latter is the li-



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FCC Report

(*Continued from page 6*)

censee or not, are: (1) operation of a station without identifying it "at the times and in the manner prescribed" by the Commission; (2) transmission of a false callsign or of a false distress call or message; (3) transmission of unauthorized communications on any frequency designated *by the FCC* as a distress frequency or a calling frequency; and (4) operation of a station so as to interfere with any distress call.

Categories applicable only to the station *licensee* are: (1) operation of a station by a person not holding a valid operator license or permit of the class prescribed (in services where required); (2) operation of a station on a frequency not authorized for use by that station, "including operation with a frequency deviation beyond frequency tolerances" set forth in the rules; (3) failure to attenuate spurious emissions of a station "to the extent required" by the rules; (4) operation with power "in excess" of that authorized; (5) use of a station to render a communication service, "including the transmission of communications not permitted" by the rules, "which is not authorized by the Commission for the particular station"; (6) operation "with a type of emission not authorized" by the FCC for the particular station involved; (7) operation with transmitting equipment not authorized for the particular station; and (8) failure to respond to a written official communication from the Commission.

To impose a forfeiture on a licensee, under the law, the Commission must send him a "notice of apparent liability" within 90 days of the day the offense is committed. While the agency cannot fine the licensee for violations taking place outside the 90-day period, it *can* use such offenses in building a case as to whether the violation was repetitive or willful.

Under the law, the licensee—and/or the station operator in cases where applicable—may be fined as much as $100 for violating each of the categories listed. The maximum fine for a licensee is $500.00 (for violating five or more categories), and $400.00 for a station operator (for violating four or more categories).

In the case of the first CB licensee coming under action,* the Commission imposed a fine of $100.00 for multiple violations of

**As we go to press, a second "Notice of Apparent Liability" has been issued by the FCC. As was expected, this one also went to a CB station—KDB5712. It imposed a $100 forfeiture for violation of section 19.61 (a)—unauthorized communications. More "Notices" are expected to be issued in rapid-fire order.*

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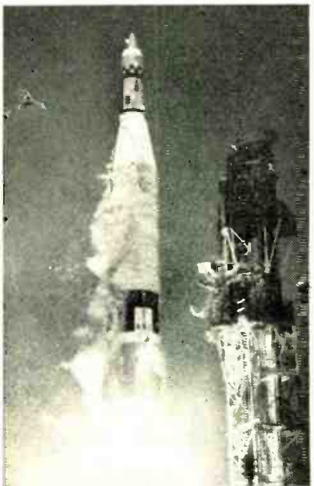

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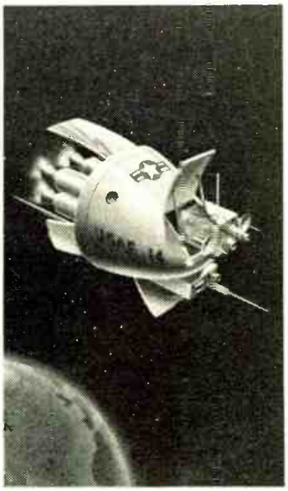

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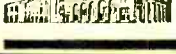

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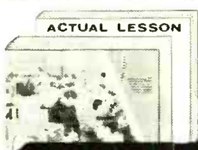

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FCC Report

(*Continued from page* 8)

each of three of the provisions—or a total of $300.00—involving the citizens rule sections dealing with unauthorized communications, improper identification, and the transmission of false call-signs.

Forfeiture Procedure. The procedure, as followed in the initial instance, is for the Commission to send its written "notice of apparent liability" by certified mail to the licensee's—or operator's—"last known address," setting forth the facts of the case and the options available to the person being fined. He then may take one of three courses of action.

The licensee may (1) send a check or money order, made out to the Treasurer of the United States, for the amount of forfeiture specified by the FCC; (2) submit a written statement denying liability, or admitting it and asking that the fine be reduced or cancelled for extenuating circumstances; or (3) ask for a personal interview with an FCC representative to be held within 30 days at the nearest FCC field office or monitoring station. In the latter case, the FCC field official who handles the interview will send a summary of the interview to FCC headquarters; the field official is not authorized to cancel or reduce the forfeiture. If the subject asks for an interview and does not show up, his rights in this respect will be considered waived.

In the event that the licensee, or operator, either submits a written statement as in (2) above, or has the summary of his field interview submitted to FCC headquarters, the Commission itself, or acting through the appropriate bureau, will either cancel the forfeiture, reduce the amount of the fine, or require it to be paid in full. If the licensee, or operator, involved does not comply with the above steps, the FCC will "without further notice" refer the case to the Department of Justice "for prosecution in the appropriate Federal District Court to recover the amount of the forfeiture initially imposed."

While it took the Commission the better part of a year to get the program off the ground due to the fact that the procedure crosses many lines within the agency, it is expected that an increasing number of forfeiture cases will be coming from the Commission week by week. It was pointed out that the initial case—involving the Florida CB'er—was considered an "aggravated" case. Except for such "aggravated" cases, the agency said, FCC policy is expected to be—at least initially—that the formal "notices of liability to forfeiture" go

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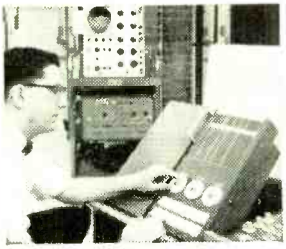

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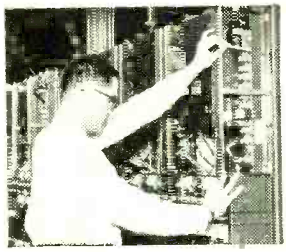

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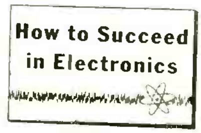

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FCC Report

(*Continued from page* 10)

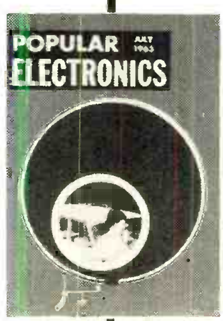
only to parties who have been specifically warned earlier that their alleged offenses might result in forfeiture unless corrected.

Frequency Usage Study. The Electronic Industries Association's Land Mobile Communications Section has volunteered to make a comprehensive study of the use of the radio frequencies presently assigned to the land mobile radio services, including the Citizens Radio Service, if the FCC will cooperate in the project by making its information available to the EIA group.

The projected study would be the first collection of concrete data to show exactly how and to what extent the spectrum allocated to public safety, industrial, land transportation, citizens, and common carrier radio services is being used. The EIA contemplates employing computer techniques to project the future growth of the radio services.

From the study, the EIA claimed, "could emerge a cooperative effort by the FCC, the users, and EIA, for developing plans and suggestions for improving the use of the land mobile spectrum." —30—

COMING NEXT MONTH



If you are a ham mobile on 6 or 10 meters, or a CB'er with a transceiver in your car, take a good look at the latest thing in antennas — the "hula-hoop." This DDRR antenna, mounted on a car-top, radiates better than a quarter-wave whip. Our July issue will tell you how to build your own.

ON SALE JUNE 27

- **EXPERIMENTERS' PHOTOCELL CIRCUITS** Get the full story on those versatile cadmium selenide and sulphide photocells. Here are half a dozen unusual, easy-to-build photocell circuits.
- **THE LASER REVOLUTION** A status report on one of the most fantastic developments of modern times—sources of coherent light that may carry a billion phone calls.
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Get Your First Class Commercial F.C.C. License In a Hurry — Or at Your Own Pace!

Is the Course Proven?

A high percentage of Grantham *resident* students get their 1st class FCC licenses in the short period of 12 or even 8 weeks from the time they start the course. Many others choose *home study*, completing the course and getting their licenses at their own convenience.

Is the Course Complete?

Not only does the Grantham course cover all required subject matter completely; it grows and changes and expands in phase with change and expansion in the electronics field generally. With the Grantham course, you are assured of modern, up-to-the-minute instruction.

Is the Course "Padded"?

The streamlined Grantham course is designed specifically to prepare you to pass FCC examinations and examinations given by electronics firms. What you need to know to achieve these goals, you are taught completely and in detail. The course is not "padded" with information you will not need.

Is It a "Coaching Service"?

The weakness of the "coaching service" or "Q & A" method employed by some schools and individuals is that it presumes the student already has a knowledge of basic electronics.

The Grantham course is presented from the viewpoint that you have no prior knowledge of the subject; nothing is taken for granted where your training is concerned. We "begin at the beginning" and progress in a logical, step-by-step manner from one point to another, with the necessary math taught as an integral part of the course. Every subject is covered simply and in detail; the emphasis is on making the subject easy to understand.

With each lesson you receive an FCC-type test so that you can discover after each lesson just which points you do not understand and clear them up as you go along. In addition to the lesson tests, ten comprehensive Review Exams are given throughout the course.

Is the School Accredited?

Grantham School of Electronics is accredited by the Accrediting Commission of the National Home Study Council.

Is It a "Memory Course"?

Grantham School has never endorsed the "memory" or "learn by rote" approach to preparing for FCC license exams. This approach may have worked in the early days of broadcasting, to the extent that a man could get his license that way; but, Heaven help the employer who expected this man to be able to demonstrate abilities implied by possession of the license!

Fortunately for all concerned, it is no longer possible for a man to pass FCC exams by spilling out memorized information which is essentially meaningless to him. Advances in the field of electronics—and the desire of the FCC to have the license really mean something — have caused upgrading of the exams to the point where only the man who is able to *understand* and *reason* electronics can acquire the 1st class FCC license.

Learn to thoroughly understand basic electronics from the school whose graduates are successfully employed by virtually every major electronics firm in the United States. Why not join them through Grantham training?

For further details concerning F C.C. licenses and our training, send for our FREE booklet

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Name ________________ Age ______

Address ________________

City ________________ State ______

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Letter Tray

(*Continued from page* 16)

Canada. Can you tell me where I can obtain a list of all the BCB stations in the United States?

BRIAN McCOOLA, WPE3DQC
Camp Hill, Pa.

A good list that we know of, Brian, is the North American Radio-TV Station Guide, by Vane A. Jones. It's available from Howard W. Sams & Co., Inc., 4300 W. 62nd St., Indianapolis 6, Ind., for $1.95.

P.E.'s Offered—Wanted

■ Like so many others, I am faced with a space problem: too many P.E.'s and too little room. Bids or offers to swap radio or photo gear for them would be appreciated. I have all issues from Vol. 1, No. 1, to the present.

Thank you for printing this letter; I appreciate it, but my wife will love it!

HERB SCHACHTER, WA2DWJ
51 East 89th St.
Brooklyn 36, N.Y.

■ I noticed in a recent issue that there are *some* people who are willing to part with their P.E.'s. My set is complete except for the May, 1955, issue. Could you put me in touch with someone who would sell me a copy?

GYULA WAJNA
1213 Neptune Ave.
Akron 1, Ohio

Two-Meter Receiver

■ I am very pleased with the "2-Tube, 2-Meter Superregen Receiver" (October, 1962). It is the first VHF receiver I have ever built, and it works well. Alterations I made include substituting a 6BQ6 for the 6BZ7, mounting the power supply in a separate box, and using a full-wave rectifier.

How about a 2-meter transmitter as a companion unit?

RICHARD GILL, WPE6ECL
Cupertino, Calif.

If enough readers are interested, we'll try to dig up plans for a 2-meter transmitter. Any comments? —30—

Out of Tune

Build the MPX (*April,* 1963, *page* 65). The polarities of diodes *D3* and *D4* in the schematic diagram of the power supply should be reversed. They are shown correctly in the pictorial diagram of the power supply turret in the May issue (*page* 71). —30—

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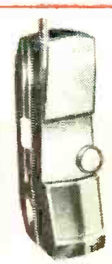

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TROUBLESHOOTING HIGH FIDELITY AMPLIFIERS

by Mannie Horowitz

A current trend in book publishing is to reprint a series of magazine articles written by the author over a period of years. Occasionally the idea goes sour, and a helter-skelter volume results; but happily enough, this is *not* one of them. In *Troubleshooting High Fidelity Amplifiers*, compiled from a series of articles in *Electronic Technician*, Mannie Horowitz covers a lot of important ground in surprisingly few words. Mannie, of course, is best known as the project engineer in charge of audio development at EICO. He writes with a voice of experience and practical knowledge—qualities that many more authors could use. Get this one if you build your own, or are servicing hi-fi gear.

Published by Radio Magazines, Inc., P.O. Box 629, Mineola, L.I., N.Y. 128 pages. Soft cover. $2.95.

HALL-EFFECT INSTRUMENTATION

by Barron Kemp

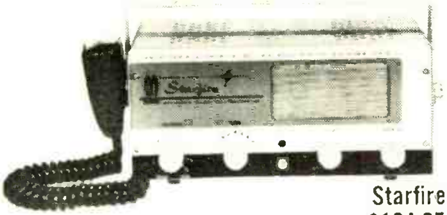
Yes, Virginia, there really is a *Hall effect*—but we're not going to spend a book review defining it for you. Buy this non-technical text and you'll have a fairly good idea of what it's all about. Discovered in 1878, the Hall effect may eventually open up a completely new era in solid-state electronics. This book summarizes current research and illustrates circuitry applications so far discovered. High school students might investigate these circuits as possible Science Fair projects.

Published by Howard W. Sams & Co., 4300 West 62 St., Indianapolis 6, Ind. 128 pages. Hard cover. $4.95.

UNDERSTANDING AMATEUR RADIO

by George Grammer

Throughout the past few years, the hams at ARRL headquarters have been discussing the possibility of putting out a "junior" handbook. Their "senior" handbook, the world-renowned 700-page *Radio Amateur's*



Starfire
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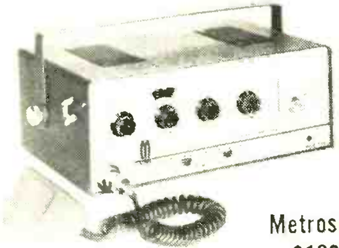

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Monocall Encoder $39.95
Monocall Encoder-Decoder $79.95

Metrotek's 66
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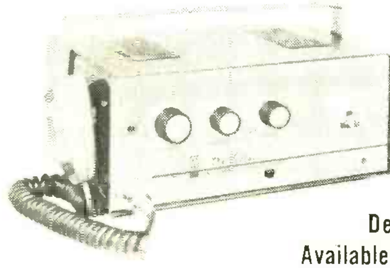

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3. Metrostar - a double conversion unit - built in mobile power supply - S meter - tunable receiver - 8 position crystal controlled transmit and receive.
4. Space Station - superb modern styling in walnut cabinet for 110 volt instalation. Desk mike - S-meter - 5 transmit - 5 receive - plus tunable.
5. Monocall - your individual selective squlch system - no personal channel monitoring - dependable unique dual tone operation - can be adapted to your present unit. Patent pending.
6. Metrotek 66 - new six meter transceiver - highly sensitive - double conversion - 25 watt unit input minimum 13 watt output with built in mobile power supply - crystal controlled or tunable functions.

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Bookshelf

(*Continued from page 20*)

Handbook, has been growing by leaps and bounds; and a second volume (or junior edition) was suggested as a logical solution to the problem of what to do with some of the material that space requirements forced out of the bigger book. *Understanding Amateur Radio* is the junior handbook—don't be fooled by the title.

This book looks like a conglomeration of editorial matter scissored out of another book—in other words, it's pretty ragged. If you have the patience, though, there are plenty of thought-provoking ideas on transmitters, antennas, and converters to be found in its 320 pages—and even conversion plans for Command receivers. It's a pity that *Understanding Amateur Radio* cannot be incorporated in the ARRL Handbook. But the $2.00 selling price is a small enough investment, and between the two books you'll acquire a thorough understanding of everything a ham does and the equipment he uses.

Published by American Radio Relay League, 38 La Salle Rd., West Hartford, Conn. 320 pages. Soft cover. $2.00.

CITIZENS BAND RADIO MANUAL, Volume 3

Strictly for the service technician or repairman handling CB gear, this is the third manual in the Sams CB series. The most popular transceivers were covered in Volumes 1 and 2. Volume 3 has full wiring and alignment data on the EICO 770, Globe CB-100, Gonset G-14, Heath GW-10, and Poly-Comm N, all of which have had good sales figures. The remaining diagrams pertain to 100-milliwatt'ers and CB transceivers that are not so well known.

Published by Howard W. Sams & Co., 4300 West 62nd St., Indianapolis 5, Ind. Soft cover. 160 pages. $2.95.

PRACTICAL RADIO SERVICING, Second Edition

by William Marcus and Alex Levy

Of all the books on servicing now in print, few—if any—can beat the approach that Marcus and Levy have taken in this volume. It is aimed right at the beginner in electronics and scores 100% as a direct hit. A combination of two previous books by the

Bookshelf

(*Continued from page 22*)

same authors, "Practical Radio Servicing" and "Profitable Radio Troubleshooting," this edition brings all of the previous material up to date. The text is leisurely, low-key, ideal for self-study; and the fact that the subject of TV servicing has been omitted should prove a boon to beginners afraid of swallowing too much theory in one gulp. Any experimenter who has a copy of this book should find no difficulty either in diagnosing troubles or effecting repairs—and should be able to amortize the cost of the volume with two service jobs.

Published by McGraw-Hill Book Co., 330 West 42nd St., New York 36, N.Y. 617 pages plus index. Hard cover. $11.95.

HANDBOOK OF HAM RADIO CIRCUITS
by David E. Hicks

This is the kind of a book that someone should have put together years ago. Dave Hicks, W9CGA, has finally done it. He has assembled complete information on 36 of the most popular receivers, transmitters, and transceivers. A detailed wiring diagram of each unit is presented, plus a photograph, and some descriptive text. The material makes for easy comparison of the ham equipment represented—we only wish that more units were covered.

Published by Howard W. Sams & Co., 4300 West 62nd St., Indianapolis 6, Ind. Soft cover. 128 pages. $2.95.

Capsule Reviews

PRINCIPLES OF APPLIED ELECTRONICS by *Ben Zeines*. This is a modern-day classroom text written at the college engineering level. It contains an excellent presentation of sample problems and solutions. The text starts with electron flow in semiconductors, finishes with vacuum tubes. *Published by John Wiley & Sons, Inc., 440 Park Ave. S., New York 16, N.Y. 426 pages. Hard cover. $6.95.* . . . . **BASIC ELECTRICITY, Second Edition,** by *Rufus P. Turner*. Exceptionally well organized, this is a straightforward, up-to-date text for the beginner or student. The title is a slight misnomer since 75% of the material is now devoted to electronics in the commonly accepted meaning of the word. *Published by Holt, Rinehart and Winston, Inc., 383 Madison Ave, New York 17, N.Y. Hard cover. 412 pages. $6.00.* —30—

New Products

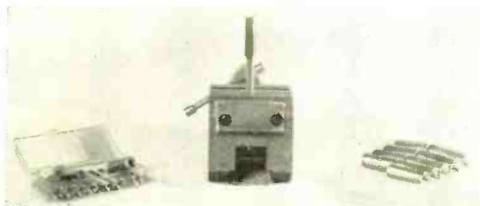
STEREO FM TUNER

Recently added to the Altec Lansing "Royale" line is the 315A "Empress Royale" stereo FM tuner. The new unit features automatic, all-electronic multiplex switching circuitry, indicator light for immediate determination of multiplex stereo reception, automatic frequency control, special

multiplex noise filter, and excellent sensitivity with a full frequency response of 20-20,000 cycles. Price, $256.00. (*Altec Lansing Corp.,* 1515 S. Manchester Ave., Anaheim, Calif.)

GUIDES FOR TAPPING ROD FACES

All radio and electronics hobbyists should be interested in the tools for tapping and drilling the ends of shafts and rods currently being marketed by Ethical Enterprises, Inc. Known as "Little Jiggers," they are guides that slip over the ends of the rods to hold a drill or tap on center. Alignment can be held to a very close tolerance, and any type of drill can be used. A set of 10 "Little Jiggers" (5 drilling and 5 tapping) for use with ¼" to ½" rods costs $5.95. Various other "Jigger" sets, includ-



ing hex rod "Jiggers," are available; check with the manufacturer for more details. (*Ethical Enterprises, Inc.,* 988 Highway 202, Somerville, N. J.)

MINIATURE WELDING TORCH

The "Microflame" is a hand-size welding torch which has a pin-point flame temperature of 4000° F. Handy to work with, the torch uses two miniature gas cartridges—one containing butane, the other oxygen—which can be obtained at either hardware or drug stores. The fuel supply will last about two hours. Precision controls

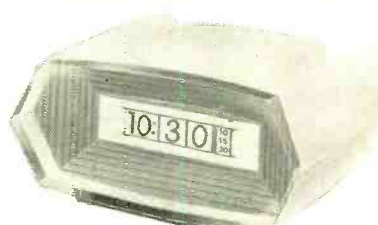
adjust the gas mixture and also turn the torch off and on to permit storage. Price, $19.95. (*Printed Circuits, Inc.,* 7800 Computer Ave., Minneapolis, Minn.)

NYLON NUT KIT

Nuts that will fit different threads have been developed. Available from Venti-Kuff in a "FITS-ALL" Nylon Nut Kit, these nuts are only partially threaded. Since they are made of nylon, a screw or bolt will cut its own thread regardless of whether it's right- or left-handed, sheet metal, British, or Acme thread. Nylon nuts will not corrode or work loose, and lock washers are said to be unnecessary. Prices: introductory kit of 21 assorted nuts, 98 cents; large plastic box containing 110 assorted nuts, $3.49. (*Venti-Kuff,* P. O. Box 11171, St. Petersburg 33, Fla.)

"TIME AT A GLANCE" CLOCK

One item that can now be purchased at a much lower cost than in previous years is the "numeral clock." Heretofore priced



above $20.00, direct-reading (or "time at a glance") clocks are currently available from Tymeter Electronics for only $11.95. The styling is modern, with cases and faces being offered in three combinations: white case, persimmon face; walnut case, white face; and ebony case, white face. All versions of the "F7 Satellite," as the clock is called, have a one-year guarantee. (*Tymeter Electronics,* Pennwood Numechron Co., 7249 Frankstown Ave., Pittsburgh 8, Pa.)

Satellites On The Air

The following satellites, launched by the United States, were reported to have beacon and telemetry transmissions as of April 17, 1963. The satellites are listed by their code names, according to frequency; because some transmit on more than one frequency, they appear more than once.

Transit 4A	54.000 mc.
Vanguard 1*	108.023 mc.
Relay 1	136.140 mc.
Transit 4A	136.200 mc.
Explorer 16**	136.200 mc.
Tiros 4	136.230 mc.
Tiros 6	136.233 mc.
Tiros 5	136.234 mc.
Explorer 17**	136.317 mc.
Ariel	136.407 mc.
Explorer 14	136.440 mc.
Explorer 17	136.560 mc.
Alouette**	136.593 mc.
Relay 1	136.620 mc.
OSO I	136.744 mc.
Anna 1B	136.815 mc.
Explorer 16	136.860 mc.
Injun 3**	136.860 mc.
Tiros 6	136.922 mc.
Tiros 5	136.923 mc.
Anna 1B	136.975 mc.
Alouette	136.979 mc.
Transit 4A	150.000 mc.
Anna 1B	162.000 mc.

*Transmits only while satellite is in sunlight—no battery power
**Transmits only upon command from ground stations—not during every pass

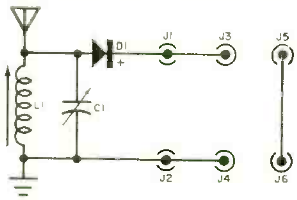
Satellites of the Soviet Union have telemetry and tracking transmissions in the 19.990-20.010 mc. band. Whenever a Cosmos series satellite is launched, check Radio Moscow for an announcement of tracking frequencies. Most Cosmos series satellites re-enter the atmosphere in 60-90 days. Cosmos 2, 5, and 8 are in orbit at press time, but do not seem to be transmitting.

If you're interested in eavesdropping on satellites, and missed our June 1962 article on the NASA-136 converter, we recommend that you look it up. Easy to construct, this sensitive converter can intercept the satellites operating in the 136-137 mc. band.

Tips and Techniques

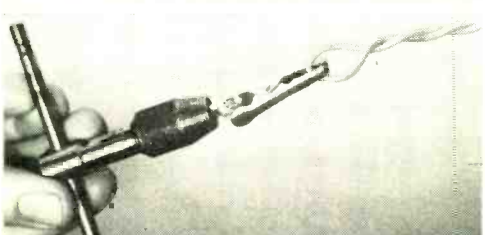
MULTIPLE EARPHONE CONNECTION SETUPS

Multiple jacks for earphone connections, shown here in a crystal radio circuit, can be used wherever provision for more than one earphone is desired, and where earphones of different types and impedances might be used. When using one set of phones, connect the cord tips to jacks *J1* and *J2*. A second pair in parallel can be connected to *J3* and *J4*. If impedances are too low, and it would be desirable to connect the phones in series, use *J3* and *J5* as one pair, and *J6* and *J4* as the other. If you're using crystal phones and there is a low d.c. voltage present (as in a transistor radio), connect the crystal phones to *J3* and *J4*, and a pair of magnetic phones to *J1 and J2* to pass the d.c. —*Art Trauffer*



SIMPLE TOOL FOR LEAD TWISTING

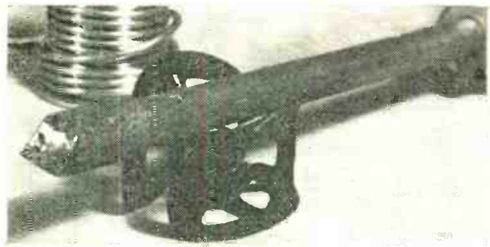
Need a "twisted pair" for heater leads in a piece of equipment you're building, an intercom or antenna lead-in? Here's a way of doing the job neatly and evenly. Make a tool for lead twisting by tightly securing an alligator clip in the chuck of a tap wrench. To make a twisted pair, measure a length of wire twice as long as the final length and



add 20% more to compensate for the twists. Fold the wire in half, and attach the ends to something or hold them securely. Simply grip the bend in the wire with your lead-twisting tool, and twist away to your heart's content. —*John A. Comstock*

RIBBON REELS BECOME SOLDERING IRON STANDS

Worn-out typewriter ribbons should be discarded, of course, but you might want to keep the reels they come on. You can make handy holders for soldering irons from this



type of reel. All you have to do is bend the reel to resemble the one shown in the photo. —*Wayne Floyd*

PREVENTING TOWER FREEZE-UPS

With the summer antenna-erecting season upon us, here's a tip that can save you a lot of trouble. If your TV or ham antenna tower is one of those triangular affairs made of welded thin-wall conduit, or if it uses tubing of any sort, check to see that each hollow member has a seep hole very near the ground. Without such a hole, rain water and condensation will collect and cause unnecessary rust and corrosion, and in colder climates, can freeze and split the tower supports. —*Homer L. Davidson*

EXPERIMENTAL CIRCUIT CONNECTORS

Breadboarding without a board is possible with the aid of rubber suction cups and coil springs. If you use the method described here, any surface—table top, desk or bench top—can become a large breadboard for experimental circuits. For tie points, all you do is secure a number of suction cups to the surface you're working on and insert coil springs in their holes. To make a connection

to a tie point, just slip the wire between the turns of the spring—bending the spring will make the job easy. Since there's no soldering or unsoldering involved, you can use the parts over and over. —*Jerome Cunningham*

OPERATION "ASSIST"

IF YOU need a helping hand or can lend one in digging up technical info or a schematic diagram on an old or unusual radio or other piece of electronic gear, check the listings below. OPERATION "ASSIST" works as follows: Readers who can help are urged to write directly to readers needing information as described in this department.

If *you* need help, send us a postcard with all pertinent data that you have on the unit (description, model and serial number, make, year, etc.). Be sure to include your name and complete address. Send the card to OPERATION "ASSIST," POPULAR ELECTRONICS, One Park Avenue, New York 16, N.Y.

Due to the large number of requests received, the Editors of POP'tronics reserve the right to select those which are unusual in nature and for which other sources are not readily available.

Schematic Diagrams

Fada Radio & Electric Co. (Model 365 T) radio, 1940 vintage. (Robert Shaw, WPE0DHG, R.R. 1, Toledo, Iowa)

Airline 6-tube battery-operated long-wave radio, about 1928. (James Jackson, WPE7BJN, Space 58, 501 Moana, Reno, Nev.)

Freshman Masterpiece (#B123899) 5-tube battery radio made by Chas. Freshman Co., N.Y., in the 1920's; 201 tubes used. (D. W. Stickley, 6312 Waldron St., Pittsburgh 17, Pa.)

McMurdo Silver Masterpiece VI Allwave radio of 1936-38 vintage. Two-piece chrome-plated set has 5 bands to 17 mc., uses 16 tubes. (G. Drexel Biddle, 134 W. Prospect St., Marquette, Mich.)

Lumophon "Super" (Model #WD570) 4-band German receiver, about 1935. (Rudolph Alonzo, 7703 Mazatlan Dr., El Paso 15, Texas)

Stewart Warner (Model R-138-A) radio. (Fred Schafer, 672 Calumet, Lima, Ohio)

Harvey Wells (Model VPS-R9) vibrator power supply. (Don Burgett, R.R. #1, Villa Grove, Ill.)

General Electric (Model No. 119) radio-phonograph (Charles Lingard, Box 853, Brookings, Ore.)

Ritchie Recorders (Model TR515) tape recorder. (M. B. Chalmers, Box 414, Harriston, Ont., Canada)

Zenith (#S462076) 8-tube, 3-band, radio-phonograph console of the late 1930's (Edward F. Maher, Jr., KGB2470, 39 Bayview Ave., East Islip, N. Y.)

RCA Victor—Canada (Model 5T-1) radio of 1932-1934 vintage. (Errol May, 21 Sovereign St., Waterford, Ont., Canada)

Radio City Products Co. (Model 664) VTVM made about 1945. (Chas. E. Moore, 318 Hillwood Dr., San Antonio 13, Texas)

Military radiosonde (T-435/AMT-4B) weather balloon transmitter (Greg Boren, 8119 Calmada Ave., Whittier, Calif.)

