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POPULAR ELECTRONICS

NOVEMBER 1962

35 CENTS

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- Build Non-Resonant Enclosure
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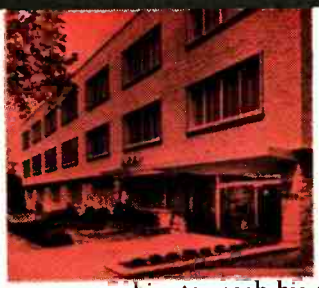

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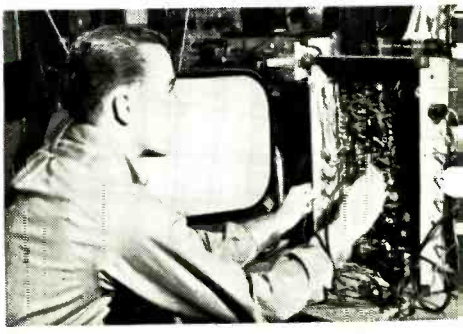

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VOLUME 17 NOVEMBER 1962 NUMBER 5

Special Features

Electronic Construction Projects

Audio and High Fidelity

Amateur, CB, and SWL

Electronic Features and New Developments

Departments

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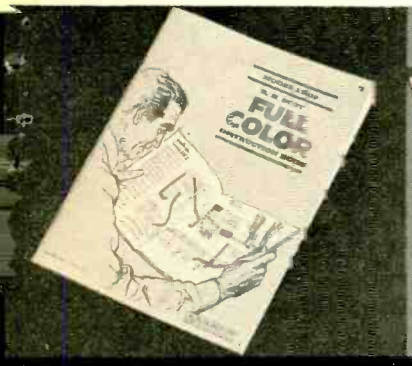
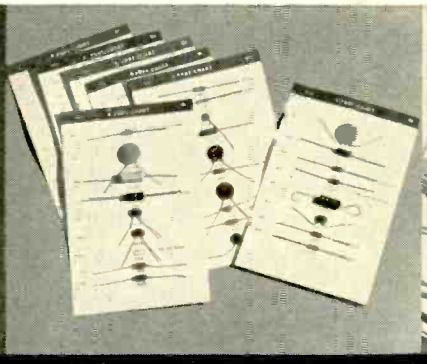


The exclusive Scott full color instruction book shows every part and every wire in natural color and in proper position. To make the instruction book even clearer, each of the full color illustrations shows only a few assembly steps. There are no oversized sheets to confuse you.



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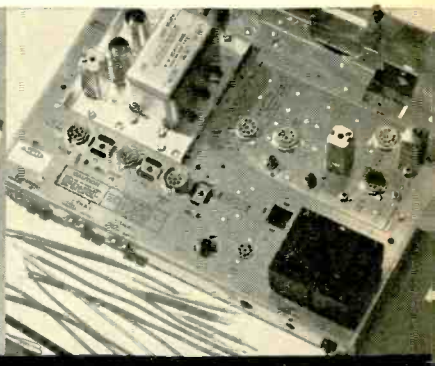

Much of the uninteresting mechanical assembly is completed when you open your Scott Kit-Pak. All the terminal strips and tube sockets are already permanently riveted to the chassis. To insure accuracy all wires are pre-cut and pre-stripped to proper length.

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*Audio — February 1961, Pages 54-56

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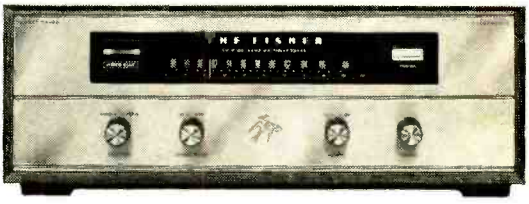

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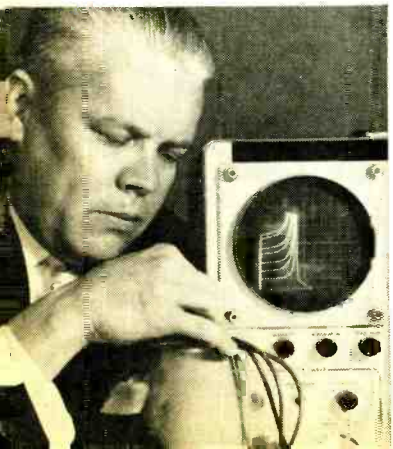
POP'tronics

NEWS SCOPE

"PRESSING" BUSINESS—The right way is the "light" way in the Paris Metro (subway system), where automation has taken over the job of dispensing travel information. A stranger in town soon discovers how easy it is to get places on the French capital's subway even if he can't speak French. He just presses the button alongside the name of the subway station that is his destination, and the entire route lights up on an electronic city map in front of him. The panel even tells the visitor where to change to another line when necessary.

QUICK KICK—What looks like a boot passing through a layer of bubble gum is actually General Electric's way of demonstrating its new tough plastic shield for TV picture tubes. The "LAMILITE" sheet shown stretched across a wooden frame is a baby brother to the two-layer laminated film designed to be bonded directly to a tube's face. The tough, transparent plastic shield will replace the much heavier and thicker plate glass or plastics now being used. Since it adds only .035" to a tube's overall depth compared to the 3/8" to 1" taken up by previous shielding methods, the new safety shield will make current slim-line TV models even slimmer.

BUILDING A BETTER "MOUSE TRAP" is half the job; doing it faster and with less rejects is the other half. In the Sperry Gyroscope plant in Great Neck, N. Y., assembly time on certain critical defense products has been cut considerably by the use of audio-visual equipment. The assembler hears instructions from a tape recorder via a headset, while observing what has to be done on a slide projector. Time-sequenced, the slides change in step with the instructions. As the assembler does the job, light classical music is played which sinks into the background as soon as the next instruction is due. Production savings during the first seven months of operation are expected to pay for the audio-visual system, which was purchased from Applied Communication Systems, Inc.



DEEP FREEZE—A new-type transistor, given a cold dunking in liquid nitrogen, registers its "shivers" on a curve tracer during a demonstration by Hughes Aircraft Company's Semiconductor Division, which developed the tiny device. Called "Microseal," the new semiconductor eliminates the fragile thermo-bonded leads that often are the cause of transistor failure. The Microseal has many advantages for missile and satellite applications: it can withstand the thermal shock and acceleration which occur in space projects and, due to its small size, it can be better shielded from radiation.

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FCC Report

By ROBERT E. TALL
Washington Correspondent

TWO KEY PROVISIONS in the comprehensive proposals of the FCC for overhauling the Citizens Band radio service are drawing considerable reaction from CB'ers throughout the country. They are: (1) the section establishing a definite communications "range" limit for CB stations; and (2) the plan to spilt the CB frequencies into two packages—one strictly for communications between units of a licensee, and the other for general CB contact. Because of the large number of comments on these proposals, the new rules are not expected to become effective before the first of the year, at the earliest.

Discussing the rules before the National Convention and Jamboree of the Mobile Civil Emergency Units in Syracuse, N. Y., FCC engineer Ivan Loucks noted that the proposals "are based on what the Commission's staff has been able to observe to be deficiencies in the present rules and what, in their judgment, is necessary to make the citizens service one which serves the needs of the general public."

Mr. Loucks cautioned CB'ers particularly on the illegality of using "Q-birds," "turkey calls," or "other audio tone signals for the purpose of attracting the attention of someone who might be only half listening at the time." Under the citizens rules, he said, a CB station "may use tone signals only for the purpose of establishing and maintaining voice communications between stations, which means for them an activation of selective calling devices or tone squelch circuits in the receivers which otherwise mute the receivers so that no signals are heard."

The new FCC CB rule proposals are partially responsive to a recent petition filed with the Commissioner by Houston, Texas, CB'er George L. Turk, Jr., who requested rule changes which would, "except in circumstances affecting the safety of persons or property," limit Class D stations to communications with radio units "operating under the same license or call-sign." Mr. Turk said his suggestion "would not affect the people using the Citizens Band in the

two-way stretch

This Ray-Tel TWR-2 CB transceiver reaches out — with highest talk power for clear, crisp transmission even under adverse conditions. And stretches effective reception range with a 10-tube dual conversion superheterodyne receiver that picks up very weak signals.

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RAYTHEON

FCC Report

(*Continued from page 8*)

manner in which it was intended," and "would put a stop to the use of the valuable frequencies as a testless ham band."

If you intend to submit your comments to the FCC on these proposals, remember that the agency's procedural rules call for an original and fourteen copies.

Assist From the FTC. The Commission got an unexpected "assist" from a sister regulatory agency on a problem which has been plaguing the FCC for some time. The Federal Trade Commission reported an order from one of its hearing examiners which would require a mid-Western manufacturer of radio equipment to stop misrepresenting the operational range, guarantee, and licensing requirements for its units.

The FTC examiner found that the company had "falsely advertised" its miniature and portable radio sets by stating that they had a satisfactory operational range of "up to 10 miles" without the use of additional equipment. Actually, he said, the range is "not more than two city blocks" when transmitting between automobiles.

The company had also advertised, the examiner declared, that the units "may be operated, under all conditions and circumstances, without a license" from the FCC, while, in fact, "when an extended wire antenna is used" with the unit, an FCC station license *is* necessary if the radio set is to be operated legally.

FCC Staff Changes. Ivan Loucks has been administering the Citizens Band service since its birth as part of his duties as chief of the agency's Land Transportation Division. Now, as part of a staff reorganization, he has finally been given responsibilities for CB and the amateur radio service.

Along with the change in responsibilities, which allows Mr. Loucks and his staff more time to devote strictly to CB matters, the division has moved to new offices in Washington. The CB-amateur administration staff, along with several other divisions of the Commission, is now located at 1101 Pennsylvania Avenue.

"Shared-Channel" Plan Postponed. Strong differences between industrial and public safety radio user organizations on FCC proposals to service-allocate mobile radio split channels in the 25-42 mc. band have shoved their final resolution into the future. These proposals would also permit CB use of the new 27.235- and 27.275-mc. channels on a shared basis with other services. -30-

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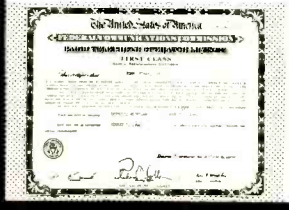

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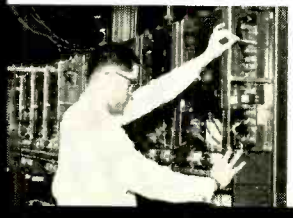

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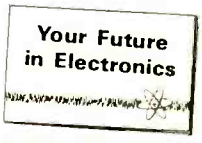

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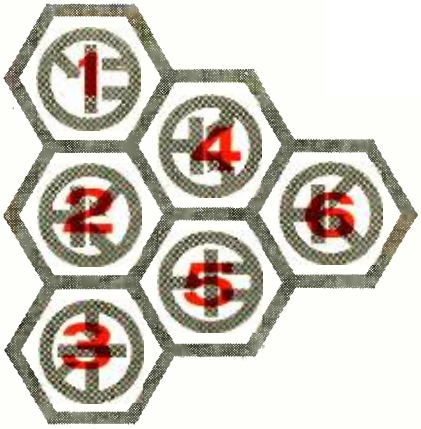

SEMICONDUCTOR SYMBOLS of odd designs have been popping up ever since the advent of the transistor about 15 years ago. On this month's cover, we show symbols of some of the many three-element semiconductor types commercially available today. If any of them are new to you, compare the numbered symbol above with the text below.

1 **Unijunction Transistor**—a comparative newcomer; an unusual switching device with negative resistance characteristics suitable for oscillators and timing circuits.

2 **NPNP Transistor**—commonly called the "hook" transistor, makes use of an extra *pn* junction in the collector to step up gain, and possesses negative input resistance useful for switching and timing circuits.

3 **Silicon Controlled Rectifier**—not an overgrown transistor but a unique semiconductor rectifier that can also be used as a latching switch and amplifier.

4 **NPN Transistor**—one of the two common types used today; arrow indicates electron current flow.

5 **Field Effect Transistor**—a new transistor type which is expected to rival multi-element vacuum tubes in a multitude of circuit applications.

6 **PNP Transistor**—other of two common transistor types, similar to *npn* type except for polarity of applied voltages. —30—

What Does F.C.C. Mean To You?

What is the F. C. C.?

F. C. C. stands for Federal Communications Commission. This is an agency of the Federal Government, created by Congress to regulate all wire and radio communication and radio and television broadcasting in the United States.

What is an F. C. C. Operator License?

The F. C. C. requires that only qualified persons be allowed to install, maintain, and operate electronic communications equipment, including radio and television broadcast transmitters. To determine who is qualified to take on such responsibility, the F. C. C. gives technical examinations. Operator licenses are awarded to those who pass these examinations. There are different types and classes of operator licenses, based on the type and difficulty of the examination passed.

What are the Different Types of Operator Licenses?

The F. C. C. grants three different types (or groups) of operator licenses—commercial radiotelePHONE, commercial radioteleGRAPH, and amateur.

COMMERCIAL RADIOTELE*PHONE* operator licenses are those required of technicians and engineers responsible for the proper operation of electronic equipment involved in the transmission of voice, music, or pictures. For example, a person who installs or maintains two-way mobile radio systems or radio and television broadcast equipment must hold a radiotelePHONE license. (A knowledge of Morse code is NOT required to obtain such a license.)

COMMERCIAL RADIOTELE*GRAPH* operator licenses are those required of the operators and maintenance men working with communications equipment which involves the use of Morse code. For example, a radio operator on board a merchant ship must hold a radioteleGRAPH license. (The ability to send and receive Morse is required to obtain such a license.)

AMATEUR operator licenses are those required of radio "hams"—people who are radio hobbyists and experimenters. (A knowledge of Morse code is necessary to be a "ham".)

What are the Different Classes of RadiotelePHONE licenses?

Each type (or group) of license is divided into different *classes*. There are *three* classes of radiotelephone licenses, as follows:

(1) Third Class Radiotelephone License. No previous license or on-the-job experience is required to qualify for the examination for this license. The examination consists of F.C.C. Elements I and II covering radio laws, F.C.C. regulations, and basic operating practices.

(2) Second Class Radiotelephone License. No on-the-job experience is required for this examination. However, the applicant must have already passed examination Elements I and II. The *second class* radiotelephone examination consists of F. C. C. Element III. It is mostly technical and covers basic radiotelephone theory (including electrical calculations), vacuum tubes, transistors, amplifiers, oscillators, power supplies, amplitude modulation, frequency modulation, measuring instruments, transmitters, receivers, antennas and transmission lines, etc.

(3) First Class Radiotelephone License. No on-the-job experience is required to qualify for this examination. However, the applicant must have already passed examination Elements I, II, and III. (If the applicant wishes, he may take all four elements at the same sitting, but this is not the general practice.) The *first class* radiotelephone examination consists of F. C. C. Element IV. It is mostly technical covering advanced radiotelephone theory and basic television theory. This examination covers generally the same subject matter as the second class examination, but the questions are more difficult and involve more mathematics.

Which License Qualifies for Which Jobs?

The THIRD CLASS radiotelephone license is of value primarily in that it qualifies you to take the second class examination. The scope of authority covered by a third class license is extremely limited.

The SECOND CLASS radiotelephone license qualifies you to install, maintain, and operate most all radiotelephone equipment except commercial broadcast station equipment.

The FIRST CLASS radiotelephone license qualifies you to install, maintain, and operate every type of radiotelephone equipment (except amateur, of course) including all radio and television stations in the United States, and in its Territories and Possessions. This is the highest class of radiotelephone license available.

How Long Does it Take to Prepare for F. C. C. Exams?

The time required to prepare for FCC examinations naturally varies with the individual, depending on his background and aptitude. Grantham training prepares the student to pass FCC exams in a minimum of time.

In the Grantham *correspondence course*, the average beginner should prepare for his *second class* radiotelephone license after from 300 to 350 hours of study. This same student should then prepare for his *first class* license in approximately 75 additional hours of study.

In the Grantham *resident course*, the time normally required to complete the course and get your license is as follows:

In the M thru F DAY course, you should get your first class radiotelephone license at the end of the 12th week of classes.

In the M-W-F EVENING course, you should get your first class radiotelephone license at the end of the 20th week of classes.

In the Tu-Th EVENING course, you should get your first class radiotelephone license at the end of the 30th week of classes.

The Grantham course is designed specifically to prepare you to pass FCC examinations. All the instruction is presented with the FCC examinations in mind. In every lesson test and pre-examination you are given constant practice in answering FCC-type questions.

Why Choose Grantham Training?

The Grantham Communications Electronics Course is planned primarily to lead to an F.C.C. license, but it does this by TEACHING electronics. This course can prepare you *quickly* to pass F. C. C. examinations because it presents the necessary principles of electronics in a simple "easy to grasp" manner. Each new idea is tied in with familiar ideas. Each new principle is presented first in simple, everyday language. Then after you understand the "what and why" of a certain principle, you are taught the technical language associated with that principle. You learn more electronics in less time, because we make the subject easy and interesting.

Is the Grantham Course a "Memory Course"?

No doubt you've heard rumors about "memory courses" or "cram courses" offering "all the exact FCC questions". Ask anyone who has an FCC license if the necessary material can be memorized. Even if you had the exact exam questions and answers, it would be much more difficult to memorize this "meaningless" material than to learn to understand the subject. Choose the school that teaches you to thoroughly understand—choose Grantham School of Electronics.

Is the Grantham Course Merely a "Coaching Service"?

Some schools and individuals offer a "coaching service" in FCC license preparation. The weakness of the "coaching service", method is that it presumes the student already has a knowledge of technical radio and approaches the subject on a "question and answer" hasis. On the other hand, the Grantham course "begins at the beginning" and progresses in logical order from one point to another. 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 you can discover daily just which points you do not understand and clear them up as you go along.

Advanced Resident Training

The Grantham F.C.C. License Course is Section I of our Electronics Series. Successful completion of this course is a prerequisite for enrollment in Section II which deals with more advanced material. However, it is not necessary for the student to take Section II unless he wishes to advance beyond the level of a first class F.C.C. License.

Accredited by the National Home Study Council

What NHSC Membership Means:

Over the years, people have come to respect membership in the National Home Study Council as a hallmark of quality. No school can be a member of the Council unless it has met the rigid standards set up by the Council's Accrediting Commission. This means that all schools, such as Grantham Schools, Inc., which display the seal of the National Home Study Council have demonstrated their integrity and adherence to high ethical standards. It means that they offer quality instruction at reasonable tuition rates. It means that these schools believe in, and are specialists in, the home study method of instruction.

For further details concerning F.C.C. licenses and our training, send for our FREE booklet, "Grantham Training". Clip the coupon below and mail it to the School nearest you.

Get your First Class Commercial F.C.C. License Quickly by training at

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Los Angeles 27, Calif.	Seattle 4, Wash.	Kansas City 9, Mo.	Washington 6, D.C.
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To: GRANTHAM SCHOOL OF ELECTRONICS

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Please send me your free booklet telling how I can get my commercial F.C.C. license quickly. I understand there is no obligation and no salesman will call. 23-S

Name _____ Age _____

Address _____

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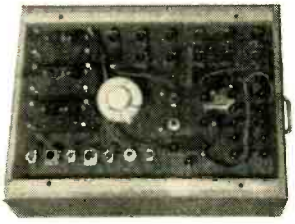
I am interested in: ☐ Home Study, ☐ Resident Classes

LETTER TRAY

Address correspondence for this department to: Letters Editor, POPULAR ELECTRONICS, One Park Avenue, New York 16, N. Y.