(*Continued on page 30*)

OPERATION "ASSIST"

(Continued from page 28)

RCA (Model WO-56A) oscilloscope. (Gavino B. Bautista, La Union School of Arts and Trades, San Fernando, La Union, Philippines)

Philco (Model 42-345. Code 121). (Clark Pullen, 1004 Crestview Dr., Sherman, Texas)

Military Navy RAO-2 receiver (Type CNA-46187). Mike Mellinger. WA6USU, 1226 East Comstock Ave., Glendora, Calif.)

Grunow (Chassis Type No. 6-C) short-wave receiver made by General Household Utilities Co., Chicago, Ill. (David Zembryski. Breezy Acres Trailer Pk., Jamesville 3, N.Y.)

Philco (Model 46-1203. Code 125) radio-phonograph. (E. M. Gable. 6057 S. Wolcott, Chicago 36, Ill.)

Technical Data and Schematics

Breting (Model 9. #62227) communications receiver. (Walter V. Niemeyer, Box 99, Shellrock, Iowa)

Hickok (Model RFO-5) oscilloscope. (James F. Zahler, 315 E. 272 St., Euclid, Cleveland 32, Ohio)

RCA (Model C9-4) AM-s.w. receiver of 1936 vintage. Philco (Model 38-2) AM-s.w. receiver made in 1938. (Alan R. Shadduck, Rt. 2, Box 940, Roseburg, Ore.)

Military (BC-1378) scope control unit. (James A. Marton, 3652 East 106th St., Cleveland 5, Ohio)

General Electric (Model A-75) receiver. (James Rzadkiewicz. 112 Hespeler Ave., Winnipeg 5, Man., Canada)

Crosley (Model 63TA. Chassis II) 2-band receiver of W.W. II vintage. (Walt Bailey. WPE8EMR, 790 Clyde St., Akron 10, Ohio)

Brunswick (Model 5KR) radio made in the late 20's. (William J. Dietz, 1180 Long Pond Rd., Rochester 15, N.Y.)

John Meck Industries (Model T60-1) amateur transmitter. (Adeline E. Kent School Radio Club, c/o Adeline E. Kent School, Kentfield. Calif.)

Superior Instruments Co. (Model 450-A) tube tester. Tube charts and operating instructions. (L. Daigneau, 2164½ Broad St., Cranston 5. R.I.)

Supreme Instruments Corp. (Model 560A) "Vedolyzer" comb. scope. VTVM. etc. (Edwin R. Gamble, 1053 Elm St., Clinton. Ind.)

Stewart-Warner-Alemite Corp. (Model R.P.A.-3) Reception Set; general-coverage s.w. set built for Canadian Government in 1944. (Gary M. Cooper, VE3PE1MX, 16 Prince St., St. Catharines. Ont., Canada.

Military frequency meter used by Royal Canadian Air Force (Type C2—RCAF, Ref. #10D/3789, Serial #1273). Mfr. was Canadian Marconi Co., Ltd., 1943. (David C. Eastman. WPE1AW. Box 336. Ashton, R.I.)

Approved Electronic Instrument Corp. (Model A-200) signal generator made in New York. (H. Jones, Box 849. Moab, Utah)

Dumont (Model 329) oscilloscope. (Sam Steele, W8GAV, 79 Hamilton St., Berea. Ohio)

Atwater Kent (Model 318) radio. (Fred Pfeffer, 625 Evergreen Ave.. Pittsburgh 9, Pa.)

Garod (Model 493) receiver. (Mark Lieberman, WPE2JJT, 118-60 Metropolitan Ave., Kew Gardens 15. N.Y.)

Grebe (Type CR-12. Serial No. 106) radio of 1914 vintage. (Howard Chapin, WN2DAZ, 64 Nautilus Ave., Northport, N.Y.)

Grunow (Model 1191) Allwave Receiver made by General Household Utilities about 1938. (Patrick Bullock, 707th Radar Sqdn., Box 411, Grand Rapids, Minn.)

Crosley (Model 22CA) AM-FM 12-tube receiver (Roger Van Divort, Rt. 2, Chatham Hill, Wenatchee, Wash.)

Military U.S. Navy receiver (Model RAL-2). Receiver unit (Type CRV 46045, #255) and power supply (Type CRV 20036). (David J. Geschwantner, 408 Brinley Ave., Bradley Beach, N.J.)

Regentone 5-tube general-coverage receiver made in Great Britain; tube line-up is UCH42, UL41, UY41, UI41, UBC41. (Frank Wisneski, WPE2IRU, 507 5th St. Union City, N.J.)

—30—

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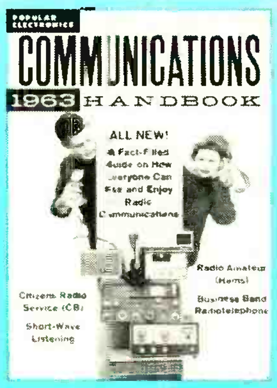

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Operation PICKUP

a transistorized PROJECT IGNITION CONVERTER KEEPING USEFUL PARTS designed to improve the performance of your automobile

By C. E. RUOFF

COVER STORY

THE ADVANTAGES to be gained through the use of a transistorized ignition system in your automobile are many. Wear and tear on the distributor points will be drastically reduced, spark plug life greatly extended, fuel economy improved, and the automobile will give peak performance over many months. Few, if any, Detroit designers argue that

(*Continued on page* 35)

Your Ignition System

IN ITS DAY, the familiar automobile ignition system was a great invention. Designed some 50 years ago by Charles Kettering, it supplanted the magneto ignition system that made car-starting a love of labor rather than a labor of love. Minor improvements in the Kettering invention have been made over the years, but in the 1960's the demands for better ignition have finally exceeded this system's potential for performance and reliability.

The Problems. The electric spark is the gasoline engine's all-important trigger. Exclusive of oil and gasoline, the components in the ignition system are the first parts you must replace. Unfortunately, spark plugs and distributor points don't tell you when they need replacing; their effectiveness in your automotive electrical system ebbs slowly away and engine performance becomes poorer and poorer until you have real trouble on your hands.

Besides the wear and tear, your ignition system is beset by a more important problem. As the rpm of your engine climbs, the spark voltage required for good gasoline combustion goes up while —because of defects inherent in conventional systems—the voltage available from the ignition coil goes down.

Thus, automotive engine designers find themselves working against a barrier as they seek to increase engine power while cutting weight and fuel consumption. They have the market, the metallurgy, and the gasoline fuels for lighter and faster engines. The only thing lacking is better ignition. The conventional ignition system cannot possibly meet the new demands; therefore, the only salvation is a basically new design.

Kettering Ignition. In the conventional system, the distributor points close and the battery drives current through the primary winding of the ignition coil. This creates a magnetic flux in the coil's soft iron core. All electronic technicians are aware that this magnetic flux can also be considered a form of stored energy. It is proportional to the square of the current and to the inductance of the primary, or approximately proportional to the number of turns.

When the distributor points open and the current stops flowing, the magnetic flux field collapses and induces a sharp spike of voltage in both the primary and secondary coil windings. The output voltage is multiplied by the ratio of the number of turns in the secondary to the number of turns in the primary. The voltage in the secondary—with its thousands of turns—is, under ideal conditions, between 10,000 and 30,000 volts. It is this high voltage that jumps the spark plug gap to ignite the fuel-air mixture in the automobile engine.

Designers of ignition systems are stymied by the time (in milliseconds) that it takes the current in the primary of the ignition coil to reach an optimum value. This inductive reactance becomes important when we consider that a V-8 engine turning at 6000 rpm must have its spark plugs firing at 0.0025-second intervals. Half of each interval, however, must occur when the points are open and no primary ignition coil current can flow.

Of course, one way to partially overcome the lag due to inductive reactance would be to increase the amount of current flowing in the primary. But this current is limited by the distributor points, which can safely pass four to eight amperes *at most* without oxidizing—or, as the automotive engineer says, "bluing."

A Solution. The present-day Kettering style ignition system, at best, is a compromise between allowable current drain through the distributor points versus the inductive reactance in the ignition coil. To resolve this dilemma, improved automotive performance—related to obtaining a more consistent and better electrical spark—necessitates these three things: (1) faster switching in the primary coil circuit; (2) higher current flow in the primary; and (3) the possibility of a greater turns ratio in the ignition coil itself.

The transistorized ignition system is one of the several methods that will resolve two or more of these three problems. Given the present state of the art, it is economical, foolproof, and capable of vastly improving automotive engine performance.

—*Stephen F. Wilder*

Operation PICKUP

a transistorized system, or some solid-state ignition switching system, is not going to be "standard" on every 1965 car. But what about those of us with 1950 or early-1960 cars?

There are kits available to convert a conventional ignition system to a transistorized system; some are good, a few are marginal, and probably one or two won't work on every car. From the standpoint of the electronics experimenter with minimum automotive electrical experience, isn't there something just a little different, and possibly just a little better?

Yes, there is. Operation PICKUP. The transistorized PICKUP ignition system described in this article has been road-tested both by the author and the POPULAR ELECTRONICS staff. It was designed to be as foolproof as humanly possible, even to the extent of employing the ignition coil that comes with the car—something that four out of five other transistorized ignition systems cannot do. The cost has been kept to a minimum consistent with good performance and insurance against ignition failure on the road.

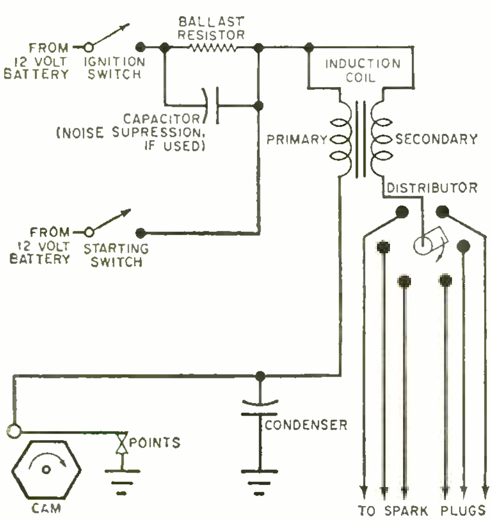
On the author's 1958 Cadillac, the PICKUP improved gas mileage by not less than two miles a gallon! On a Pontiac station wagon with a low-horsepower (economy) engine, it also improved gas mileage while simultaneously permitting smoother idling, faster pickup, and greatly improved engine performance at high speeds.

If you are reasonably familiar with automotive electrical systems, you should be able to install the PICKUP in five to ten minutes. Should it ever fail on the road, even the most perfunctory gas station mechanic can put your original ignition system back into operation in the same amount of time.

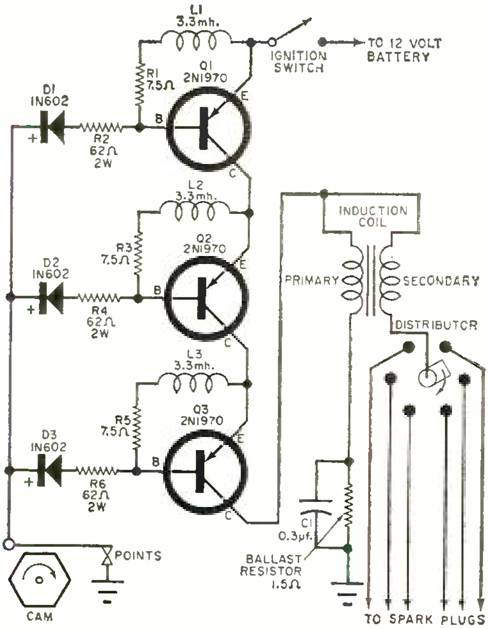
Substitution of Parts. The Delco 2N1970 power transistors specified in the Parts List were chosen for the PICKUP after considerable research into the basic requirements that should be met by an ignition switching system. The transistors—for a negative ground 12-volt automotive electrical system—must have a rating of at least 15 amperes maximum collector current (*Ic*) and a minimum collector diode breakdown rating of 100 volts. The 2N1100 is the only safe substitution recommended for this circuit; it is considerably more expensive, though more commonly available since it is produced by various manufacturers.

Diodes *D1*, *D2*, and *D3* must be silicon units rated equal to or better than 200 volts PIV (Peak Inverse Voltage) at 600 ma. One of the PICKUP prototypes built for this article utilized the General Electric Type 1N602, while a second

Circuit of the usual negative ground automotive ignition system. Note how ballast resistor (usually 1-2 ohms) is shorted out by starting switch.



Operation PICKUP

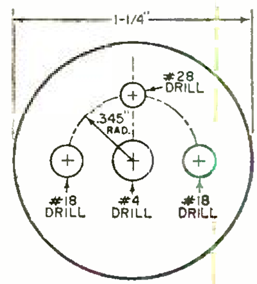


Negative ground circuit ONLY. The connections to the induction coil now have the ballast resistor in what may be called the "cold" lead. Although six spark plugs are shown here, the circuit will obviously operate with four, six, or eight plugs.

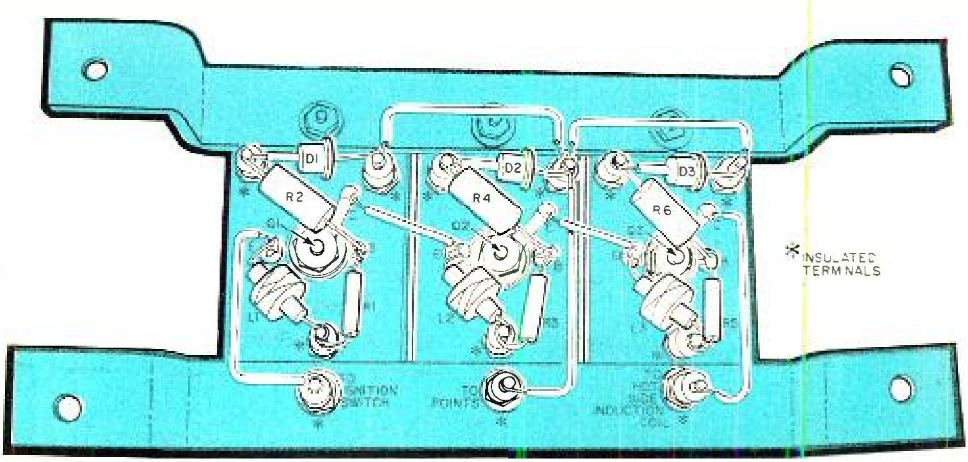
PARTS LIST

C1—0.33-μf., 100-w.v.d.c. Mylar capacitor (Cornell-Dubilier WMF-1P33 or equivalent)—(Note: Insert for radio interference reduction—if not already part of ignition circuit)
D1, D2, D3—Silicon diode, 200 volts PIV, 600 ma., or better (General Electric 1N602 or equivalent)
L1, L2, L3—3.3-mh. ferrite core choke (National R40-3.3—see text)
Q1, Q2, Q3—Delco 2N1970 power transistor—see text
R1, R3, R5—7.5-ohm, 1-watt resistor
R2, R4, R6—62-ohm, 2-watt resistor (Note: reduce this value to 47 or 39 ohms if the car is slow starting)
3—Heat sinks (Delco 7281360)
Misc.—Aluminum bar stock, nuts and bolts, wire

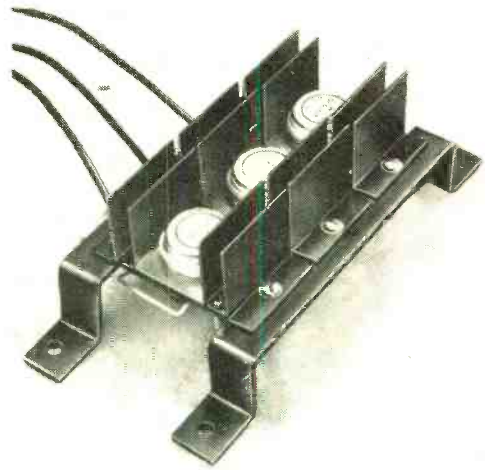
Transistor template. Larger holes can be reamed with hand reamer if necessary.



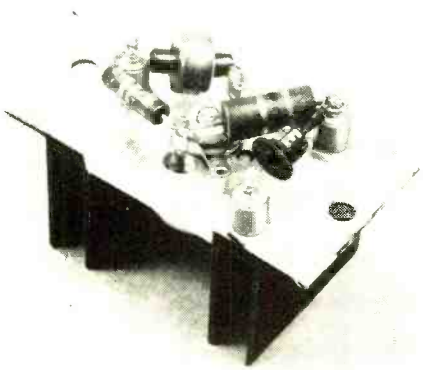
The underside of your PICKUP should look like this after wiring is completed. The leads to the points, ignition switch, and induction coil may be any length. It's a good idea to mount the system where there will be a sizable volume of moving air around the heat sinks.



Make up three heat sink modules using the parts listed at left. Insulated standoff terminals will hold the components rigid as described in text. Mica insulator which comes in cardboard pocket folder should be handled with care.



Mounting of the three modules to a supporting frame is not critical—this frame was bent out of aluminum bar stock—but the legs must be high enough to provide clearance between the insulated terminals and the fire wall of the car.



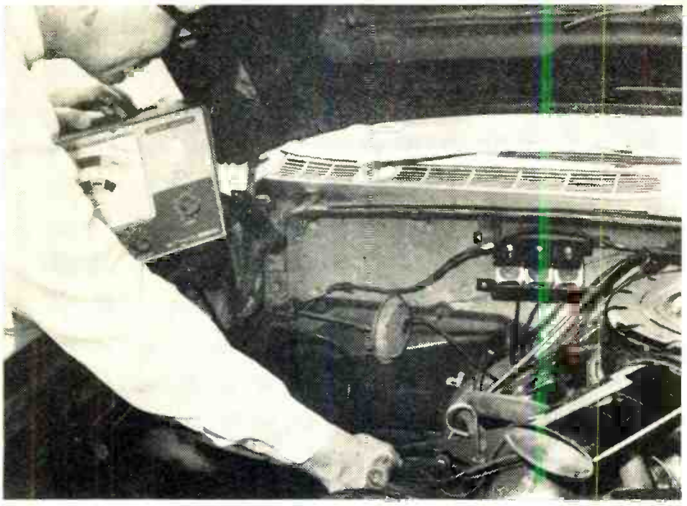
prototype utilized an epoxy-encapsulated silicon diode of comparable rating but without an established brand name. Since we are talking here in terms of saving only 60 or 75 cents, it's a good idea to stick with an established brand.

Chokes *L1*, *L2*, and *L3* must form a series resistance path in conjunction with resistors *R1*, *R3*, and *R5* to equal or exceed 24 ohms. In one prototype the Superex M25 Mini-choke was used with satisfactory results. In the second prototype, and the one illustrated in this article, a National ferrite core choke was used in series with a small resistor. The d.c. resistance of *L1* and *R1* was measured to be 24 ohms. Although the National choke appears to be more readily available than the Superex Mini-choke, the latter does make an ideal substitution since the d.c. resistance is 28 ohms when it is used. In any case, approximate the d.c. resistance of the inductance and add a series resistor to effect a 24-28 ohm path between the base and emitter of each transistor.

Construction. The mechanical layout shown in the photographs and pictorial diagram does not have to be duplicated exactly. This particular layout was employed largely because small, blank, single-transistor heat sinks were readily available. Although heat sinks for mounting two transistors are easy to find, very few—if any—manufacturers offer a heat sink large enough to conveniently mount three *round* transistors.

There is just enough room between the upright fins of the Delco 7281360 heat sink to mount the 2N1970 transistor. The template at left is required to drill the four holes for mounting the 2N1970; these holes must be positioned within $1/32''$. The fiber spacer fits over the threaded stud of the transistor to provide electrical insulation.

If you have not previously mounted a *round* transistor, note that the square pre-punched mica sheet goes under the transistor between it and the heat sink. The round mica washer goes between the metal washer and the underside of the heat sink. Thread the nut down on the metal washer, but don't apply too much pressure when tightening this "sand-



The PICKUP was mounted and tested on this '59 Pontiac station wagon. The modular unit can be seen attached to the fire wall of the car under the air vents. A Lafayette TE-40 ignition analyzer was used to check voltages delivered by the PICKUP to the primary of the induction coil under varying load conditions.

wich" of transistor, mica, and heat sink. Be sure that the transistor case is centered and not shorted out to the fins of the heat sink. If your drilling is a little inexact, you can easily ream any of the four holes to slightly reposition the transistor. Of course, you must be sure that the base and emitter connections are not shorted out in the process.

To insure that the wiring around the transistors would be rigid, three miniature insulated standoff terminals were utilized in the prototype. These terminals were mounted using a *4-40* bolt that passes through holes drilled between the upright fins of the heat sink. As shown in the photographs, two of the terminals are mounted on the side adjacent to the insulated stud of the transistor. The remaining terminal is mounted on the opposite side of the heat sink.

The last holes to be drilled in the heat sink are for mounting it to some suitable frame that may be attached under the car hood at a convenient location. The prototype was mounted on an aluminum frame bent out of ¾"-wide aluminum bar stock. The frame must be bent to provide sufficient clearance for the components on the underside of the PICKUP.

If you follow the mechanical layout shown here, make up three heat sinks with transistor, choke coil, diode, and two resistors each, so that one heat sink module is a carbon copy of the others.

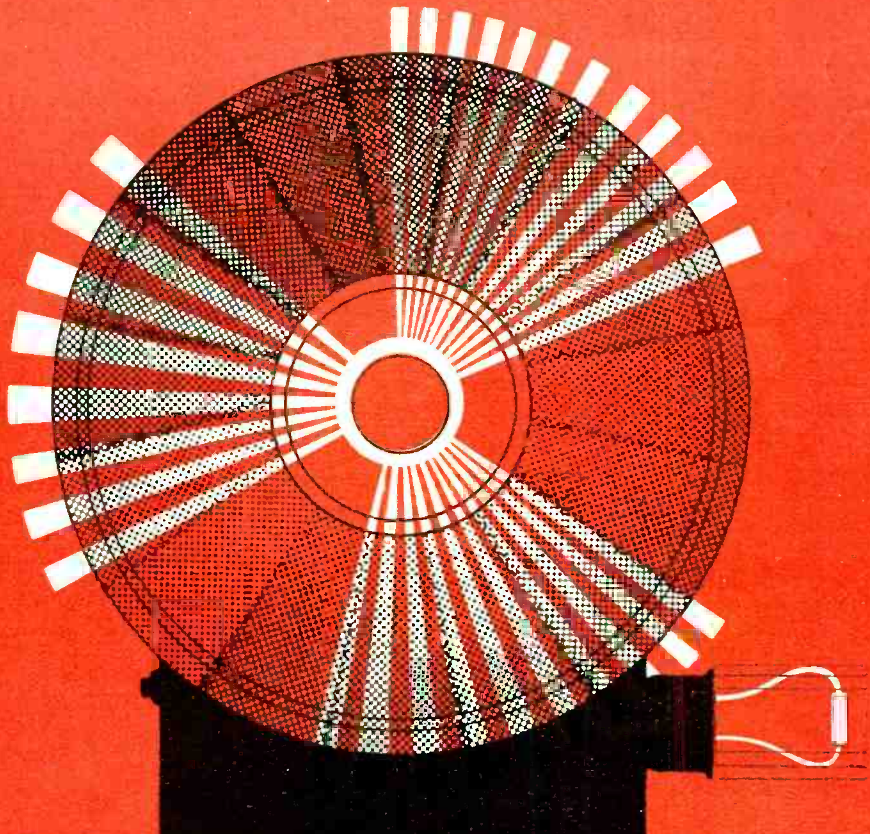
As a matter of convenience, three more miniature insulated standoff terminals are mounted along one edge of the frame to serve as take-off points for the connecting wire to the automobile. The length of the three connecting wires to the present ignition coil and ballast resistor will, of course, depend on the make of the car and the location chosen for mounting the ignition system. The transistorized PICKUP must be mounted where there will be heat conduction away from the frame that holds the heat sinks. In some General Motors cars, the most convenient spot will be on the fire wall.

Weatherproofing. It is necessary to weatherproof as well as waterproof the underside of the heat sinks, especially around the chokes, diodes, and resistors. Several methods are being tested by the Editors of POPULAR ELECTRONICS. One of them is a simple epoxy encapsulation, such as that sold by Lafayette Radio Electronics under their stock number MS-520.

A second method now being tested involves the use of a General Electric silicon filler cement called RTV-102. The advantage of using this material is that the silicon filler may be pressed around the underside of the heat sinks to form a tight, waterproof "pack."

Details on results obtained with each of these encapsulation methods will appear in POPULAR ELECTRONICS after an opportunity to "life-test" the PICKUP has been afforded.

(*Continued on page* 86)



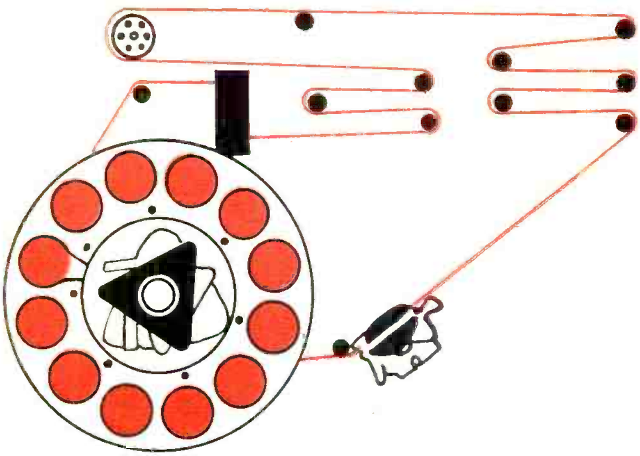
"ZJ" Photoflash Slave

By BRICE WARD

Introducing the light-activated switch—a startling new development in the field of semiconductors

THE TERM "photoflash slave" is often inappropriate. Practically every advanced amateur or semi-professional photographer will tell you it's used to describe an exasperating piece of machinery that may or may not give light at the right (or wrong) time. Slaves can be triggered by a stray headlight passing the window, or, on the other hand, become so insensitive that they refuse to fire unless their photocells happen to be facing in exactly the right direction. Slaves that incorporate relays occasionally misfire due to dirty contacts, and the complexity of some circuits only adds up to component failures.

The "ZJ" photoflash slave has *no* relay contacts to get dirty, needs *no* sensitivity adjustments, and has *no* built-in delay except the ordinary



FROM $URPLU$ A BARGAIN COMPUTER

Care to own a beautifully complex computer capable of handling almost anything? Here's a man who bought one for just $1500

By **AL ERXLEBEN**

EVER DREAM of owning your own computer? If you're interested in electronics, science or mathematics, you probably have. Perhaps you've even constructed simple models.

Alfred Domin, an electronics technician who also operates an electronics parts store in Jacksonville, Fla., made his dream come true for just $1500.00. He is now the proud owner of a government-surplus Univac Model 1103 computer originally costing $1.5 million—all 10 tons, hundreds of miles of wire, and 4500 tubes of it!

Space for a Univac? Well, yes, the 1103 does need quite a bit of room. Originally designed for about the same area as the ground floor of a small house, Domin's unit, composed of two long rows of 6′ cabinets, practically fills his parts store. It generates so much heat in operation (the power bill is $2.00 an hour), that a 20-ton air conditioner is required to cool the electronic components. The associated wiring diagrams form a fair-sized library and weigh some 400 pounds just by themselves.

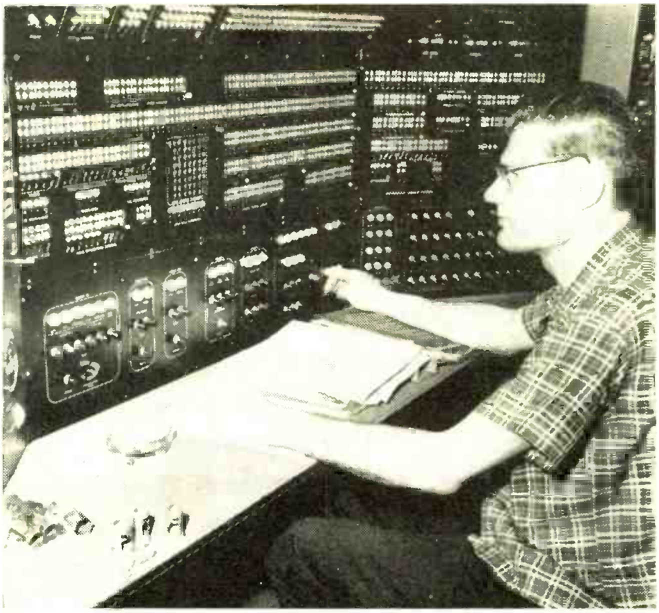
The surplus Univac 1103 was used for years at Eglin Air Force Base, Fla., to analyze the results of rocket test flights. It was replaced recently with two smaller computers and put on the auction block, giving Domin his opportunity.

Incorporating a fantastic storage capacity and high speed operation, the 1103 is undoubtedly one of the largest computers owned by a private entrepreneur in terms of the amount of information it can handle. Only 36 Model 1103's were ever built, incidentally. Originally designed by Remington Rand for the government, these general-purpose computers were later sold to industrial users.

The chores the machine can perform are awe-inspiring, and include carrying out up to 49 different functions (addition, multiplication, etc.), and giving answers where the problem involves a simple "yes" or "no," or "go" or "no-go" reply. Its speed is 60 microseconds per unit of addition—in other words, it can add 16,700 numbers, each consisting of ten digits (1,234,567,899, for example), in a single second.

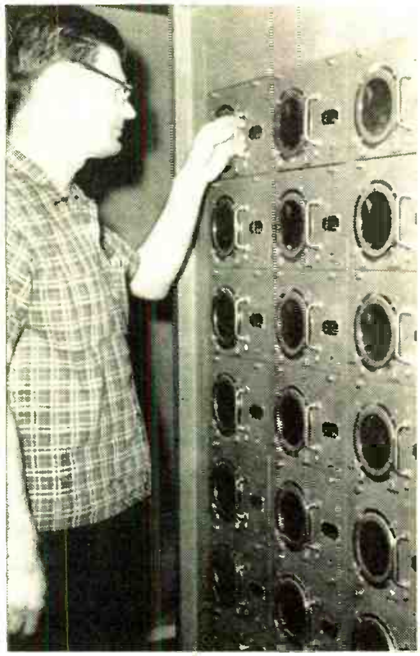
A similar computer in New York City is currently being used to translate Russian texts into English. It does not provide literal translations, but gives a contextual analysis.

Putting It Together. What happens when you buy a previously-installed surplus computer? Well, Domin says that

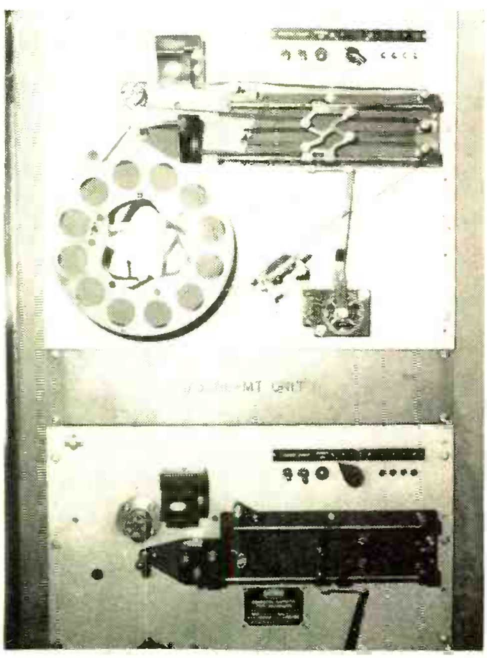


Checking out circuits at the control console of his surplus computer is Al Domin.

The 1103's rapid memory is made up of electrostatic cathode-ray tube storage units which can hold a total of 1024 "machine words." Access time is 6-10 microseconds.



Tape decks (two shown) use zig-zag feed with many springs to prevent tape breakage. Unit has 800,000 unaddressed tape registers.

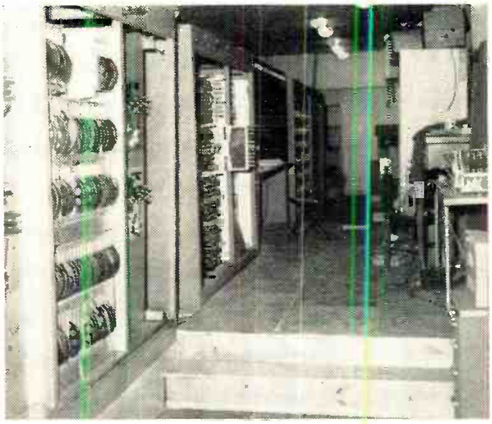


when his 1103 was dismantled for shipment to him, they must have put carpenters on the job instead of electricians. Wires connecting various subassemblies were cut helter-skelter instead of being unplugged. This has caused Domin many headaches in rewiring the unit, and he is still several months away from having it in operating condition.

The 1103 operates on the binary numerical system in which combinations of the digits 0 and 1 are used (corresponding to two complementary alternatives: on-off, yes-no, etc.). Most of the tubes in the computer are 12AU7's connected in flip-flop circuits (circuits with two complementary alternative states). There are, in addition to the 4500 tubes, 2000 neon indicator lights, mostly connected across fuses. When a fuse blows, a light comes on.

The computer's giant storage capacity lies in three separate devices. It has a total of 16,384 addressed (i.e., "labeled") word registers in magnetic drums. It has 1024 electrostatic word registers, and 800,000 unaddressed word registers in tape storage. Incidentally, a "register" in computer parlance means the hardware needed to store one machine word. Putting it a different way, the 1103

Acres of tubes? Almost. Many are 12AU7's connected in "yes-no" type, flip-flop computer circuits.



The 1103, in two rows of cabinets like these, takes up almost all the space in Al Domin's parts store.

has a storage "vocabulary" of 817,408 "words"! A "word" can convey considerable information.

Neighborhood Computer Service? Why would Domin—an alumnus of M.I.T.—want a Univac? A strictly for-profit operation as far as Domin is concerned, he hopes to rent the 1103's services to various businesses to assist them with their bookkeeping. Inventory control is another function the machine could perform. Local enterprises, too small to own or rent computers, will be able to take advantage of Domin's machine, and the savings in time and effort that it offers.

A university in Florida has expressed interest in the service. According to university officials, the machine might be put to good use in several research projects and for instructing students in higher mathematics. Domin also sees a possible use for the computer in drafting baseball or football schedules.

If all goes as planned, Al Domin's computer service, utilizing his 1.5-thousand-dollar bargain, will soon be in operation. —30—

A YELL FROM AN XYL

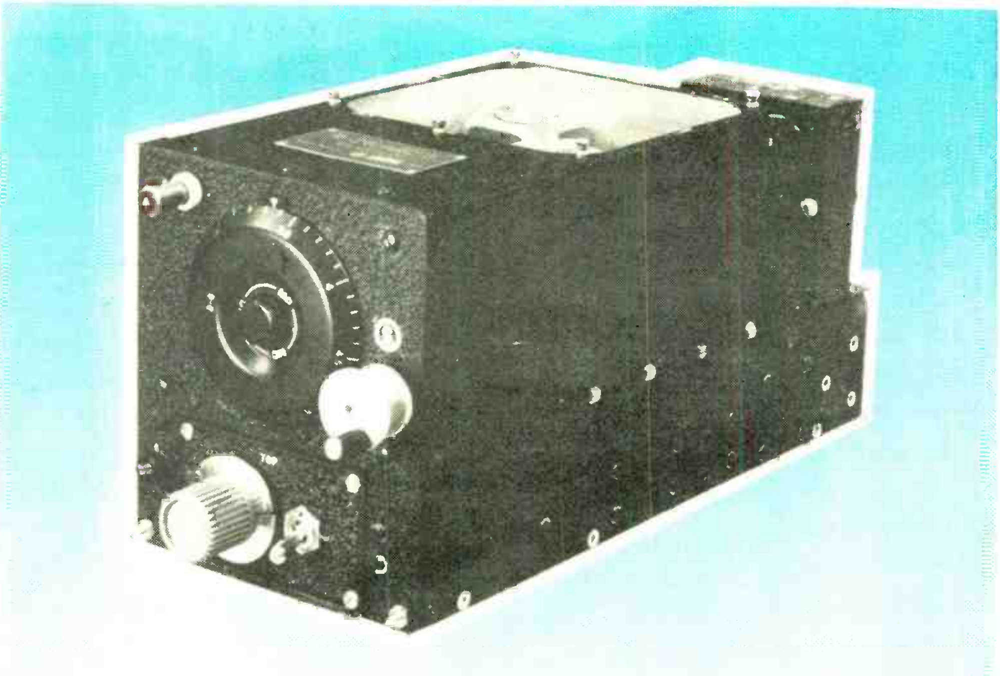
She had just received her General
So she got right on the air;
CQ'd and made a contact
Without a bit of care.

The QSO was a good one
With signals loud and clear;
Not a sign of QRN
Or QRM to interfere.

Now you'd think she'd have been delighted
With a contact such as this;
The report that she was given would have
Filled any other ham with bliss.

But she stomped out of the ham shack
And announced that she was through;
"That man said I was FORTY OVER
But I'm only THIRTY TWO!"

K8AOU



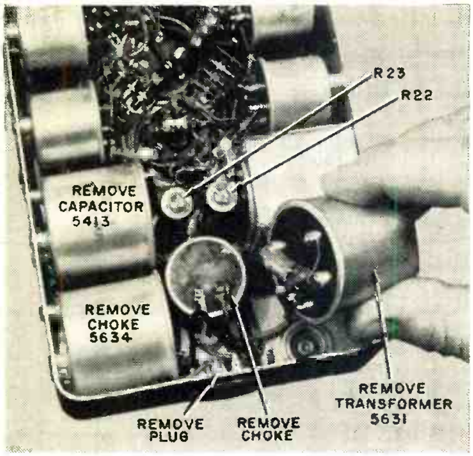
Converting Your First "Command" Receiver

By E. H. MARRINER, W6BLZ

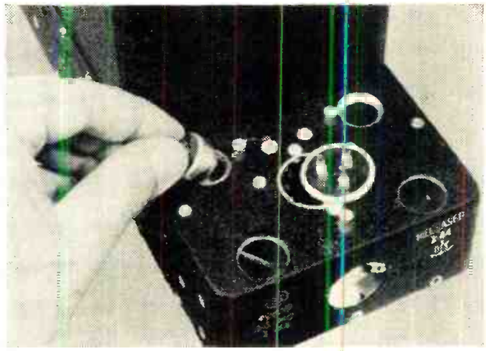
Here, in response to many requests, are some new thoughts on modifying these little surplus units

ONE OF THE BIGGEST BARGAINS ever to hit the World War II surplus market was the Command aircraft receiver. We say "was" because this straightforward, compact, rugged little receiver has been around for a generation, but the fact of the matter is that it *still* is a bargain—one that would be hard to match for a beginning SWL or ham.

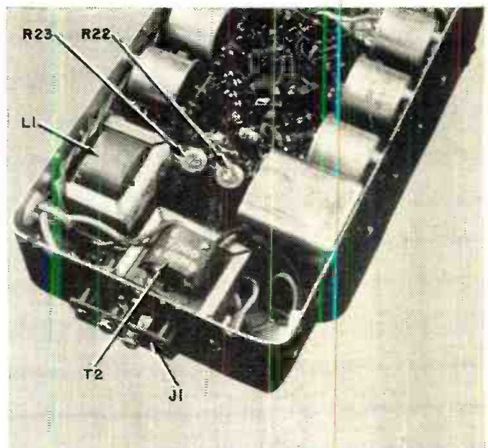
Command receivers, which have served in military aircraft in a wide variety of guises over the past 25 years, were manufactured in the millions and are still sold by surplus electronics dealers from coast to coast. Measuring 5″ x 6″ at the front and 11½″ deep, they were intended for 28-volt d.c. operation. The filaments were connected directly to the 28-volt source, and plate voltage came from a miniature 28-volt input dynamotor shock-mounted on the rear of the receiver chassis. Since the



"Surplus surplus" that must be removed before converting Command set is shown at left. Four cans come out, including two chokes, a transformer and capacitor. Note location of R22 and R23; B-plus connections are made to these resistors as indicated in text and schematic.



Remove the dynamotor shock mounts, retaining rings and the three-prong plug as described in the text. The holes in the chassis are used to mount the new power supply components.



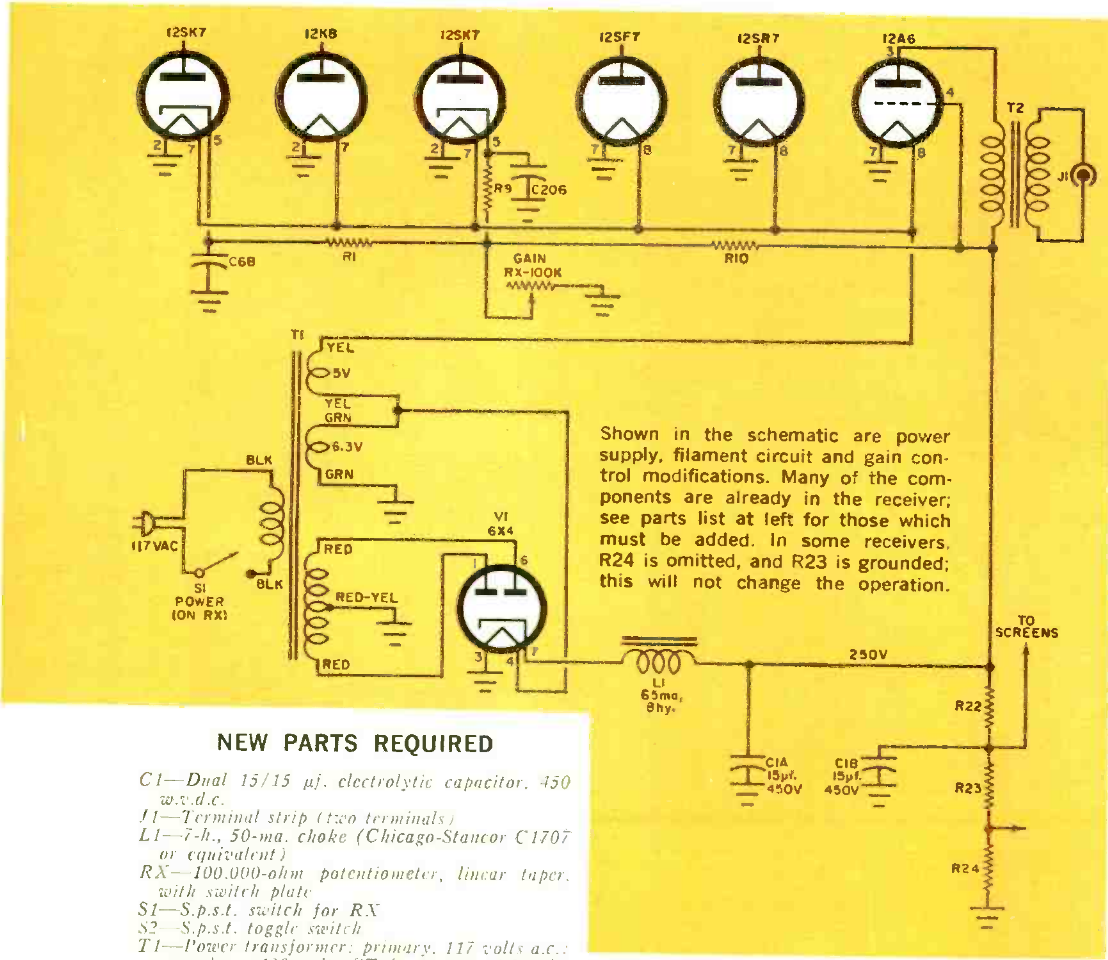
The new power supply choke, L1, and the audio output transformer, T2, are mounted under the chassis in the space left after removing the extra components. The terminal strip, J1, is mounted on the back for connecting a speaker.

Command receivers were designed for single band operation, changing bands meant activating a new receiver—the basic reason for the small, lightweight construction. The frequency ranges of commonly available units are: 190-550 kc., 520-1500 kc., 1.5-3.0 mc., 3.0-6.0 mc., and 6.0-9.1 mc.

The U. S. Air Force gave the receiver described in this article, a 3.0-6.0 mc. unit, the designation R—26/ARC-5. In the Signal Corps it was the BC-454, and the Navy called it the CBY-46105. Regardless of nomenclature, these three models are basically the same (with the exception of slight external differences), tuning 3.0-6.0 mc. with a little extra coverage at each end of this range, and having an i.f. of 1415 kc. The conversion data given here applies to any of the Command receivers, regardless of tuning range and nomenclature.

Getting Started. Even a beginner should have no difficulty in converting a Command unit to a first-rate, 110-volt a.c. receiver. Briefly, all that's required is to rewire the filament circuit for 12 volts (instead of 28), and construct a small power supply to provide this voltage and 250 volts B-plus. The power supply can be mounted on the back of the receiver where the dynamotor was originally located. Other, more minor, modifications described here include adding a combination gain control and on-off switch (*RX-S1*), a BFO on-off switch (*S2*), and speaker output terminals.

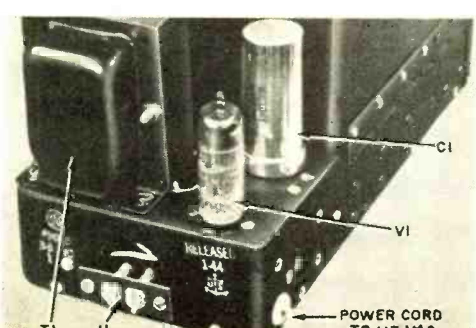
Make sure that the receiver you purchase is in reasonably good condition—surface blemishes won't matter as long as none of the tubes or other components are bashed in. You *may* want to buy an unused receiver—these are a bit more expensive than the used variety (by about $10), running around $20-$25. Before you do anything else, take off the top cover of the unit and check to see that all the tubes are there and mounted in their proper sockets.



Shown in the schematic are power supply, filament circuit and gain control modifications. Many of the components are already in the receiver; see parts list at left for those which must be added. In some receivers, R24 is omitted, and R23 is grounded; this will not change the operation.

NEW PARTS REQUIRED

C1—Dual 15/15 µf. electrolytic capacitor, 450 w.v.d.c.
J1—Terminal strip (two terminals)
L1—7-h., 50-ma. choke (Chicago-Stancor C1707 or equivalent)
RX—100,000-ohm potentiometer, linear taper, with switch plate
S1—S.p.s.t. switch for RX
S2—S.p.s.t. toggle switch
T1—Power transformer: primary, 117 volts a.c.; secondary, 480 volts CT @ 55 ma., 6.3 volts @ 2.0 amp, 5.0 volts at 2.0 amp (Chicago-Stancor PC-8402 or equivalent)
T2—Output transformer: primary, single-ended 7000-ohm plate; secondary 4 ohms (Chicago-Stancor A-3878)
V1—6X4 tube
1—7-pin miniature tube socket
1—Splined tuning knob (available from E. H. Marriner, 526 Colima St., La Jolla, Calif., for 35 cents)
Misc.—Knob for RX, a.c. cord, hardware, solder, wire, etc.



Mount the new power transformer, T1, the dual-section filter capacitor, C1, and the rectifier, V1, on the top of the chassis. Enlarge a hole at the side of the chassis, line it with a grommet, and use it for the a.c. cord.

When you're ready to start working, turn the receiver over and remove the bottom cover. Remove the original output transformer which is in a can with the number "5631" stamped on it. (It's mounted on one side of the chassis at the back and has a little neon bulb connected to its terminals.) Cut all of the wires going to the transformer can and unscrew the mounting studs to take it out. Label the red wire going to the 12A6 (and also connected to a mica capacitor bolted to the chassis); this is the plate lead from the audio output tube.

The next step is to remove the socket

Working space at the front for mounting controls can be gained by temporarily removing the plug-in coil bracket. Take out the two screws (one at either side) and pull it out.

at the back end of the chassis, but first note the connections to it, and label the wires as you cut them. The black wire connected to prong 1 is "Ground." Label the green wire, going to prong 3, "Gain Control"; and the two red wires, soldered to prong 4, "C.W. (BFO) Switch." A yellow wire is connected to prong 5; this is the screen voltage lead. The white wire connected to prong 6 goes to the filament circuit and is not used. The center prong is the B-plus lead. The black wire going to pin 2 will not be used.

To remove the socket, force a screw driver under the lip inside the chassis and then bend up. After you do this a few times, the plug will pop out. Other parts that must be removed at the back of the chassis are a filter choke in can "5634," and a capacitor in can "5413."

From the top of the chassis, remove the screws holding a second choke mounted just behind *R22* and *R23* (see the top left photograph, page 46), and take this one out also. Remove the dynamotor mounts by screwing them out of their settings. The settings themselves are taken out by nipping through each of the retaining rings and twisting them out.

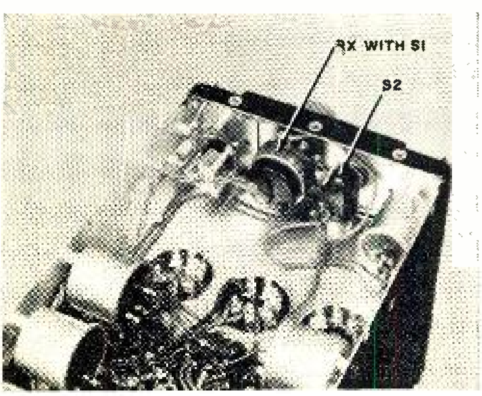
In one of the holes previously occupied by a dynamotor shock mount, mount the new filter capacitor (*C1a-C1b*). Install a 7-pin miniature tube socket in another hole, and bolt the new power transformer (*T1*) in position.

Filament Wiring. Within limits, the filament voltage for the Command set is not critical, and the small, conventional power transformer specified here will furnish it. When correctly connected in series, the two transformer filament windings will give 11.5 volts; if they're out of phase so that they "buck" each other, the output will be one volt or less. Reverse the connections if necessary.

One of the green transformer filament leads is grounded. Connect the other green lead to one of the yellow filament leads, and run them both to pin 4 of the 6X4 rectifier (*V1*). The remaining yellow lead is connected to the receiver filaments.

The Command set filament circuit is series-parallel for 28-volt operation; this must be changed to all-parallel in order to use 12 volts. To rewire the filaments, simply ground pin 2 of both 12SK7's and the 12K8. Also ground pin 7 of the 12SR7, 12SF7, and 12A6. The "hot" side of the filament string (the remaining yellow transformer filament lead) goes to pin 7 of the two 12SK7's, pin 7 of the 12SR7, pin 8 of the 12SF7, and pin 2 of the 12A6. (You'll find that pin 7 of the 12K8 is already connected to the hot side of the circuit.)

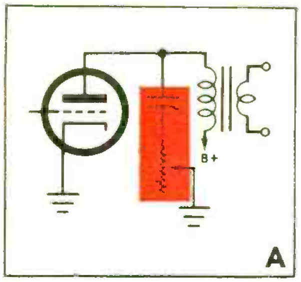
(*Continued on page* 100)

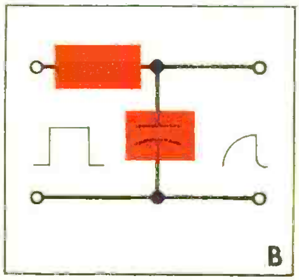


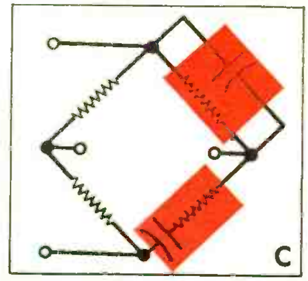
The new controls include RX-S1, and S2, the BFO grounding switch. Both are mounted on a small panel cut away from the original front control box. The panel can also be fabricated from a piece of stock aluminum.

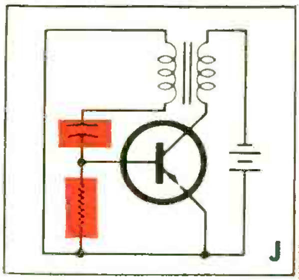
RC CIRCUIT QUIZ

By ROBERT P. BALIN



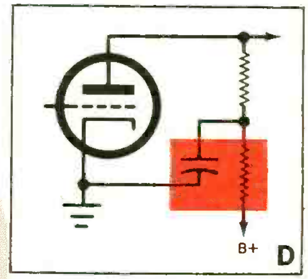


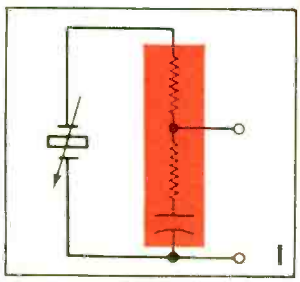


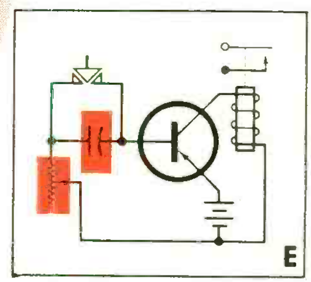


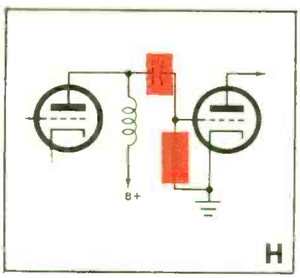
Circuits that are made up of resistors and capacitors *only* perform a wide variety of functions in electronic equipment. Try to match the RC circuit functions listed (1-10) with the circuits (A-J) to which they apply.

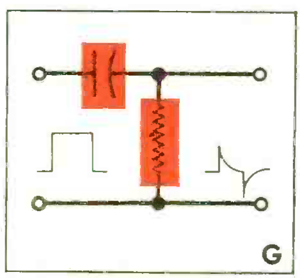
(*Answers on page* 93)

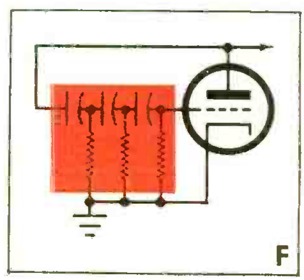












1 Decoupling network ________

2 Treble-cut tone control ________

3 Differentiator ________

4 Frequency control ________

5 Phase-shifting network ________

6 Timing control ________

7 Equalizer ________

8 Integrator ________

9 Band suppression filter ________

10 RC coupling circuit ________

HI-FI SHUTOFF

A time-delay switch that really works, this device almost "reads your mind" and then acts accordingly

By **RONALD WILENSKY**

IN THIS, the age of automation with its automatic clothes washers, dish washers and can openers, one of the last outposts of manually operated equipment in the home is the hi-fi system. What happens when your record player or changer finishes the last record? Assuming that it has an automatic shut-off, it stops; but the amplifier remains on.

By utilizing the automatic features of a changer or turntable that incorporates an automatic shut-off, the "Hi-Fi Shutoff" described here will effectively disconnect your amplifier after the last record has spun. Unlike other such devices, however, the Hi-Fi Shutoff allows for a two-minute delay between the time when the changer stops and when the amplifier goes off.

Shutoff with Brains. Why the two-minute delay? It makes it unnecessary to reconnect your system if you want to put another load of records on the changer immediately. You won't have to twiddle your thumbs during another warm-up period, and you'll save wear and tear on your equipment. Expensive power tubes and other components do not take kindly to the current surges that occur when you turn a unit on and off repeatedly.

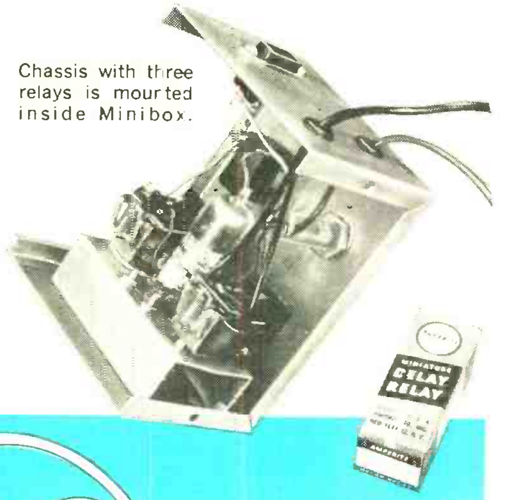
The heart of the delay circuit is an inexpensive Amperite thermal time delay relay (*K3*). Mounted in a 9-pin miniature tube socket, the contacts of this relay are built to open upon application of heat from its 117-volt, a.c. filament. With two other relays of the magnetic type (*K1* and *K2*), *K3* forms a simple logic circuit which operates in the following way.

When the manual or override switch (*S1*) is open, turning on your phono motor will close *K1*, which will then send power to the amplifier through a.c. socket *SO1* on the Shutoff. When the motor shuts off, *K1* opens, but a.c. power to the amplifier is now maintained through still-closed *K2*. However, when *K1* opens, the filament of *K3* is heated, and, 120 seconds later, *K3* opens, causing *K2* to open and turn off the amplifier. The Shutoff is then ready for another cycle.

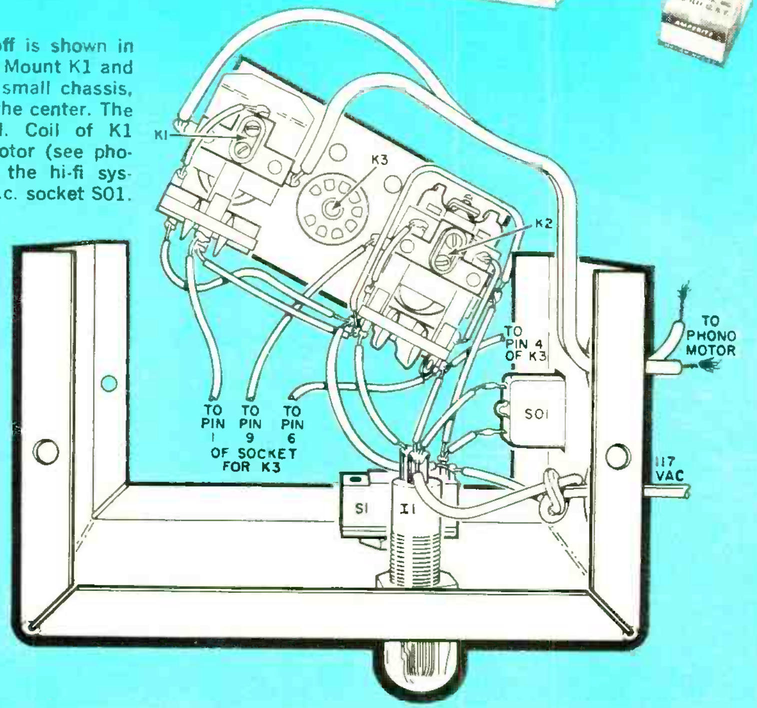
An optional feature is neon lamp assembly *I1* (which comes with a built-in resistor). As connected in this circuit, *I1* lets you know when the hi-fi system is disconnected, and remains lit until the changer is turned on, or *S1* is closed. If *I1* is not used, a d.p.s.t. relay can be substituted for the d.p.d.t. type specified for *K2*.

Construction. You'll need an aluminum chassis approximately 1¾" x 3⅛" x 1"

(*Continued on page* 109)



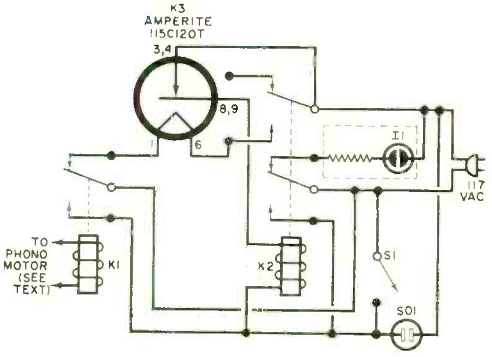
Chassis with three relays is mounted inside Minibox.