Prize-Winning Digital Computer



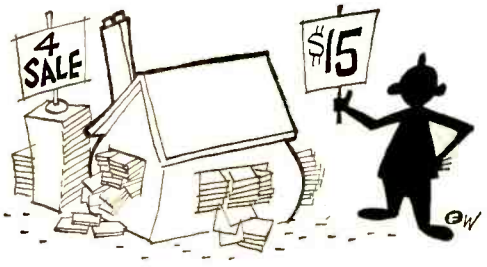
■ Being very much interested in computers, I built a digital model (photo enclosed) for the local science fair. It's design was based on your "Flip-Flop" articles in the March and April, 1961, issues. The exhibit won the grand prize! Thanks a lot for your help.

DENNIS RUSSELL
Aberdeen, Wash.

That's certainly a competent-looking unit, Dennis. Congratulations!

Still More P.E.'s For Sale

■ Lawrence Churchill and Herman Stern (see July and October, 1962, "Letter Tray," respectively) had all P.E.'s from the first issue to the present one for sale. Well, I didn't get on the P.E. "bandwagon" right at the beginning, but if anyone



would like all the issues from October, 1955, through the present (except December, 1957), I'll let 'em go for $15.00. Space-wise, I've had it, too.

WILLIAM H. RAUCKMANN
1604 Longs Peak Ave.
Longmont, Colo.

De-Emphasize AM?

■ Robert Angus' "What's Wrong With American FM" (June, 1962, issue) answers the question very well. But there is an additional solution: more FM-only receivers *now*. Most American AM programming is either also broadcast on FM or not worth listening to. Yet there are no readily available FM-only receivers on the market, and automobile sets are almost universally AM. A stronger emphasis on FM-only by manufacturers would

(*Continued on page* 20)

RCA Training Can Be The Smartest Investment You Ever Made!

If you're considering a future in electronics, investigate the courses offered by RCA Institutes Home Study School. In the rapidly expanding world of electronics, good basic training in Electronic Theory and Practice is most important. And you can be sure of the very finest when you enroll at RCA Institutes.

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You Get Prime Quality Equipment. All kits furnished with the course are complete in every respect, and the equipment is top grade. You keep all the equipment furnished to you for actual use on the job . . . and you never have to take apart one piece to build another.

RESIDENT SCHOOLS

in Los Angeles and New York City— You can study electronics in the city of your choice.

No Previous Technical Training Required For Admission. You Are Eligible Even If You Haven't Completed High School. RCA Institutes Resident Schools in Los Angeles and New York City offer training that will prepare you to work in rewarding positions on research and production projects in fields such as automation, transistors, communications, technical writing, television, computers, and other industrial and advanced electronics applications. If you did not complete high school, RCA will prepare you for such training with courses specially designed to provide the basic math and physics required for a career in electronics.

Free Placement Service. RCA Institutes graduates are now employed in important jobs at military installations with important companies such as IBM, Bell Telephone Labs, General Electric, RCA, and in radio and TV stations all over the country. Many other graduates have opened their own businesses. A recent New York Resident School class had 93% of the graduates who used the FREE Placement Service accepted by important electronics companies . . . and had their jobs waiting for them on the day they graduated!

Coeducational Day and Evening Courses. Day and Evening Courses are available at Resident Schools in New York City and Los Angeles. You can prepare for a career in electronics while continuing your normal full-time or part-time employment. Regular classes start four times each year.

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3 NEW LOCATIONS

In addition to RCA Institutes Inc. courses, Radio Corporation of America offers a limited selection of basic Resident School Courses in Electronics at three new locations . . . Chicago, Philadelphia, and Cherry Hill, N. J., (near Camden). For complete information, write the city of your preference next to your name on the attached postcard.

RCA INSTITUTES, INC. DEPT. PE-N2 A SERVICE OF RADIO CORPORATION OF AMERICA, 350 WEST 4TH ST., NEW YORK 14, N. Y.
PACIFIC ELECTRIC BLDG., 610 S. MAIN ST., LOS ANGELES 14, CALIF.

The Most Trusted Name in Electronics

Letter Tray

(*Continued from page* 14)

build up FM as a primary broadcast medium, and people would soon see that AM was quickly becoming something they could do without. Then, perhaps, we'd get some dynamic FM programming —reviving radio as a major home entertainment medium.

HOWARD M. LAWRENCE
Yonkers, N.Y.

We don't entirely agree, Mr. Lawrence. It's very likely that, if FM gained listeners at the expense of AM, the quality of FM programming would worsen rather than improve (more people to please—hence a lower "lowest common denominator"). And junk is junk, whether the carrier is frequency- or amplitude-modulated.

CB Hams?

■ Just recently I decided to "give a listen" on the CB channels to see what was happening there. I was amazed at the disregard for the FCC regulations that I found. I heard stations working DX, casual conversations, traffic handling, and one station was even calling CQ. Instead of violating the law, why don't these would-be hams study for their licenses and operate legally?

SID BONDURANT, WA5AIX
Forest, Miss.

We agree! Why don't they? -30-

Out of Tune

Transceiver for 6 (*August*, 1962, *page* 48). Two *S1*'s are shown in the photo. The uppermost switch should be labeled *S2*.

Hi-Fi Showcase (*September*, 1962, *page* 98). The correct prices for the Ferrodynamics color-coded "signal" reels are $1.40 for the 3" reels and $3.15 for the 7" reels.

Directory of World-Wide Newscasts (*September*, 1962, *page* 55). Due to an error at press time (over which P.E. had no control), the times from 1345 down to 1630 are in the wrong sequence. -30-

bzzzz

When a very small boy has his hair cut, the clippers make a harsh buzz—a nervous, exciting sound. Yet the same machine gives off only a dull hum when it's used on a man.

The unfortunate part is that once you've heard the dull hum, you never get to hear that exciting buzz again. No matter what. Even Audiotape can't record it.

Audiotape can (and does) take care of everything else that adds to listening enjoyment. It gives you clarity and range, freedom from noise and distortion and unequaled uniformity, reel after reel. All you have to supply is the point of view. Audiotape does the rest, and does it superbly.

Whether you're taping a barbershop quartet or a hundred-voice choir, there's an Audiotape exactly suited to your needs. From Audio Devices, for 25 years a leader in the manufacture of sound recording media—Audiodiscs*, Audiofilm* and . . .

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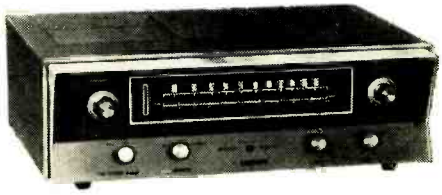
*TRADE MARK

Hi-Fi Showcase

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

JUST ABOUT every feature you could ask for is present in a new FM/FM-stereo tuner by ***Heath***, and you can put it together yourself or buy it factory-wired and tested. There's a stereo indicator that lights up when the station you have tuned in is broadcasting stereo, and a stereo phase control can be adjusted for maximum stereo



Heath AJ-12 FM tuner

separation and minimum distortion. Automatic frequency control provides drift-free reception, and tuning is as easy as 1, 2, 3 with a bar-type "eye" tuning indicator, an edge-lighted slide-rule dial, and a flywheel tuning mechanism. Taping stereo off the air is a cinch, too, thanks to a special filter that eliminates any possibility of interacting "beat notes." The kit, Model AJ-12, sells for $69.95; while the fully assembled unit (Model AJW-12) is priced at $119.95 (both prices FOB Benton Harbor, Mich.) . . . . Also available from Heath is a new FM auto radio kit which can provide you with all the advantages of FM programming wherever you motor. Supplied only in kit form, the GR-41 features separate tuner and amplifier sections for ease of construction, and broadband circuitry for true hi-fi performance. Its cool-running, 10-transistor circuit offers better than 1.25 μv. sensitivity for a 20-db signal-to-noise ratio. All critical components come aligned to exacting laboratory standards, and complete installation instructions are included for mounting the GR-41 in any auto. As for the circuit itself, it boasts an r.f. amplifier, separate mixer and oscillator stages, and a push-pull output delivering a full 10 watts to an external speaker (the one in your

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

how will your success in electronics compare with this man's?

Will you have a rewarding career, like Robert T. Blanks? or will you never get beyond a routine job? It's up to you.

LET'S LOOK AT THE FACTS. There's something wonderful about knowing how a circuit works or what a filter capacitor does. If you've ever fixed a TV set, built a radio or used a voltmeter, you've tasted the thrills of electronics.

This excitement may have led you to a job in electronics. But the glamour fades if you are stuck in the same job year after year. You'll be bored with routine and unhappy about prospects for future earnings. You'll discover, as have many men, that simply working in electronics does not assure a good future.

If electronics is the "field of opportunity," how is this possible? No question about it, electronics offers many opportunities, *but only to qualified men.* In any career field, it is how much you know that counts. This is particularly true in the fast moving field of electronics. The man without thorough technical education doesn't advance. Even men with intensive military technical training find their careers can be limited in civilian electronics.

ADVANCED TECHNICAL KNOWLEDGE IS THE KEY to success in electronics. If you have a practical knowledge of current engineering developments, if you understand "why" as well as "how," you have what employers want and pay for. With such qualifications, you can expect to move ahead.

CREI OFFERS YOU, for study at home, a complete program in electronic engineering technology designed to prepare you for a rewarding, well-paying career in electronics. CREI equips you with a practical working knowledge of advanced and up-to-date electronic developments that will put you on the level of specialization where men are most in demand.

CREI MEN LIKE ROBERT T. BLANKS hold positions as associate engineers, engineering aides, field engineers, project engineers and technical representatives.

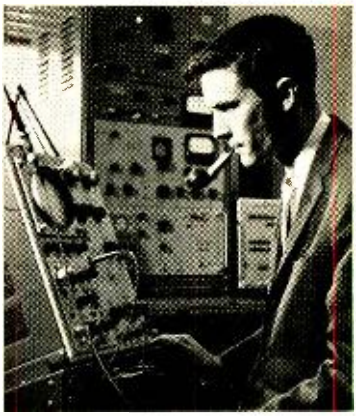
WHEN YOU ENROLL IN A CREI HOME STUDY PROGRAM, you study courses to which a number of today's leading engineers and scientists have made substantial contributions. You are guided and assisted by CREI's staff of experienced instructors. You study texts that are specifically prepared for home study use.

Through CREI, you have a choice of programs covering every field of electronics:

servomechanisms • instrumentation • radar • computers • aeronautical and navigational • communications • aero-space • television • automation and industrial engineering technology • nuclear engineering technology

Programs are available for men, such as engineers, who already have extensive technical knowledge, as well as for men with limited technical training or experience.

THE HIGH CALIBRE OF A CREI HOME STUDY EDUCATION is attested to by America's biggest corporations, where CREI students and alumni attain positions ranging from engineering technicians to engineers to top officials. Such companies are National Broadcasting Company, Pan American Airways, Federal Electric Corporation, The Martin Company, Northwest Telephone Company, Mackay Radio, Florida Power and Light and many others. They not only recognize CREI Home Study educational qualifications but often pay all or part of CREI tuition for their employees.



A CREI Home Study Program helped Robert T. Blanks become an Electronics Engineer. Blanks is employed by the Research and Study Division, Vitro Laboratories, Silver Spring, Md. Division of Vitro Corporation of America.

CREI HOME STUDY PROGRAMS are the product of 35 years of experience. Each program has been developed with the same painstaking skill and care that CREI put into its electronics courses for the Army Signal Corps, its special radio technician courses for the Navy, and its group training programs for leading aviation and electronics companies. For those who can attend classes in person, CREI maintains a Residence School in Washington, D. C.

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CHECK FIELD OF GREATEST INTEREST: ☐ Electronic Engineering Technology ☐ Nuclear Engineering Technology ☐ Servo and Computer Engineering Technology ☐ Automation and Industrial Electronic Engineering Technology ☐ Aero and Navigational Engineering Technology ☐ Communications

Name ..... Age .....

Address .....

City ..... Zone ..... State .....

Employed by .....

Type of present work .....

Education: Years High School ..... Other .....

Electronics Experience .....

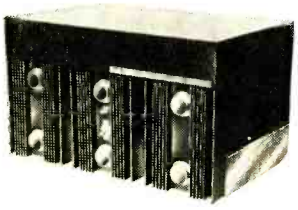
Check: ☐ Home Study ☐ Residence School ☐ G.I. Bill #22

Showcase

(*Continued from page* 22)

present AM radio, for example). Price of the GR-41, $64.95.

An all-transistor stereo power amplifier by ***Lafayette*** employs a total of 30 solid-state devices (16 transistors and 14 silicon diodes) to develop a whopping 100 watts (music power) per channel. Heart of the LA-280WX amplifier is a unique Class B bootstrap output circuit with 70 db of feedback. The unit is equipped with both high-level and low-level preamp inputs, and it can be used with either transistor or vacuum-tube preamplifiers. There are level controls for each channel as well as a power on/off switch; in addition, the LA-280WX is provided with screw-type speaker terminals, stereo headphone jacks, and four a.c. outlets. Price of the amplifier, $299.50. . . . A "handcrafted" stereo cartridge by ***Pickering,*** the Stanton 481AA "Calibration Standard" is intended for use with tone arms capable of tracking at pressures from ¼ to 3 grams—the company's Model 200, for example. Developed as a laboratory standard for the recording industry, the new cartridge brings cleaner sound reproduction with virtually undetectable wear on the record groove and stylus. Price, $49.50.



Lafayette LA-280WX amplifier

A completely portable stereo record and playback system, ***Superscope***'s 464-CS Sony contains everything you need for recording and playback of four-track stereo and mono tapes. An idler-wheel drive mechanism and a dynamically balanced capstan-flywheel assembly result in a wow and flutter content below 0.2% at 7½ ips, and push-button switches select channel 1, channel 2, or both, for either mono or stereo recording. A built-in "channel integrator" is just the thing for making sound-on-sound recordings (for language or music training, say), and there are provisions for connecting external amplifiers and speakers. Supplied complete with two Sony F-7 microphones, the 464-CS sells for $299.50.

Heath Company, Benton Harbor, Mich.
Lafayette Radio Electronics Corp., 111 Jericho Turnpike, Syosset, L.I., N.Y.
Pickering & Co., Inc., Plainview, N.Y.
Superscope, Inc., Audio Electronics Div., 8150 Vineland Ave., Sun Valley, Calif.

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Here's the 2-way Knight-Kit everyone wants! In a few fun-packed hours you'll have this 3-transistor beauty assembled and ready for reliable on-the-move communication. The C-100 is great for camping, hunting, boating, picnic outings, or just talking to friends in your neighborhood. You'll find new uses for this exciting walkie-talkie every day. Just press the push-to-talk button and you're "on the air" (built-in 2" speaker also serves as mike). Release button to listen. Fits your hand snugly—only 5 11/32 x 2⅞ x 1¾". Operates up to 75 hours on low-cost cell. With crystal for channel 7; has 40" telescoping whip antenna. Includes high-impact Caribbean blue case, all parts, wire, solder, easy instructions. Less carrying case and battery. Wt. 9 ozs. Buy two for a matched 2-way system—(or special 2-station outfit described below).

83 Y 804DE. C-100 Walkie-Talkie Kit....*Only* **$9.95**
83 Y 013. Leatherette Carrying Case.....**98c**
83 Y 002. 9-Volt Battery.....**21c**

Complete 2-Station System Outfit. Includes 2 Knight-Kit C-100 Walkie-Talkie Kits; 2 Leatherette Carrying Cases; 2 9-Volt Batteries; Wall Soldering Iron; Screwdriver; Miller Wire Stripper/Cutter—everything you need for easy assembly of a complete 2-Station System. Shpg. wt., 6 lbs.
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☐.....9 V. Battery(ies) 83 Y 002
☐ **Complete C-100 2-Station System 21 HF 708DE**
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Fascinating, Fun-Filled, Instructive

100-in-1 ELECTRONIC LAB KIT

ONLY **$29.95**

$5 per month

BUILD OVER 100 THRILLING PROJECTS

12 different AM Radios—including one operating from sunlight • Radio Broadcaster • Code Practice Oscillator • Electronic Metronome • Light Meter • Resistor & Capacity Checker • Air-Powered Earphone Amplifier • "S" Meter • Lie Detector • Audio Amplifier • Code Transmitter • Telephone-type Intercom • Electronic Timer • Conelrad Monitor • Sound-Powered Telephone • Mike Preamp • Photoelectric Relay • Electronic Scale • Fire Alarm • Burglar Alarm • Voice-Operated Relay • Electronic Switch • CW Monitor • Applause Meter • Flasher • Magic Music Oscillator • Ohm-Meter • DC Voltmeter • VTVM • Signal Generator • Electronic Cat • Code Buzzer • Signal Injector • Boat Horn—plus dozens of others!

There's nothing like it—perform over 100 electronic experiments—discover how transistors and vacuum tubes work—get endless enjoyment applying every type of modern electronic component to create exciting projects that entertain as well as instruct. Use sunlight to power a radio; make an audio amplifier for your record player; build useful testing circuits; construct an intercom; practice sending and receiving code—enjoy over 100 separate projects.

No soldering required—just use a screwdriver to set up any circuit. Once the main parts are mounted on the master control panel, just pull back unique spring-type connectors, insert leads and parts to complete each project. Special safety-design transformer reduces all voltages to a safe 25 volts. Special 156-page manual shows and explains all circuits in detail.

Includes Everything: Here's everything you need to complete any project: Solar Photocell, Meter, Relay, Speaker, Headphones, transistors and tube, antenna wire, all parts required, clearly illustrated step-by-step instruction manual. Size, 8 x 14½ x 8". For 110-125 v., 60 cycle AC. Shpg. wt. 6 lbs.

83 YX 997DE. 100-In-1 Electronic Lab Kit, only . . **$29.95**

Now! Drive As the Experts Do!

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ELECTRONIC TACHOMETER KIT

ONLY **$21.95**

only $5 monthly on Allied's Credit Fund Plan

- **Reads 0-8000 RPM, 3% Full-Scale Accuracy**
- **Zener Diode Regulation for High Stability**
- **20,000 Ohm Hi-Z Input—No High Voltage Loss**
- **Transistor Circuit**

Automotive and power-boating experts agree that for best fuel economy plus lower engine wear and peak performance, an accurate tachometer is a "must." Here is your best "tach" value. This easy-to-assemble precision instrument accurately registers engine speed in rpm—electronically! Has transistorized switching and zener diode regulation; maintains accuracy regardless of voltage or temperature changes. Big illuminated dial face has red reference pointer that may be set to any speed—lets you know at a glance when to shift gears. No ignition rewiring required.