Layout of Hi-Fi Shutoff is shown in the pictorial diagram. Mount K1 and K2 on either side of small chassis, and socket for K3 in the center. The bulb, I1, is optional. Coil of K1 connects to phono motor (see photograph above), and the hi-fi system is connected to a.c. socket SO1.

PARTS LIST

I1—Neon pilot light assembly with built-in resistor (Drake 105 or equivalent)—optional
K1—S.p.d.t. relay, 115-volt, a.c. coil (Potter and Brumfield KA5AY or equivalent)
K2—D.p.d.t. relay, 115-volt, a.c. coil (Potter and Brumfield KA11AY or equivalent)
K3—Thermal time delay relay, normally-closed, 120-second delay (Amperite 115C12OT)
S1—S.p.s.t. toggle switch
SO1—Chassis-mounted a.c. receptacle
1—3"x4"x5" aluminum Minibox
1—1¾"x3⅛"x1" (approx.) aluminum chassis
1—9-pin miniature tube socket
Misc.—Hookup wire, a.c. line cord, grommets, hardware, solder, etc.



ELEMENTARY INDUCTION

A Carl and Jerry Adventure in Electronics

By
JOHN T. FRYE
W9EGV

". . . see if you don't make out a pair of wires going down over the edge of the bluff . . ."

THE dew-washed June morning found Carl and Jerry testing out their super-duper Field Day radio station atop a high limestone bluff overlooking the river. Radio amateurs, on their annual Field Day, familiarize themselves with the operation of emergency radio equipment by competing to see which station can make the most contacts during a 24-hour period. The score made is multiplied substantially if the station is set up out in the "field" with no connection to commercial power lines.

Determined to run up a high score, the boys had two five-hundred-watt transmitters in the back of a station wagon borrowed from Carl's parents. One was a bandswitching job that could be operated on all amateur bands from 75 through 10 meters. The other transmitter was for six meters only.

An all-band trap antenna had been swung between two trees for use with the bandswitching rig. On Field Day, there would be a rotatable beam for the six-meter station, but today the boys intended to test the station out with a halo-type antenna mounted on the rear bumper of the station wagon.

A two-wheel trailer containing a husky 10-kw. gasoline-powered a.c. generator was hitched to the rear bumper of the station wagon. It was puttering away while Jerry hunkered down inside the station wagon connecting antennas, mikes, switches, relays, etc. Carl was outside playing around with a powerful, tripod-mounted, prism-type spotting telescope he had recently acquired.

Carl looked back along the steep, narrow, twisting dirt path up which the station wagon had clawed its way from the paved road running alongside the river down below. Then he raised the front of the telescope and looked across the river at the road running along the top of the bluff on that side.

"Hey, wonder why the law is so busy across the river," he called to Jerry. "I can see the sheriff's car and two state police cars cruising along over there."

"Didn't you look at last night's paper?" Jerry asked. "The president of a South American country is going to inspect a typical Midwest corn farm about two miles west of here on the other side of the river at ten this morning. It's feared political enemies from his country may try to kill him and so create an international incident. Naturally, our government intends to do everything possible to prevent anything of this nature. That's undoubtedly why the police are checking the route so carefully."

"So that's it," Carl muttered, swinging the telescope to the right and peering through a thin screen of bushes at the top of another limestone ridge a half-mile away on his side of the river. "Boy, this 'scope is really a honey," he remarked. "There are a couple of guys sitting over there on that other ridge, and I can see the buttons on their shirts. Wonder what they're doing. They seem to be just sitting there with a kind of funny-looking gasoline can between them. One of them keeps watching the road across the river through a pair of binoculars."

Jerry slid out the back of the station wagon and came over for a look. "That's no gasoline can," he exclaimed; "it's a blasting-cap detonator! Look closely and see if you don't make out a pair of wires going from it down over the edge of the bluff to the road below and then across the road through some treetops and on down toward the river."

"Yeah," Carl agreed, "and those wires keep right on going across the river and up the bluff to that little culvert under the road over there. So help me: those jokers must be planning on blowing up the president when he crosses the culvert! We better go tell the police."

"There's no time," Jerry objected, looking at his watch. "The president's car should be along any minute now, and there isn't a farmhouse either way for two miles. By the time we got to a telephone it would be too late. I'm going to try to raise someone on seventy-five meters and have them call the police!"

THE BOYS scrambled into the station wagon and fired up the bandswitching transmitter. Jerry pushed the button on the mike while he watched the meters on the front of the transmitter. A worried frown creased his forehead as he quickly rechecked the knob settings.

"Something's wrong," Jerry said. "We're getting no drive to the final." Gingerly he raised the lid of the exciter and peered inside. "The driver tube is

(*Continued on page* 84)

POPULAR ELECTRONICS news

USCG Beacons to Change

Due to a 200% increase in the number of radiobeacons operated by the Coast Guard, sequencing of six beacons on a single frequency will be initiated this summer. Each beacon will transmit for one minute in rotation with five others without any off-the-air period. Among other changes, there will no longer be a distinction between fair and foul weather operation.

"Ballon" is the French name for a new air-dielectric cable which will shortly be produced in the U.S. Designed to replace coax types, it's insulated by air bubbles encased in plastic and crimped at regular intervals. It has a low dielectric constant.

New Propagation Handbook

A publication that tells you how to use the new propagation predictions issued by the National Bureau of Standards has been announced. Titled *Handbook for CRPL Ionospheric Predictions Based on Numerical Methods of Mapping*, it is available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., at 40 cents a copy.

The new propagation predictions issued by the Bureau enable the user to solve high-frequency propagation problems with the familiar graphical methods or with a computer. Even when a computer cannot be used, however, the current prediction maps provide more data than did the zone prediction charts which they replace.

TV in Singapore

Singapore's first television service, using the 625-line standard, went on the air recently. The station, equipped by the English Marconi Co., will carry programs in four different languages.

Satellite Failures Explained

A study made jointly by the U.S. Air Force and the Westinghouse Air Arm Division may explain the in-space failure of transistorized equipment such as that used by Telstar.

The temporary death of a transistor is due to the charge which is caused by ions collecting on its surface. Transistor surface charges may result from space radiation, electrical discharge, exposure to ultraviolet light, static charging by a nylon-clad assembler, or even from transient pulses during operation. If the charge does not flow off rapidly, it can cause the type of failure exhibited by Telstar.

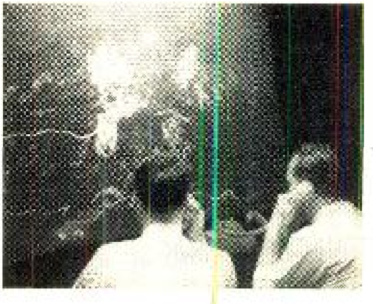
It is believed that the problem can be solved by developing methods of rapid charge removal, or transistors with surfaces that can rapidly and effectively repair themselves and thus avert a breakdown.

In-Space Television System

A slow-scan TV system for sending back "live" pictures from outer space is being installed aboard a Mercury capsule by NASA. Current plans are to use the system in the manned orbital flight scheduled to take place in the late spring.

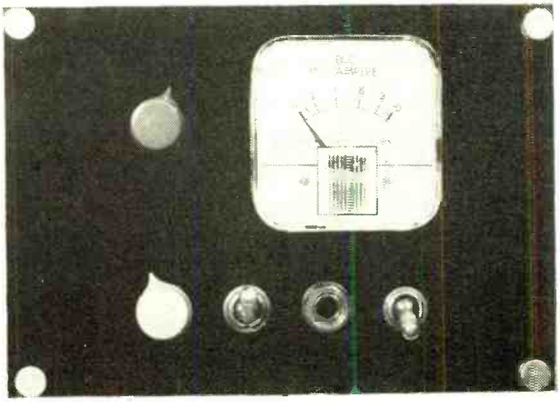
The 8-pound camera takes one picture every two seconds; photos are relayed to ground using one of the capsule's communication links. The camera would normally be focused on the astronaut, but can be hand-held and focused outside the spacecraft.

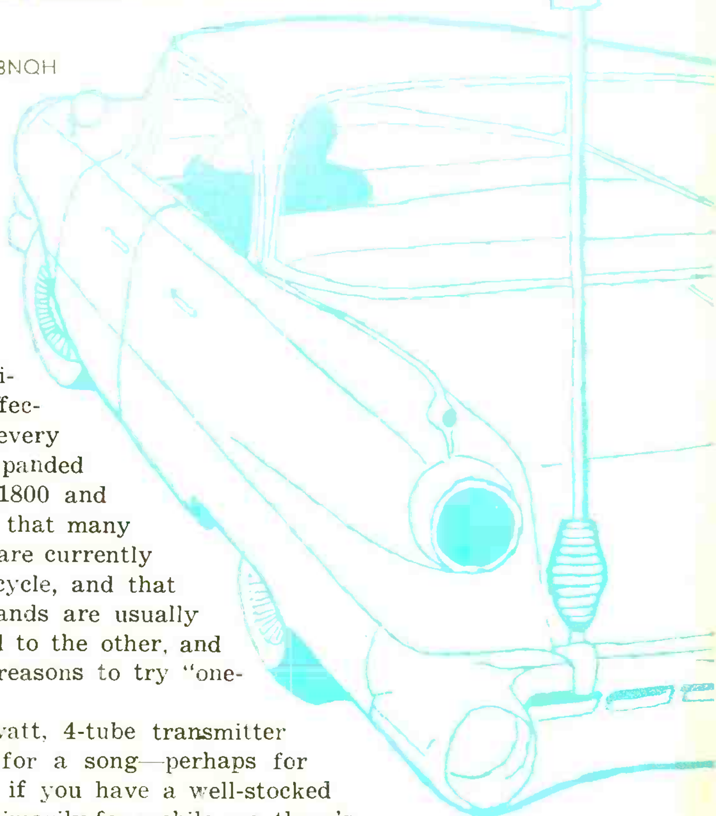
Cardiac monitor (left), developed by Sanborn Co., warns of heart irregularities, can record an electrocardiogram or "pace" patient's heart if cardiac arrest occurs. A fire-fighting simulator (right), created for U.S. Forest Service by Intl. Electric Corp., projects fire scene complete with smoke, flames, and char.



TOP BAND GOES MOBILE

Tried "one-sixty" recently? Here's a simple, low-cost transmitter . . . you can use your car radio for receiving





By JAMES E. ROHEN, K8NQH

THE BIG TOPIC of conversation in amateur circles these days is the long-awaited announcement that the FCC has expanded amateur privileges in the 160-meter band. Effective February 21, 1963, hams in every state of the Union were given expanded frequency allocations between 1800 and 2000 kc. Add to this the facts that many of our higher frequency bands are currently in demise due to the sunspot cycle, and that the popular lower frequency bands are usually filled with signals from one end to the other, and you've got three mighty good reasons to try "one-sixty."

As a clincher, here's a 10-watt, 4-tube transmitter that you can throw together for a song—perhaps for the price of a pair of brogans if you have a well-stocked junk box. Although designed primarily for mobile use, there's no reason why it can't be part of a low-power fixed station for trying out the low frequency end of the amateur spectrum.

TOP BAND GOES MOBILE

If you're still not convinced, remember this: you have a 160-meter mobile *receiver* as close as your car radio. Most broadcast-band receivers can be easily converted to cover the 160-meter band, and will perform well for all except DX reception.

Circuit Design. For the sake of simplicity, the transmitter is designed around three 12AQ5's. These miniature audio output tubes are inexpensive, take up little space, and work well in this application.

The circuit consists of a triode-connected 12AQ5 Pierce crystal oscillator (*V1*) driving a 12AQ5 final (*V2*) with pi-network output (*C5*, *C6*, and *L3*). Another 12AQ5 is used as the modulator (*V4*). The 12AX7 preamplifier stage (*V3a-V3b*) allows operation with any carbon mike, and adjustment of the level control (*R6*) will give 100% modulation. Slight changes in the circuitry of the preamplifier will permit the use of a crystal microphone.

With the tubes specified, the heaters can be powered directly from a 12-volt auto electrical system. If you have a 6-volt system (or if you're using a 6.3-volt filament transformer in a fixed station setup), necessitating the use of tubes with 6-volt heaters, simply substitute 6AQ5's for the 12AQ5's and wire the 12AX7 for 6 volts.

The B-plus voltage for the transmitter can be taken from any power supply delivering about 260 volts at 75 ma. This will usually be no problem if the rig is used as part of a fixed station; but for a mobile installation, a small vibrator or transistorized power supply will be needed. It is possible in some cases, however, to steal B-plus from a car receiver—assuming that it isn't transistorized or of the "hybrid" type.

Flexible Components. Complete flexibility describes the parts specifications for building the transmitter. The only restriction on the variable capacitors is that they be of the same or a greater value than specified. You should have no difficulty in finding suitable units: *C6* (700 μμf.) is simply a BC receiver variable capacitor with the stators tied together, and *C5* is a "garden variety" 140-μμf. variable.

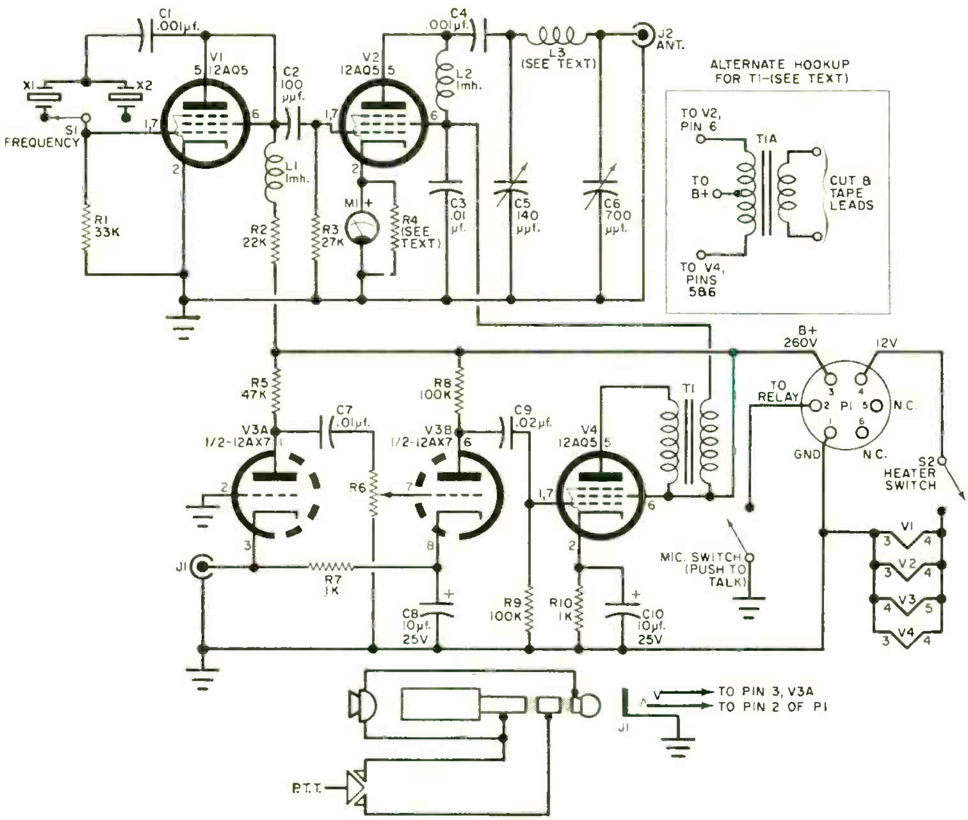
If you don't have a modulation transformer and don't want to go to the trouble and expense of buying one, you can substitute almost any push-pull audio output transformer, connecting it as shown in the inset portion of the schematic diagram.

A 0-50 d.c. ma. meter would be most suitable for measuring the current drawn by the final stage of the transmitter, but meters of greater or lesser sensitivity will serve as well. The author increased the range of a meter reading 10 ma. full-scale by connecting a shunt across its terminals. (To find the proper shunt values, use the formula for shunt calculations, $R = R_m \div (N-1)$, where R=shunt value in ohms, N=the new full-scale reading divided by the old one, and R_m=the meter resistance in ohms.)

The coil used in the pi-network output (*L3*) is a 25-watt "baby" plug-in for 160 meters. Such a unit—or anything similar—can be used if it is available; if not, *L3* can be made by cutting a length of prefabricated air-wound coil to size. To make *L3*, use a stock coil 1¼" in diameter and wound with #24 wire, 32 turns per inch. Start with a 2" length of coil, and clip off a few turns as required. Of course, *L3* could be wound on a solid ceramic or plastic form if desired.

Construction. The unit is built on a 2" x 5" x 7" aluminum chassis, and the front panel is made of either aluminum or plastic. Scrap plastic was used for the model shown, since a piece happened to be available and because it is an easy material to work with.

Front panel controls include capacitors

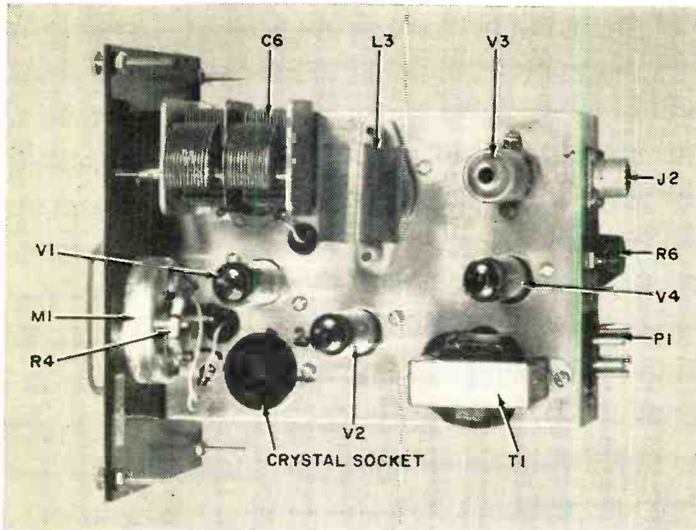


PARTS LIST

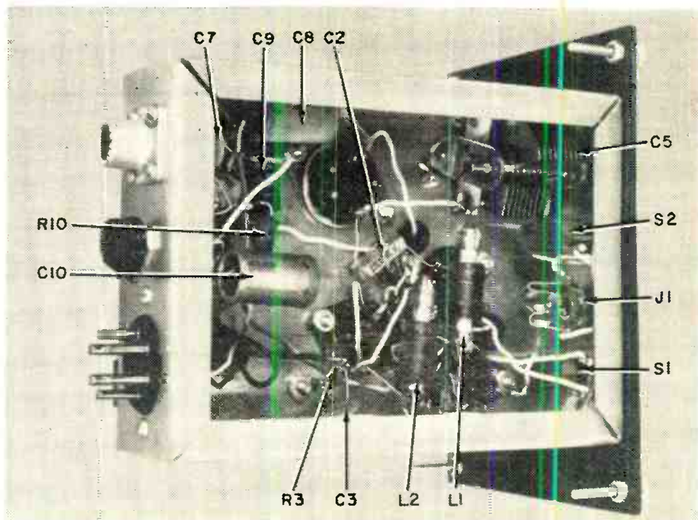
C1, C4—0.001-µf. ceramic disc capacitor
C2—100-µµf. mica or ceramic disc capacitor
C3, C7—0.01-µf. ceramic disc or paper capacitor
C5—140-µµf. variable capacitor (Bud 1856 or equivalent)
C6—365-µµf., 2-gang variable capacitor with gangs paralleled, or any variable with a total capacity of 700 µµf. or more (Allied Radio 60 L 725 or equivalent)
C8, C10—10-µf., 25-w.v.d.c electrolytic capacitor
C9—0.02-µf. ceramic disc or paper capacitor
J1—3-contact phone jack (Switchcraft "Littel Jax" 12B, Lafayette PJ-80, or equivalent)
J2—Coaxial antenna connector (Amphenol 83-1R)
L1, L2—1-mh. r.f. choke (National R-50 or equivalent)
L3—160-meter coil (2" of Illumitronic Air Dux #1032 or 25-watt "baby" plug-in—see text)
M1—0-50 d.c. ma. meter—see text
P1—Panel-mounting plug (Amphenol 86-CP6 or similar unit)
R1—33,000-ohm, ½-watt resistor
R2—22,000-ohm, 2-watt resistor
R3—27,000-ohm, 1-watt resistor
R4—Meter shunt (if required—see text)
R5—47,000-ohm, ½-watt resistor
R6—500,000-ohm audio taper potentiometer
R7, R10—1000-ohm, ½-watt resistor
R8, R9—100,000-ohm, ½-watt resistor
S1—S.p.d.t. miniature switch
S2—S.p.s.t. miniature switch
T1—Modulation transformer: primary, 10,000 ohms CT; secondary, 4000 ohms (Stancor A-3812 or equivalent); see text and schematic for alternate T1, a push-pull audio output transformer
V1, V2, V4—12AQ5 tube (or 6AQ5—see text)
V3—12AX7 tube
2—160-meter crystals cut for desired frequencies
1—2" x 5" x 7" aluminum chassis (Bud AC-402 or equivalent)
1—5" x 7" (approx.) piece of scrap aluminum or plastic for front panel
1—9-pin miniature socket
3—7-pin miniature sockets
1—Octal socket or crystal socket for mounting crystals
1—Optional socket for mounting coil—see text
Misc.—Knobs, miniature tube shield, wire, solder, hardware, etc.

C5 and *C6*, switch *S1* which selects either of the two 160-meter crystals, microphone jack *J1*, and heater switch *S2*. Mounted on the rear of the chassis is the coaxial antenna connector (*J2*), the audio level control (*R6*), and a six-prong panel-mounting plug (*P1*) to which power connections are made.

Parts layout is not critical, and can be altered so that the unit will fit in a given



Top view of chassis shows the coil (L3) and the 700-$\mu\mu$f. capacitor (C6) that, with the 140-$\mu\mu$f. variable mounted underneath, make up the pi-network output circuit. Speech amplifier (V3) and modulator (V4) were kept at the rear of the 2"x5"x7" chassis, and the oscillator (V1) and final (V2) at the front. The coaxial antenna lead is connected to J2, and the power supply and relays to P1; R6 controls V3.



Placement of components in the 160-meter unit is not critical. A front panel, made of scrap plastic or aluminum, is mounted to one end of the chassis. Other arrangements can be used to tailor the transmitter to fit on a given chassis or in a given amount of space under an auto dashboard.

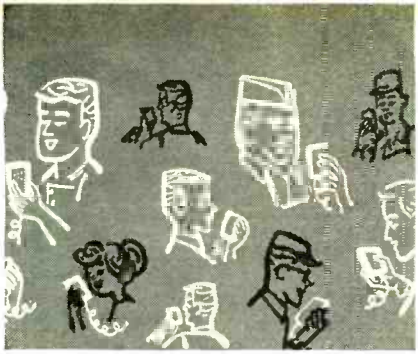
space or on an existing chassis. Due to the low frequencies involved, little shielding is required, and a rather loose layout is permissible. The audio stages and modulation transformer should be separate from the r.f. section, however, and *V3* should be shielded.

An octal socket was used to mount the crystals as indicated in the top photograph. The coil in the author's model mounts on a five-prong socket; if you make your own coil, you can construct a similar arrangement with an old tube base and matching socket.

A push-to-talk feature was incorporated in the transmitter by using a three-terminal phone jack and matching plug. As shown in the schematic, the third connection is for power and antenna relays. The wire for the relay connection is routed around the side of the chassis and out of the rear of the unit through the six-prong plug.

Antennas and Antenna Tuning. Information on antennas for 160 meters can be found in various amateur publications, but a few words might be added on mobile versions. Not found in most catalogs but available at this writing is a loading coil for 160 meters made by "Master Mobile." It can be used for either base-

(*Continued on page* 108)



On the Citizens Band

with **MATT P. SPINELLO,** 18W4689, CB Editor

THE Federal Communications Commission has its revision pencil out again. But don't panic! The project this time is simply to come up with a revised version of the already uncomplicated license Form 505 covering Classes B, C, and D of the Citizens Radio Service. The new form will be adaptable to electronic data processing, which will probably mean a shorter waiting period after applying for a license than the current (average) six weeks.

Licensees who joined CB radio from September, 1958, to December, 1962, will clearly remember the 60-to-90 day waiting period that went along with the old Form 505 which dated from September, 1958. Form 505, "April, 1962," replaced the earlier form, and the transference of license application handling from Washington, D.C., to Gettysburg, Pa., meant less work and handling for FCC worker and CB'er alike.

At the present time, applications are being accepted only on the "April, 1962" version of FCC Form 505. The newly revised form, to be dated October, 1962, is tentatively scheduled for distribution on or before July 1, 1963, and applications submitted on the "April, 1962" version will not be accepted after August 31, 1963.

Applications on the "October, 1962" form will be accepted by the Federal Communications Commission for machine processing starting July 1, 1963.

From Border to Border. The decal at left, below, is the official insignia of the solidly organized Newfoundland Citizens Band Radio Club of Canada, whose members can be found throughout the St. John's area. One of the first Canadian CB associations, this club's growth might be considered indicative of the celerity with which Canadians from border to border have found a need for a citizens' two-way radio service. Rex Stirling, the club secretary, recently informed us that in less than four months membership of the NCBRC rose from 9 to their present roster of 85! That's real growth!

One of the obvious reasons Canadians were quick to adopt the use of CB radio (GRS, or the General Radio Service, as it is officially dubbed by the Department of Transport, Canada) stems from their $3\frac{1}{2}$-year wait for this service to be established in their country, during which time they could do no more than read about—and listen to—CB'ers across the border. Hence, when their big gun went off, in April of 1962, they were ready—not only with a backlog of ideas and a choice of equipment that had been developed and improved over those

Officers of the fast-growing Newfoundland Citizens Band Radio Club of Canada include (from left to right): Richard Ruby, XM66027, executive member; W. Rex Stirling, XM66053, secretary; Fred Holloway, XM66012, club president; and Cliff Stevens, XM66003, vice president.

The Telegram, Newfoundland

Here are some of the members of the Newfoundland CB Radio Club with their cars, mikes in hand, and ready for action.

St. John's Daily News, Newfoundland

years, but with much CB knowledge gained from the experiences of their brothers to the south!

The objectives of the Newfoundland Citizens Band Club parallel those of equally successful CB organizations here in the United States. Basically, the group was organized to: (1) foster a spirit of friendly cooperation between all members; (2) promote the orderly use and development of CB operations; (3) assist any agency of the Federal, Provincial or Municipal Government in times of local or national emergency or disaster; (4) assist owners and operators of CB stations in time of need; (5) relay messages between CB stations when possible; (6) assist charitable organizations in such a manner, and at such times, that the club may decide; (7) sponsor activities that will help develop the technical skills of members in the use of CB equipment; (8) monitor the CB channels to assure that all members are operating in an approved manner; (9) invite guest speakers to monthly meetings; and (10) sponsor social activities for the enjoyment of club members and their wives or girl friends.

The Newfoundland club's doors are also open to interested non-CB'ers in that they may join as affiliate members and become active, voting members once they are licensed. Interested parties in the area should investigate the advantages of becoming a member of this active group. As Rex puts it: "The club is reaching such proportions that it has become more beneficial for CB'ers to be members than to be on the outside looking in!"

More information on the NCBRC may be obtained by writing to: W. Rex Stirling, Secretary, 1 B Tunis Court, St. John's, Newfoundland, Canada.

Roving Communications Center. Feeling the need for an active CB club in the Greensboro, N. C., area that could offer organized services to local authorities, 25 CB'ers formed the Greensboro Citizens Band Service Unit. Under the direction of Clyde Nance, 5Q0693, this club indulges in much more than idle chit-chat, and recently came up with a pretty sharp looking (and efficiently operating) CB base station—sort of a "roving communications center!"

According to club secretary "Woody" Wilson, 5W2205, all of the club members had a hand in constructing this little jewel, from the bottom up. They began by reworking an old boat trailer, equipping it with its present mast, sections of conduit piping, boom pole, antenna, and winch. Finishing touches were a portable generator and four floodlights, operable on 110 volts, a.c., and 12 volts, d.c. The control panel houses receptacles for drawing power from the generator and 110-volt source, and includes individual switches and indicators for their operation. Atop all of this sits a 5-watt Hallicrafters CB transceiver, "on guard" to answer the call!

"Woody" tells us that the whole project involved three months of club meetings, including the gleaming red paint job and chrome-plated control panel. To put the emergency unit into action, any one of the members may be called upon to deliver the trailer to a given location. All of the members have hitches installed on their cars for just such an assignment.

On location, the group is divided into teams. Each member has a particular job to perform—operating the winch, hoisting the piping and antenna into place, attaching the proper cables, or "kicking" the unit on the air. Mission accomplished, the piping, antenna, and related accessories are stored compactly on one side of the trailer.

In recent demonstrations, the unit received hearty acclaim from rural fire departments, and—at a local shopping center—drew the curiosity of over a thousand people, who got an idea of how CB radio could be put to use by private citizens, volunteers, and businessmen.

The total cash outlay for the entire project was a mere $78.00. More important, the Greensboro CB Service Unit members took a good idea, put effort behind it, and now stand ready to put the results to good use!

To round out their emergency preparation program, the club members have also participated in standard and advanced Red Cross First Aid Courses; each member carries a first aid kit in his vehicle, identified by a Red Cross First Aid emblem. Fifteen members also belong to the local Police Department Emergency First Aid Rescue Team.

Club Chatter. The Illinois Valley Citizens Banders Club of Peoria, Ill., invites one and all to their third annual get-together. Their "BREAK-BREAK" Jamboree will be held at Exposition Gardens, Sunday, June 9, 1963. The affair promises plenty of entertainment and a bundle of prizes. There will be a large "swap" area, ample parking space, and fun for all. Manufacturers' and dealers' products will be on display, and refreshments will be served on the grounds. Your CB Editor, for one, plans to be there. For more information, contact Dick Jackson, Committee Chairman, Illinois Valley CB Club, P.O. Box 141, Peoria, Ill.

The 132 members of the Firelands Citizens Band Emergency Net, Norwalk, Ohio, will sponsor their Jamboree on August 24 and 25. The event will be held at Huron County Fairgrounds in Norwalk. This is all the information we have on this particular "Jam" at present, but there's still time to drop a note of inquiry to Robert H. Kearney, Secretary, Firelands CB Emergency Net, % Huron County Sheriff's Department, Norwalk, Ohio.

Caleb W. Cope, Jr., publicity director of the Delaware Valley Citizens Band Association, writes that membership has risen to 58 as the group enters its second year of operation. Club president is Russ Bainbridge, 3Q0970. CB'ers interested in joining this group should contact Caleb at 12 Parkside Circle, Levittown, Pa.

Bill Atkinson, editor of the "Clear 9," monthly CB publication of the 5 Watter CB Club, Lansing, Mich., recently reported a successful assist given the "March of Dimes" in Lansing. After pulling their trailer into the National Foundation's lot and "setting up shop," the group was sent to collect in one of the school areas that had not been organized. Cars were dispatched to about ten of the mothers' homes, and mobile units stayed with them until the collecting had been completed. Four *male* club members went so far as to put "Mother" tags on their coats and join in the march! All in all, the gang collected over $400.00.

S. D. Dimond of Minneapolis, Minn., informed us of a rescue made via CB radio when two Richfield youths rolled their car over on a seldom-traveled country road. Equipped with CB gear, the boys put out a call that was picked up by another mobile unit. The recipient got the father of one of the youths, raced to the scene, and then delivered the injured boys to the hospital. Without the use of CB radio, it might have been several hours before the two youths, or the wreckage, would have been spotted.

"A'hunting they did go!" Members of the 5-11 Radio Club of Pittsburgh, Pa., vividly recall one freezing morning last January when they added a CB touch to a fox hunt. The usual red-clad horseman and his bugle were replaced by handie-talkies furnished and operated by club members. Despite six inches of snow, three-and-a-half hours of biting cold, and a near-blizzard, a ball was had by all. Fortunately, no one became a statistic—not even the fox, unfortunately!

Got an unusual mobile installation or neat-looking CB shack? Tell us about it! Sit in there and have someone take a good, clear picture of you and your gear, and send it along. We'll show it to the rest of the gang via this column!

—Matt, 18W4689

The Greensboro (N. C.) Citizens Band Service Unit members constructed their own "roving communications center." See text for details on this unusual mobile emergency unit.

TUNNEL DIODE RECEIVER

Add a flea-power RF stage to a simple crystal detector circuit and get souped-up performance—thanks to negative resistance

By ROBERT D. GRIMM, K6RNQ

A FEW years back, P.E. readers were introduced to a semiconductor diode with unusual properties ("The Tunnel Diode," September, 1960, issue). The article outlined basic theory, then showed how to use a tunnel diode in the oscillator circuit of a miniature transmitter. Much more recently ("TD/RFG," February, 1963, issue), the oscillating properties of a tunnel diode were once again employed—this time in an r.f. signal generator.

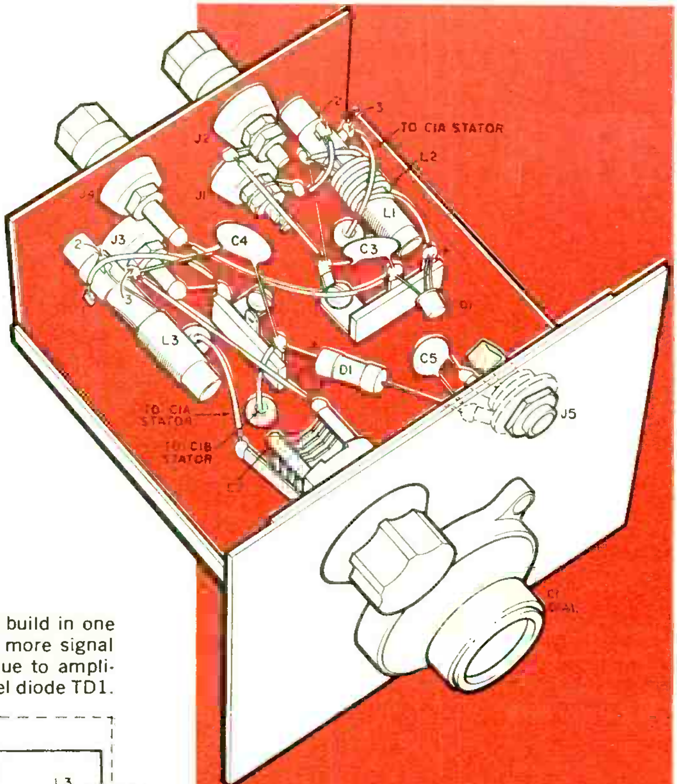
But the experimental broadcast-band receiver described here demonstrates another of the "talents" of this versatile component—its ability to amplify. Connect the set to a good antenna and ground, plug in a pair of headphones, and you have the equivalent of an ordinary crystal receiver. Then apply about 300 millivolts to the unit's tunnel diode, and the resulting increase in volume will be dramatic evidence of the "TD's" amplifying power.

About the Circuit. Broadcast-band signals from the antenna are selected by a pair of tuned circuits (coil *L1*/capacitor *C1a* and coil *L3*/capacitors *C1b*, *C4*). These circuits are adjusted so that they will always resonate at identical frequencies as dual capacitor *C1* is tuned across the band. Capacitor *C2* varies the coupling between *L1*/*C1a* and *L2*/*C1b*,*C4*, thus controlling the selectivity of the receiver.

Capacitors *C4* and *C1b* form a "capacitive divider," providing a means of coupling diode *D1* to the second tuned circuit without overloading the latter. Diode *D1* detects the selected signal, making it audible in headphones connected at jack *J5*.

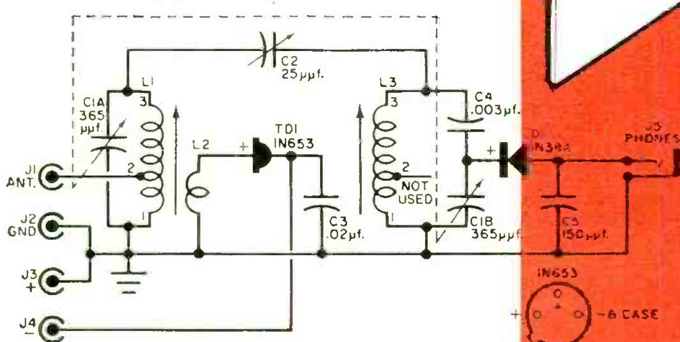
Tunnel diode *TD1* is link-coupled to *L1* by means of coil *L2*. When an appropriate voltage (see *"The Power Supply"* section on page 65) is applied across binding posts *J3* and *J4*, *TD1* will act as an r.f. amplifier—increasing the volume of the signals heard in the headphones. With no voltage across the binding posts, *TD1* is not operative, but the receiver still functions as an ordinary crystal set.

Construction. The set is built on a 4" x 4" x 2" chassis, which is of the type equipped with an interlocking bottom cover. Jack *J5* and variable capacitor *C2* are installed behind the front chassis



Capacitor C2 must be electrically isolated from front panel. Use a molded fiber washer between shaft and panel.

Circuit is simple enough to build in one evening. Coil L2 puts back more signal into L1 than it takes out due to amplification by germanium tunnel diode TD1.



apron, mounting in holes drilled through both the apron and a 4⅞″ x 5″ aluminum front panel.

Place dual variable capacitor *C1* on the chassis top, and locate this capacitor's vernier dial on the front panel. Be sure the vernier shaft coupling aligns with the shaft of *C1*. Grommet-lined holes in the chassis accommodate leads running to *C1a*'s and *C1b*'s stator terminals. Terminal strips should be installed under two of *C1*'s mounting screws as shown in the pictorial diagram.

Binding posts *J1*, *J2*, *J3*, and *J4*, as well as coils *L1* and *L3*, are mounted on the rear apron of the chassis. But before installing *L1* and *L3*, it's necessary to do some work on them.

PARTS LIST

C1—Dual 365-µµf. variable capacitor (Lafayette MS-142 or equivalent)
C2—25-µµf. midget variable capacitor (Hammarlund APC-25B or equivalent)
C3—0.02 µf.
C4—0.003 µf. } *ceramic disc capacitors, voltage not critical*
C5—150 µµf.
D1—1N34A diode
J1, J2, J3, J4—Insulated binding post
J5—Open-circuit phone jack
L1, L3—Ferrite-rod antenna coil (Miller 2002 or equivalent—see text)
L2—5 turns of #22 insulated, stranded hookup wire wound on L1 (see text)
TD1—Tunnel diode (Texas Instruments 1N653, Philco 1N3652, or General Electric TD-3)
1—4″ x 4″ x 2″ interlocking chassis (LMB 144 or equivalent)
1—4⅞″ x 5″ piece of aluminum (front panel)
1—Vernier dial for C1 (Lafayette F-347 or equivalent)
Misc.—Knob for C2, terminal strips, grommets, rubber feet, wire, solder, etc.

TUNNEL DIODE RECEIVER

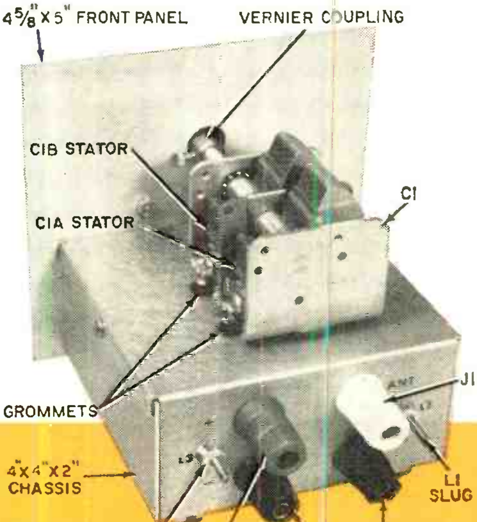
The coil assemblies used at *L1* and *L3* each have three terminals (see pictorial diagram). Terminal 3 connects to the top end of the coil winding, terminal 1 to the bottom (ground end) of the winding; terminal 2 connects to a tap located a few turns above the ground end. Several turns of a "coupling gimmick" are wound on the original coil by the manufacturer and connected to terminal 1.

To make *L2*, unwind the "coupling gimmick" on *L1*. Then rewind six turns of this wire (in the direction shown on the pictorial diagram) around the coil form. These turns should begin just above *L1*'s terminals and end just below the point where the windings of *L1* begin. Then wind three more turns over the bottom end of *L1*, and use a drop of cement to prevent coil *L2* from unwinding.

To make coil *L3*, just unwind the "coupling gimmick" on the original coil and cut it away. Coils *L1*, *L2*, and *L3* will then be complete.

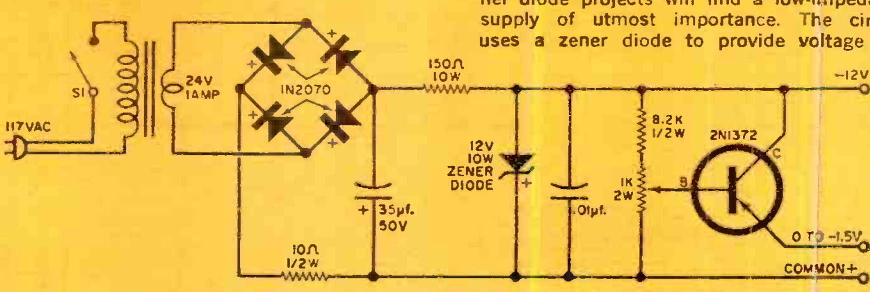
Tunnel diode *TD1* (see base diagram on schematic) is equipped with two positive leads. These are connected together internally to reduce stray inductance. When wiring *TD1* into the circuit, solder the two leads together. Be sure to take precautions against overheating *TD1* (or *D1*) while soldering.

The last two construction hints center around *C2*. First, neither the rotor nor the stator of this capacitor should be grounded. Take special care to insure that the rotor shaft hole is large enough to provide plenty of clearance between shaft and chassis. Also, keep the leads running to the rotor and stator terminals of *C2* at least an inch apart. Otherwise,



Colored binding posts (J1-J4) on rear panel of receiver are a safeguard against accidentally connecting power supply leads improperly.

Serious experimenters who want to build and test tunnel diode projects will find a low-impedance power supply of utmost importance. The circuit below uses a zener diode to provide voltage regulation.



stray capacitive coupling between these leads might reduce the effectiveness of *C2* as a selectivity control.

The Power Supply. One of the special problems encountered in tunnel-diode work is the unusual type of power supply which is required. Less than a volt of d.c. is needed, and the load will usually not exceed a few milliamperes; but the supply should present a very low impedance across its output terminals (10 ohms or less). In addition, the output voltage must be extremely stable under varying loads and adjustable at very small increments.

A battery power supply is the least desirable. Voltage stability is not good and internal resistance is too high. A potentiometer circuit can be wired across the battery in order to provide proper output impedance and voltage control, but the circuit draws enough current to render the battery useless in very short order.

Some of these difficulties can be avoided by using a transistor to control the battery voltage; but a small auxiliary battery (usually a mercury cell) is then needed to provide base bias for the transistor. Construction details for both battery/potentiometer and battery/transistor units will be found in the January, 1962, issue of P.E. ("TD Power Supply").

The experimenter who intends to work with tunnel diodes seriously, however, should have an appropriate line-operated supply. A schematic diagram of the one used by the author is shown on page 64. Features include transistorized output voltage control and zener diode voltage regulation. The unit has a 0 to −1.5 volt low-impedance output for tunnel diode work, as well as a fixed 12-volt output for transistor circuits.

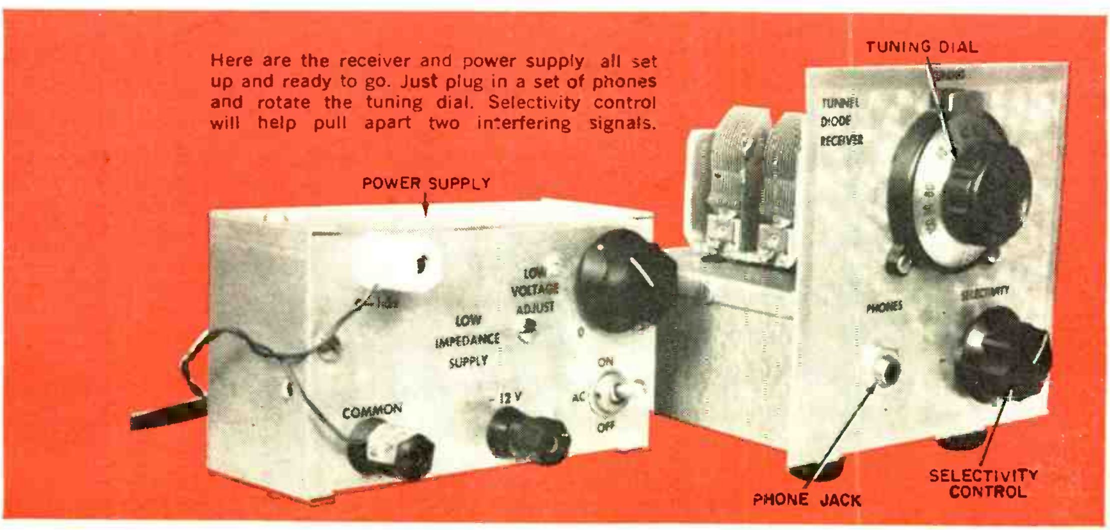
A less elaborate, but useful, line-operated supply is described in the September, 1960, P.E. article mentioned earlier.

Adjusting the Receiver. Begin by turning the slug-adjusting screws of both *L1* and *L3* *all* the way out (counterclockwise). Then turn in *L1*'s screw 28 turns and *L3*'s screw 31 turns. Connect the set to a good antenna, set selectivity control *C2* so that its plates are fully meshed, and plug a set of high-impedance headphones into *J5*.

The unit should now function as an ordinary crystal receiver, and you will hear a few of the stronger local stations as you turn *C1*. (You may have to make minor adjustments on *L1* and *L3*.) Tune to a strong station—preferably one near the center of the dial—and back off *C2* so that its plates are half-meshed. Then set your power supply voltage control to zero and connect the supply across *J3* and *J4*, making sure to observe the proper polarity.

Increase the voltage slowly and listen for a slight click in the headphones. At

(*Continued on page* 91)



Here are the receiver and power supply all set up and ready to go. Just plug in a set of phones and rotate the tuning dial. Selectivity control will help pull apart two interfering signals.

Transistor Topics

By **LOU GARNER,** Semiconductor Editor

TRANSISTOR APPLICATIONS in consumer products—such as radio receivers, TV sets, hi-fi gear, and automobiles—have been widely publicized in the press. Military and space semiconductor applications—missiles, rockets, satellites, and space probes—also have received their share of the national limelight. On the other hand, industrial and commercial applications have had relatively little publicity. From a broad viewpoint, these latter applications may be, eventually, the most important in our daily lives, for the day may come when nearly everything we eat, drink, wear or use is produced, processed, or handled by equipment controlled by transistorized instruments.

One area of industrial activity where transistorized units are being used in ever-increasing numbers is the monitoring and control of material levels in tanks, bins, silos, and similar containers. The types of materials which must be handled may vary considerably, depending on the type of activity involved, and can range from relatively safe liquids (water and milk) to inflammable substances such as oil, solvents, and hydrocarbons. Sometimes, thick, pasty substances must be handled (paper pulp) or highly corrosive fluids, including acids and alkalis. In still other cases, dry materials must be measured and controlled, whether they are in powder, granular, or lump form.

The "Dielectrol" continuous level indicator is an example of a transistorized system used for liquid and bulk materials measurement and control. As the name implies, this instrument utilizes the differences in the dielectric constants of materials as compared to air. Designed and manufactured by the Milton Roy Company (P. O. Box 12169, St. Petersburg, Fla.), it can be adapted to a broad range of industrial applications.

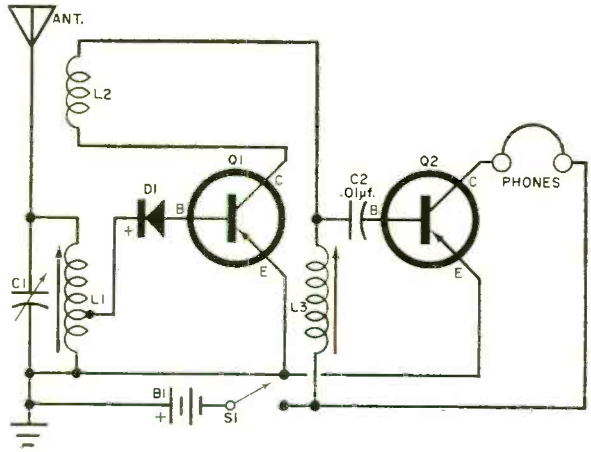
In a typical installation, a transmitter/detector head assembly is mounted on the top or side of the bin, tank, or hopper, which will contain the material to be measured. An insulated probe projects into the container vertically along its entire height. The transmitter circuitry includes a single-ended transistor oscillator, an inductance-capacity bridge, and a full-wave diode detector. An indicator and/or control unit is remotely mounted—in the plant supervisor's office.

The insulated probe and the grounded tank or bin form an electrical capacitor which serves as one leg of the inductance-capacity bridge. In operation, the bridge circuit is driven by the transistorized oscillator, with its output detected by diode rectifiers and fed to the indicating meter. During initial installation, when the tank is empty, the bridge is balanced by means of trimmer capacitors. As the tank fills, the air is displaced by material with a different dielectric constant, changing the probe-tank capacity and unbalancing the bridge. As the bridge becomes unbalanced, its output increases in proportion to the level to which the tank is filled. The circuit used is sensitive enough to detect variations as minute as 2 $\mu\mu$f., equivalent to about a ⅛" variation in water level in a typical tank.

Readers' Circuits. Simple AM broadcast-band receiver circuits continue to be extremely popular with readers. This month we are featuring two such circuits. Both require two transistors and employ readily available components.

Kenneth J. Baer (2902 Anderson St., North Bellmore, N. Y.) submitted the circuit shown in Fig. 1. Featuring a regenerative detector and single-stage audio amplifier, Ken's circuit uses *pnp*

Fig. 1. The two-transistor receiver circuit submitted by reader Kenneth Baer features a regenerative detector and a single-stage audio amplifier.



transistors in the common-emitter configuration.

As shown, r.f. signals picked up by the antenna-ground system are selected by tuned circuit *L1-C1* and coupled through diode detector *D1* to *Q1*. A portion of *Q1*'s output signal is coupled back to the tuned circuit by *L2* to provide regenerative action, while the remainder of the signal is applied to the output amplifier, *Q2*, through coupling capacitor *C2*. Coil *L3* serves as *Q1*'s collector load, with a pair of 2000-ohm headphones used as *Q2*'s output load. Operating power is supplied by a 3-volt battery, *B1*, controlled by s.p.s.t. switch *S1*.

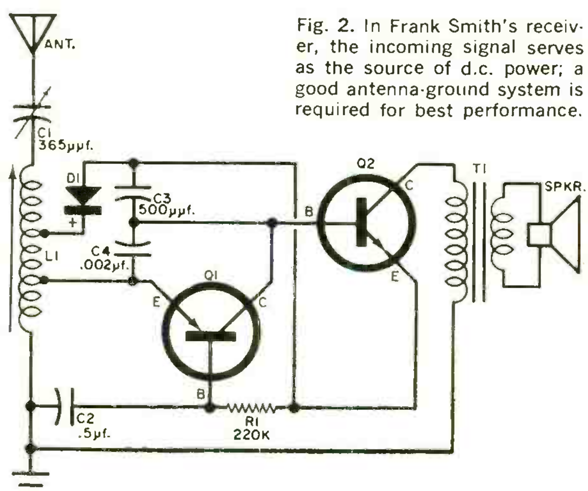
Ken's circuit can be assembled on a small metal chassis or "breadboard fashion" on Bakelite or fiberboard. Neither layout nor lead dress should be critical. Coils *L1* and *L3* are standard ferrite loopsticks, while *L2* consists of 12 to 15 turns of #18 hookup wire on a small coil form fitting over *L1*. The position of *L2* is adjusted for maximum sensitivity after the circuit has been wired.

Capacitor *C1* is a 365-$\mu\mu$f. tuning capacitor and *C2* is a 0.01-μf. paper or disc ceramic unit. Transistors *Q1* and *Q2* are general-purpose units (CK722, 2N107, etc.), while *D1* may be any standard diode—typically, a 1N34, 1N34A, or 1N60. The power supply can be made up by connecting two penlight cells in series.

Submitted by Frank Smith (97 Ferrier Ave., Toronto 6, Ont., Canada), the AM receiver circuit given in Fig. 2 has a number of interesting design features. First, a *series-type* tuned circuit (*C1-L1*) is employed, in contrast to the more common receiver designs, which generally use parallel-tuned circuits. Second, complementary coupling is used between stages, with *Q1* and *Q2* being *pnp* and *npn* types, respectively. Finally, d.c. operating power is obtained from the "carrier" of the incoming signal rather than from a separate source, such as a chemical or sun battery. It's something like an "electronic perpetual motion machine!"

In operation, signals picked up by the antenna-ground system are selected by *C1-L1*. Diode *D1* serves as a power rectifier, supplying d.c. operating biases to *Q1* and *Q2*. The *pnp* transistor, *Q1*, is connected in the common-base configuration and is direct-coupled to the output stage, *Q2*, an *npn* unit used as a common-emitter amplifier. Transistor *Q2*'s amplified output signal is coupled to the loud-

Fig. 2. In Frank Smith's receiver, the incoming signal serves as the source of d.c. power; a good antenna-ground system is required for best performance.



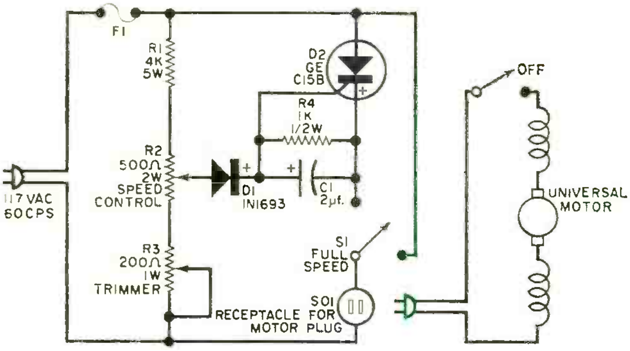


Fig. 3. Like to try your hand at this simple speed control circuit? It incorporates a GE C15B silicon-controlled rectifier (see text).

speaker by impedance-matching transformer *T1*.

According to Frank, standard components are used: *L1* is a broadcast-band ferrite-core antenna coil, modified by adding taps at the 6th and 30th turns; *C1* is a conventional 365-µµf. tuning capacitor, *C2* a small paper unit, and *C3* and *C4* ceramic types (working voltages not critical); *R1* is a half or quarter-watt resistor; *Q1* is a 2N107 transistor, *Q2* a 2N170; and *D1* is a 1N34 diode. Frank did not specify the type of output transformer used in his model, but indicated simply that "the output transformer and loudspeaker should be large and of good quality."

With neither parts arrangement nor wiring critical, Frank's "carrier-powered" receiver circuit may be assembled on an etched-circuit board, conventional metal chassis, or breadboard, depending on the requirements of the individual builder. However, since the incoming r.f. signal serves as a source of d.c. power, a good-quality antenna-ground system is needed for optimum performance. Frank suggests the use of an antenna at least 100′ long and placed as high as practicable, plus a substantial earth ground.

SCR Speed Control. Since discussing silicon-controlled rectifiers in a recent column (November, 1962), we've received a number of requests for additional practical circuits using these interesting semiconductor devices. The circuit given in Fig. 3, which has been featured in recent General Electric advertisements in professional journals, should prove of value to most hobbyists.

Using a handful of low-cost components, this circuit provides continuous speed control for standard universal (a.c.-d.c.) motors up to ⅛th horsepower. This is the general type of motor used in most hand power tools, kitchen appliances, vacuum cleaners, and sewing machines. Featuring *automatic* torque compensation (stalled torque remains the same at all speed settings), the circuit can be assembled quite easily in a standard Minibox or similar case. For specifications of the semiconductor components used, write to: Rectifier Components Department, General Electric Company, Auburn, N. Y.

Product News. A new, high-sensitivity phototransistor has been announced by Fairchild Semiconductor (545 Whisman Rd., Mountain View, Calif.). Designated as Type 2N2452, the device was designed as a companion to the 2N986, but it has a much higher sensitivity than the older unit. Current selling price is $27.00 each, in small quantities.

General Electric's Semiconductor Products Department (Electronics Park, Syracuse, N. Y.) has developed a new type of silicon diode that turns "off" in the time it takes light to travel one and a half inches. Called a *snap-off* diode, the device will find its major use in space and missile projects, computers, and similar applications requiring extreme speed in reaction capability.

A transistor circuit trainer known as the "Digiac 50" is being produced by Digital Electronics, Inc. (2200 Shames Drive, Westbury, L.I., N. Y.). Designed so that resistive, capacitive, and diode circuit components may be plugged into symbol-coded front panel jacks, the trainer can be used to construct such circuits as diode gates, peak detectors, linear amplifiers, one-shots, inverters, operational amplifiers, clippers, astable, bistable and monostable multivibrators, Schmitt triggers, differentiators, and pulse shapers. The unit has a built-in power supply and is priced at $97.50.

That's all for now—see you next month.

—Lou

New Voice From Africa

AS MOST SWL's soon realize, HCJB in Quito, Ecuador, is the most frequently heard short-wave broadcasting station in the world. Year after year, this powerful station has beamed interesting and inspirational programs on behalf of the World Radio Missionary Fellowship. But not so well known is the fact that on February 26th of this year a similar station went on the air from Addis Ababa, Ethiopia, sponsored

RVOG's studios and administration building.

by the Lutheran World Federation. Its call-sign is RVOG, "The Radio Voice of the Gospel."

Station RVOG's two 100-kilowatt transmitters are located on a 300-acre tract 18½ miles from Addis Ababa. Studios and housing facilities for the staff have been built on a 40-acre tract in the capital city itself.

Ten towers, the highest of which is 400 feet, support the antenna system. Six miles of transmission line feed the antennas while 18 miles of wire are used as radiating elements between the towers. The antenna system, being directional, produces the equivalent of two million watts of effective radiated power. A third transmitter of 1-kw. rating will be added later this year to broadcast to the Addis Ababa area on the medium-wave band.

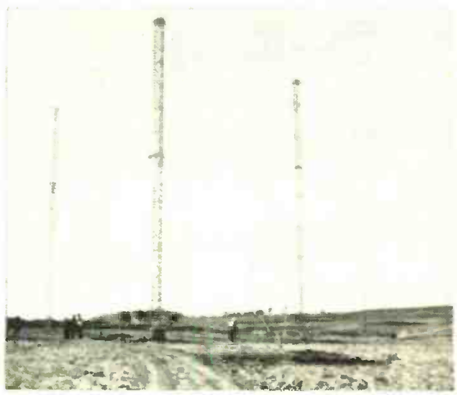
The engineering staff is made up of a technical director, two studio technicians, and two transmitter technicians.

Although the station is operated by a church group, only about 30% of the broadcast time is devoted to religious programming. During the balance of the time, programs of an educational and cultural nature are presented.

Initial broadcasts are being beamed to 20 countries in Africa, the Middle East, and Asia. More countries will be added to the list at a later date. Languages now in use include: Amaric, Arabic, English, Swahili, French, Malagassy, Zulu, Sesota, Afrikaans, Telegu, Tamil, and Hindi. More languages will also be added when the second 100-kw. transmitter goes into operation.

Regular transmissions are scheduled from 1200 to 2000 UT on the following frequencies: 15.315, 11.970, 11.880, 9.540 and 6.140 mc.