For 1-8 cylinder, 2 cycle; or 1-16 cylinder, 4-cycle engines using ignition coil and distributor of 9-32 VDC; for magneto and 6-VDC systems with external 9-V battery (not supplied; see below). Available in positive-ground and negative-ground models (virtually all late-model American cars have negative-ground systems). With all cables, universal mounting base, tension strap, and easy-to-follow assembly instructions. 4⅞x3¼x3⅞". Shpg. wt., 4 lbs.

83 Y 944DE. For Negative-Ground Systems
83 Y 980DE. For Positive-Ground Systems
No Money Down. *Each only* **$21.95**

83 Y 909. 9-V Battery & Accessories..... **$1.50**

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YOUR PERSONAL PASSPORT TO EXCITING SHORTWAVE LISTENING

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only $5 monthly on Allied's Credit Fund Plan

- Tunes Shortwave and Broadcast from 540 kc to 30 mc
- Bandspread Control for easy enjoyable tuning
- Sensitive Regenerative Circuit for world-wide radio
- Built-in Speaker, plus headphone terminals
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Hear *everything* on the fun-to-build "Span Master"—leader in its class for radio coverage, sensitive performance and value. Continuous tuning from 540 kc to 30 mc lets you hear ships, planes, direct broadcasts from London, Paris, Moscow, Berlin, Rome; tunes 160, 80, 40, 20, 15 and 10-meter Ham bands—plus powerful local AM reception and dozens of other exciting broadcast services. Features: Bandspread dial for easy tuning; fine-regeneration control; built-in PM speaker, plus headphone terminals for private listening. Complete with all parts, tubes, wire, solder, step-by-step instructions and handsome wood cabinet. 6¼ x 14 x 6¾". For 110-125 v. 60 cycle AC. Shpg. wt., 8 lbs.

83 YX 258DE. "Span Master" 4-Band Shortwave Kit, only **$25.95**

83 Y 025. Outdoor Antenna Kit, **$1.03.** **83 Y 027.** Dual Headset, **$2.08**

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Hear ships at sea


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- ☐ **Tachometer for Negative-Ground Systems 83 Y 944DE**
- ☐ **Tachometer for Positive-Ground Systems 83 Y 980DE**
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ONLY **$99.95**

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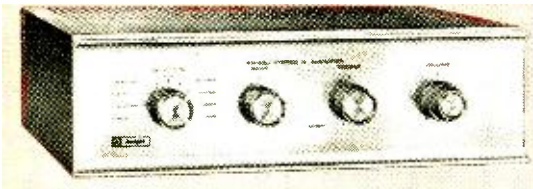
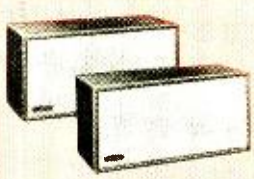
SAVE $51.94 on the complete Phono System this easy do-it-yourself way



Knight-Kit KG-250 20-Watt Stereo Amplifier Kit with Metal Case

Garrard Autoslim Changer with Base, and Shure M3D Cartridge

Two Knight KN-809 Full-Range 8" Speakers



OPTIONAL ALTERNATE: 2 Lincoln L-150 Speaker Enclosures

If you're looking for quality and value in Stereo hi-fi, here's the great music system buy for you! Simply assemble the amplifier yourself—it's easy, it's enjoyable—and you SAVE. You save even more by buying the complete system—$51.94 less than the cost of the components bought separately. Here's the amazing value you get:

Genuine Knight-Kit KG-250 20-Watt Stereo Amplifier Kit—Full array of controls for complete, simple adjustment of sound; clutch-type volume controls; separate boost-and-cut bass and treble controls; with DC-operated tube filaments; twin push-pull output circuits; ± 1 db, 30-15,000 cps response at full rated output; less than 1.5% harmonic distortion at 20 watts. Easy to assemble with step-by-step instructions. Handsome metal case included.

Famous Garrard Autoslim 4-Speed Changer—Plays both stereo and monphonic LP's, all speeds; intermixes all size records; automatic shutoff. Complete with quality Shure M3D cartridge and diamond stylus. Handsome walnut wood base included.

2 Knight KN-809 Full-Range Hi-Fi 8" Speakers—Offer realistic, full-depth reproduction. Easy to custom-mount in wall or in your own enclosures. With 10-oz. ceramic magnet, rigid die-cast frame, soft-suspension hyperbolic woofer cone.

Complete Music System—Includes all components described above; with all cables needed; all parts, tubes, wire, solder and instructions for easy assembly of the KG-250 amplifier. With metal case. Shpg. wt., 46 lbs.

22 HF 084DE. Complete 20-Watt System, *only* **$99.95**

System With Shelf Enclosures. As above, but includes two Lincoln L-150 walnut leatherette shelf-type speaker enclosures. Shpg. wt., 72 lbs.

22 HF 085DE. System with Enclosures, *only* **$122.50**

83 YX 030. Wood Case for KG-250. 5 lbs.....**$9.95**

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- ☐ Wood case for KG-250 83 YX 030
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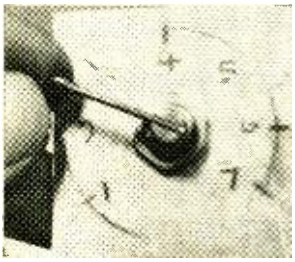
Tips and Techniques

"HANDLE" FOR SCREWDRIVER-ADJUSTED POTS

Experimenters who "cannibalize" government-surplus equipment for parts often end up with a large supply of screwdriver-adjusted potentiometers. Though these controls are usually superior in quality, it's almost impossible to install standard knobs on their shafts. A very acceptable "handle," however, can be made from an ordinary finishing nail. Cut off the point and flatten two opposite sides of the nail with a file. Now just press-fit the flattened sides into the screwdriver slot as shown in the photograph. —*Robert E. Kelland*



NE-2 LAMP MAKES USEFUL NIGHT LIGHT

A useful and compact night light can easily be made from a small plastic line plug, an NE-2 neon lamp, and a 220,000-ohm, ½-watt resistor. Enlarge the hole in the top of the plug to accept the lamp, and secure the lamp in the opening with a drop of cement; the resistor is placed in the body of the plug and wired in series with the plug terminals and the lamp. Make an extra unit for your tool box—it will come in handy for checking wall outlets and extension cords. —*Stanley E. Bammel*

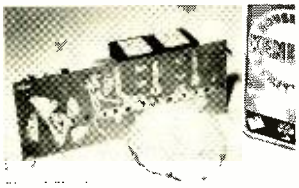
(*Continued on page* 30)

Tips

(*Continued from page 29*)

LUBRICATING OIL PROTECTS P-C BOARDS

If you make your own printed-circuit boards, you've probably noticed that newly etched copper surfaces quickly develop a coat of oxide on exposure to air. The oxide makes soldering difficult, requiring the use of excess heat — which may be damaging to components and even to the board itself. You can remedy the situation by applying (with a wad of cotton) a thin film of lubricating oil to the new board. The oil won't interfere with soldering and will indefinitely prevent oxide formation.



—Hamish Robertson

COMING NEXT MONTH

Dry cells, unaltered in shape and chemistry for decades, have been revamped to meet the needs of this transistor and space age. You will be amazed at the variety of new techniques being devised to package power for tomorrow's world.

ON SALE

NOVEMBER 27

- **HANDY HANDSET**
  The small fry in your family will surely enjoy their very own telephone system, and you can build it in one evening. Made from a pair of crystal earphones, the self-powered hookup will provide many hours of winter fun.

- **REAR-VIEW MIRROR DIMMER**
  It'll take Detroit a good many years to fully automate your car, but you can get a head start by arranging to "dim" those bright headlights of the cars behind you—electromechanically!

- **BLINKING BEE**
  Two relaxation oscillators lend life and color to a carved balsa wood "bumblebee" by blinking the lights in the ends of the "bee's" antenna.

Recommended TOPS *in* CB

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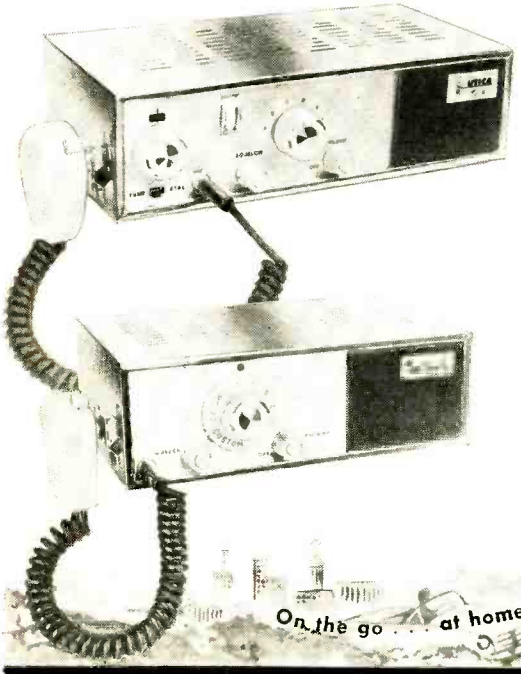

UTICA *T&C* II TRANSCEIVER

With all the deluxe features and performance you could possible want. A new dual conversion 6 channel crystal controlled transceiver with tunable receiver. S meter and signal strength output indicator, external crystal socket, auxiliary speaker terminal and universal power supply are only a few of the many plus features that make the T&C II outstanding. Deluxe chrome cabinet 199.95

UTICA *Town & Country* MC-27 TRANSCEIVER

A handsome, rugged top performer. The MC-27 is a dual conversion 6 channel crystal controlled transceiver with exceptional sensitivity and selectivity. Features Double Gaited Noise Suppression Circuit, Automatic Volume Control with improved squelch circuit and universal power supply. Deluxe chrome cabinet 179.50

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Vertical - Horizontal Beam Antenna for hi-efficiency and greater distance base station performance 55.95

BUDDY WHIP
96 inch fibre glass mobile antenna with unique pivot base that permits immediate antenna adjustment to any position from driver's seat 24.50

GROUND PLANE
Heavy duty ground plane antenna prematched for 52 ohm impedance 24.50

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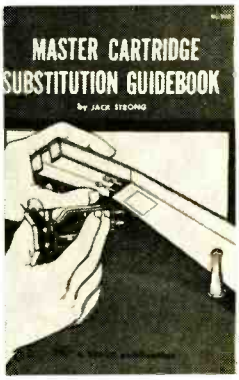
MASTER CARTRIDGE SUBSTITUTION GUIDEBOOK

by Jack Strong



This "Guidebook" is a reference volume which should be of use to service technicians, dealers, distributors, and manufacturers' representatives. It lists the cartridges (both monophonic and stereophonic) which have been produced by major manufacturers since 1930, and the numbers and makes of all possible substitutes, with the data arranged in alphabetical—as well as numerical—order. There is also a listing of model numbers of record players (alphabetical, by manufacturer) and the part numbers of the cartridges used in them. The latter information is most helpful when a cartridge has been lost or when the cartridge number becomes unidentifiable.

Published by John F. Rider Publisher, Inc., 116 W. 14th St., New York 11, N.Y. 96 pages. Soft cover. $2.00.

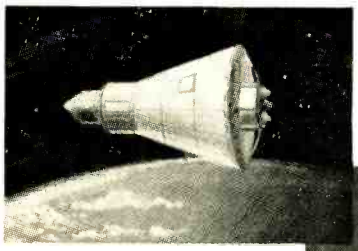
HOW TO MAKE MORE MONEY IN YOUR TV SERVICING BUSINESS

by John Markus

This volume should be of interest to every TV serviceman who either owns a repair shop or contemplates opening one. It discusses all conceivable aspects of both part-time and full-time servicing operations, from successful advertising to modernizing the shop. Many tested ideas for getting more business at fair prices are presented. Of special interest is the chapter describing a simplified single-entry bookkeeping system developed expressly for the television and radio servicing business.

Published by McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y. 340 pages. Hard cover. $7.95.

(*Continued on page* 38)



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Hallicrafters World Range Radios bring the words and sounds of adventure into your living room direct—from a huge liner fog bound at sea to a giant bomber on Arctic patrol. Even America's Astronauts may be heard on some models!

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No tyrant in history has yet been able to crush the free exchange of good will that occurs every day among the radio amateurs of the world. "Hams" (250,000 strong in the U.S.A. alone) are our first line of communication in time of disaster, too. Hear them on your Hallicrafters!

When emergency strikes, you may be on the scene with your Hallicrafters World Range radio. Marine . . . fire . . . police . . . civil defense channels . . . all at your fingertips.

Before you retire tonight, a new dawn of critical world events will begin in the major capitals and trouble spots around the globe.

Yet *tonight,* through Hallicrafters World Range Radio, tomorrow's history springs to life in your own home. *While it is happening.*

With a twist of a knob, you could be listening to Moscow one minute . . . Berlin . . . Africa or New Delhi the next. You tune easily through the decisive voices of varied world reaction and opinion — hundreds of English, as well as foreign language, broadcasts from the four corners of the earth.

Never before have you been so *thoroughly informed.* Never before have you grasped *so quickly* the full impact of momentous events. Or felt so much a part of them.

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Bookshelf

(*Continued from page* 32)

AVIATION ELECTRONICS HANDBOOK

by Keith W. Bose

As aviation electronics keeps pace with the progress made in other branches of the art, the problem of learning to use and take care of the resulting new equipment arises. This practical handbook covers the design, operation, and maintenance of automatic direction finders, distance-measuring equipment, omni-range, ATC transponders and weather radar, communications and instrument landing systems, and other equipment.

Published by Howard W. Sams & Co., Inc., 1720 East 38th St., Indianapolis 6, Ind. 224 pages. Soft cover. $4.95.

New Literature

Over 100 new or restyled kits appear for the first time in the Fall & Winter 1962-63 Heathkit catalog, bringing the total number covered to more than 250. The kits illustrated and described range in complexity from a basic electricity course to analog computers, and in variety from hi-fi to marine equipment, amateur radio to test instruments, educational equipment to a science series. Complete specifications are included for each of the various units. For your free copy, write to Heath Co., Benton Harbor, Mich.

Lafayette Radio Electronics' 1963 catalog is now available for the asking. The largest and most comprehensive ever offered by this company, catalog #630 contains 388 pages. The latest equipment of all major manufacturers is presented — electronic components, CB and amateur equipment, hi-fi and stereo components, test equipment—as well as the company's own line of equipment in both kit and factory-wired form. Copies are available from Lafayette Radio Electronics Corp., 111 Jericho Turnpike, Syosset, L.I., N.Y. -30-

BEST BUYS IN STEREO AND MONO HI-FI

Transistorized Stereo/Mono 4-Track Tape Deck RP100
Semikit (electronics in kit form) $299.95 Wired $399.95

New Stereo FM Multiplex Tuner ST97
Kit $99.95* Wired $149.95*

FM-AM Stereo Tuner ST96
Kit $89.95* Wired $129.95*
*Incl. FET

70-Watt Integrated Stereo Amplifier ST70
Kit $99.95 Wired $149.95

40-Watt Integrated Stereo Amplifier ST40
Kit $79.95 Wired $129.95

28W Integrated Stereo Amplifier HF81
Kit $69.95 Wired $109.95

FM Tuner HFT90
Kit $39.95 Wired $65.95
Incl. FET Metal Cover $3.95

AM Tuner HFT94 Incl. FET
Kit $39.95 Wired $65.95

Stereophonic Dual Preamplifier ST84
Kit $59.95 Wired $89.95

Stereo Power Amplifiers

	Kit	Wired
100W HF89:	$99.50	$139.50
70W HF87:	$74.95	$114.95
28W HF86:	$43.95	$ 74.95

FM-Multiplex Autodaptor MX99
Kit $39.95 Wired $64.95
Cover Optional, $2.95
(Patents Pending)

Bookshelf Speaker System HFS1 Kit $39.95 Wired $47.95

BEST BUYS IN CITIZENS TRANSCEIVERS, HAM GEAR, RADIOS

Citizens Band Transceivers 770 Series from Kit $79.95 Wired $109.95

U. S. Pat.

60W CW Transmitter #723
Kit $49.95 Wired $79.95

Walkie-Talkie Citizens Band Transceiver #740
Kit $54.95.
Wired $79.95.
Complete with rechargeable battery & charger.

BEST BUYS IN TEST EQUIPMENT

Metered Variable Auto-Transformer AC Bench Supplies

Model 1073 (3 amps)
Kit $35.95 Wired $47.95

Model 1078 (7½ amps)
Kit $42.95 Wired $54.95

Peak-To-Peak VTVM #232 & Uni-Probe® (U.S. Pat.)
Kit $29.95
Wired $49.95

VTVM #221
Kit $25.95 Wired $39.95

DC—5 MC 5" Scope #460
Kit $79.95
Wired $129.50

General Purpose 5" Scope #427
Kit $69.95 Wired $109.95

Tube Tester #625
Kit $34.95 Wired $49.95

RF Signal Generator #324
Kit $26.95
Wired $39.95

1000 Ohms/Volt V-O-M #536
Kit $12.90
Wired $16.90

6- & 12V Battery Eliminator & Charger #1050
Kit $29.95
Wired $38.95

Extra-filtered for transistor equipt. #1060
Kit $38.95 Wired $47.95

AC Volt-Watt Meter #261*
Kit $49.95
Wired $79.95

*Formerly called #260

Multi-Signal Tracer #145A
Kit $19.95
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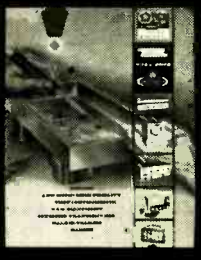

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The ABC's of listening to airplanes, airports, and radar controllers

By KEN GREENBERG

THE DAY when the SWL confined his interest solely to the ordinary short-wave or AM broadcast bands is all but over and done with. He now looks for greater novelty, interest, and excitement—all of which can be found in the aeronautical band (108 to 132 megacycles).

Spotted just on the "other side" of the FM broadcast band, the aero band is chock full of signals that don't fade in and out, and that don't suffer from Soviet jammers, atmospheric static, and sunspots. With the help of this article, you should be able to pinpoint several frequencies where things are *really* happening. Transmissions from radar controllers at the major airports; control towers giving landing, takeoff, and taxiing instructions; commercial planes en route back to their owners; and private aircraft are but a few of the goings-on that'll hold your interest for hours.