RVOG will verify all correct reception reports. Such reports should include: frequency, time heard, signal strength,



Some of the towers in RVOG's antenna system.

interference, fading, static, program heard, and a description of your receiver and antenna. Reports should be addressed to: The Radio Voice of the Gospel, The Lutheran World Federation Broadcasting Service, Box 654, Addis Ababa, Ethiopia.

So, warm up your receiver and try picking up this new and interesting find. It will be a real feather in your cap to bag an early verification from the "New Voice from Africa." *—Gerry L. Dexter*

DX AWARDS

Are you a champion DX'er? If you are, and can prove it, you can qualify for a POPULAR ELECTRONICS DX Award. How? Well, you must have logged and *verified* at least 25 different countries. And you must comply with the rules below. Read them over carefully, then fill out the coupon. If you're not sure about a particular point, see page 71. Good luck!

1 Each applicant must be a registered WPE Short-Wave Monitor, and must enter his call letters on the application form.

2 Each applicant must submit a list of stations for which he has received verifications, one for each country heard. The list should contain 25, 50, 75, 100, or 150 countries, depending on which DX Award is being applied for. And the following information must be furnished in tabular form for each verification:

(a) Country heard
(b) Call-sign or name of station heard
(c) Frequency
(d) Date station was heard
(e) Date of verification

All the above information should be copied from the station's verification. Do not list any verification you cannot supply for authentication on demand.

3 All pertinent verifications, whether QSL cards or letters, should be carefully packaged and stored by the applicant until such time as instructions are received to send in some or all of them for checking purposes. Instructions on how and to whom to send the verifications will be given at that time. Failure to comply with these instructions will disqualify the application.

4 A fee of 50 cents (in U.S. coin) must accompany the list of verifications to cover the costs of printing, handling, and mailing. This fee will be returned in the event an applicant is found to be ineligible for an Award.

5 Apply for the highest DX Award for which you are eligible. If, at a later date, you become eligible for a higher Award, then apply for that Award, following these rules and regulations exactly as before.

6 Awards will be issued to all duly qualified applicants whose applications are received during the year 1963. Any applications postmarked after midnight, December 31, 1963, will be invalid.

7 Mail your verification list, 50¢ fee, and application form to: Hank Bennett, Short-Wave Editor, POPULAR ELECTRONICS DX AWARDS, P. O. Box 254, Haddonfield, N. J. Include in the envelope only those items which are directly related to your entry for the Award. Do **not** include an application for a Short-Wave Monitor Certificate (you are not eligible for any of the Awards until you have a Short-Wave Monitor Certificate in your possession). If you want to ask other questions or supply news items, reports, etc., use another envelope.

POPULAR ELECTRONICS' DX AWARD APPLICATION FORM

(please print)

WPE Call Letters ______ Name ______

Address ______ City ______ Zone ______ State ______

Please enter my application for the following POPULAR ELECTRONICS' DX AWARD:

(check one) **25** ☐ **50** ☐ **75** ☐ **100** ☐ **150** ☐

☐ I have enclosed a list of the required number of countries, and I hereby certify that I hold a verification from at least one short-wave broadcasting station in each of the countries listed

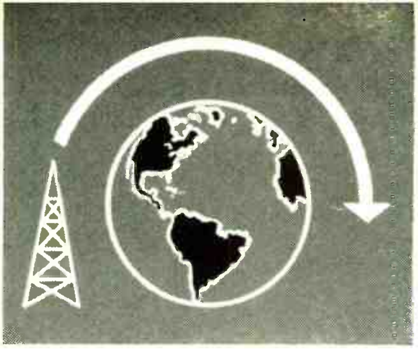
☐ I have enclosed 50 cents to help cover the costs of processing and mailing my DX Award

Signature ______________________ Date ________ 1963

This form valid only through December 31, 1963

3

Mail to Hank Bennett, POPULAR ELECTRONICS DX AWARDS, P. O. Box 254, Haddonfield, N. J.



Monthly Short Wave Report

By **HANK BENNETT,** W2PNA/WPE2FT
Short-Wave Editor

THE DX AWARDS PROGRAM

SINCE the inception of the DX Awards program, many readers have written in for specific information on several points, and the Awards Committee has been asked to define some of the rules more clearly. The following questions are typical of those which have been received. The answers should help clear up any confusion.

Q: Why is it necessary for an applicant for a DX Award to be a registered WPE monitor?

A: The DX Award program is intended basically for the readers of this column and other articles on short-wave listening which are published in POPULAR ELECTRONICS. Anyone is permitted to apply for an award, of course, regardless of whether he reports to this column or belongs to another "radio club" or takes part in other award programs. However, each applicant must have a WPE Monitor Registration certificate and identification in order to qualify for any of our DX Awards.

Q: In Rule 2(d) and 2(e), it is stated that the date a station is heard and the date of verification are required. In some cases, it is not possible to provide the exact dates. Will the omission of this information disqualify an entry?

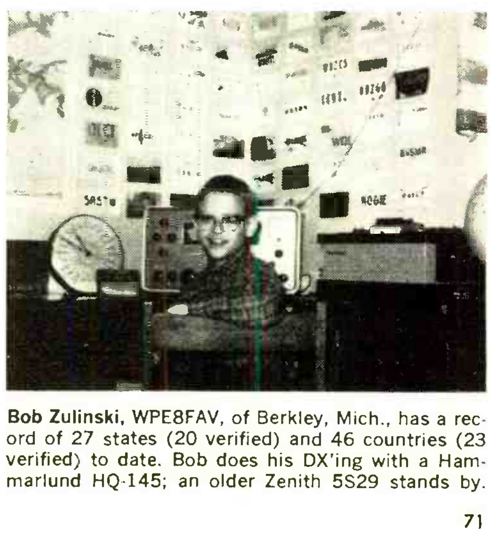
A: We anticipated this problem. We realize that the logging dates of some DX'ers will be accurate only as to month and year. We also realize that many stations do not show the exact date of verification on their cards or letters. Therefore, we are willing to go along with the honesty and integrity of the DX'er so far as exact dates are concerned. We ask only that you give the dates to the best of your ability. When known, of course, they should be clearly indicated.

Q: Are short-wave stations the only type of stations which can be included?

A: No. You can list any station on any frequency and in any service—from the long-wave band to the TV and FM channels, and from local broadcast stations to coastal, Morse, and utility stations. Any station from which you can obtain a verification is fair game.

Q: Rule 2(c) states that the frequency must be given. Does this have to be exact?

A: The majority of DX'ers do not have the frequency-measuring equipment that would enable them to pinpoint the exact frequencies of many stations, especially those in the amateur service—although this information will appear on the verification in most



Bob Zulinski, WPE8FAV, of Berkley, Mich., has a record of 27 states (20 verified) and 46 countries (23 verified) to date. Bob does his DX'ing with a Hammarlund HQ-145; an older Zenith 5S29 stands by.

FLASH! First Awards Presented!

Awards have been issued for 25 countries verified to the following DX'ers, in the order in which they appear. Congratulations to all of you!

Don Stitt (WPEØBCT), Hastings, Nebr.
Guy Ingram, Jr. (WPE4BWR), Danville, Ky.
Harvey Rogoff (WPE9EFG), Calumet City, Ill.
Ronald Grzelak (WPE1DWA), Willimansett, Mass.
Clarence Bell (WPE7AOA), Winslow, Ariz.
Bill Knochel (WPE9EGY), Kingsport, Tenn.
David Algeo (WPE8ELZ), Dayton, Ohio
Dennis Dyroff (WPE3EAG), Norristown, Pa.
Joe Brown, (WPE4BDK), Charlotte, N. C.
Delbert Hirst (WPE5CFU), Snyder, Tex.
Thomas McNiff (WPE4FEW), Arlington, Va.
Jack Pritchard (WPE5CDY), Dallas, Tex.
James Kazalis (WPE2HQT), Kearny, N. J.
Joseph McDaniel (WPE3CXY), Hagerstown, Md.

cases. We will accept an application that shows a listing of amateur stations heard in—for example—the 20-meter band, provided that the other requirements are met.

Q: Some stations do not specifically spell out the word "verification." Can we claim the "verifications" that we receive from them?

A: You are probably referring to the fact that the British Broadcasting Corporation does not show the word "verification" on their cards. To the best of my knowledge, the BBC has never "verified," with the sole exception of the BBC TV audio channels in the 40-megacycle band. Their card says that a report is acknowledged and that it is in agreement with their station schedule. This departure from "standard" practice has caused many hot arguments over the years, and some organizations claim that such wording is not sufficient for the acknowledgment to be included in the "verification" category. However, we feel that it is acceptable in this instance as long as the station indicates that your report is in agreement with the schedule.

Q: I have two *Voice of America* veries,
(*Continued on page* 101)

ENGLISH-LANGUAGE NEWSCASTS TO NORTH AMERICA

All of the stations below specifically beam English-language newscasts to the U.S.A. The times may vary a few minutes from day to day.

COUNTRY	STATION	FREQUENCY *(kc.)*	TIMES *(EST)*
Australia	Melbourne	17,840, 15,315	2030, 2130, 2230
		9580	0745
Bulgaria	Sofia	6070	1900, 2000, 2300
East Congo	Leopoldville	11,755	1630, 2100, 2230
West Congo	Brazzaville	11,725	2015
Czechoslovakia	Prague	11,990, 9795, 9550, 7345, 5930	2000, 2330
Denmark	Copenhagen	9520	2100, 2230
West Germany	Cologne	11,795, 9735	1530
		9605, 6145	1920
		9735, 6145	0000
Hungary	Budapest	9833, 7220, 5960	1900, 2230
Italy	Rome	9575, 5960	1930, 2205
Netherlands	Hilversum	11,710, 9715,	1625 (exc. Sun.)
		9630, 6035	2030 (exc. Sun.)
Portugal	Lisbon	6185, 6025	2105, 2305
Spain	Madrid	9360, 6130	2215, 2315, 0015
Sweden	Stockholm	17,840	0900
		9605	2215
		6065	2045
Switzerland	Berne	11,865, 9535, 6165	2030, 2330
U.S.S.R.	Moscow	9650, 9570, 7330, 7320, 7290, 7280, 7250, 7240, 7200, 7180, 7170, 7150, 7130, 6100, 6070, 5960[1]	1700, 1900, 2000, 2100, 2300, 0000, 0040
Vatican City	Vatican City	9645, 7250	1950

1. Not all channels are in use at any one time; other unlisted frequencies may be in use.

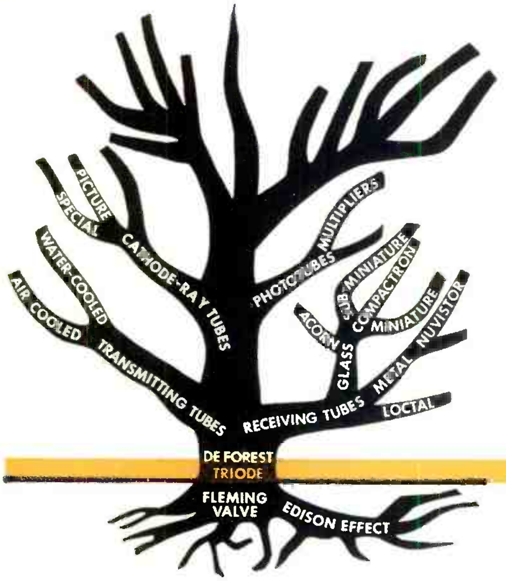
THE FAMILY TUBE TREE

PART 2

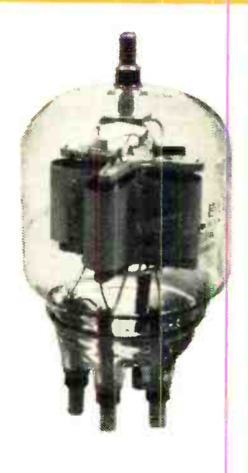
The "second generation" of vacuum tubes, offsprings of the first simple types, found new jobs to be done

By LOUIS E. GARNER, Jr.

IN THE EARLY DAYS of radio, essentially the same tubes were used for both transmitters and receivers. Even today, although transmitting tubes are considered a distinct class, there is a considerable overlap between higher power receiving and lower power transmitting tube types—in construction, in design, and in electrical characteristics. Hams, for example, frequently use receiver power tubes, such as the 6L6, in their radio transmitters. The low-power transmitting tube does not differ appreciably in appearance, size or power-handling



THE TUBE FAMILY TREE



This is a typical transmitting tube, by Westinghouse. Plate is made of graphite.

capacity from the tubes used as horizontal deflection amplifiers in television receivers.

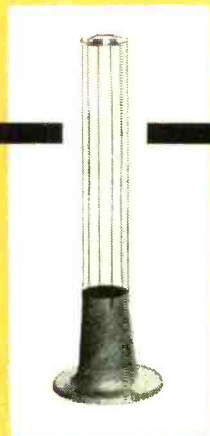
There is also a good correlation between transmitting and receiving tubes as far as generic types are concerned. Both classes can be divided into such groupings as diodes, triodes, tetrodes, pentodes, and beam power tubes. Both filamentary and indirectly heated cathodes are used in each class. The tube electrodes have the same designations—plate, grid, cathode, and so on—in both. And the same general characteristic terms are used in describing both.

When we turn to specifics, on the other hand, we find that there is a considerable difference between transmitting and receiving tubes. Transmitting types, in general, are constructed of sturdier materials, and, as a result, are larger, heavier, and more expensive than their receiving type counterparts.

Two extreme examples may be helpful. The 6AQ5 is a typical beam power *receiving* tube, while the RCA 2039 is a high-power shielded-grid beam triode *transmitting* tube. The basic specifications of the 6AQ5 include: filament voltage, 6.3 volts; filament current, 0.45 amp.; peak positive-pulse plate voltage, 1100.0 volts; peak plate current, 0.115 amp.; average plate current, 0.040 amp.; and plate dissipation, 10.0 watts. The same basic specifications of the 2039 are: filament voltage, 7.3 volts; filament current, 1140.0 amp.; peak positive-pulse plate voltage, 40,000.0 volts; peak plate current, 92.0 amp.; average plate current, 5.7 amp.; and plate dissipation, 150,000.0 watts. These comparative specifications emphasize the primary difference between transmitting and receiving tubes: their power-handling capacity.

To obtain high powers, very high voltages and currents are required. This means that the tube's electrodes must be very heavy in order to handle the large currents without melting, and widely separated to prevent arcing at the high voltages. (Arcing can destroy a tube.) Special insulation must be used where the electrodes are mounted to withstand a combination of high heat and tremendous voltages. And, of course, heavy-duty terminals are needed to handle the currents. Finally, all of the above construction factors must be taken into account and balanced against the tube's

Components of a high-power Federal Telephone & Radio transmitting tube. Electrodes are heavy and special insulation is used to withstand high voltages and heat; heavy-duty terminals take care of high currents. Tubes of this general type may be forced air-cooled or water-cooled.



designed operating frequency (which may require close spacing) and desired electrical characteristics.

While maximum electrical ratings, amplification factor, mutual conductance, and similar characteristics are all important, the transmitting tube's *most* important single characteristic is probably its rated maximum *plate dissipation*. Specified in watts (or kilowatts), this is directly proportional to the amount of power that the tube can handle and hence the r.f. power it can deliver.

In practice, the tube's actual plate dissipation is the difference between its d.c. plate input power (plate voltage multiplied by average plate current) and its r.f. output power. For example, if a Class C r.f. power amplifier is 70% efficient and has a d.c. input of 10 kw. (5000 volts at 2 amperes, say), it will deliver 7 kilowatts r.f. (approximately) and will have a plate dissipation of 3 kw.

With plate dissipations running into the kilowatt range for some types of tubes, it is obvious that a means must be provided for removing the heat generated if the tube is to be kept from melting. While lower power transmitting tubes are invariably convection air-cooled, higher power types are either forced air-cooled or water-cooled. Medium-power tubes are often provided with radiating fins, while high-power types are equipped with water jackets. The cooling device, whether a radiating fin system or a water jacket, may be either an integral part of the tube or a separate accessory.

Designed for forced air-cooling, this Amperex high-power transmitting tube has a finned radiator fitted over the plate.

Industrial Tubes. Except for a few special types, industrial electron tubes correspond in most ways to their receiving and transmitting tube counterparts. Low-power receiving types are used in industrial controls, alarm circuits, counters, protection devices, and similar equipment, while transmitting types are found in high-voltage and high-current power supplies, welders, and induction and dielectric heaters.

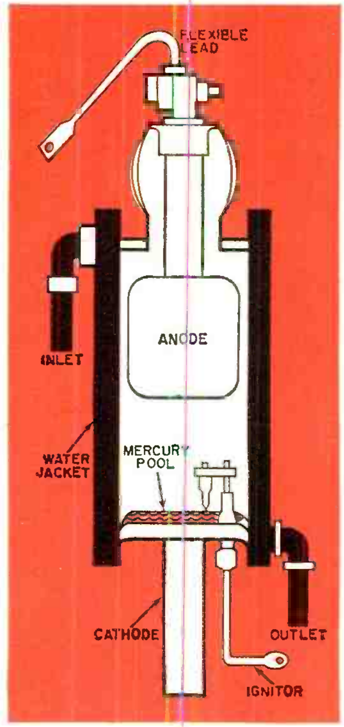
In general, industrial receiving type tubes, while basically similar to ordinary receiving tubes, are usually of sturdier construction and designed for continuous operation under rigorous physical conditions. Industrial tubes, as a rule, must have extremely long filament life, for equipment shutdowns—even for short periods—can be extremely costly to a manufacturer. In addition, the tubes must be able to withstand extremes in temperature, shock, and vibration.

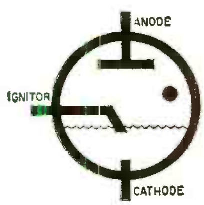
Gas-filled tubes are used extensively throughout industry. Thyratrons and cold-cathode tubes are utilized for motor, electromagnet, and solenoid control, while mercury vapor rectifier tubes are employed in heavy-duty d.c. power supplies for electroplating, electrolysis, and similar work.

There is one type of electron tube that is used in many industrial applications but which is not, however, found in communications equipment: the *ignitron*. Used for high-capacity switching and in heavy-duty d.c. power supplies for welding, motor control, and certain electrochemical processes, the ignitron is basically a special type of cold-cathode tube in which mercury vapor is produced by a controlled electric arc. In one sense, it is a type of rectifier. Some types are capable of handling voltages as high as 20,000 volts and conducting currents as great as 35,000 amperes for short periods.

In its basic form, the ignitron consists of an evacuated metal envelope (which may be double-jacketed for water cooling), a pool of mercury which serves as a cathode, a heavy metal anode, and a special *ignitor* of rough-surfaced material which resists "wetting" by the mercury but which projects into the pool of liquid metal.

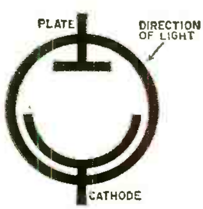
In operation, the tube will not conduct until "fired" by current applied to its ignitor electrode. A moderate-current pulse here creates high-current densities at the rough points of contact with the

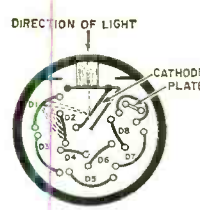




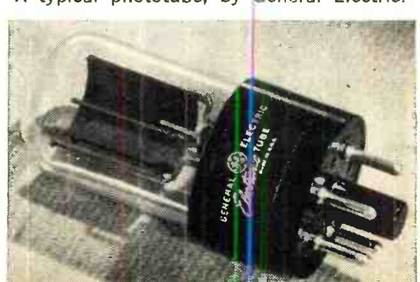
Details of the ignitron are shown above. At left is the schematic symbol for this industrial tube.

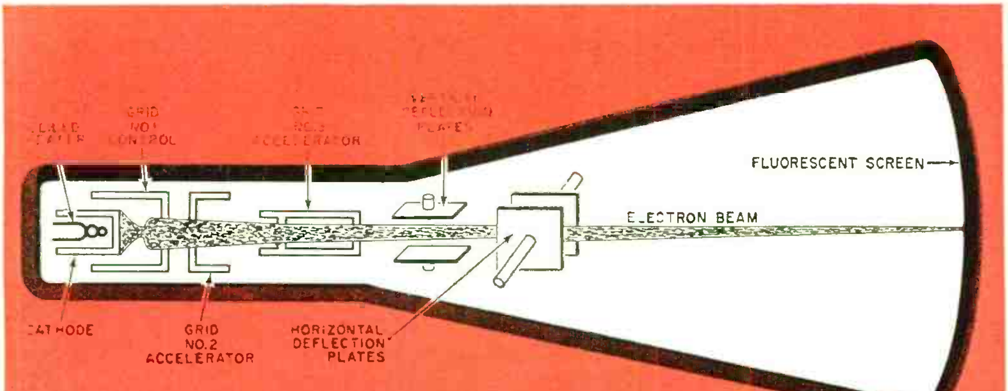
Basic phototube symbols appear below. At left: the standard version. At right: a photomultiplier.





A typical phototube, by General Electric.





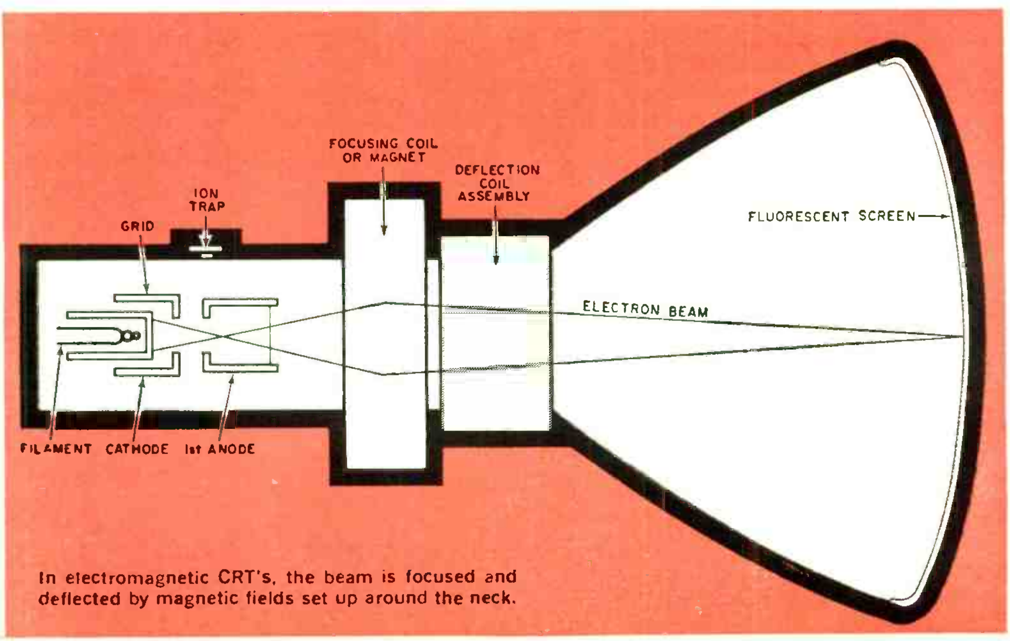
In electrostatic cathode-ray tubes, the electron beam is deflected and focused by internal elements.

mercury pool, establishing a hot arc which vaporizes the mercury, filling the tube with vapor and allowing conduction to take place between the cathode and anode. Afterwards, the anode-cathode current is sufficient to keep the arc established and to maintain current flow.

Phototubes. When light falls on certain metals and metallic compounds, such as cesium, cesium oxide, potassium, and zinc, electrons are emitted from the material's surface. This photoemissive effect was first noticed, although not fully understood, by Heinrich Hertz in 1887. Like many early discoveries, this one eventually led to the development of the *phototube:* a light-sensitive electron tube with an electrical output proportional to the amount of light falling on its sensitized surface.

Phototubes are used extensively in both industrial and commercial applications—burglar alarms, automatic door openers, electronic counters, doorway annunciators, safety equipment for industrial machines, sound motion picture projectors, etc.

The phototube is a special type of



In electromagnetic CRT's, the beam is focused and deflected by magnetic fields set up around the neck.

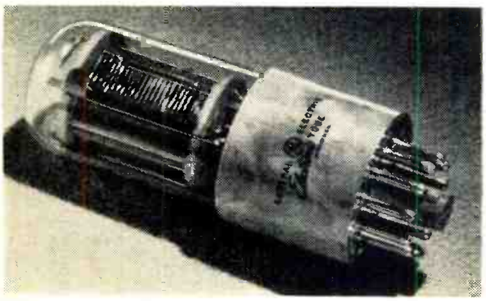
cold-cathode diode. The cathode is generally a semicircular metal plate coated with photoemissive metallic compounds, the plate a small rod or wire. In operation, light falling on the cathode causes electrons to be emitted. If a positive voltage is applied to the plate (or anode), these free electrons migrate to it, producing a minute output current.

Like human eyes, phototubes differ in their response to light. While their current output is directly proportional to light intensity, the current may vary considerably with identical light levels in different colors. Depending on the types of photoemissive compounds used, phototubes may be made more sensitive to infrared, ultraviolet, or to the whole spectrum of visible light. Except for physical contruction and type of lead connections, the chief differences between phototubes are found in their *spectral responses.*

Sometimes, a small amount of selected gas will be introduced in a phototube. The gas ionizes and reduces the tube's internal cathode-anode resistance, permitting it to deliver a greater current output for a given cathode illumination. Gas phototubes have a higher sensitivity than high-vacuum types but are more easily damaged by excessive voltages and are somewhat less stable.

Photomultipliers. Unfortunately, the current output of standard phototubes is extremely small—on the order of a microampere or less at typical illumination levels. This fact has led to the development of a class of special phototubes called *photomultipliers.* Used in scintillation counters, automatic light dimmers, and in similar applications, photomultipliers make use of the principle of secondary emission (which we discussed in Part 1) to increase their current output.

Multiplier-type phototube, General Electric version.



The photomultiplier consists of a photoemissive cathode, a series of secondary anodes called *dynodes,* and the output anode or plate. Depending on tube type and physical design, the dynodes may be arranged in a circle around the cathode, or in parallel lines behind the cathode, which is tilted at a small angle.

Cathode-Ray Tubes. By definition, a cathode-ray tube (CRT) is a device which utilizes cathode "rays," i.e., "rays" emitted by the device's cathode. Cathode rays are, of course, streams of electrons.

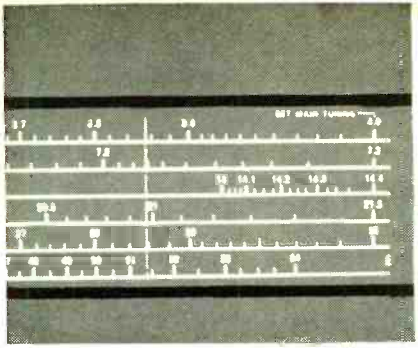
Although often considered a relatively modern invention, cathode-ray tubes are, historically, even *older* than more familiar electron tubes. Various types of cathode-ray discharge and display tubes were used extensively in physics laboratories and schoolrooms before the turn of the century, and as early as 1897 Karl Braun developed a cathode-ray display tube very similar to modern television tubes.

The "heart" of most present-day CRT's is the *electron gun.* The gun is made up of a filament, an indirectly heated cathode, a disc-shaped control grid, and disc- or cylindrical-shaped focusing and accelerating grids (or anodes). Its purpose is to produce a sharp stream of accelerated electrons. The number of electrons in the stream (and hence its intensity, as well as the brightness of the spot it produces when it strikes a screen) is controlled by the voltage applied to the control grid. The beam's sharpness of focus is determined by the voltage relationships between the focus and accelerating anodes.

Display Tubes. Direct descendants of the early Braun tube, *display* CRT's are used extensively in TV receivers and monitors, oscilloscopes, radar equipment, and in a variety of test and research instruments. As the name implies, these tubes serve to display electrical phenomena on a fluorescent screen, either as a line, pattern, or reproduced picture.

In general, display tubes are made up of an electron gun assembly, a means for focusing (if not contained within the gun itself) and deflecting the electron beam, and a fluorescent screen. Manufactured in sizes ranging from tiny units

(*Continued on page 88*)



Across the Ham Bands

By **HERB S. BRIER,** W9EGQ
Amateur Radio Editor

EMERGENCY PREPAREDNESS—AND FIELD DAY

IF A MAJOR DISASTER suddenly struck your community, causing widespread damage, injury, death, and disruption of electric power and communications circuits, what would you do? Suppose the American Red Cross asked you to use your ham station to summon help—would you be able to uphold amateur radio's proud tradition of emergency service? Do you have emergency power available for your equipment, or could you quickly move your equipment to a location where electrical power would be available? Could you do a fast job of erecting an efficient temporary antenna at an emergency location, or replace your regular one if it blew down?

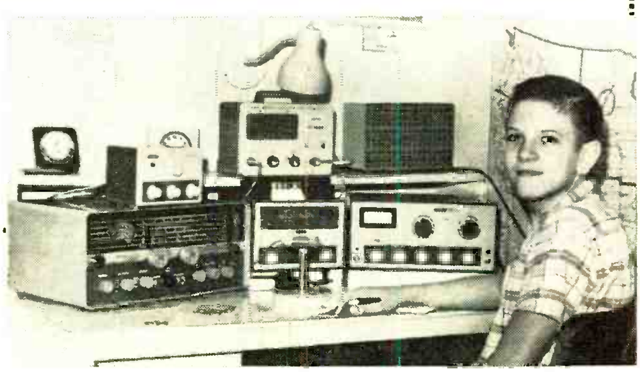
If you are the only ham for miles around, you should have complete emergency facilities at hand. Otherwise, you may have to sit helplessly by during some future disaster while better-prepared hams battle their way into your area with the equipment and know-how to establish an emergency communications link. The hams in a larger community, on the other hand, do not all have to have their own complete emergency communications facilities. Instead, they can make plans to pool their equipment and skills through the local Amateur Radio Emergency Coordinator or ham club. If necessary, the club or emergency group can invest in a gasoline-powered generator as a source of emergency power.

To be certain that the plans and the equipment will function properly when needed, they must be tested periodically under actual operating conditions. This

Novice Station of the Month

Greg Saiter, WN8CAU, Marion, Ohio, will receive a one-year subscription to P.E. for submitting the winning photo in our Novice Station of the Month contest for June. Greg works all four Novice bands, using a Heathkit DX-60 transmitter and a Hallicrafters SX-110 receiver on the three lower bands, and a Heathkit "Twoer" transceiver on 2 meters. If you look closely, you'll notice that a Heathkit VFO also has a prominent position in Greg's shack; it's awaiting the arrival of his General Class license, which should be in the mail any day now.

If you would like to enter our photo contest, send us a clear picture of your station—preferably showing you at the controls—along with some information about yourself, your equipment, and your operating achievements. Even if you don't win the prize, we'll try to publish your picture anyway, as space permits us to do so. All contest entries should be sent to Herb S. Brier, Amateur Radio Editor, POPULAR ELECTRONICS, P. O. Box 678, Gary, Indiana.



Short-Wave Broadcast Predictions

By STANLEY LEINWOLL
Radio Propagation Editor

JUNE 1963

DURING the month of June the highest static levels of the year usually occur. In spite of the continuing decrease in sunspot activity, the lower frequency bands will not be as good for DX'ing as they have been recently. During the nighttime hours, the 7- and 9-mc. bands should present optimum receiving conditions but there will be relatively few openings appearing in the regional bands below 6 megacycles. In the daytime (from around sunrise to slightly after sunset), the 15- and 17-mc. bands will be the best ones for DX'ing, with some reception possible on 21 mc. but practically none at all on 26 mc.

TIME (EST)

Between Eastern USA and:	00	02	04	06	08	10	12	14	16	18	20	22 24
Western Europe	7	7	9	11	15	15	15	15	15	15	11	9
Eastern Europe	7	7	9	11	11	11	15	15	15	11	11	9
South & Central America	11	11	9	11	17	17	17	17	17	17	15	11
Near East	7	6	9	11	11	15	15	15	15	11	11	9
North Africa	7	6	9	15	15	15	15	15	17	17	11	9
South & Central Africa	9	9	9	15	17	17	17	17	15	11	9	9
Australia & New Zealand	11	11	11	11	11	11	*	17	21	21	21	17

TIME (CST)

Between Central USA and:	00	02	04	06	08	10	12	14	16	18	20	22 24
Western Europe	6	6	9	11	15	15	15	15	15	9	9	7
Eastern Europe	7	6	9	11	11	11	15	15	11	11	11	9
South & Central America	11	9	9	15	17	17	17	17	17	15	15	11
North Africa	6	6	7	11	15	15	15	15	15	11	9	7
South & Central Africa	6	6	9	15	15	15	15	15	11	11	9	7
Far East	9	6	6	9	11	11	11	15	15	15	15	11
Australia & New Zealand	11	11	11	11	11	11	*	21	21	21	21	15

TIME (PST)

Between Western USA and:	00	02	04	06	08	10	12	14	16	18	20	22 24
Western Europe	6	6	9	11	11	11	15	15	11	9	9	9
Eastern Europe	7	7	9	11	11	11	11	11	11	11	11	9
South & Central America	9	9	11	15	17	17	17	17	17	17	15	11
Africa	7	7	11	15	15	15	15	11	11	11	9	9
Far East	9	7	9	9	11	11	15	15	15	15	15	15
South Asia	9	9	9	9	11	11	11	11	15	15	15	11
Australia & New Zealand	11	11	11	11	9	15	17	21	21	21	21	15

To determine the frequencies and times for best short-wave reception in the United States, select the table for the area you are located in, read down the left-hand column to the region you want to hear, then follow the line to the right until you are under the figures indicating your approximate local time. The boxed numbers will tell you the frequency band (in megacycles) to listen to during any 2-hour interval. Asterisk (*) indicates that signals will probably not be heard.

Elementary Induction

(Continued from page 53)

stone cold," he announced, "and we don't have a spare. The filament must have been jarred in two by the rough ride up here."

"Try the six-meter rig," Carl suggested, glancing nervously across at the empty highway on the other side of the river.

Jerry quickly put the high-frequency transmitter into operation and desperately called "QRRR," the amateur emergency distress signal. No sign of an answer was heard in the receiver.

Twice more he put out the distress call, with absolutely no results. "It's no use," he said as he snapped off the receiver and started unscrewing the coax cable antenna lead from the other transmitter. "No one monitors six meters around here this time of day. Our only chance is to get down there to where the wires cross the road and try to break them before the president comes along.

"You drive," he suggested hurriedly as he threw the end of the cable out the rear of the car, "and don't spare the horses."

"Hadn't we better uncouple the generator?" Carl asked as he climbed into the driver's seat.

"No time for that; get going!" Jerry urged.

THE DRIVE up that steep zigzagging path had been spine-tingling, but it was nothing compared to the ride down. Carl sent the station wagon hurtling along the narrow, twisting path while behind, the heavy generator, still humming away, bumped and jolted and careened first over on one wheel and then on the other, threatening to overturn at any instant. Somehow, though, they finally reached the black-topped road that paralleled the river.

Just as Carl made a tire-screeching right turn onto the road, Jerry glanced up at the top of the bluff directly across the river and uttered an exclamation.

"There's the motorcade now," he shouted. "See if you can gain a good lead on them before we reach the wires."

Carl tried. The accelerator was clear to the floor as the station wagon and the heavy trailer raced along the winding black-topped road, but the cavalcade across the river was also traveling at a fast clip on a stretch of highway that ran perfectly straight. As the station wagon neared the point where the wires should run across the road, it was obvious to both boys the scant 200-yard lead they had over the state police car leading the motorcade was not enough to give them time to locate the detonating wires, stop the car, get to a point where they could reach the wires, and cut them.

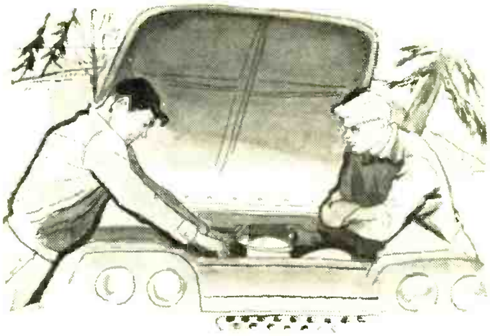
Carl kept taking quick upward glances as he let the car slow down. "There they are!" he said, pointing to where two inconspicuous wires crossed the road from one treetop to another. A glance was all that was needed to convince the boys that the wires were far too high to be reached even if they stood on top of the station wagon.

"Stop the car with the back bumper directly under the wires," Jerry called to Carl.

Carl slammed on the brakes, and the wagon came to a lurching stop with the halo antenna squarely underneath the twin strands of wire. Jerry threw full power into the six-meter transmitter, and he and Carl stared in sickening fascination at the rapidly closing gap between the motorcade and the mined culvert acros the river.

SUDDENLY there was a muffled roar, and a fountain of dust and broken pieces of concrete erupted from the point where the highway crossed the culvert. As the rocks and chunks of concrete rained down into the river, causing splashes that reached almost halfway across, the boys saw the entire cavalcade brake to a halt a scant hundred yards from where the explosive had torn a gaping trench clear across the highway.

The boys leaped from their car and looked upward at the point where the wires disappeared over the top of the bluff above. Two dark-skinned faces silhouetted against the blue sky stared down at the boys and at a car parked at the side of the road not far away from the station wagon. After a few frozen seconds, the faces disappeared.



"That must be their getaway car," Carl exclaimed. "They probably will be afraid to try to get to it now with us here, but just to make sure we'd better take the rotor out of their distributor. They must really feel pretty sick about getting impatient and blowing up the culvert too soon."

"They didn't blow up the culvert; *we* did," Jerry corrected him.

"We *what?* You must have had your little gray cells jarred by that explosion. How could we have set off the dynamite, or whatever it was?"

"We did it with r.f. from our six-meter transmitter. Radio frequency currents from the halo antenna induced similar currents in the wires leading to the dynamite caps. Standing waves on these wires produced heating in the caps and detonated them."

"So that's why you wanted me to stop with the back of the car directly under the wires! What ever made you think of detonating the caps with r.f.?"

"Well, we both know it's dangerous to use transmitting equipment in an area where blasting is going on. We've seen highway signs warning against that sort of thing. And then I was reading a story recently about a patent that had been taken out to eliminate explosions on airplanes caused by bombs concealed in baggage. The apparatus is called SNARE, or *S*ignal *N*et for *A*ctuating *R*adio-sensitive *E*xplosives. A man by the name of Irwin Ehlmann of Hatboro, Pennsylvania, is the inventor.

"The device consists of a 30-foot bombproof chamber with a conveyor belt running through it. Baggage on this belt is exposed to strong radio frequency waves of different wavelengths. These radio frequency waves will detonate any caps concealed in the baggage and so set off the explosive.

"When I realized we couldn't reach the wires in time, all this flashed through my mind. There wasn't anything else we could do; so it seemed worth a try—"

JERRY WAS INTERRUPTED by a wailing siren, and in a few seconds a state police car came to a stop behind the generator which was still sitting in the middle of the road. The police across the river had seen the wires leading across the water, and they had dispatched a cruiser to investigate. The officer, "Doc" Watson, was known to the boys, and they quickly explained to him what had happened. He relayed the information over his radio, and a net was quickly thrown up around the area.

"Those fellows will be picked up shortly," officer Watson prophesied. "They don't stand a ghost of a chance of getting away on foot.

"We all certainly owe you two a big debt of gratitude," he said then, "but I must admit I still can't understand how you set off that dynamite clear across the river without even touching the wires."

"Elementary induction, my dear Dr. Watson, elementary induction!" Carl replied with a teasing grin. —30—

To Carl and Jerry Fans:

I'd like to answer personally all the wonderful cards, letters, and messages wishing me a quick recovery from my recent illness; but, as I'm sure you understand, that is virtually impossible; so I'm taking this means to thank all of you who sent them.

The good wishes and prayers mentioned in so many of these heart-warming messages must certainly have "worked," for I have recovered completely.

Writing future Carl and Jerry stories will be even more fun now that I know so many of you readers enjoy them. Thanks a million!

John T. Frye

Operation PICKUP

(*Continued from page* 38)

Connecting the New System. Whether or not you should connect the transistorized PICKUP yourself depends upon your familiarity with automotive electronics. In particular, you must be able to disconnect the "condenser" from the *points* in the distributor. Actually, this is not a difficult task, and the connection of the system itself is "child's play."

First, locate the ballast resistor. You will need a low-ohmage tester to determine that the ballast resistor does not exceed 1.5 ohms. If it does, a resistance measurement must be made to find the actual value of your present ballast resistor. Using the well-known formulas, or by cut-and-try methods, reduce the value of the ballast resistor to 1.0 or 1.5 ohms. In some cars, it might be best to attempt a simple reduction of the ballast resistor by wiring in parallel a 10-ohm, 10-watt resistor.

After locating the ballast resistor, disconnect the two wires and insert a new wire from one side of the ballast resistor to the engine block. This will serve as the ground for your whole system. From the other side of the ballast resistor, connect a wire to the "ground" side of your induction coil. The "hot" side of the induction coil goes to the collector of transistor *Q3*.

Now locate the wire coming from the distributor that originally went to the ground side of the induction coil. This wire is then connected to the cathode side of all three silicon diodes.

The last wire to be connected is the one from your ignition switch. This wire goes directly to the emitter of transistor *Q1*. In many automobiles, the electrical wiring is arranged to short out the ballast resistor when the car is being started (see schematic diagram on page 35). If your car is arranged in this fashion, you must parallel the ignition wiring with the *start* wiring of your ignition switch.

Spark Plugs. Many advertisements on transistorized ignition systems loudly proclaim that "any old" spark plug will work. Possibly this statement is true, but it's rather foolish economy to believe it. In setting up your car for top performance, check your plugs; if they have over 5000 miles on them, install a new set.

When replacing the plugs, set the gaps somewhat wider. The PICKUP has more than enough h.v. to fire across a wide gap, and best motor performance will result if the plugs can take advantage of this "extra" voltage. In tests made by the POP'tronics staff with the PICKUP, the plugs were set at 0.045", although the auto manufacturer's specifications called for a setting between 0.033" and 0.035". This is one place where you can disagree with Detroit and get away with it.

Distributor Points. Unless the points in your car have pretty well had it, there is no reason to replace them or go to a new gap setting. The points will now be breaking less than 10% of the current used in a standard system. Where formerly the points had to make and break a current of about 5 - 6 amperes, the current from the PICKUP's transistor switching circuit will be on the order of 400 - 500 ma. In fact, it is our prediction that the fiber cam kicking the points open and shut will wear out before the points need replacing. A reasonable life estimate is on the order of 40,000 miles for points when using the PICKUP.

Check Timing and Dwell. To insure premium performance from the PICKUP, you should have a reputable automobile service shop check the timing and dwell before you install the new system. Be sure that the timing is set to the car manufacturer's specifications. If it is not —if the car's timing is 6-8° late, rather than 5-6° early, for example—your car will probably not start with transistorized ignition.

Setting the dwell to the manufacturer's specs is not as important as timing, but nevertheless it should be held to a tolerance of within ±2°.

If it is not possible to check timing and dwell before installation, be sure to have it done as soon as possible after the PICKUP is installed. The ignition spark is now hotter and of shorter duration, making both of these adjustments more important than they would be in ordinary circumstances. Once timing and dwell have been set, they should never (!) need to be reset. —30—

TRY THIS STEREO TEST RECORD!!

Special to our readers for only...$3.98

Featuring Tests Never Before Available To The Hobbyist

Why We Make the Model 211 Available Now

Although there are many stereo test records on the market today, most critical checks on existing test records have to be made with expensive test equipment.

Realizing this, HiFi/STEREO REVIEW decided to produce a record that allows you to check your stereo rig, accurately and completely, just by listening! A record that would be precise enough for technicians to use in the laboratory—and versatile enough for you to use in your home.

The result: the HiFi/STEREO REVIEW Model 211 Stereo Test Record!

Stereo Checks That Can Be Made With the Model 211

- ✓ Frequency response — a direct check of eighteen sections of the frequency spectrum, from 20 to 20,000 cps.
- ✓ Pickup tracking — the most sensitive tests ever available to the amateur for checking cartridge, stylus, and tone arm.
- ✓ Hum and rumble — foolproof tests that help you evaluate the actual audible levels of rumble and hum in your system.
- ✓ Flutter—a test to check whether your turntable's flutter is low, moderate, or high.
- ✓ Channel balance — two white-noise signals that allow you to match your system's stereo channels for level and tonal characteristics.
- ✓ Separation—an ingenious means of checking the stereo separation at seven different parts of the musical spectrum—from mid-bass to high treble.

ALSO: ✓ Stereo Spread
Speaker Phasing
Channel Identification

PLUS SUPER FIDELITY MUSIC!

The non-test side of this record consists of music recorded directly on the master disc, without going through the usual tape process. It's a superb demonstration of flawless recording technique. A demonstration that will amaze and entertain you and your friends.

UNIQUE FEATURES OF HiFi/STEREO REVIEW'S MODEL 211 STEREO TEST RECORD

- Warble tones to minimize the distorting effects of room acoustics when making frequency-response checks.
- White-noise signals to allow the stereo channels to be matched in level and in tonal characteristics.
- Four specially designed tests to check distortion in stereo cartridges.
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All Tests Can Be Made By Ear

HiFi/STEREO REVIEW's Model 211 Stereo Test Record will give you immediate answers to all of the questions you have about your stereo system. It's the most complete test record of its kind—contains the widest range of check-points ever included on one test disc! And you need no expensive test equipment. All checks can be made by ear!

Note to professionals: The Model 211 can be used as a highly efficient design and measurement tool. Recorded levels, frequencies, etc. have been controlled to very close tolerances — affording accurate numerical evaluation when used with test instruments.

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The Model 211 Stereo Test Record is a full 12″ disc, made from the finest virgin vinyl. For a limited time only, it is being sold by Popular Electronics for $3.98. Starting July 1, 1963 we will sell this record for $4.98. **Order now and save $1.** Make sure you don't miss out on this special offer. Fill in and mail the coupon, together with your check ($3.98 per record) today!

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SORRY—No charge or C.O.D. orders!
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The Tube Family Tree

(*Continued from page* 78)

with a 1"-diameter screen to giant picture tubes with 30" screens, they are usually funnel-shaped. The screen itself may be round, square, or rectangular. The envelopes or "funnels" are made either of metal or glass, or a combination of both.

Most display tubes are identified by a combination numeral-letter type number. The first number indicates the nominal size of the tube's screen, the first letter (or letters) the particular tube, and the last letter and numeral the type of fluorescent material (or *phosphor*).

Phosphors. Typically, a type 5BP1 tube has a 5" screen with a type "P1" phosphor. Similarly, a type 20DP4 has a nominal 20" screen and a "P4" phosphor. Cathode-ray tubes used as TV picture tubes generally have rectangular screens and their size designation refers to a diagonal measurement across the face of the tube. In some cases, TV picture tubes are called *kinescopes*.

An arbitrary system is used for identifying the various phosphors used. A type P1 phosphor, for example, has green fluorescence and medium persistence; you'll find this type in most oscilloscope tubes. Type P4 phosphors have white fluorescence and medium persistence, and are employed primarily in television tubes. Type P5 phosphors have a bluish-white fluorescence and very short persistence; tubes with this type of phosphor are used for high-speed photography of electrical phenomena having a short time duration. The P11 phosphor is similar to the P5 type, but has a slightly longer persistence.

Types P7 and P14 are both two-layer phosphors. The P7 type has a long persistence, first emitting a bluish light, then a greenish-yellow. The P14 type has medium persistence, first emitting a bluish, then an orange light which persists for over a minute. These two types of phosphor are useful in instruments employed to observe low-speed recurrent and non-recurrent phenomena. The last type of phosphor, P15, has a

(*Continued on page* 90)

SHORT-WAVE MONITOR CERTIFICATE APPLICATION

To become a Short-Wave Monitor registered with POPULAR ELECTRONICS, just follow these simple directions:

1 Fill out the form below. (You must be a short-wave listener presently active in the hobby to be eligible for a Short-Wave Certificate.)

2 Send us 10 cents in coin to cover the cost of the certificate as well as the handling and registration costs. If you live outside the United States and cannot obtain U. S. coins, send either 15 cents in Canadian currency or two International Reply Coupons (IRC's).

3 Insert the application form, coins (or IRC's) and a stamped, self-addressed envelope in another envelope and mail it to:

Monitor Registration, POPULAR ELECTRONICS
One Park Avenue, New York 16, N. Y.

(Please Print) Name			Ham Call-Area Prefix ....
Address	City	Zone	State ....
Receivers	Make	Model	
	Make	Model	
Principal SW Bands Monitored		Number of QSL Cards Received	
Type of Antenna Used			
Signature		Date	

very short persistence in the near ultra-violet region, emitting a visible blue-green light afterwards; its principal application is in flying-spot scanner tubes.

Electrostatic and Electromagnetic. *Electrostatic* CRT's are those which employ electrostatic fields to move the electron beam obtained from the gun assembly. Electron beams may also be deflected by magnetic as well as electrostatic fields, however. Most TV picture tubes are *electromagnetic* types.

In many cases, the beam may be focused as well as deflected by magnetic fields, with a permanent magnet or electromagnetic coil placed around the tube's neck near the gun assembly. In some tubes, the electron gun is aimed at an angle, rather than straight towards the center of the screen, so that gas ions (in the cathode beam) which may be produced are sent to one side and do not strike the screen (where they could cause a damaging "burn"). Where this technique is used to "trap" ions, a separate *ion trap* magnet restores the lighter electron beam to its straight-line path before deflection.

Some CRT's combine the basic operating features of both electrostatic and electromagnetic types. Electrostatic focusing may be employed, for example, by using a suitable electron gun, with electromagnetic means used for deflecting the beam.

Cathode-ray tubes designed for color television receivers are basically similar to the tubes described above, except that several electron guns are employed and a special screen is used which fluoresces in the three primary colors: blue, green, and red. The screen itself is made up in a repetitive triangular pattern of small phosphor dots and protected by a mask, aligned so that each of the electron guns excites only its particular phosphor (blue, green, or red).

Flying-Spot Scanner. The *flying-spot scanner* is a special type of display tube, similar to more conventional CRT's except for its phosphor. In general, it is used in conjunction with picture transparencies (such as motion picture film or slides) and a phototube to produce a sequential electrical signal (or *video* signal) which can be televised or used to reproduce the original picture.

In operation, a *raster*, or rectangular light pattern of fixed intensity, is formed on the flying-spot scanner's fluorescent screen as the spot of light produced by the electron beam "flies" across the screen. This moving spot of light is transmitted through the transparent film to the phototube, where it develops a varying electrical signal, dependent on the film emulsion density at each spot and hence on picture content. The video signal obtained from the phototube is similar to that produced by a TV camera and is used in the same way.

(To be continued)

Tunnel Diode Receiver

(Continued from page 65)

this point, the tunnel diode begins to operate in its "negative resistance" region (current flow decreases as voltage is increased). The click will occur at about 50 millivolts, and may be accompanied by oscillation.

A further increase of the voltage (to about 325 millivolts) should cause any oscillations to stop, and the station to which you are tuned should become louder. The tunnel diode is now functioning as an r.f. amplifier.

If the voltage is increased still further, oscillation may begin again; in any case, you will eventually hear a second click. This occurs at about 475 millivolts and indicates that the tunnel diode is no longer in the negative-resistance region. Do not increase the voltage past this point, or you may burn out the diode.

If you hear oscillation over the entire voltage range between the two clicks, try removing a turn from *L2*. Conversely, if you obtain little or no amplification, try adding a turn.

Once the tunnel diode is operating properly, you can complete the receiver adjustment. Tune to a weak station near the low end, or the middle, of the band and peak the slug-adjusting screws of *L1* and *L3* for maximum volume. Then tune to a weak signal near the high end of the band and peak the two adjustment trimmers located on *C1*.

Operating Procedure. With the power supply voltage adjusted as outlined in

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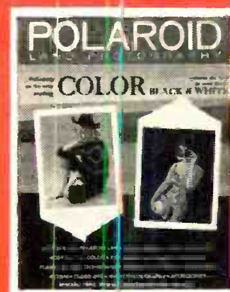

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the previous section, set selectivity control *C2* so that its plates are about half meshed and rotate tuning dial *C1*. To separate two interfering signals, slowly reduce the capacity of *C2* as much as is necessary. Since *C1* and *C2* will interact slightly, you'll have to readjust *C1* for each new setting of *C2*.

Another trick which seems to work quite well in clearing up interference is to reduce the voltage on the tunnel diode until the circuit is on the verge of oscillation. Strong stations can't be tuned in with the voltage set this way, though, because the tunnel diode will be overloaded and cause distortion.

As a matter of fact, strong signals may overload the diode even under normal operating conditions. This can usually be cleared up by detuning capacitor *C1* slightly. -30-

RC Circuit Quiz Answers

(Quiz on page 49)

1 - D A DECOUPLING NETWORK acts as a low-pass filter so that signal frequencies are bypassed to ground and not coupled to other stages via the power supply.

2 - A A TREBLE-CUT TONE CONTROL in the plate circuit of an audio amplifier acts as a low-pass filter. Decreasing the amount of resistance bypasses an increasing amount of the highs to ground.

3 - G A DIFFERENTIATOR is a high-pass filter which removes low-frequency components of a square wave. Capacitor charges very quickly and permits only short pulses of current through resistor.

4 - J The FREQUENCY CONTROL circuit for this blocking oscillator biases the transistor to cutoff until the capacitor has discharged through the resistor. The capacitor then charges up again through the transistor when it begins to conduct.

5 - F The PHASE-SHIFTING NETWORK to provide in-phase (positive) feedback for this oscillator consists of three cascaded RC circuits. The voltage across each resistor leads the signal applied to each RC section by 60 degrees.

6 - E The TIMING CONTROL for this time delay circuit is an RC circuit which controls the transistor emitter-base biasing. The relay remains energized until the capacitor is charged and opposes the forward bias provided by the battery.

7 - I An EQUALIZER for a crystal phonograph cartridge is a low-pass filter designed to compensate for the attenuation of low frequencies in disc recordings.

8 - B An INTEGRATOR is a low-pass filter which removes high frequencies from a square wave. In this long-time-constant circuit, the capacitor charges and discharges slowly through the resistor.

9 - C A BAND SUPPRESSION FILTER such as this Wien bridge contains both series and parallel RC circuits which balance with the resistive arms to null the output signal at a particular frequency.

10 - H An RC COUPLING CIRCUIT is really a form of high-pass filter; capacitor must be large enough in proportion to resistor to pass the lowest signal frequency without excessive attenuation.

Across the Ham Bands

(*Continued from page 81*)

teurs in the 160-meter band. As you probably know, U. S. hams share the 1800-2000 kc. region with the radionavigation (LORAN) service on the basis of not causing harmful interference to this service.

Under the previous regulations, most hams east of the Mississippi River could operate in the 1800-1825 kc. segment, and most hams west of the Mississippi could operate in the 1975-2000 kc. segment, with certain areas—notably the Gulf states—denied *any* 160-meter privileges. Under the new regs, some hams can use c.w. (A1) and AM phone (A3)—*and*, as of April 15, SSB—in all the 1800-1825, 1875-1900, 1900-1925, and 1975-2000 kc. segments. Hams in other areas can use either the 1800-1825 and 1875-1900 kc. segments, *or* the 1900-1925 and 1975-2000 kc. segments, depending on their location.

For full information on the frequencies available and the power limitations for 160-meter operation in your area, check with your local FCC office. Incidentally, you'll find a complete listing of the FCC offices in the recently released *1963 Communications Handbook*—along with much other valuable data.

News and Views

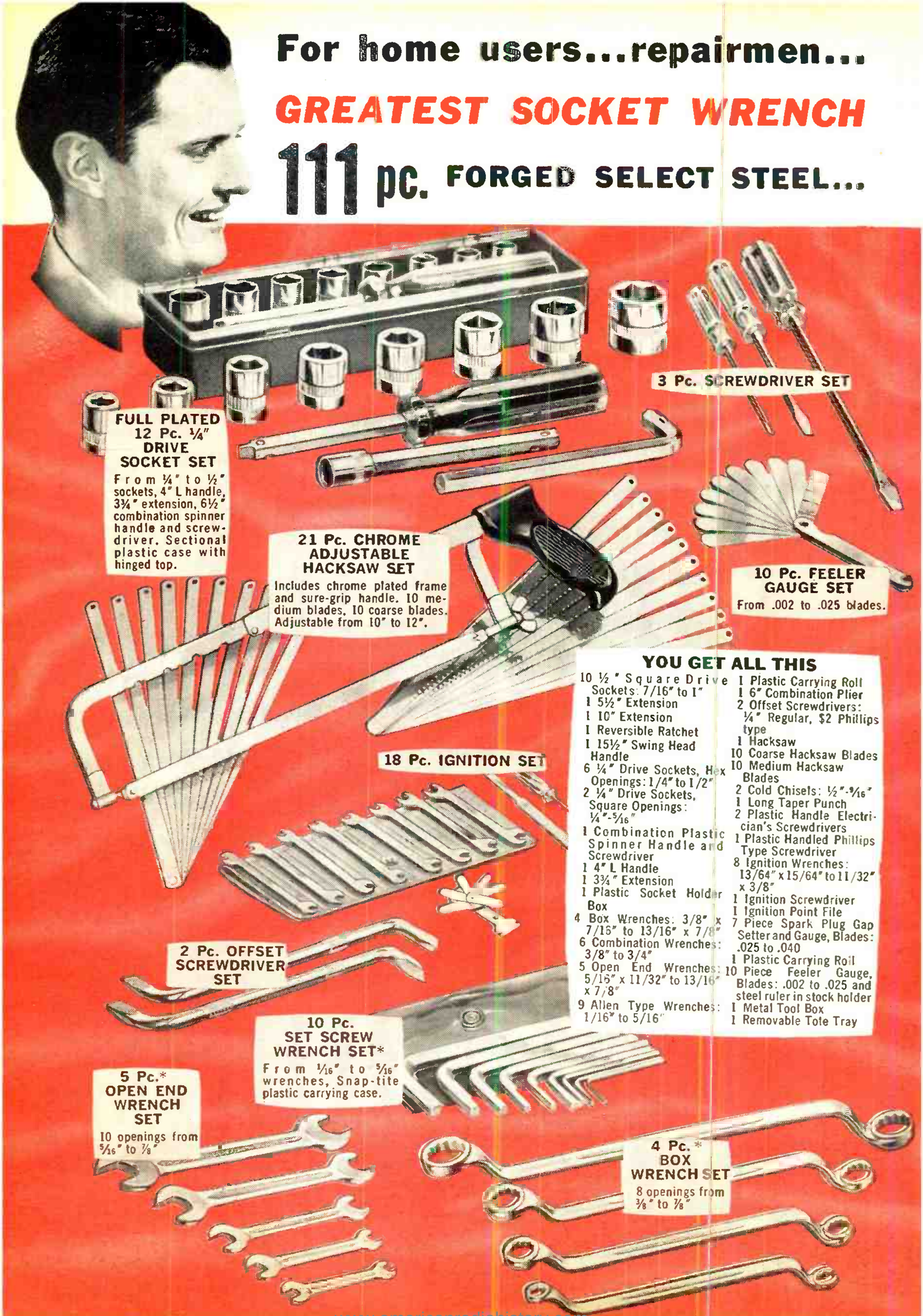
Dennis Dalpini, HS1A, JUSMAG, Bangkok, Thailand, Box 226, APO 146, San Francisco, Calif., signs WØAEU when he is home in Florissant (St. Louis), Missouri. Dennis has been on the air for less than two months in Bangkok and has already worked all continents a couple of times over. But it breaks his heart to hear U.S. stations come through with S9 signals and be unable to answer them, because of the current ban on radio communications between the U.S. and Thailand. Dennis expects to be in Bangkok for two years, however, and he hopes the ban will soon be lifted. In the meantime, I've suggested that he might send us lists of the Novices that he hears on the other side of the world. . . . **Bob Mott, WN2DDA/WB2DDA,** 25 Continental Ave., Morristown, N.J., uses a Heathkit DX-60 transmitter and a Hammarlund HQ-110 receiver in conjunction with an 80-meter "long wire" and a 40-meter dipole on 80, 40, and 15 meters. A record of 40 states and 9 countries worked is evidence that everything—including the operator—performs well. On 2 meters, Bob feeds the output of a Gonset Communicator into a home-brew 7-element rotary beam. . . . From the rare state of South Carolina, **Marion "Jack" Jackson, WN4LDM,** Route 3, Box 79A, Florence, S.C., has worked one state on 40 meters in six weeks. But on 80 meters it's a different story! There he has knocked off 23 states (15 confirmed), a couple of Canadians, Mexico, and the Panama Canal Zone. No wonder he doesn't "waste" much time on 40 meters! A Heathkit DX-35 transmitter excites Jack's multiband "trap" dipole antenna, and he receives on a Hallicrafters SX-99 helped along by a Q-multiplier for increased selectivity.