(*Continued on next page*)

TOWER, ILS AND

LOCATION	Approaching Flights	Local Flights	Ground Control	Departing Flights	ILS	VOR
Akron, Ohio	125.5	120.1	121.7	118.6	110.9	–
(Akron-Canton)	125.5	118.3	121.9	118.6	109.5	–
Albany, N. Y.	125.0	119.5	121.9	125.2	109.5	116.9
(Schenectady)	125.0	121.3	–	125.2	–	–
Albuquerque, N. M.	124.3	118.3	121.9	121.1	110.3	113.2
Allentown, Pa.	118.2	120.5	121.9	–	110.7	117.5
Amarillo, Texas	121.1	118.3	121.9	119.5	110.3	117.2
Asheville, N. C.	121.1	121.1	121.9	–	110.5	112.2
Atlanta, Ga.	118.1	119.1	121.9	119.3	109.9	117.6
Atlantic City, N. J.	123.8	119.5	121.9	124.4	110.5	108.6
Austin, Texas	124.9	118.3	121.9	119.1	109.5	112.5
Bakersfield, Calif.	123.7	118.1	121.9	–	109.9	115.4
Baltimore, Md.	121.1	118.7	121.9	120.4	109.7	117.9
Baton Rouge, La.	119.7	118.3	121.9	–	110.3	116.5
Beaumont, Texas	121.1	119.5	121.9	–	109.5	114.9
Billings, Mont.	118.3	118.3	121.9	–	110.3	114.5
Binghamton, N. Y.	118.6	119.3	121.9	123.8	110.3	114.1
Birmingham, Ala.	119.9	118.7	121.9	124.9	110.3	114.4
Boston, Mass.	118.1	118.3	121.9	119.1	110.3	117.7
Buffalo, N. Y.	123.7	120.5	121.9	119.8	110.3	116.5
Burbank, Calif.	120.9	118.7	121.9	118.4	109.5	–
Burlington, Vt.	121.1	118.3	121.9	119.2	110.3	112.4
Cedar Rapids, Iowa	119.9	118.7	121.9	–	109.3	117.6
Charleston, S. C.	119.3	118.3	121.9	123.9	109.7	113.5
Charleston, W. Va.	119.8	120.3	121.9	124.1	110.3	115.4
Chattanooga, Tenn.	125.1	118.3	121.9	–	109.5	112.8
Chicago, Ill. (Midway)	119.5 W	118.7	121.7	119.9	109.9	–
(Midway)	123.7 E	–	–	–	109.5	–
(Meigs)	127.8	121.3	121.9	–	–	–
(O Hare)	119.0	118.1	121.9	125.4	109.7	111.6
Cincinnati, Ohio	124.7	118.3	121.7	121.0	109.9	112.9
Cleveland, Ohio	118.5	119.9	121.9	121.0	109.9	113.6
Colorado Springs, Colo.	118.5	119.9	121.7	120.2	109.9	112.5
Columbus, Ohio	119.0	121.1	121.9	120.5	109.5	–
Corpus Christi, Texas	118.3	118.1	121.9	125.3	110.3	115.5
Dallas, Texas	119.8 E 123.7 W	118.7	121.9	119.5	110.3	114.6
Dayton, Ohio	118.0	119.5	121.9	119.9	110.3	115.0
Denver, Colo.	119.5 N 120.5 S	118.3	121.9	124.8	110.3	116.3
Des Moines, Iowa	124.9	118.3	121.9	118.6	110.3	114.1
Detroit, Mich. (Metro)	124.9	121.1	121.7	118.4	109.3	–
(Willow Run)	123.7	121.3	121.9	118.4	109.5	111.4
Duluth, Minn.	118.3	118.3	121.9	–	110.3	112.6
El Paso, Texas	118.7	118.3	121.9	119.1	109.5	114.5
Ft. Lauderdale, Fla.	118.1 S 123.7 N	119.3	121.7	119.7	–	–
Ft. Worth, Tex. (Meacham)	118.1	118.3	121.9	123.9	109.9	–
(Carter)	118.1	118.9	121.8	123.9	109.5	110.6
Grand Rapids, Mich.	124.6	119.3	121.9	–	109.5	–
Harrisburg, Pa.	120.9	119.5	121.9	124.2	109.1	109.8
Hartford, Conn. (Rentsch)	124.2	119.9	121.9	124.6	–	114.9
(Brainard)	124.2	–	–	124.6	–	–

VOR FREQUENCIES (In megacycles)

LOCATION	Approaching Flights	Local Flights	Ground Control	Departing Flights	ILS	VOR
Houston, Texas	118.1	118.7	121.9	123.7	109.9	115.9
Indianapolis, Ind.	118.1	120.9	121.9	121.1	109.3	116.3
Jacksonville, Fla.	119.3	118.3	121.9	124.9	110.3	114.5
(Craig)	119.3	—	—	124.9	—	—
Kansas City, Mo.	119.5	118.3	121.9	118.1	109.9	112.6
(Fairfax)	119.5 E 121.1 W	119.1	121.7	118.1	—	—
Little Rock, Ark.	119.5	118.7	121.9	118.1	110.3	113.9
Los Angeles, Calif.	119.3	118.9	121.7	124.3	109.9	—
Memphis, Tenn.	119.1	118.3	121.9	119.7	109.9	115.5
Miami, Fla.	118.1 S 123.7 N	118.3	121.9	119.7	109.5	115.9
Minneapolis, Minn.	120.0	118.7	121.9	119.3	109.3	117.3
Newark, N. J.	118.1 S 127.6 N	118.3	121.9	119.2	110.3	—
New Orleans, La.	125.5	119.5	121.7	121.0	109.9	112.7
(Moisant)	125.5	119.9	121.9	121.0	—	—
New York, N. Y. (Idlewild)	119.7	119.1	121.9	121.1 E	109.5	115.9
(Idlewild)	123.7	—	—	123.9 W	110.9	—
(La Guardia)	118.9 E 125.7 W	118.7	121.7	120.4	109.9	115.4
Oklahoma City, Okla.	119.3	118.3	121.9	121.1	109.9	115.0
(Wiley Post)	119.3	119.7	121.7	121.1	—	—
Orlando, Fla.	119.4	118.7	121.9	121.1	109.9	112.2
Philadelphia, Pa.	124.6 S 125.0 N	118.5	121.9	119.0	109.3	—
Pittsburgh, Pa. (Allegheny)	118.7 S	121.1	121.9	125.9	109.1	—
(Allegheny)	123.6 N					
Portland, Ore.	118.1	118.7	121.9	124.9	109.9	115.7
Providence, R. I.	118.6	118.7	121.9	118.0	109.3	115.6
Richmond, Va.	119.0	119.5	121.9	125.0	110.3	114.1
Rochester, N. Y.	124.7	118.3	121.9	121.0	109.5	110.0
Sacramento, Calif.	119.1	119.5	121.9	123.6 S 124.5 N	110.3	115.2
St. Petersburg, Fla.	119.5	118.3	121.9	126.5	109.1	116.4
San Antonio, Texas	—	—	—	—	110.9	—
San Francisco, Calif.	118.5 N 120.9 S	120.5	121.8	124.8	109.5	111.8
Seattle, Wash. (Int'l)	119.5	119.9	121.7	119.2	110.3	114.5
(Boeing)	119.5	118.3	121.9	119.2	110.9	—
South Bend, Ind.	121.0	118.9	121.9	—	110.3	115.4
Spokane, Wash.	124.7	118.3	121.9	124.3	109.9	115.5
Tampa, Fla.	119.5	119.9	121.7	126.5	110.3	—
Teterboro, N. J.	118.1 S 127.6 N	119.5	121.9	119.2	109.3	—
Topeka, Kan.	120.9	118.7	121.9	120.9	109.5	117.8
Tulsa, Okla.	119.1	118.7	121.9	120.7	110.3	114.4
Washington, D. C.	118.3 W 126.5 E	119.1	121.7	127.0	109.9	111.0
Westchester Co., N. Y.	118.5	118.5	121.9	—	109.7	—
Wichita, Kan.	120.1	119.5	121.9	124.5	110.3	113.8
(Beech)	—	119.9	121.9	—	—	—

Every Day From 108 to 132

You can hear

You'll need a moderately priced receiver and an antenna tuned to the aero band to hear these signals. Your receiver should have at least three controls—tuning, volume, and squelch. The latter is a circuit familiar to CB'ers, but not well known by SWL's. By careful adjustment of the squelch control, you can eliminate all interfering background noises. The only sound out of the speaker will be the short transmissions from the towers and planes you want to hear. Further details on receivers and antennas appear at the end of this article.

VOR and ILS. There are numerous VOR (*V*HF *O*mnidirectional Radio *R*ange) stations scattered throughout the country between 108.1 and 117.9 mc. These stations have antennas that radiate at very high angles, limiting ground-wave coverage to 10-15 miles. The distinctive VOR transmissions can be easily recognized by the fluctuating interaction between the "reference" and "rotating" signals. Aircraft in flight receive these two signals and, through a phase-comparison circuit, are able to establish the magnetic north meridian.

The ILS (*I*nstrument *L*anding *S*ystem) signals are also heard over very limited distances. Unlike the VOR signals, which are radiated in an omnidirectional pattern, ILS signals are beamed off the ends of major airport runways so that they can be heard clearly about 25 miles away at heights of 10,000-12,000 feet.

Details on VOR, ILS, and many other airport frequencies (including l.f. range signals) can be found in *Sectional Aeronautical Charts*. These charts point out landmarks, municipal boundaries, etc., and can be purchased from the Director, Coast and Geodetic Survey, U.S. Department of Commerce, Washington 25, D.C., or authorized agents in most major cities.

Popular aero band receivers include the Gonset 3156-B (top), Hallicrafters CRX-3 (center), and the Nova-Tech 711WN (bottom). The CRX-3 has two crystal-controlled receiving channels, and the Nova-Tech unit will pick up the long-wave, AM broadcast, and short-wave bands, as well as aero signals.

Towers and Radar Controllers. The tables on pages 42-43 list frequencies used by some of the major airports throughout the United States. All transmissions are via high-level amplitude modulation—not FM, as used by police, fire, and taxicab stations in another part of the VHF spectrum.

The frequencies shown are those most generally used by the towers and/or radar controllers. Obviously, controllers are primarily interested in "Approaching" flights and establishing a stacking plan or landing order. Most towers are capable of operating on numerous other frequencies when air traffic is especially heavy. Some airports have separate frequencies for incoming or outgoing flights

in north-south or east-west flight paths; these are noted in the tables on pages 42-43.

With a simple antenna, you can expect to receive transmissions from airport towers at distances of 20-30 miles.

Planes En Route. Although the VHF band is pretty much limited to "line-of-sight" transmissions (you can hear signals just a little bit beyond the maximum distance you can see), don't be surprised if you pick up airplane signals that are 100, or more, miles away.

Most commercial jets fly at altitudes above 25,000 feet, offering a radio distance range for their signals of about 200 miles! Low-flying aircraft—at altitudes of only 3000-5000 feet—can be heard 70 to 90 miles away. Even airplanes at altitudes of only 1000 feet can be regularly received over a distance of 40-50 miles.

In addition to the frequencies used by planes to communicate with towers and radar controllers, there are numerous frequencies (mostly above 126.8 mc.) for two-way communications between commercial planes en route and their owners (United Airlines, TWA, American, etc.). The frequencies aren't set aside for particular airline companies, but rather are changed monthly to suit air traffic and airline schedules. This "master plan" is operated by Aeronautical Radio, Inc. (ARINC).

Military planes don't commonly use the frequencies discussed in this story —although they can occasionally be heard on 125.2 mc.

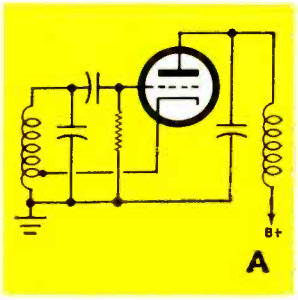
Short-wave listeners familiar with the great care exercised by broadcasting, ham, and CB stations will be surprised to find that no call letters are used by any of the aero stations. Instead, the towers identify themselves by location. Commercial flights use a combination of company ownership and arbitrary flight numbers; private planes use their own license numbers.

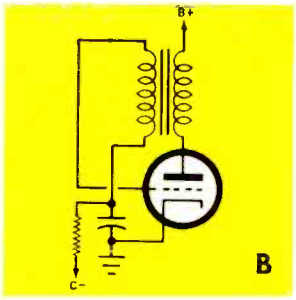
(*Continued on page* 116)

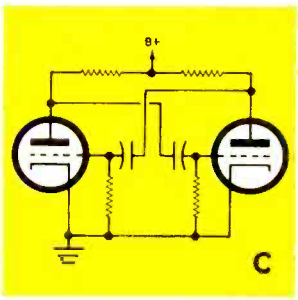
AERONAUTICAL FREQUENCIES

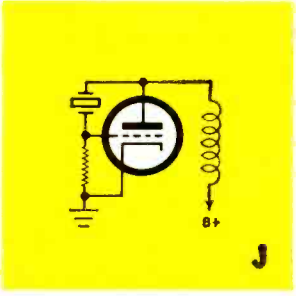
FREQUENCY (mc.)	PURPOSE
108.1—111.9	ILS systems with superimposed voice modulation (see table on page 42)
108.2—117.9	VOR systems including those along FAA designated airways (see page 42)
118.0—121.4	Air traffic control from FAA towers (see page 42)
121.5	International distress and survival channel for aircraft in trouble; also radiobeacons used by "downed" aircraft
121.7—121.9	Airport and ground control to provide taxiing instructions (see page 42)
122.1—122.3	Private aircraft en route for communication with FAA
122.5, 122.6. 122.7, and 122.9	Private aircraft to towers at any airport
122.6	Pilot-to-forecaster experimental system now being tested in Washington, Kansas City, and Los Angeles
122.8 and 123.0	Unicom channels for communications at small airports and some plane-to-plane transmissions
122.9	New "Aeronautical Multicom" frequency for private aircraft engaged in ranching, forestry, etc.
123.1 and 123.55	Flying schools and flight testing
123.6—126.8	Air traffic control from FAA towers (see page 42)
126.7	Any civil aircraft to FAA airways stations
126.85—131.95	All commercial aircraft en route to FAA towers and ARINC

OSCILLATOR QUIZ





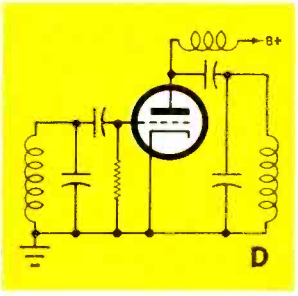


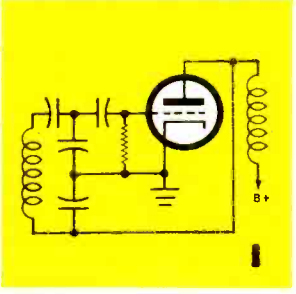


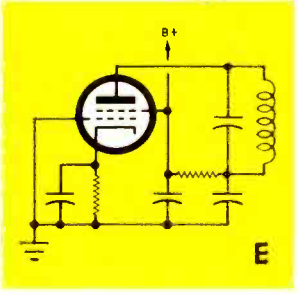
By ROBERT P. BALIN

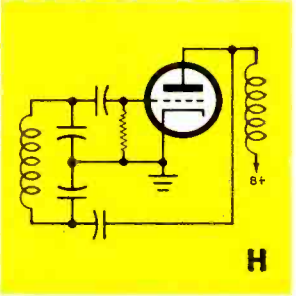
There are many types of oscillator circuits used in electronic equipment. You can tell them apart by noting the tube type, tank circuit, or feedback path used. See how many of the circuits (A-J) shown here you can match with their common names (1-10) listed at bottom of page.

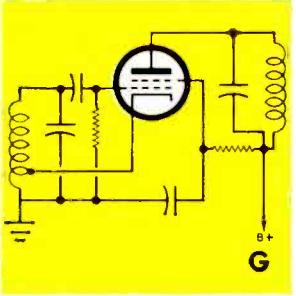
(*Answers on page* 108)

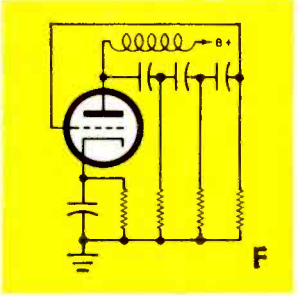












1 Colpitts oscillator_____ **2** Hartley oscillator_____ **3** Clapp oscillator_____

4 Electron-coupled oscillator _____ **5** Pierce oscillator_____ **6** Multivibrator_____

7 Dynatron oscillator_____ **8** Blocking oscillator_____ **9** Phase shift oscillator_____

10 Tuned plate-tuned grid oscillator_____

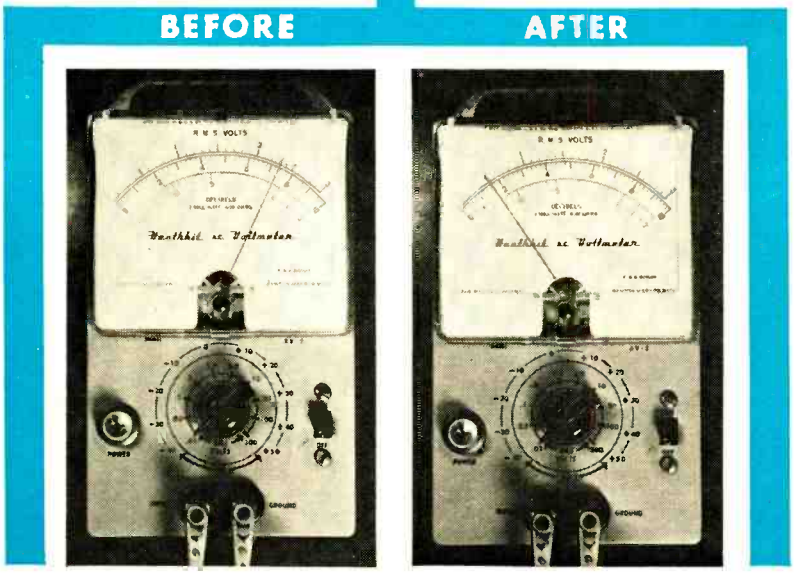
The LITTLE HUMS Of Hi-Fi

By LEWIS A. HARLOW

LET'S FACE IT: manufacturers of hi-fi components do a masterful job of minimizing hum. The hum level in a good power amplifier, for instance, may be rated at "80 db below maximum output." As long as the amplifier is in good working order, this much hum is so low that you literally can't hear it. Therefore, hum should never give you any problem—except for the fact that there's much more to a hi-fi system than the power amplifier!

Inasmuch as your preamp, turntable, tape recorder, FM tuner, and so on, also figure in the total hum picture, the matter isn't nearly as simple as you might like. Each of these units produces its own share of hum. And since all of this hum is delivered to your speaker system, you have much more than the original minimum to contend with.

Now there are many "kinds" of hum, and we aren't going to attempt to cover all of them. Something can



Hook up an a.c. VTVM to your component hi-fi system, and you're likely to get a "collected hum picture" that looks something like this—or even worse.

Make a few adjustments here and there, and hum level should drop markedly. A meter is a "must" for such work, due to comparative insensitivity of the ear.

be done about minimizing much of the hum, however, and this "something" doesn't require a degree in electronics engineering. Nor do you have to get inside the cabinet with a soldering iron to rearrange the carefully planned, hum-minimizing design of the manufacturer. "Workshop" skills are enough: "workshop" skills—and the right meter!

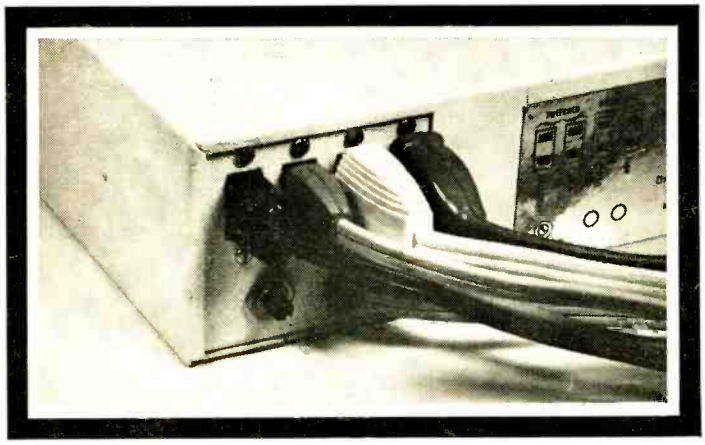
Visual Indicator. Hum *must* be measured with a meter. Even if the hum is bad enough to be audible (and this is pretty bad), the human ear is too imperfect an instrument for so delicate a measurement.