Rick Wenklar, KN3UTR/K3UTR, 1535 Emmett Drive, Johnstown, Pa., got started in ham radio as a result of the encouragement and inspiration provided by his SWL monitor registration (WPE3DQB). Now he has his eye set on a General Class ham license, a commercial ticket, and—a degree in electrical engineering. Rick's first transmitter was the "High Performance" unit described in our January, 1962, column; it worked well until it was replaced by a pair of 807's a few weeks ago. Rick prefers long rag-chews with strong stations to chasing DX, so his states-worked total is only 10. . . . **Jed Power, KN1ZCS,** 17 Hilltop Terrace, Woburn, Mass., says that his record of six states worked in a month wouldn't be much to brag about—except that his antenna is nothing more than a 10' piece of wire in his room. Jed uses a Heathkit DX-40 to alert the Novice world to his presence in it and a Hallicrafters S-120 receiver to listen to the replies. . . . **Ron Evans, WN5BQI,** 6805 Cloverdale Dr., Little Rock, Ark., has 40- and 80-meter dipole antennas and works the three low-frequency Novice bands. Eighty meters is his favorite band, however. A Heathkit HX-11 transmitter running 50 watts input and a Hammarlund HQ-145 receiver complete the major equipment. Ron has QSL cards from 33 states on his shack wall and a space reserved for the still-to-arrive 34th one.

Keith Moe, KN7VRS, 2038 West Monte Vista, Phoenix 9, Ariz., admits that he hasn't been setting the bands on fire, but he's in there pitching—mostly between 2200 and 2400, EST, on weekends. Keep an ear open for KN7VRS's Heathkit DX-60 if you need an Arizona contact; he'll be listening for you on a Heathkit GR-91 receiver. . . . **Dan Eskelson, WV6YAT,** 1439 Descamso, La Canada, Calif., proves that his Hallicrafters HT-40 transmitter, Hammarlund HQ-100A receiver, and Hy-Gain 14-AVS vertical antenna are all working well by his display of QSL cards. He has 45 states worked—42 confirmed—and seven different countries confirmed. Dan rates VR3A, Christmas Island, as his rarest and most enjoyable DX contact; he has also worked Okinawa, New Zealand, and Japan several times.

Have a good time on "Field Day," and be sure to send us your "News and Views," pictures, and suggestions. The address is: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P.O. Box 678, Gary, Indiana. 73,

—Herb, W9EGQ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1 Plastic Socket Holder Box
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6 Combination Wrenches: 3/8" to 3/4"
5 Open End Wrenches: 5/16" x 11/32" to 13/16" x 7/8"
9 Allen Type Wrenches: 1/16" to 5/16"
1 Plastic Carrying Roll
1 6" Combination Plier
2 Offset Screwdrivers: ¼" Regular, $2 Phillips type
1 Hacksaw
10 Coarse Hacksaw Blades
10 Medium Hacksaw Blades
2 Cold Chisels: ½"-9/16"
1 Long Taper Punch
2 Plastic Handle Electrician's Screwdrivers
1 Plastic Handled Phillips Type Screwdriver
8 Ignition Wrenches: 13/64" x 15/64" to 11/32" x 3/8"
1 Ignition Screwdriver
1 Ignition Point File
7 Piece Spark Plug Gap Setter and Gauge, Blades: .025 to .040
1 Plastic Carrying Roll
10 Piece Feeler Gauge, Blades: .002 to .025 and steel ruler in stock holder
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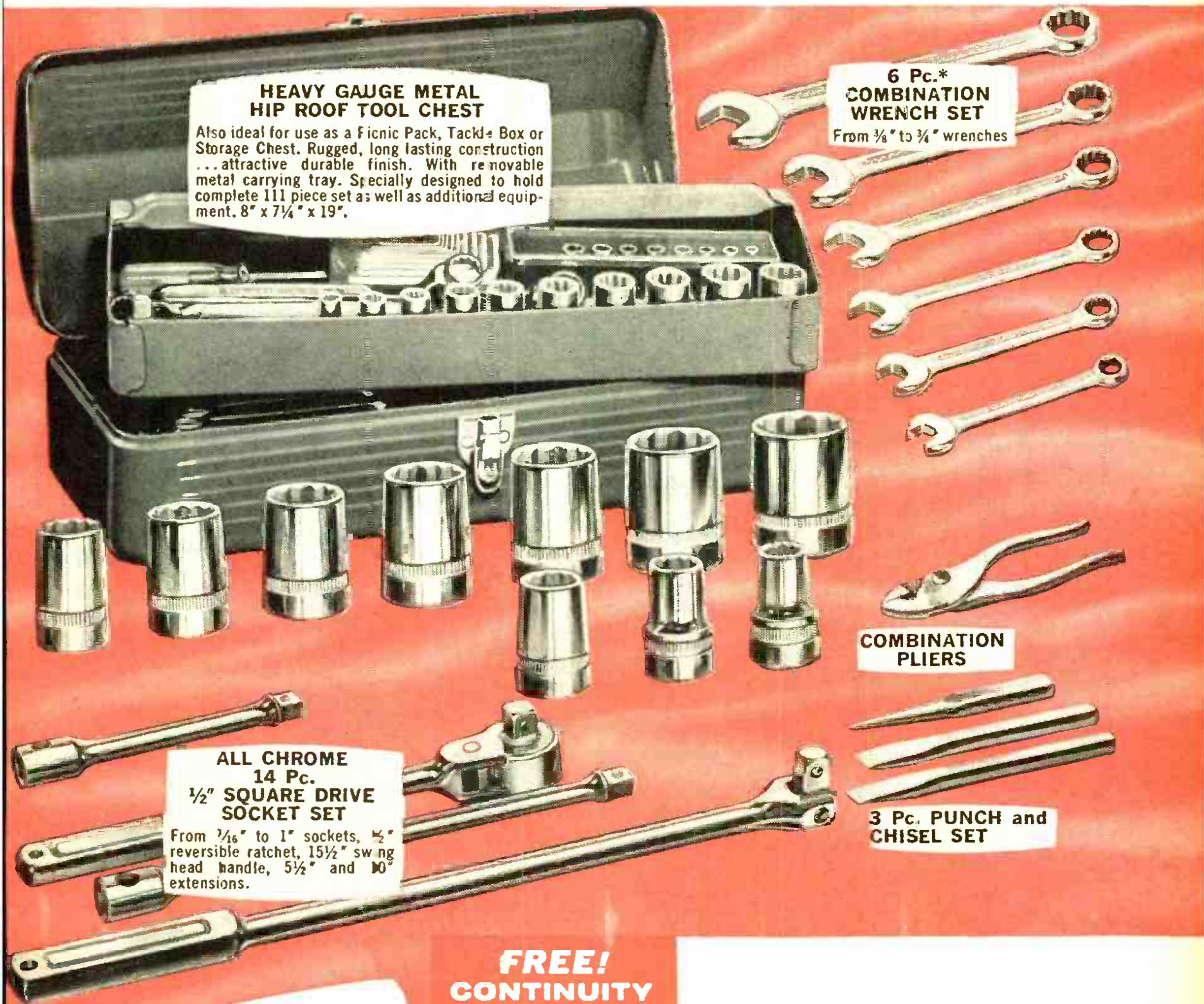

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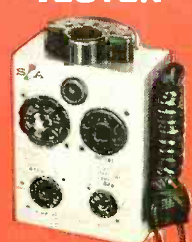

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Converting "Command" Receiver

(*Continued from page* 48)

Front Panel Modifications. At the front of the chassis, remove the small aluminum box held under the tuning dial by four screws. This space will be used for *RX-S1* and *S2*. You can make a small panel from sheet aluminum, or cut the box from the original panel and use it; in either case, mount the new 100,000-ohm gain control and switch (*RX-S1*) and the s.p.s.t. BFO toggle switch, *S2*.

Temporarily remove the plug-in coil bracket at the front of the receiver by taking out the two screws, one at each side, that hold it in place (see the top photograph, page 48). This will give you more room in which to work. With the small front panel installed, route the green "Gain Control" wire from the back socket to the arm (center lug) of *RX*. Ground one end of *RX* as shown in the schematic (see page 47). Twist two wires together for about 12", connect them to *S1* and route them along the left side of the chassis, between the mounting lugs of the three remaining can capacitors, to the power supply.

One side of *S2* is connected to one of the red wires originally soldered to pin 4 on the back plug. One of these red wires, which originally went to the front box under the tuning dial, can be used for this purpose, or a new lead can be installed. The other side of *S2* is grounded—the BFO is always in operation unless it is grounded out.

Final Wiring. Connect the leads from *S1* so that they break one side of the primary of *T1*; drill or ream out a hole at the back of the chassis, line it with a grommet, and install the line cord. Complete the power supply wiring as indicated in the schematic, including the wiring to *V1*, *C1a-C1b*, and choke *L1*. Now bolt *L1* in position, and mount the new audio output transformer, *T2*.

Note that the output end of *L1* is connected to *R22*; this is the large black vertical resistor nearest *L1*. The connection is made to the end of *R22* closest to the chassis. The yellow screen voltage lead (as well as *C1b*) is connected to the *junction* between *R22* and *R23* (see top left photo on page 46). It should also be noted that *R24*, shown in the schematic on page 47, is not included in many units. If such is the case, *R23* is simply grounded.

Connect the plate lead of the audio output transformer (*T2*) to the plate of the 12A6 tube. The brown mica capacitor connected to the plate lead was connected across the primary of the original audio output transformer to cut out some of the high-frequency impulse noise, and it may either be kept or discarded. In any case, try substituting a .001 to .005 μf. disc capacitor if you have a noise problem. Connect the B-plus lead of *T2* to the B-plus.

You will find it convenient to mount a two-pole terminal strip (*J1*) at the rear of the receiver. Solder the voice coil leads from *T2* to the two terminal strip lugs; connect a 3.2-ohm speaker to the screw terminals.

Double-check your wiring before plugging in the a.c. cord and turning on switch *S1* (always connect a speaker first). When you're satisfied that everything is right, connect an antenna, and you're ready to go. —30—

Short-Wave Report

(*Continued from page* 72)

one for Monrovia, Liberia, and one for a continental United States station. The postmark is the same on both. Will these count as two countries verified?

A: Yes, for you have logged and verified both the U. S. and Liberia, regardless of the postmark. The *VOA* nearly always verifies from one central point for all of their transmitters, regardless of location.

To sum up briefly: We do have definite rules and regulations for the DX Awards (see page 70). These are necessary, of course, for proper functioning of the entire program. The rules, however, are not so hard and fast that they are inflexible. Only in rare instances, so far as the applications received to date are concerned, has it been deemed necessary to contact the applicant for further proof of one or more of his listings.

Send in your application when you are sure that you have met all of the requirements to the best of your ability, and let the Awards Committee do the evaluating.

Current Station Reports

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. Reports should be sent 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 Monitor Registration and the make and model number of your receiver. We regret that we are unable to use all of the reports received each month, due to space limitations, but we are grateful to everyone who contributes to this column.

Afghanistan—The current complete schedule from Kabul includes Eng. at 0530-0600 to the Far East on 9650 kc., and to S.E. Asia and Indonesia at 0600-0630 on 9595 kc. The Eng. Third Program is broadcast at 0900-0930 on 4775 kc. Other xmsns: Urdu at 0830-0900 and Russian at 1230-1300, both on 4775 kc.; Arabic at 1300-1330 on 9600 kc.; German at 1330-1400 and French at 1400-1430, both on 9635 kc. and both beamed to Europe.

China—The latest Eng. schedule reads: to United Kingdom and Western Europe at 1400-1500 and 1530-1630 on 5880, 6210, 7080, 7115, and 9457 kc.; to Eastern N.A. at 2000-2100 and 2100-2200 on 7480, 9480, 9945, 11,780, 11,945, and 11,975 kc.; to Western N.A. at 2200-2300 and 2300-0000 on 7080, 9457, 11,715, 11,820, 15,060, and 17,745 kc.; to Australia and New Zealand at 0330-0430 and 0430-0530 on 11,650, 12,055, 15,060, and 17,835 kc.; to S. E. Asia at 0700-0800 on 7480, 9480, 11,800, and 15,060 kc., and on medium-wave 1190 kc.; to Ceylon, India, Nepal, and Pakistan at 0900-1000 and 1000-1100 on 7060, 7350, 9480, 9660, 11,685, and 11,740 kc.; to Africa at 1100-1200 and 1200-1300 on 6125, 7350, 9595, 9775, 12,055, and 15,095 kc., at 1300-1400 on 6125, 7180, 7350, 9595, 9785, and 12,055 kc., and at 1630-1730 on 5950, 6080, 7270, 7480, 9510, and 9570 kc. There are "Letter Boxes" on Tuesdays and Sundays and Chinese lessons on Saturdays and Wednesdays.

A weak signal on 2476 kc., noted in Chinese around 0900, is believed to be from Hangchow.

Cook Islands—According to *R. Australia*, *R. Rarotonga* operates on 5450 kc. (*ZK5OK*), 9695 kc. (*ZK3OK*), and 11,760 kc. (*ZK4OK*), with Eng. at 1745-1815 on Mondays, Tuesdays, Thursdays, and Fridays. English is also broadcast on Tuesdays at 2330-0230, Thursdays at 2330-0315, and Saturdays at 2330-0250 on 5450 kc.

Costa Rica—A seldom-logged station is TIGPH, *R. Monumental,* San Jose, 6215 kc. It has been noted at 1900-1930, all-Spanish, with Latin American dance music, ads, and anmts. This one MAY be operating irregularly.

TIFC, San Jose, has changed the time of the 2300-0000 Eng. religious program to 2200-2300, still on 9645 and 6037 kc. Another Eng. program continues to be aired on Sundays at 1500-1600.

Ecuador—A rough station to log is HCVC3, *R. Cintenela Del Sur*, 6250 kc. Look for it around 1910-1937 with music and, presumably, Spanish language. It is located in Loja.

England—In the Dec., 1962, issue your Short-Wave Editor suggested that monitors might watch around 2880 kc. for possible activity from London, since this frequency was in use to N.A. several years ago during another low sunspot period. However, a recent letter from the BBC stated: "We have no intention of mounting a further transmission on this waveband" (75 to 100 meters). That ends that!

Germany (East)—Two new channels for *Radio Berlin International* are 15,280 kc., noted at 1000 with ID in Eng., and 6080 kc., heard around 1415.

Germany (West)—The following broadcasts represent frequency changes for Eng. programs: to Western N.A. at 0000-0040 on 6145 and 9735 kc. (replacing 6110 kc.) and at 1530-1610 on 9735 and 11,795 kc. (replacing 5980 kc.); to Eastern N.A. at 1920-2000 on 6145 and 9605 kc.; to Australia and Far East areas at 1620-1700 on 7205 kc. (replacing 7235 kc.), 9735 and 11,795 kc. (replacing 6015 kc.) and at 0350-0430 on 15,275 kc. (replacing 15,410 kc.), 17,845 and 21,705 kc.; to S. Asia at 1045-1115 on 15,275 and 17,815 kc. (replacing 9545 and 11,905 kc.); to Africa at 0100-0130, 0130-0140 (Swahili), 0140-0220 (French) and 1235-1315 (Eng.) on 15,275 and 17,845 kc.

Ghana—Eng. releases from Accra now read: to W. Africa on 6070 kc. at 0945-1045 and 1200-1245, and on 9545 kc. at 1630-1715; to Sudan and Ethiopia on 11,800 kc. at 1330-1415, and on 15,190 kc. at 0900-0945; to Europe on 11,800 kc. at 1550-1635; to S. Africa on 15,287 kc. at 1500-1545; to E. Africa on 17,910 kc. at 0945-1030; to the Congo and Central Africa on 17,910 kc. at 1130-1215; and to S., S.W., and S.E. Africa on 21,545 kc. at 0945-1030. While not listed in the station schedule, Eng. has also been noted on 4915 kc. at 1300-1345 and 1630-1700.

Greenland—*Grønlands Radio* has informed the International Shortwave League that transmissions will commence from a shortwave xmtr on Kook Island sometime in 1964.

Guatemala—TGQB, 11,700 kc., Guatemala City, is reported (by the station) to have a "Buzon International" DX program in Eng. on Saturdays at 2300. The station signs off before this time, however. Has anyone ever heard the program?

India—*All India Radio,* Delhi, has the following Eng. schedule at present: 1930-1940 to Burma and Malaya on 7225, 9765, and 11,895 kc.; 2330-2340 to E. Africa on 15,130 and 17,855 kc.; 0500-0600 to Australia and New Zealand on 11,710 and 15,160 kc. and to N.E. Asia and China on 11,730, 15,105, and 17,855 kc.; 0830-1000 to S.E. Asia on 11,810 and 15,225 kc.; and at 1445-1545 to United Kingdom and W. Europe on 7235, 9520, and

9870 kc., and to W. Africa on 9690 and 11,785 kc. The station has also been heard on 5975 kc. at 1030 with an Eng. newscast.

Indonesia—YDF, Djakarta, has moved from 6045 to 6103 kc. and was noted around 0730 with news in Indonesian.

Japan—Here is the latest schedule from Tokyo: to N.A. at 1830-1930 on 11,780, 15,135, and 15,285 kc.; to N.A. and Latin America at 2100-2300 on 11,705, 15,135, and 15,235 kc.; to Hawaii at 0030-0200 on 15,235 and 17,725 kc.; to Europe at 0115-0345 on 11,705, 15,135, and 15,425 kc.; to Australia and New Zealand at 0430-0530 on 11,875 and 15,235 kc.; to the Philippines and Indonesian areas at 0730-0830 on 11,780 and 15,135 kc.; to S.E. Asia at 0800-1100 on 9675 and 11,705 kc.; to S. Asia at 1000-1130 on 9525 and 11,780 kc.; to Mid-East and N. Africa at 1145-1345 on 9525, 11,780, and 11,875 kc.; and to Africa at 1400-1500 on 9525 and 11,875 kc. English is broadcast during each segment. The General Service, each xmsn lasting 30 minutes, is given at 1900, 2000, 2100, 2200, 2300, and 0000 on 15,105, 15,195, and 15,310 kc.; at 0100, 0200, 0300, 0400, 0500, and 0600 on 9505, 15,195, and 15,310 kc.; at 0700, 0800, and 0900 on 9505, 11,815, and 15,310 kc.; and at 1000, 1100, 1200, 1300, and 1400 on 9740, 11,725, and 11,815 kc.

Lebanon—Beirut's Eng. xmsn is heard well on 11,890 kc. at 1630-1645, after which Arabic is used.

Malaya—The BBC Far Eastern Station at Tebrau is observing this schedule: 7110 kc. at 0410-0615; 7135 kc. at 1100-1150 (to 1220 on Saturdays); 9555 kc. at 0630-0700; 9690 kc. at 0945-1150 (to 1220 on Saturdays); 9725 kc. at 0410-0615 and 0845-1150 (to 1220 on Saturdays); 11,750 kc. at 0410-0630, 0800-0815, and 0915-1150 (to 1220 on Saturdays); 11,955 kc. at 0410-0745 and 0800-1150 (to 1220 on Saturdays); 15,260 kc. at 0410-0745 and 0800-1150 (to 1220 on Saturdays); 15,310 kc. at 0800-0845; 15,435 kc. at 0630-0815 and 0845-0915; 17,755 kc. at 0800-1045; 17,880 kc. at 0410-0630 and 0700-0745; and 21,610 kc. at 0700-0745.

Netherlands—The latest *R. Nederland* Eng. schedule reads: Monday through Saturday to New Zealand and Australia at 0200-0250 on 17,775, 9715, and 9630 kc., to S. Asia at 0900-0950 on 17,810 and 15,445 kc., to Europe and N.A. at 1625-1720 on 11,710 and 9715 kc. (and on 6020 kc. to Europe), to N.A. at 2030-2120 on 9630 and 6035 kc.; Tuesdays and Fridays only to S. Africa at 1000-1015 on 21,480 and 17,810 kc., and to N.A. at 1030-1045 and 1415-1430 on 17,810 and 15,445 kc.; to Africa and Europe at 1430-1520 (Monday through Saturday) on 15,425 and 6020 kc. (the latter to Europe only), and at 1430-1520 Mondays, Wednesdays, Thursdays, and Saturdays only on 11,780 kc.

Pakistan—Karachi has been noted on 17,895 kc. at 0835 with dictation news, and on 5035 kc. at 0600-0800 with the Home Service.

Panama—HOH31, *Circuito RPC*, Panama City, is heard on 9685 kc. from 2314 to 0000 with light music, Spanish anmts, and an anthem at 0000 s/off.

Portugal—The 0815-0900 Eng. xmsn from Lisbon is now aired on 15,125 kc., having replaced 17,895 kc.

Rhodesia and Nyasaland—Federal B/C Corp.

SHORT-WAVE ABBREVIATIONS

anmt—Announcement	N.A.—North America
BBC—British Broadcasting Corporation	QRM—Station interference
B/C—Broadcasting	R.—Radio
Eng.—English	s/off—Sign-off
ID—Identification	VOA—Voice of America
kc.—Kilocycles	xmsn—Transmission
	xmtr—Transmitter

of Rhodesia is noted on 4911 kc. on Sundays from 2300 with news and weather followed by request music, time checks, and commercials. Reports should go to either of two places: Northern House, Baker Avenue, Salisbury, Southern Rhodesia *or* P. O. Box 2696, Salisbury. Do not combine them. The second is preferred.

Sarawak—Kuching is noted on 4950 kc. from 0823 to 0930 s/off with Eng. talks and orchestral music.

Senegal—Dakar has moved down to 4890 kc. and was noted around 0215. Ziguinchor, 3336 kc., was heard at 0200 with talks in French but with heavy QRM from fixed station WRW70.

South Africa—Try for *Springbok Radio* on 6150 kc. at 2330 with Eng. news, commercials, and request music. Other Paradys outlets were noted on 7190 kc. at 2315-0000 with same type program, and on 7275 kc.

South Korea—The General Service in Eng. is aired at 2230-2300 and 0530-0600 on 9640 kc., and at 0030-0100 and 0230-0300 on 11,925 kc. (a move from 15,125 kc.). Another outlet, on 2510 kc., was heard on the West Coast at 0900-1000 with piano music and a talk in Korean.

Spanish Guinea—*R. Ecuatorial Bata,* Bata, 4925 kc., has been tuned at 1645 with piano music, an ID at 1648, and more music on records.

Tunisia—An unidentified Arabic station on 6115 kc. is likely the Arabic Network of *R. Tunis*, scheduled for 6110 kc. at 2328-1825. This one is unstable and may run to as high as 6117 kc.

Turkey—Ankara can be noted on 7285 kc. daily broadcasting in Eng. at 1600-1700 to Western Europe and England.

Uganda—*R. Uganda,* Kampala, 5026 kc., now runs to 1600 on Saturdays. An Eng. newscast is given at 1550.

Upper Volta—Ouagadougou, 6043 kc., was tuned at 1802 with final ID in French, then an anthem. It has been heard from 1620 with instrumental music.

U.S.A.—While the complete schedule of the *VOA* Greenville station is too lengthy to list here, these frequencies have been in use: 17,830, 17,730, 15,400, 15,390, 15,290, 15,270, 15,235, 12,215, 15,160, 11,970, 11,940, 11,875, 11,810, 11,800, 11,760, 11,705, 9770, 9755, 9740, 9700, 9635, 9540, 9520, 6160, 6075, and 5975 kc.

A station that terms itself "the most unusual radio station in the world" is KLOK, San Jose, Calif., 1170 kc. Programs are presented in 15 different languages, including Chinese at 2330.

Vatican City—*Vatican Radio's* Eng. schedule now reads: to N.A. at 1950 on 7250 and 9645 kc.; to Asia at 1100 Mondays, Wednesdays, and Saturdays on 11,880 and 15,120 kc., and at 1730, Mondays, Wednesdays, and

Fridays on 11,880 and 9540 kc.; to Australia daily at 0630 on 15,120 and 17,780 kc., and at 1700 on 11,880 and 9540 kc.; to Africa weekdays at 0520 on 17,840 and 21,490 kc.; and to Europe daily at 1000 on 9645, 11,880, and 15,120 kc. and at 1315 on 6190, 7250, and 9645 kc.

Vietnam—Saigon is noted on 4877 kc. at 1045 with "westernized" music, and at 1740 with songs.

Windward Islands—Those who want to try for St. Georges, Grenada, the hard way should look for the 500-watt outlet on 540 kc., or the 25-watt stations on 1530, 1570, and 1580 kc. They are all on the medium waves, and all are 24-hour stations. —30—

SHORT-WAVE CONTRIBUTORS

Anson Boice (*WPE1BD*), New Britain, Conn.
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Taddy Witowski (*WPE1EDI*), Ludlow, Mass.
Thomas Walsh (*WPE1EGZ*), Quincy, Mass.
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TO VOLUME 18

Jan.-June, 1963

AMATEUR RADIO AND SWL

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—30—

Top Band Goes Mobile

(*Continued from page* 58)

or center-loading a whip antenna (most whips are about 8′ long). For those who want to "roll their own," a coil form 3″ in diameter by 1′ long and a pound of #18 enameled wire will do the trick; the wire should be close-wound on the form.

As with all mobile antennas, adjustment for best results will be necessary. If at all possible, use a grid-dip meter. Adjust it to the frequency on which the transmitter will be operated, and couple it to a two-turn link coil connected between the base of the antenna and ground (the bumper or frame of the car).

As a shorting bar for adjusting the inductance of the loading coil, use a length of hookup wire connected to the lower part of the antenna where it's attached to the coil. Clip the other end of the wire from one turn on the coil to another until a dip is noted on the meter, indicating that the antenna is tuned for operation. The dip will be very sharp, and further adjustments will be needed if you change frequency appreciably.

Converting Auto BC Receivers. If the receiver to be converted uses *inductive* tuning, locate the oscillator trimmer capacitor. Normally, it will have a fixed capacitor of about 300 $\mu\mu$f. in parallel with it; this should be removed and a 250-$\mu\mu$f. capacitor substituted.

The next step is to tune in a broadcast station near the high end of the band, and adjust the oscillator trimmer capacitor and/or the oscillator coil slug until the same signal appears about 250 to 400 kc. lower on the dial (depending on how much of 160 meters you want to cover). A grid-dip oscillator or r.f. signal generator, if available, can be tuned to the frequency on which you intend to operate, and used for this step.

Finally, the r.f. trimmers should be adjusted for maximum gain and the dial reading noted for future reference. If the receiver has push-button tuning, one or more of the push buttons can be set up for frequencies within the band.

Capacitive-Tuned Receivers. If the receiver uses *variable* capacitors for tuning, it can be modified by merely insert-ing a 100-$\mu\mu$f. capacitor in series with each of the leads to the variables. This, however, will greatly cut the coverage of the BC band with the low frequency end of the dial representing about 1100 kc.

In all cases, remember to re-peak the antenna trimmer capacitor. This should be done while listening to a weak signal at about 1800 kc. —30—

Hi-Fi Shutoff

(*Continued from page* 51)

on which to mount the relays. Drill or punch a ⅜″ round hole for the 9-pin miniature tube socket, and drill mounting and positioning holes for the socket and *K1* and *K2*. Finally, drill holes for bolts to mount the chassis inside the 3″ x 4″ x 5″ Minibox used as a housing.

On the top of the main part of the Minibox, drill a hole for *S1*, and for *I1* if you're going to include it. In one end, drill two ⅜″ holes and line them with rubber grommets; the a.c. power cord and the cord to the phono motor will pass through them. The hole for the a.c. receptacle can be made with a thin-bladed coping saw (drill a ⅛″ hole to start it), or it can be drilled out by making a number of small holes. On the opposite end of the Minibox, drill holes to mount the chassis; these holes should line up with the mounting holes in the chassis.

When the wiring is completed, connect a length of a.c. cord to the coil of relay *K1* and draw it out of the Shutoff through one of the rubber grommets. Connect the other end of the cord to the *motor terminals* of your record changer or turntable. Then connect the power cord from your amplifier to *SO1*, and the power cord from the Shutoff to the a.c. line.

Now, when your changer or turntable is turned on, the amplifier (which is left in the "on" position) will go on also. If you need additional warm-up time (or if you're using an FM tuner as a program source), switch *S1* to manual. Always return *S1* to automatic (which will turn off your system) so that *K2*'s coil is not continuously energized. —30—

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June 1963

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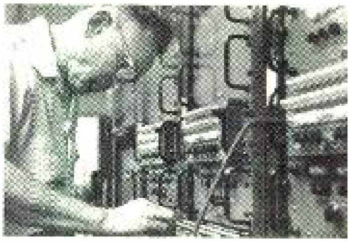

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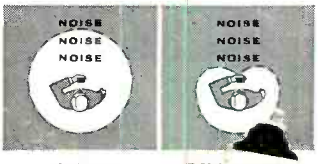

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