The most popular types of meters won't do the job, either. It's true that an ordinary VOM or VTVM will measure alternating current (and hum is an a.c. signal), but the most sensitive range on these meters is usually no better than "one volt full scale." Hum fed into so insensitive a meter probably won't even budge the needle from the zero mark. And it certainly won't provide the convincing indications of "more hum" and "less hum" which are needed.

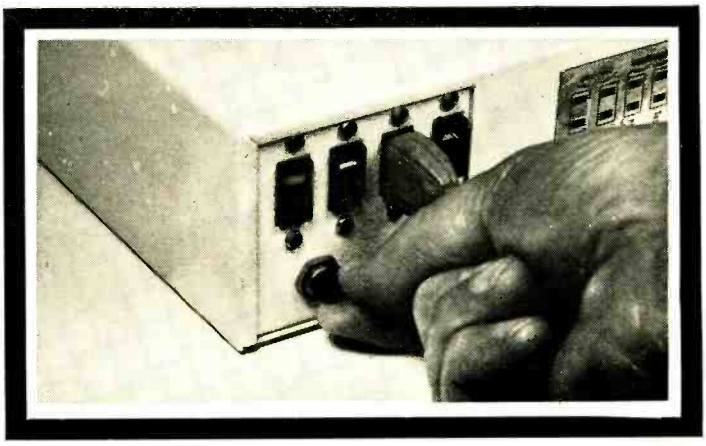
Hum measurement is a job for the "a.c. VTVM." Such an instrument is a sensible investment for any well-equipped hi-fi household, and manufacturers of do-it-yourself electronics equipment offer a.c. VTVM kits for around $40.00 or so. These instruments boast amplifying systems which enormously increase their ability to read very weak hum signals. In fact, the most sensitive range on a good a.c. VTVM is "0.01 volt full scale"—100 times the sensitivity of an ordinary VOM or VTVM!

How do you use this meter? Just clip it across the output terminals of your power amplifier (each channel, if it's a stereo amplifier)—or to the terminals, if present, on the back of your speaker enclosure(s); don't under any circumstances disconnect the speaker(s). Take

(*Continued on page* 99)



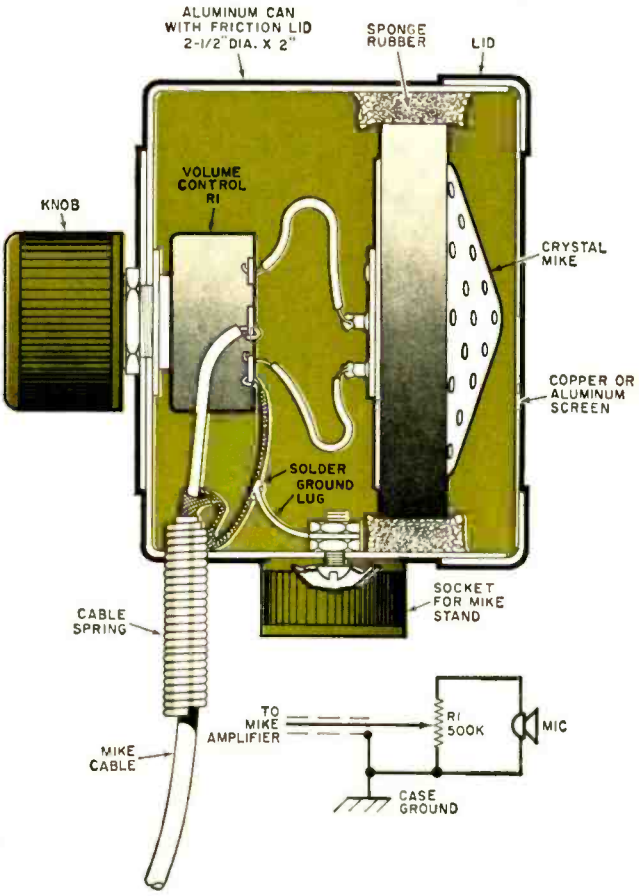
One sure way to reduce hum is to find the "low-hum" positions of the various power plugs by removing them, rotating them 180°, and reinserting them. The modern hi-fi installation includes an ever-growing number of power plugs, and there is a "right" and a "wrong" position for each one.

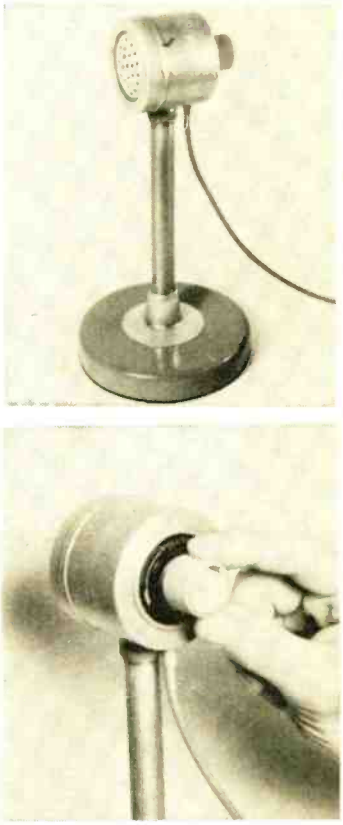


Adjusting a hum null control on a hi-fi component is an extremely simple operation—if you make proper use of an a.c. VTVM. You'll observe a big swing of the meter needle, and there will be absolutely no doubt in your mind about the optimum setting of the control for minimum hum.

LEVEL With Your MIKE

Utility mike features built-in volume control





Front and back views of completed mike (above). Dial plate under volume control knob and a desk stand give the mike a professional look.

LOCAL electronic parts suppliers stock many makes of low-cost crystal microphone replacement cartridges, and a cartridge with a frequency response of 30-7000 cps can be had for five dollars or less. With one of these cartridges and a little bit of effort, plus some spare parts and a microphone desk stand, you can come up with a useful microphone that has a built-in level control (see diagram) and is ideal for tape recording or p.a. announcing.

The aluminum can with friction lid can be found at the toy counter of your local "five and dime." You'll also need a standard 500,000-ohm volume control, the spring from an old mike connector, a socket made from an Amphenol 75-CCC1 connector cover, mike cable, sponge rubber, and a ground lug. Add a cable connector to the free end of the mike cable to match your audio input jack, screw the unit onto a mike stand, and you'll be all set to record or announce—on the level.

—Art Trauffer

THE LITTLE VOLTER

Instant power for your one- or two-tube projects

By **FORREST H. FRANTZ, Sr.**

ALTHOUGH experimenters are devoting more and more of their time to transistors these days, circuits always seem to come up which require the use of one or two tubes. And it's for just such circuits that this inexpensive little power supply was designed.

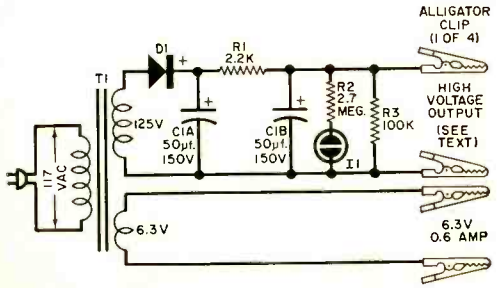
The high-voltage output is about 150 volts under a 1-ma. load, and drops to about 110 volts under the maximum load of about 13 ma. This range is fine for most one- or two-tube equipment intended for 90-180 volt operation. A heater supply of 6.3 volts at 0.6 ampere is also incorporated in the unit.

The simple circuit of the "Little Volter" (see schematic diagram below) is assembled on a 1¾" x 3⅛" x 1" aluminum open-end chassis. Dual-section filter capacitor *C1* is installed under the chassis, and there's room on top for transformer *T1* and all of the other components. A 5-lug terminal strip mounts diode *D1*, resistors *R1*, *R2*, and *R3*, and neon "on-off" indicator *I1*.

To keep expenses down and simplify construction, the author used no power switch or output jacks. You turn the unit on and off by simply inserting its plug into a wall outlet or pulling it out. As for the output connections, they are made by means of leads which are wired directly into the supply at one end and terminated in insulated alligator clips at the other.

If you wish, you can dress up the "Little Volter" a bit by housing it in an appropriate box. But don't forget to provide openings for ventilation and for viewing indicator *I1*. —30—

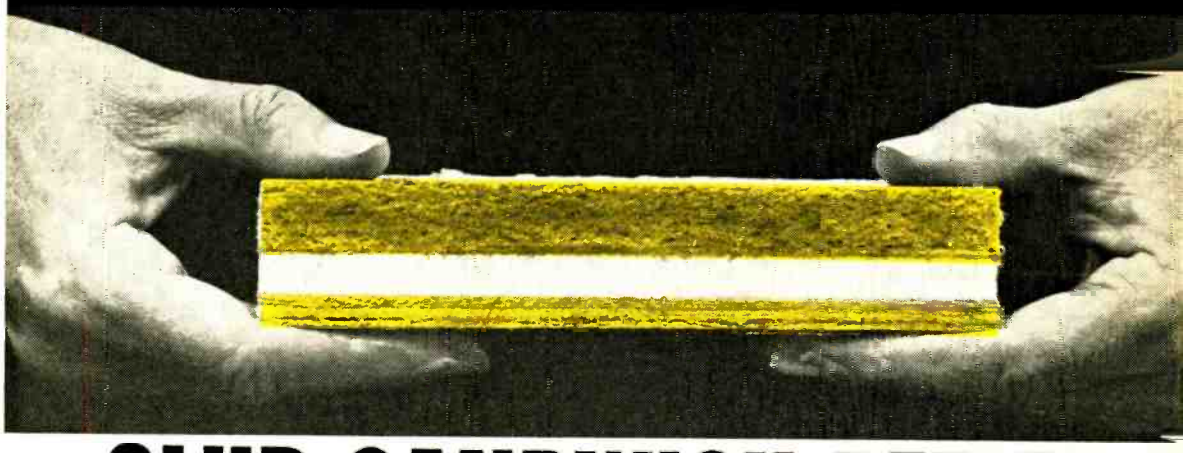
Schematic diagram of the "Little Volter." Neon "on-off" indicator I1 operates from high-voltage output.



PARTS LIST

C1—Dual 50-μf., 150-volt electrolytic capacitor
D1—130-volt (r.m.s.), 20-ma. selenium rectifier (I.T.T. 1159 or equivalent)
I1—NE-2 neon lamp
R1—2200 ohms
R2—2.7 megohms
R3—100,000 ohms
all ½-watt resistors
T1—Power transformer; primary, 117 volts; secondaries, 125 volts @ 15 ma., 6.3 volts @ 0.6 amp. (Stancor PS-8415 or equivalent)
1—1¾" x 3⅛" x 1" aluminum open-end chassis (Premier ACH-1351 or equivalent)
Misc.—Line cord and plug, terminal strip, insulated alligator clips, wire, etc.

Panel resonance has long been a problem with speaker baffles—especially bass-reflex types. But this enclosure cuts resonances to the bone. We call it the



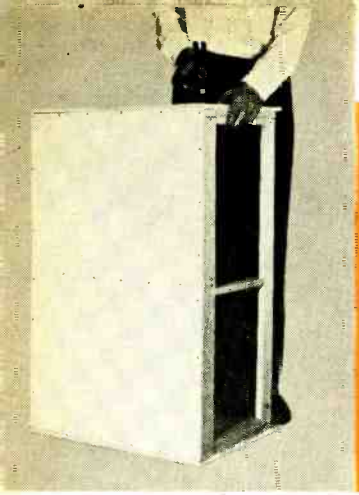
CLUB SANDWICH REFLEX

HERE'S a speaker system that's about as free from faults as any you're likely to encounter. The cabinet material is amazingly non-resonant; the enclosure itself is inexpensive and easy to construct with simple tools. Yet it looks good—so good, in fact, that you won't be tempted to hide it behind drapes when it's finished. Add the Electro-Voice 12TRXB speaker, and you'll have some magnificent sound.

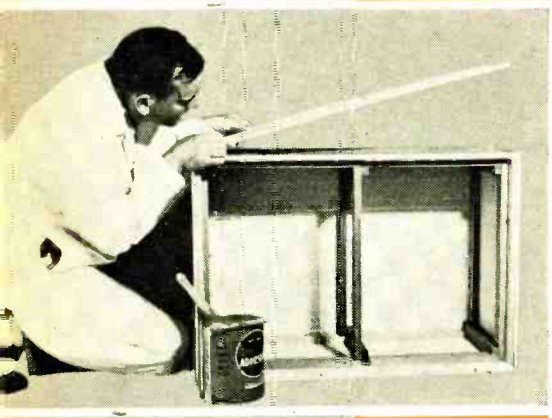
Good enclosures can be made from ordinary plywood, of course, but the sandwich-type construction used here has several advantages. For one thing, three different kinds of material stacked together club-sandwich style are much less likely to show pronounced resonances than several layers of the same type of material.

It's true that proper bracing will limit panel vibration in conventional plywood enclosures, but here we have gone to the heart of the problem by using materials which are

By DAVID B. WEEMS



Building the Club Sandwich is much like building a house—construction begins with a wooden frame. Celotex is nailed on first, and layers of Sheetrock are then glued and nailed to the Celotex, as pictured below.



Some types of adhesive must be applied to both surfaces. Exact method of applying adhesive will vary with different brands, so be sure to read instructions on can and follow them carefully for best results.

Plywood sides are glued but not nailed in place. Depending on the type of cement you use, it may be necessary to apply some pressure while the cement is setting.

inherently more "dead" than plywood. Celotex alone added to plywood is more effective in damping vibrations than simple bracing. And a look at the drawings and photos will show you that this enclosure is rather adequately braced in the bargain.

You have a considerable range of choice for the outside covering on the Club Sandwich Reflex. The author used unfinished mahogany plywood because it was readily available at a bargain price. However, prefinished plywood would eliminate much of the finishing work. The actual cost of the cabinet will depend on your decisions here as well as the kind of legs or base you choose.

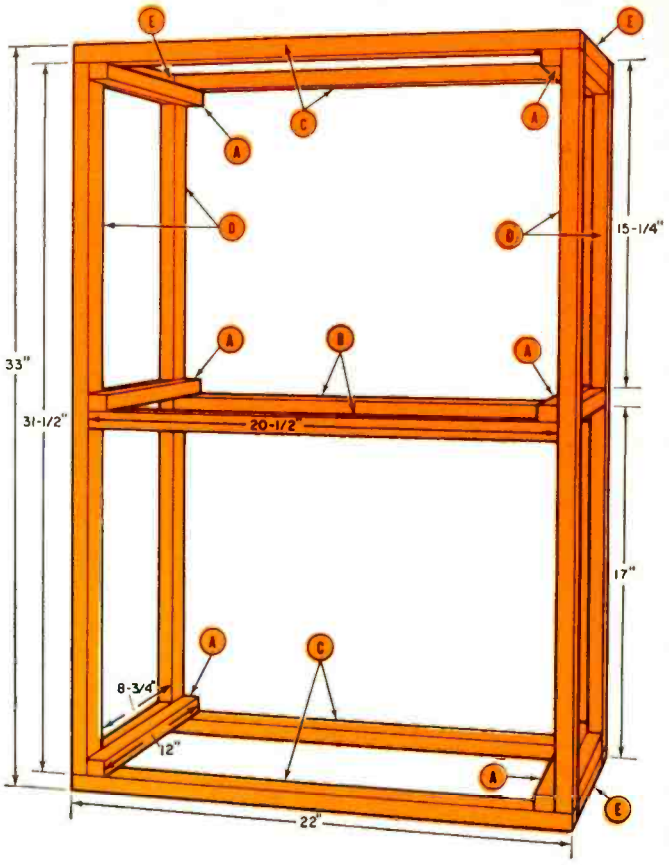
Tri-Layer Construction. If the materials seem to be more typical of house building than cabinet-making, so is the method of construction. You start by building a frame and go on from there. For this reason, any minor mistakes or rough edges in the first stages can be disregarded—they won't show up in the finished product.

Don't cut out the parts all at once, but stick to the sequence of steps outlined here—even if they seem arbitrary to you. You're likely to find that the dimensions of various parts will not be quite accurate because glue occupies some space between layers, and not everyone will use the same kind or amount of glue. The important thing is to have each piece cover what it is supposed to cover.

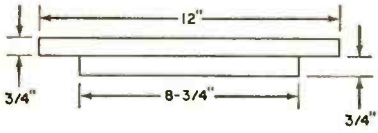
Gluing and Nailing. Glue and nail the frame first; then nail on the Celotex in the following steps: front, top and bottom, sides. This order permits the top and bottom to overlap the front, and the sides to overlap the front as well as the top and bottom. Face the rough, unpainted side of the Celotex in, and be sure to use cement-coated nails—these hold much more firmly than ordinary nails.

Next, apply glue; then nail on the Sheetrock in the same sequence as the Celotex. There are many kinds of adhesives available for this kind of work. Some, called "contact-bond" cement, stick firmly on contact. Others are slower in setting and have the advantage that parts can be moved into position after making contact. Either type is satisfactory, but the methods of apply-

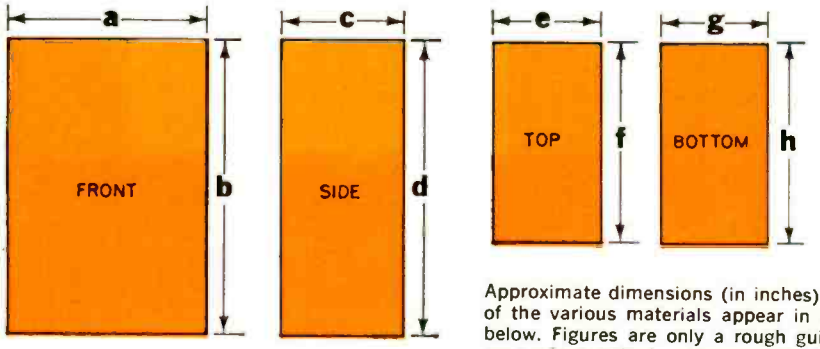
Frame for Club Sandwich is comprised of Parts [A] through [E] and is first step in constructing enclosure. It should be built exactly as shown, and made as rigid as possible through use of plenty of glue and nails or screws.



FRAME SPACER DETAIL
(ONE OF 6)



Frame spacer (identified as Part [A] on the drawing at the right) is made by gluing two pieces of ¾" stock together.



Approximate dimensions (in inches) for each of the various materials appear in the table below. Figures are only a rough guide, however, since actual measurements may vary somewhat. The back will be identical—22" x 33"—for each of the different materials.

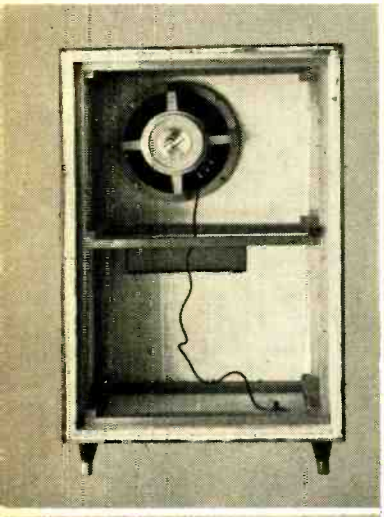
MATERIAL	a	b	c	d	e	f	g	h
CELOTEX	22	33	13 5/8	33	13 5/8	22	13 5/8	22
SHEET ROCK	23	34	14	34 3/4	14	23	14	23
FIR PLYWOOD	23 3/4	34 3/4	—	—	—	—	14 1/4	23 3/4
HARDWOOD PLYWOOD	—	—	14 1/4	35	14 1/4	24 1/4	—	—

Final steps in building the Club Sandwich are mounting speaker and putting the back in place.

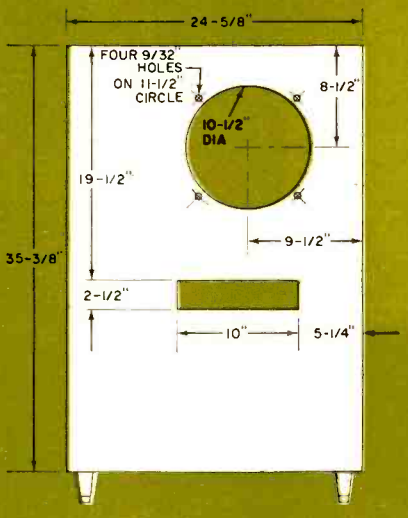
ing and bonding the adhesive will depend on the particular brand and type you choose.

The amount of cement will vary according to type, too, but you'll probably need at least half a gallon. Some is applied to one surface, some to both; some in high, wide ridges and valleys; some in narrow, thin ridges. Read all directions on the can and follow them exactly if you want satisfactory results.

After the Sheetrock is in place, the fir plywood front can be cut to fit, then glued and nailed on. Incidentally, there should be no problem in getting a front, a back, and a bottom from the 4′ x 4′ sheet of fir plywood *if* you mark out the parts before sawing. Therefore, it's wise



The Club Sandwich was specifically designed for use with Electro-Voice 12TRXB speaker (see photo at left). Tweeter control can be mounted in bottom of enclosure as described in the text.



Location of the speaker mounting hole and port are indicated on the diagram at right. Keep in mind that dimensions are only approximate, since some of the measurements will vary with the thickness of your "sandwich."

Completed Club Sandwich is impressive-looking system. It will grace any listening room, and performancewise—well, let's just say that it's darn good.

to make accurate measurements for each part to be cut from the fir plywood *before* you start sawing.

The back can now be assembled from sheets of Celotex, Sheetrock, and fir plywood. This particular sandwich is simply glued and nailed, but it's best to apply pressure on it with weights. Use the #3 nails here, nailing from the Celotex out. If there is any tendency for the nails to penetrate the back, they can be driven at a slight angle.

Speaker and Port. The holes for the speaker and port should be cut before you paint the front flat black—other-

wise, the edge of the cut Sheetrock will show through as a gleaming white rim inside the grille cloth.

In case you're wondering why the port size doesn't correspond to the exact area suggested by design charts, the explanation is that this port is based on specifications from Electro-Voice. In selecting this size, efficiency as well as bass range was considered.

Actually, with the 12TRXB speaker, port size isn't as critical as with lower quality speakers. The bass resonance of the 12TRXB is very low and presents no problem in itself, so other factors become more important in this bass-reflex design. A smaller opening—about 16 square inches—would tune the "Club Sandwich" enclosure more critically, but less efficiently.

BILL OF MATERIALS

32—Feet of 1¾" x 15⅝" wood (any kind, straight and free of knots) to be cut into:
- *6—8¾" strips for spacers (A)*
- *6—12" strips for spacers (A)*
- *2—20¼" strips for middle braces (B)*
- *4—22" strips for top and bottom cross pieces (C)*
- *4—31½" strips for sides (D)*
- *4—8¾" strips for corners (E)*

1—4' x 8' sheet of ½" Celotex
1—4' x 8' sheet of ⅜" Sheetrock
1—15" x 8' sheet of ¼" hardwood plywood
1—4' x 4' sheet of ¼" fir plywood
10—Feet of hardwood door stop or other trim
1—12" hi-fi speaker (Electro-Voice 12TRXB)
4—3/16" x 3" bolts for speaker
24—#10 x 2" wood screws for back
1—Gallon of adhesive—see text
1—Pound of #5 cement-coated box nails
1—Pound of #3 cement-coated nails
Misc.—Grille cloth, legs, etc.

Finishing Up the Sandwich. The fir plywood bottom should be put on next, making it overlap the Sheetrock sides and the plywood front. The legs can now be attached to protect the sides when you move the cabinet. Now, measure and cut out the sides from hardwood plywood, making them the exact dimensions as the sides of the enclosure. When in position, they should overlap and hide the present Sheetrock side, the edge of the plywood front, and the edge of the plywood bottom.

The plywood sides are bonded into place without nailing. With most kinds of cement, it will be necesary to place a weight or other pressure on each piece while the cement is setting.

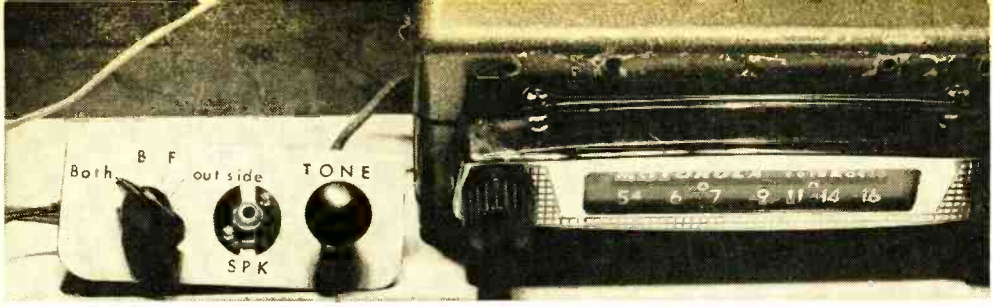
When the sides are in position, cut and add the plywood top, fitting it to cover the top edges of the sides and the front. At this point, it's a good idea to do any staining—if you're going to do any staining—just to make sure that no stain slops over on the grille cloth. Of course, if you use prefinished plywood, the job is virtually done.

One little task still remaining is to mount the tweeter control (it's part of the Electro-Voice 12TRXB speaker) on the rear panel. Because of the thickness of the sandwich it will be necessary to cut out a circle in the inside layer (the Celotex) for the body of the control.

Installation. With everything finished and mounted, you'll note that the Club Sandwich is becoming rather heavy (after all, one of the reasons for choosing Sheetrock was its density!). Therefore, you may not want to screw the back firmly in place until you've moved the enclosure to its permanent location. The brace across the back of the frame was meant to be just a brace, but with the back off it makes an excellent "handle" for carrying.

Coloration proved no problem when the 12TRXB was installed in the bare cabinet. No doubt this is partly due to the tri-layer construction, because some Celotex-lined enclosures sound "loud." Even so, extra padding in the form of cotton batting, foam plastic, or felt would be advisable. Electro-Voice recommends a stretched 2" thickness of "Kimsul" paper on three sides but warns against rock or glass wool which may work into the gap of the speaker. Naturally, some people will want more padding than others, depending on taste.

Now To Listen. Some enclosures are described as "good for the cost," or as having "surprisingly true bass for their size." Admittedly, a much larger model would permit a somewhat lower bass range, but one thing about this system is certain. The Club Sandwich Reflex needs no qualifying phrases added to its description. In any man's language, it's *good!* —30—



Add-On Auto Radio Controls

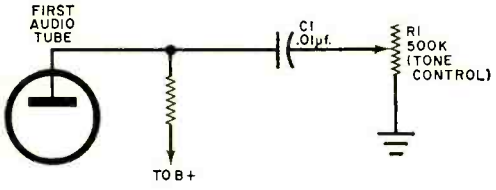
Handy switch panel pipes your car radio's output to a rear-seat or external speaker, also controls tone

A FRONT / REAR speaker switch, a jack for an "outside" speaker, and even a tone control are features a good many auto radios don't have. Yet you can add one or all three of these "extras" in about as much time as it takes to talk about them.

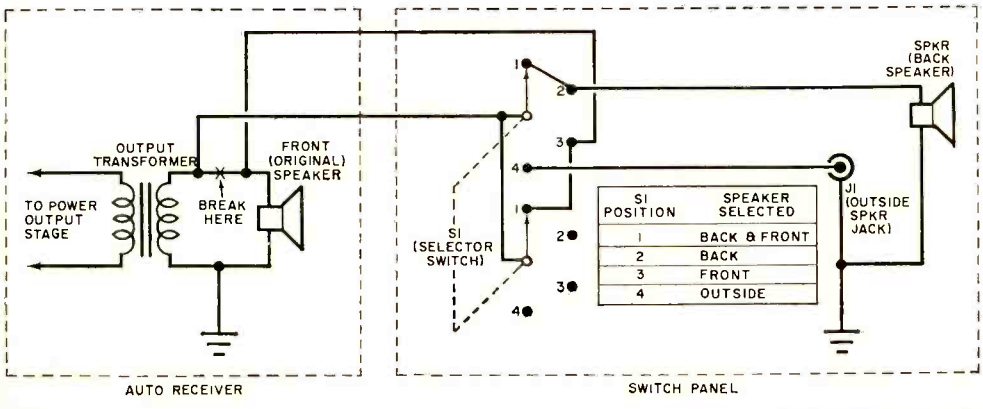
In the author's case, provisions for all three "add-on" features were incorporated on a 2″ x 4½″ aluminum panel which had a ½″ mounting lip. A 2-pole, 4-position rotary switch (*S1*) selects front or rear speakers (or both), and it also switches in an RCA-type phono jack (*J1*) so that an outside speaker can be used. Such a speaker is just the thing at picnics, and it's mighty handy if you're caught at home washing windows and screens when your favorite football or baseball game is on.

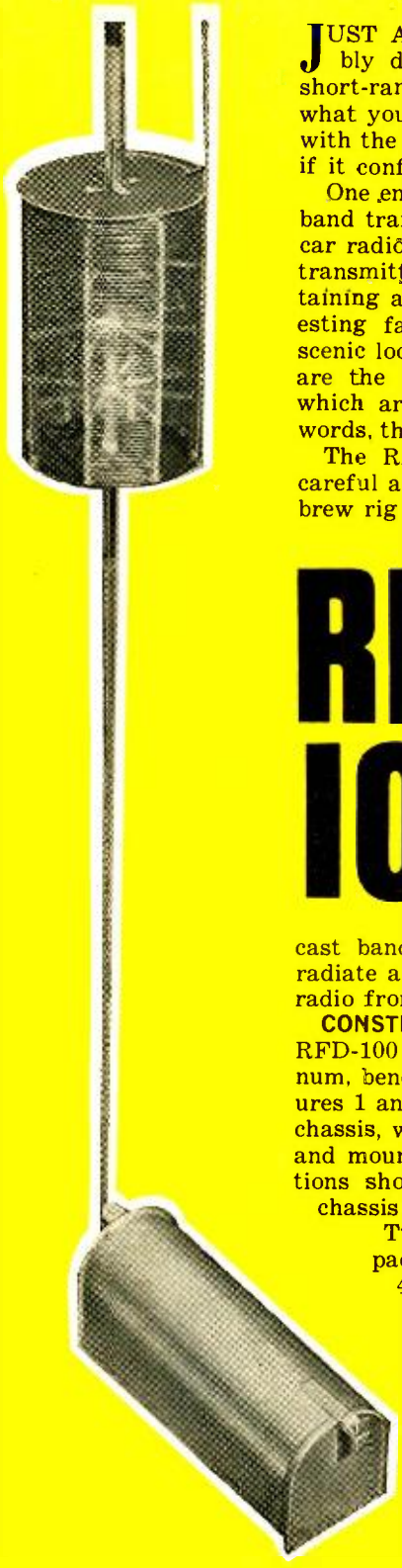
To add a switch panel to your car radio, remove the radio from the car and take off the bottom cover. Ground one side of the output transformer secondary and one side of the speaker (if they aren't already grounded). This done, break the lead from the other side of the transformer secondary to the speaker. Wire up the switch panel as shown, mount it at some convenient spot near the radio, and you're all set.

If your car radio doesn't have a tone control, adding one is easy. Solder a 0.01-μf., 600-volt paper capacitor to the plate terminal of the first audio tube (or the collector of the first audio transistor), and connect the other end of the capacitor to an insulated tie point. Then run a wire from this tie point to a 500,000-ohm tone control (*R1*) mounted on the switch panel. Could anything be simpler? —*Homer L. Davidson*



Schematic below shows switch panel and receiver connections. Optional tone control circuit is above.





JUST ABOUT ANY electronic experimenter could probably dream up dozens of new and exciting uses for a short-range broadcast-band transmitter. And contrary to what you might think, such a transmitter is not only okay with the FCC but may even be operated without a license—if it conforms to certain regulations (see box on p. 60).

One enterprising small businessman employs a broadcast-band transmitter to instruct student drivers, through their car radios, as they circle an auto driving range. A similar transmitter, used in conjunction with a tape recorder containing a message-repeating cartridge, could provide interesting facts and historical data to sightseers parked at scenic lookouts and other tourist attractions. More common are the phonograph broadcasters and wireless intercoms which are put to use countless times each day. In other words, the applications are limited only by your imagination.

The RFD 100, a 100-milliwatt transmitter designed in careful accordance with FCC regulations, is just the home-brew rig for knocking out a maximum signal on the broad-

RFD 100

Housed in a rural mailbox broadcast-band transmitter puts out 100 milliwatts on center-loaded vertical

By HARTLAND B. SMITH, W8VVD

cast band. When properly installed and adjusted, it will radiate a signal that can be picked up on an average table radio from a distance of several hundred feet.

CONSTRUCTION. Start off by forming a chassis for the RFD-100 transmitter from a piece of 4″ x 6″ sheet aluminum, bending a 1″ lip at a right angle along a 4″ edge. Figures 1 and 2 on next page show the parts placement on the chassis, which, incidentally, is not critical. Drill the chassis and mount the parts on it following the approximate positions shown in the photograph; then carefully wire the chassis following the schematic diagram (Fig. 3).

Tuning capacitor *C2* can be any small variable capacitor with a maximum capacity of approximately 400 $\mu\mu$f. Just about any unit salvaged from a broadcast receiver will do.

Tank coil *L1* is cemented to a pair of ¼″-diameter polystyrene rods which serve as chassis stand-off insulators. Tapping the 96-turn coil will be simplified by first pushing inward on the turns on either side of the 26th turn from the *C3* end of the coil. This way you will have sufficient room to solder-tap without shorting out any of *L1*'s turns.

(*Continued on next page*)

Power for the transmitter is obtained from a string of 13 size "D" flashlight cells wired in series to provide a total of 19.5 volts. A 3″ x 1⅝″ x 17¼″ battery box constructed from ⅛″ Masonite acts as a convenient container for the cells (see Fig. 2). If you wish, snap-in battery holders can be used.

A rural mailbox serves as a weatherproof housing for the transmitter and batteries. Mount the transmitter chassis far enough to one side so that the battery holder may be easily slid in next to it. Support the parts for the two r.f. pi-network filters, *C5-L3-C6* and *C7-L4-C8*, on a couple of two-terminal tie points located on the floor of the mailbox, about 4″ behind the transmitter. Terminal strip *TS2* should be installed on the underside of the mailbox, near r.f. chokes *L3* and *L4*. Center and secure a ½″ pipe flange to the underside of the mailbox; this flange will be used later to mount the mailbox to a ½″ ground stake support.

The antenna assembly consists of two 53″ pieces of ½″ rigid copper water pipe with a loading coil between them. This assembly is held upright by two porcelain stand-off insulators (Fig. 4) at the rear of the mailbox. Energy developed in *L1* reaches the antenna by means of a wire which runs along inside the mailbox from *C4* (Fig. 2) to the bottom antenna stand-off insulator. Use ¼″ scrap polystyrene rod to keep this

HOW IT WORKS

When d.c. power is applied to the collector of transistor *Q1*, current flowing into tank circuit *L1/C2* sets up a disturbance which is transferred via quartz crystal *X1*, to the transistor's base. Energy reaching the base is of such phase that it causes the transistor to amplify the original disturbance and to finally break into oscillation. Since *X1* is a high-*Q* device, it will only pass an appreciable amount of energy at the frequency for which it is cut. Thus, oscillation takes place at this frequency only, and an extremely stable signal results. Maximum transmitter output is obtained when *L1* and *C2* are tuned near the crystal frequency.

The base of *Q1* receives a small forward bias from the junction of *R1* and *R2*. This bias causes the transistor to conduct sufficient current to initiate oscillation. Stabilization resistor *R3* prevents thermal runaway, thus permitting the circuit to operate in the hot sunlight. Bypass capacitor *C1* shunts r.f. around *R3* to ground, eliminating degeneration or loss of amplification due to the resistor. Capacitors *C3* and *C4* conduct r.f. energy, while keeping the d.c. voltage present on *L1* from shorting to ground or reaching the antenna.

Loading coil *L2*, plus the capacity to ground

Fig. 1. Chassis is fabricated from sheet aluminum and mounts most of the circuit's components. One-inch lip at bottom mounts on floor of the mailbox.

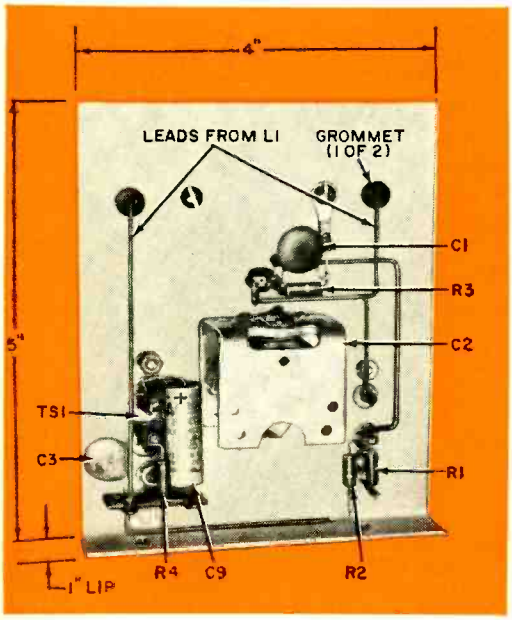
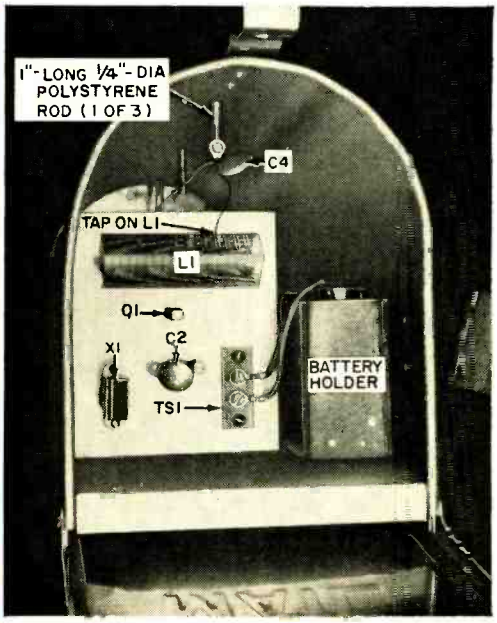


Fig. 2. Looking inside the mailbox, the chassis is seen installed vertically. Tap on L1 connects to antenna via C4 and standoff-mounted "lead-in" wire.



of the antenna pipes, forms a series-resonant circuit which appears, electrically, as if it were a full-length quarter-wave vertical antenna. Chokes *L3*, *L4*, and capacitors *C5*, *C6*, *C7* and *C8* filter r.f. from the modulator line, thus stopping it from acting as a portion of the antenna system.

Provided battery potential does not exceed 19.5 volts, the total resistance of *R3* and *R4* will cause a voltage drop sufficient to make it impossible for the transmitter input to exceed 95 milliwatts, no matter how much collector current is drawn.

An impedance-matching transformer (*T1*) connected across the output terminals of a tape recorder or small amplifier supplies audio to modulate the transmitter. Direct current from the battery is present in *T1*'s high-impedance winding, and so the transmitter may be turned on and off with a switch (*S1*) located at this point. A 100-ohm resistor (*R5*) protects the modulator's regular output transformer from the voltage surges that may occur if the line to terminal strip *TS2* is accidentally disconnected or broken.

Battery life is excellent, since current drain is only about 7 ma. when the transmitter is adjusted for maximum output.

PARTS LIST

B1—19.5-volt battery (13 size "D" flashlight cells in series)
C1, C4—0.01-μf., 600-volt disc capacitor
C2—400-μμf. (maximum) variable capacitor—see text
C3—0.0047-μf., 600-volt disc capacitor
C5, C6, C7, C8—0.001-μf., 600-volt disc capacitor
C9—10-μf., 25-volt electrolytic capacitor
L1—96 turns of Barker and Williamson 3016 coil stock, tapped 26 turns from C3 end
L2—88 turns of #20 enameled wire on 8"-diameter, 12"-long form—see text
L3, L4—2.5-mh., 125-ma. r.f. choke
Q1—CK722 transistor
R1—5600 ohms
R2—56,000 ohms
R3—180 ohms
R4—820 ohms
(All resistors ½ watt unless otherwise specified)
R5—100 ohms, 2 watts
S1—D.p.d.t. toggle switch
T1—Audio output transformer; 2000-ohm primary, 3.2-ohm secondary (Stancor A3332 or equivalent)
TS1, TS2—Two-screw terminal strip
X1—Broadcast-band transmitting crystal (Texas Crystals FT-243 or equivalent)
1—Crystal socket, pin spacing .486", pin diameter 0.093" (Texas Crystals SSO-1 or equivalent)
1—4" x 6" piece of sheet aluminum for chassis
1—Transistor socket
2—¾"-o.d., ⅝"-i.d. polystyrene tubing, 12" long (Allied Radio 71 H 890 or equivalent)
1—⅝" polystyrene rod, 12" long (Allied Radio 71 H 881 or equivalent)
8—⅜"-diameter polystyrene rods, 12" long (Allied Radio 71 H 879)
8—¼"-diameter polystyrene rod, 12" long (Allied Radio 71 H 877)
2—½"-i.d. (approximately ⅝"-o.d.) rigid copper water pipes, 53" long
1—½" galvanized water pipe, one end threaded, 6' long
1—½" pipe cap
1—½" pipe flange
1—Rural mailbox
2—2¾" porcelain stand-off insulators
4—1" metal angle brackets
4—2" metal angle brackets
Misc.—Screws, nuts, washers, lugs, grommets, Masonite, cement, varnish, tie points, etc.

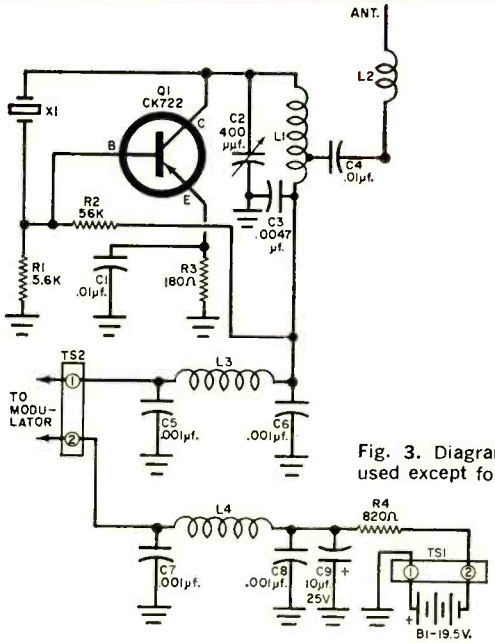


Fig. 3. Diagram of transmitter shows all electronic parts used except for R5, S1 and T1. These are in the modulator.

wire approximately one inch away from the wall of the box.

The tubing assembly (see Fig. 5) is used as the central support of loading coil *L2* and it is made from polystyrene parts. To fabricate this plastic assembly, join together two 12" lengths of ¾"-o.d. tubing by inserting a 12" piece of ⅝"-o.d. rod centered inside them. Apply a liberal amount of polystyrene cement to the inner and outer tubes in the vicinity of the splice.

Cut two 8" discs from ⅛" Masonite, and give them three coats of high-quality spar varnish. At the center of each disc (Figs. 5 and 6), drill a ¾" hole; and around the outer edge, drill eight equally spaced small holes about ¼" from the outside edge to accommodate the screws which will go into the ⅜"-diameter polystyrene rods.

Now assemble the Masonite discs and ⅜" x 12" polystyrene rods and insert the 24" tubing assembly through the

THE FCC AND THE RFD-100

The Federal Communications Commission Rules allow the operation of "low-power communication devices" in the broadcast band without a license under strict curbs. Part 15 of the FCC Rules was established to enable home experimenters, primarily for their own personal convenience, to use wireless telephones, phonograph oscillators, and electronic baby sitters, and to control garage-door openers, model airplanes, etc.

The RFD-100 transmitter conforms to all of the Part 15 rules laid down by the FCC provided that the construction plans in this article are carefully followed and that the completed unit is checked out by an FCC-licensed radio technician. The RFD-100 is so designed that:

(a) the antenna, feedline, and ground lead do not exceed 10 feet in length;
(b) the power input to the final amplifier does not exceed 100 milliwatts;
(c) emissions below 510 kc. and above 1600 kc. are suppressed at least 20 db;
(d) power is obtained from batteries and not a public utility, so that signal measurement on the a.c. mains need not be made.

The Part 15 rules were not intended to cover "pee-wee" or neighborhood broadcasting, since such broadcasting efforts can disrupt regular broadcast reception and may interfere with other forms of radio communications. All too often, aviation, police, fire and other radio services on which life and property depend are accidentally jammed. If the RFD-100 causes harmful interference to an authorized radio service or interferes with a station a neighbor is listening to, it must be shut down at once.

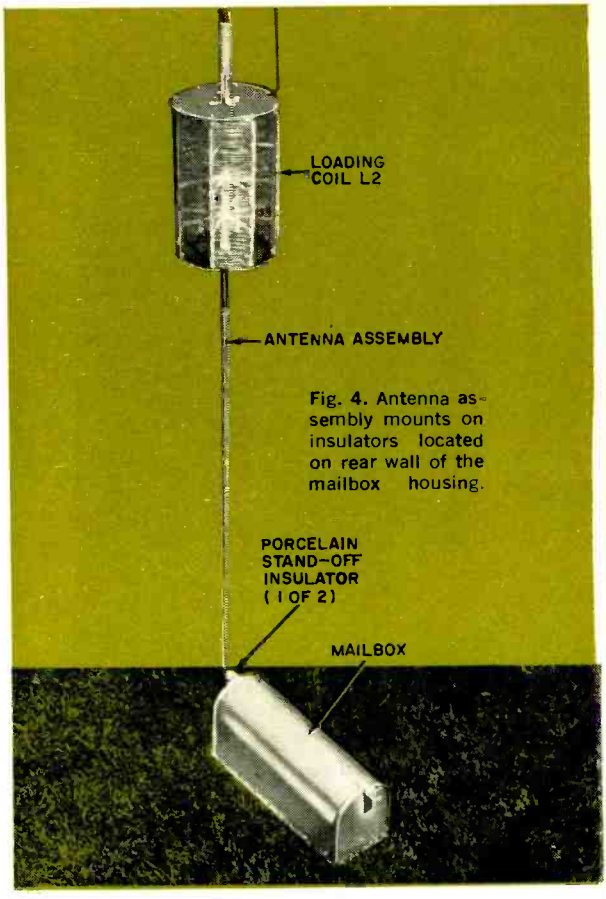


Fig. 4. Antenna assembly mounts on insulators located on rear wall of the mailbox housing.

¾" holes. Fasten the tubing assembly to the discs with 1" and 2" angle brackets and bolts, with equal lengths of the tubing sticking out the top and bottom of the coil form. Three struts, cut from ¼"-diameter polystyrene rod, should now be cemented between each of the ⅜"-diameter rods and the tubing assembly.

Winding coil L2 on the drum formed by the Masonite discs and polystyrene rods is not difficult if done slowly. Start winding at one end and allow ⅛" spaces between turns. Start and end the coil on solder lugs mounted under screw heads on the Masonite discs (Fig. 6). Now cement the turns of the coil to the ⅜"-diameter polystyrene rods to hold them permanently in place.

Temporarily remove the angle bracket bolts which run through the tubing assembly. Just above the 1" brackets at the top of the coil and just below the 1" brackets at the bottom of the coil, drill ⅜" holes (Fig. 6) in one side of the tubing assembly. Insert the top and bottom copper pipes into each end of the tubing assembly for a distance of six inches.

Drill the pipes to accept the bracket bolts, and drill a hole for a bolt through the center of the ⅜" hole drilled in the tubing assembly. Now replace the bracket bolts. Put a solder lug under the head of a bolt and pass the bolt through the hole centered on the ⅜" hole; the solder lug should rest flush against the copper tubing. Then run a couple of 4¼" lengths of hookup wire between the ends of the coil and the pipes as seen in Fig. 6.

Most of the construction has now been completed. All that remains is to install the RFD-100 and wire up a modulator from existing audio equipment.

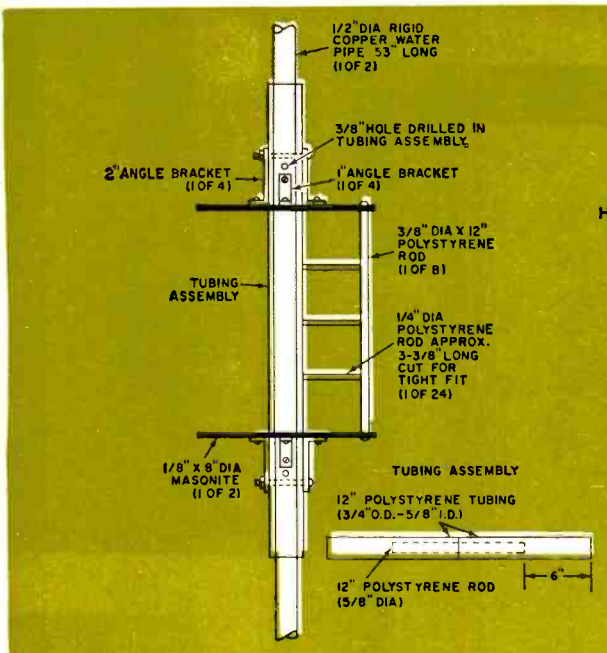


Fig. 5. Follow the details for the loading coil frame very carefully. Hack saws can be used to cut polystyrene rods. Use metal drills to make holes.

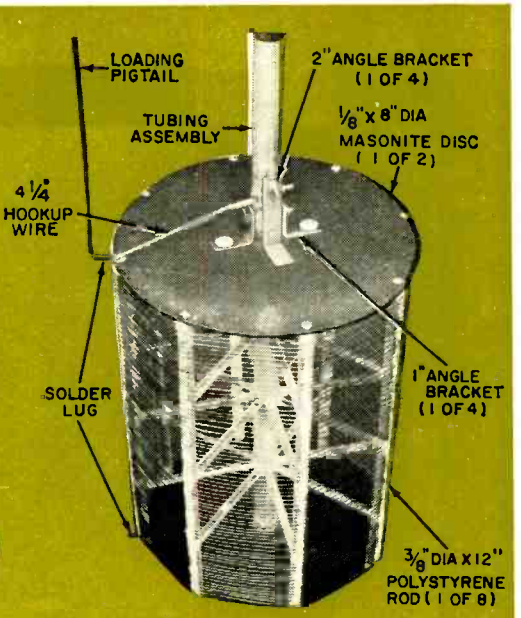


Fig. 6. Wind loading coil L2 using uninsulated copper wire spaced 1/8" between turns. Use any wire size from 12 to 20. Be sure to avoid kinks.

INSTALLATION. The transmitter must be located out-of-doors, close to the ground, and preferably away from trees and buildings. (See Fig. 4.) At the site you choose, drive a 6′ section of a ½″ galvanized pipe into the ground until only a 2″ portion remains above the earth's surface. Protect the threads on the exposed end of the pipe with a ½″ cap during the driving process. Once the pipe is in place, remove the cap. Screw the ½″-pipe flange on the underside of the mailbox onto the pipe.

MODULATOR. Audio for the transmitter can be obtained from a plate-to-voice-coil transformer, *T1*, connected across the output circuit of a phonograph, tape recorder or a small amplifier. The amplifier's output rating should not exceed 5 watts. A suitable hookup is shown in Fig. 7. Note that one section of a d.p.d.t. switch, *S1*, turns the transmitter on and off, while the other silences the speaker whenever the amplifier is working as a modulator.

Install a pair of wires between the plate winding of the transformer and terminal strip *TS2* located on the bottom of the mailbox. This line may extend, if necessary, for a distance of a hundred feet or more, and must run underground from the transmitter to the point where the wires enter the

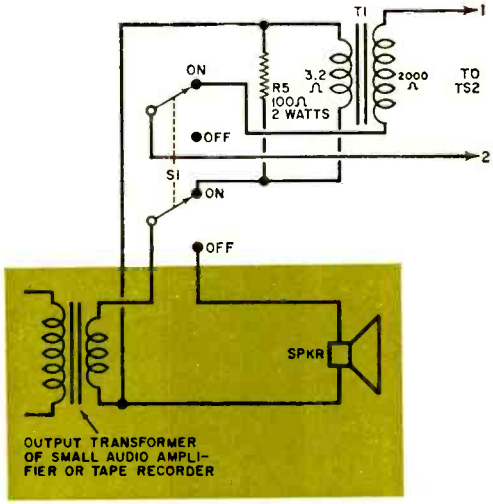


Fig. 7. Modulator parts may be mounted in a metal box and secured to the unit supplying audio signal.

building housing the modulator. Bury the wires a few inches under a lawn by slitting the sod with a shovel and laying the grass back for a moment while you insert the line.

PICKING A CHANNEL. A 10′ antenna radiates most efficiently at the high-frequency end of the broadcast band. The average a.c.-d.c. midget radio is also most sensitive at the high end of the dial. Consequently, it will pay you to choose a transmitting frequency not lower than 1300 kc.

To prevent sideband spillover outside the band allotted to Part 15 rigs, never use a crystal cut for a frequency above 1590 kc. Since the RFD-100 must cause no harmful interference to an established radio service, make certain that both the spot you finally settle on and the immediately adjacent channels are free of broadcast stations claiming your locality as part of their service area.

Using a sensitive receiver, carefully tune back and forth until you find a frequency that meets these requirements. Purchase a quartz transmitting crystal ground for this specific frequency.

CERTIFICATION. Before you attempt to put the RFD-100 on the air, it must be checked over by a competent technician (holder of a First or Second Class Radiotelephone License) who can verify that the transmitter complies with FCC requirements. His signed certificate, worded as follows, must be permanently attached to the transmitter:

> I have examined this low-power communications device and find that it will comply with Sec. 15.204 of the Rules and Regulations of the Federal Communications Commission, provided that it is operated under the following conditions:
> 1. The total length of the antenna and feedline does not exceed 9 feet 10 inches.
> 2. The unit is mounted on and connected to a ground pipe which does not extend more than 2″ above the surface of the earth.
> 3. The d.c. potential applied to power terminals does not exceed 19.5 volts.
> 4. A quartz crystal ground for a fundamental frequency no lower than 520 kc. nor higher than 1590 kc. is used as the frequency-determining element.
>
> Date: .....
> Signature of
> Technician: .....

TUNE-UP AND OPERATION. Some sort of field strength meter is required to peak the transmitter for top efficiency. A broadcast receiver with a tuning eye or S-meter may be employed or you can build a sensitive indicator by following the circuit of Fig. 8.

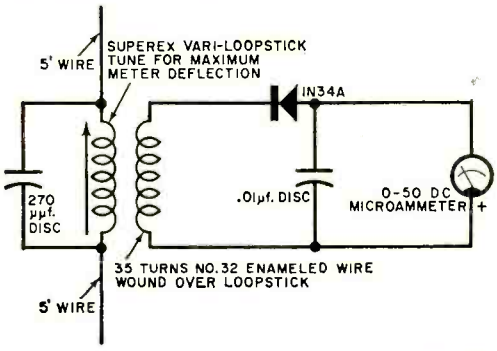


Fig. 8. Sensitive broadcast-band field strength meter can be made from spare parts. Drape FSM on ladder a few feet away from antenna assembly.

Turn on the transmitter by setting *S1* in the modulator output circuit at *On*, but allow the audio ampifier itself to remain off for the time being. Rotate *C2* back and forth until you hear the transmitter's carrier in a nearby receiver tuned to the crystal frequency, or until the field strength meter begins to show at least a small indication.

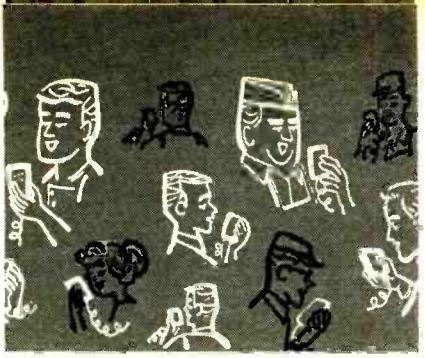
The *L2* winding data given in the Parts List will produce a coil resonant near 1300 kc. Some pruning will undoubtedly be needed to put the coil on your exact operating frequency.

Move your hand close to *L2*. If the field strength drops, the coil is too large. Take off one turn and make another meter reading. Continue pruning, a turn at a time, until you reach a point where the field strength rises slightly as your hand approaches the coil. Now, add a loading pigtail by soldering an 8″ length of #12 wire to the top of *L2*. (See Fig. 6.)

Bend the pigtail at various angles with respect to the coil, until you discover a position which gives the greatest field strength indication. During final adjustments of the pigtail, stand well away from *L2* each time you read the field strength meter. You may have to clip an inch or two off the wire before you are able to achieve the highest possible transmitter output.

Changes in *L2* will affect the reso-

(Continued on page 105)



On the Citizens Band

with **DICK STRIPPEL,** 2W1452, CB Editor

CITIZENS BAND RADIO played an important role in the preparations for the America's Cup Races at Newport, R. I., this fall.

To help train the crew of the yacht *Nefertiti,* Captain Fred E. Lawton, its sailing coach, set up a CB network. Fred's regular job is as director of marine safety for the Raytheon Company, and the units he used were "Ray-Tel" TWR-2's. He installed TWR-2's aboard *King Tut*, *Nefertiti*'s consort, on two other vessels in her retinue, and at her base on shore. Aboard the yacht itself, helmsmen Don McNamara and Ted Hood used handie-talkie units.

CB TRAINS FOR AMERICA'S CUP RACES

Although communications with the racing boats were not permitted during the official races conducted all summer off Brenton Reef, the CB units were used extensively for training. From a vantage point on the *King Tut*, Captain Fred would watch the crew members perform their maneuvers and man their stations as they drilled the 70-foot racer on every point of the wind. Like a football coach perched in the press box far above the playing field, he could quickly see the boat and the "set of her sails" as the competition would see her, and could assess the teamwork of the 11-man crew.

"From my 'sky hook' aboard the *King Tut,* I could see all 11 men at once," Captain Fred said. "As a teaching tool, CB is most effective. The improvement in sail-handling skills has been really outstanding."

The CB network was also used to pass on weather reports and even summon hot coffee and sandwiches for the weary crewmen. Since *Nefertiti* has no engine aboard, power for the CB sets and various electronic navigation aids was provided by automobile batteries.

Hold It, Boy! That's Illegal! We recently heard of a couple of situations in different call areas which would seem to indicate that a certain illegal form of operation might be fairly widespread.

A youngster, below the required 18

(*Continued on page* 101)

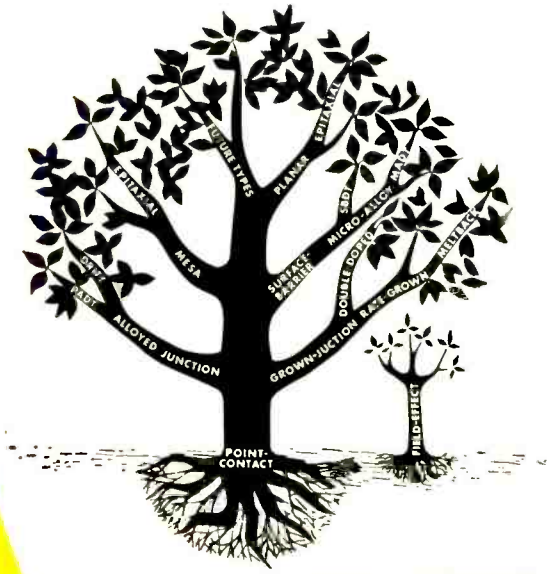
From a vantage point on the "King Tut," escort vessel for America's Cup Races contender "Nefertiti," Captain Fred Lawton used a Raytheon "Ray-Tel" TWR-2 CB radio to communicate with the 11-man crew.

Aboard the "Nefertiti," helmsman Don McNamara received advice from sailing coach Lawton on a Raytheon handie-talkie unit. The CB equipment was a valuable aid in the training of the crew members.

TRAN

Do epitaxial, alloyed junction, MADT, and mesa transistor types confuse you? Discover the transistor tree and you'll know the "how" and "why" for each

By LOUIS E. GARNER, JR.
Semiconductor Editor



SISTORS

TYPES & TECHNIQUES

SINCE THE INVENTION of the transistor over a decade ago, manufacturers have been constantly seeking new methods to produce better and more reliable units—transistors that would not only have a broader range of operating capabilities, but also be lower priced. Often, a process has been developed which is capable of producing low-cost units. But, by its very nature, such a technique has resulted only in low-frequency (audio) types. Another process may deliver extremely high frequency units, or transistors with closely controlled characteristics, but be rather expensive.

The net result has been a great variety of transistor types—over 2000 at last count—made by a dozen or more processes. Today, transistors are available with *betas* (gains) from 5 to over 50,000, power-handling capacities from milliwatts to hundreds of watts, and frequency capabilities from d.c. to thousands of megacycles. Prices, too, vary just as widely—from less than 50 cents to over $100 each, even in production quantities.

PNP and NPN. Except for specific electrical characteristics and maximum ratings, there are only two general types of triode transistors: *pnp* and *npn* units. These two classifications refer to the arrangement of the alternate layers of "*p*-type" and "*n*-type" semiconductor material making up the device.

Whether the semiconductor material itself is basically germanium or silicon, the "*p*-type" material conducts by means of the migration of positive charges (called "holes"). Similarly, the "*n*-type" material conducts by means of the movement of negatively charged free electrons through the crystalline structure.

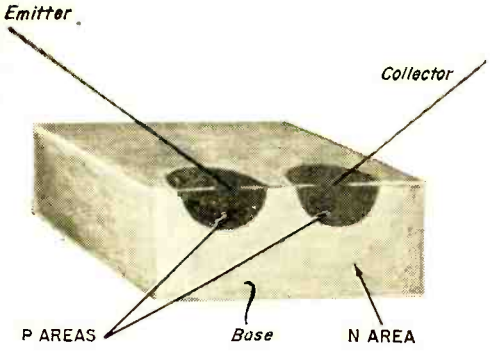
The fact that many transistor manufacturers refer to their products primarily in terms of their internal construction has led to a good deal of confusion for newcomers to the electronics field (and, often, for "old-timers" as well). One firm will refer to its line of *surface-barrier* transistors. Another will sing praises about its high-quality *mesa* types. Still another will point out the advantages of its *planar* units. Sometimes, even minor refinements in production techniques will lead to new designations and such jawbreakers as *VHF npn silicon epitaxial planar transistor*.

Such confusion, however, is really unnecessary—if you have some idea of what each basic type is all about. Let's look over the transistor tree and see if we can bring some order out of what may—for you—be chaos.

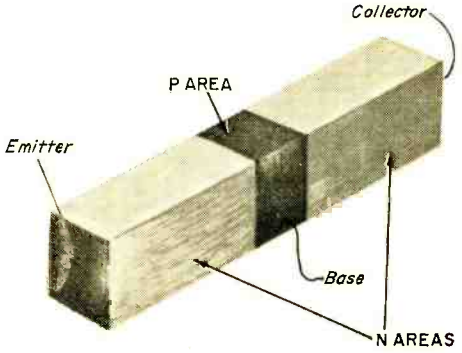
Point-Contact. Although now considered obsolete, the point-contact type was the original transistor... the first, and—for a while—the only, type produced. In its basic form, this type of transistor is made up of a small cube of *n*-type semiconductor material to which are attached two closely spaced fine metal wires or "cat's whiskers." The unit is treated during the manufacturing process so that atoms from the contact wires migrate into the semiconductor cube to form small *p*-type regions at their tips. One of the wires serves as the emitter electrode, the other as the collector, and the semiconductor cube is the transistor's base (hence the original name).

Point-contact transistors have extremely high gain and good high-frequency characteristics, but they are also

◀ **The transistor tree** groups together similar types in branches. Field-effect transistors are the beginning of a new semiconductor tree.



Point-Contact



Grown-Junction

unstable, noisy, and difficult to manufacture. In addition, it is difficult to produce this type of transistor to close production tolerances, making the units quite expensive.

Grown-Junction. As the name implies, this type of transistor is made by "growing" the *pn* junctions during the original crystal-forming process. Two basic types have been produced. In one, the semiconductor material (germanium, for example) is "doped" with chemical *impurity* elements to give it both *n*- and *p*-type properties with, say, the *n*-type predominating.

During the crystal-forming process, the growing rate is altered, changing the concentration of impurities so that alternate layers of *p*-type and *n*-type material are formed. A transistor cut from a crystal formed by this process is identified as a *rate-grown* type. (In a related manufacturing process, the concentration of impurity elements is changed by the addition of extra chemicals as the crystal is formed.)

Physically, grown-junction transistors are all quite similar in appearance and are essentially small rectangular bars of semiconductor material with alternating layers of *n*- and *p*-type material. Grown-junction transistors are relatively easy to manufacture and can be produced in large quantities inexpensively. In addition, they offer good high-frequency characteristics, low noise figures, and reasonably close tolerances.

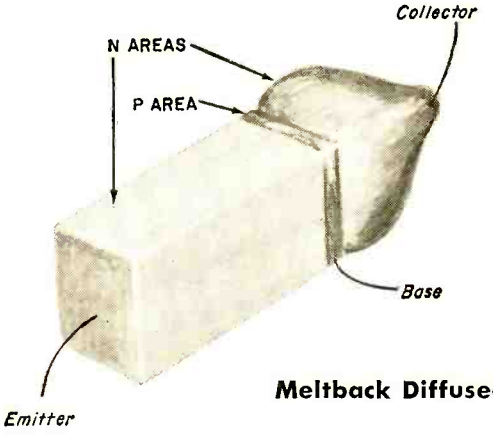
Meltback Diffused. This type of transistor is manufactured from a small rectangular bar of semiconductor material similar in appearance to a rate-grown transistor. However, it is cut from a crystal containing both *n*- and *p*-type impurity elements, with the *n*-type predominating. One tip of the bar is melted into a drop and allowed to recrystallize. During the "refreezing" process, the *p*-type element concentrates at the junction between the melted and unmelted parts of the bar, forming a thin *p*-type base layer. The meltback transistor has general characteristics very similar to those of grown-junction units, but often with somewhat better high-frequency response.

Alloyed Junction. As this is written, the alloyed junction transistor is perhaps the most popular type. It is manufactured in both *pnp* and *npn* units and has a wide range of electrical characteristics. The majority of high-power (multi-watt) transistors are alloyed junction types.

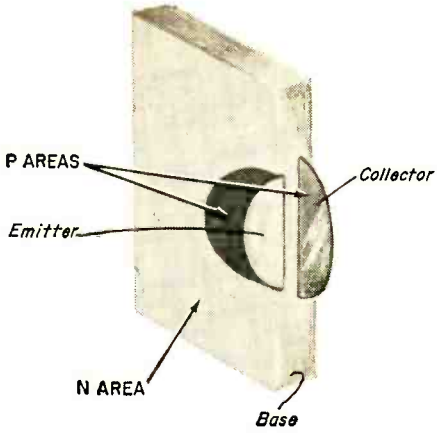
Again, the name gives a clue as to the manufacturing process, since the transistor is produced by alloying small pellets of metallic impurity elements to each side of a thin wafer of semiconductor material. If an *n*-type semiconductor is used, for example, the metallic pellets might be of indium.

During the alloying process, the metal diffuses into the wafer, forming regions of the opposite type of semiconductor on either side. The wafer itself becomes the base, while the opposite regions become the emitter and collector electrodes. As a general rule, the collector is made larger than the emitter.

Surface-Barrier. Sometimes known as an *SB* type, the surface-barrier transistor is produced by an electrochemical



Meltback Diffused

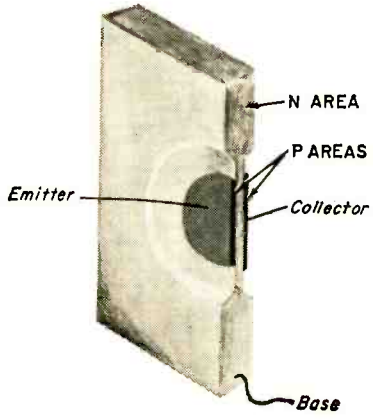


Alloyed Junction

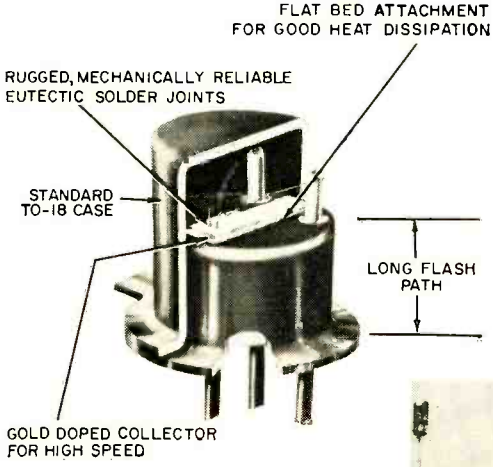
process which permits the formation of a very thin base region. Typically, a wafer of *n*-type semiconductor material is placed between two very fine streams of a metallic electrolytic solution. A d.c. potential is applied, causing the solution to etch away the semiconductor material.

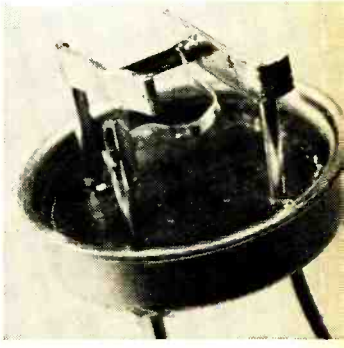
When the desired thickness is obtained, the d.c. polarity is reversed, permitting the metallic solution to plate small metal dots on opposite sides of the etched-out region. These metal dots become the emitter and collector electrodes, while the etched-out wafer becomes the transistor's base.

In some cases, the completed transistor is heated in an oven, permitting atoms from the plated-on metal dots to diffuse into the base wafer and forming a surface-barrier diffused type, or *SBDT* transistor. A modified, but related, etch-

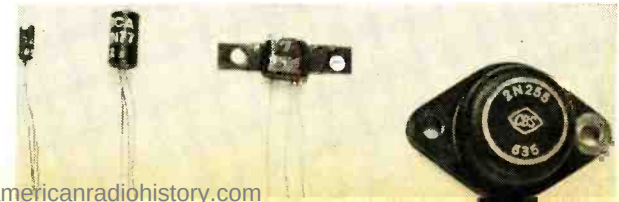


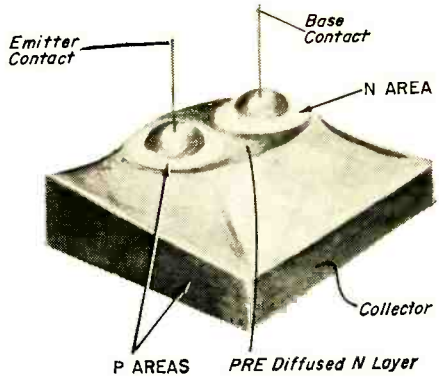
Surface-Barrier

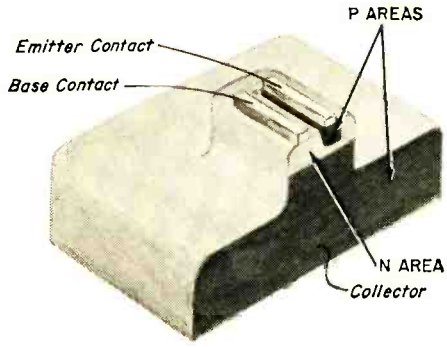




At left is cut-away view of post-alloy diffused type. Photo at right shows meltback diffused type with cover removed. Below (l. to r.) are subminiature, standard small-signal, medium power and high-power types of transistors.







Post-Alloy Diffused

Mesa

ing technique is used to produce micro-alloy (*MA*) and micro-alloy diffused type (*MADT*) transistors. All transistors of the "surface-barrier" family, including SBDT, SB, MA, and MADT types, are characterized by their excellent high-frequency response, but limited voltage-handling capability.

Post-Alloy Diffused. This transistor, popularly known as a *PADT* type, is built up on a wafer of *p*-type semiconductor (typically, germanium). A pre-diffusion process gives a controlled depth of *n*-type material on the surface of the wafer. Later, two metallic pellets are placed near each other on the *n*-side of the wafer. One pellet, which eventually becomes the base electrode, contains only *n*-type impurity elements. The other contains both *n*- and *p*-type impurities and eventually becomes the emitter. The wafer itself becomes the collector.

The assembly is heated under controlled conditions and the impurities in the base and emitter pellets diffuse into the semi-molten germanium. The *n*-type impurities are chosen to have a high rate of diffusion and penetrate deeply into the wafer to form an *n*-type layer. The *p*-type impurity in the emitter pellet diffuses slowly and to a limited depth.

Upon cooling and recrystallization, the emitter pellet region is predominantly *p*-type material and is separated from the *p*-type collector by a diffused *n*-type layer which acts as the base. The resulting assembly is then etched and leads are attached.

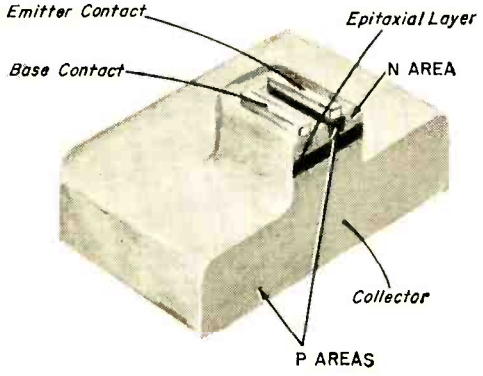
Mesa. This type of transistor derives its name from its physical appearance rather than from the manufacturing process used. Under a powerful microscope, the mesa transistor looks something like the flat-topped hills or mesas which characterize the Southwest. The name, of course, is derived from the Spanish word for "table."

The manufacturing process is a relatively simple one. A layer of, say, *p*-type semiconductor material serves as the collector. A thin film of *n*-type impurity is vapor-diffused on top of the *p*-type material to form the base region. Finally, the *p*-type emitter region is formed either by an alloying process or by vacuum evaporation techniques. An etching process is then used to produce the table-like structure which characterizes the mesa transistor.

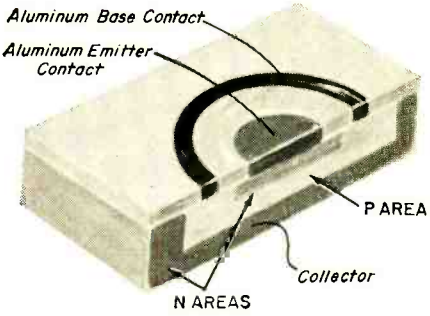
Mesa transistors are theoretically inexpensive to produce, and they have excellent high-frequency characteristics coupled with good power-handling capability.

Epitaxial Mesa. Physically, the epitaxial mesa transistor looks just like its "first cousin," the conventional mesa type. The difference between the two lies in the formation of a thin film between the diffused base region and the large *p*-type wafer which normally serves as the collector electrode.

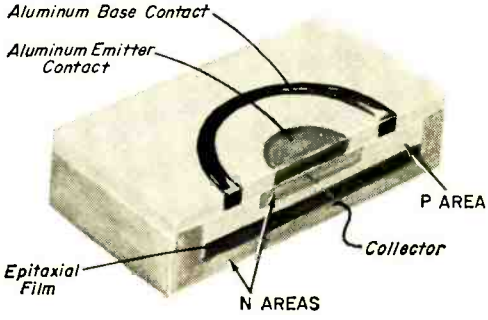
This film, known as an epitaxial layer because its crystalline structure is homogeneous with that of the main body collector, serves as an intermediate collector electrode. Even though it is the same basic *p*-type material, this film has electrical (resistivity) characteristics which are different from that of the main body collector, permitting the manufacturer to achieve an optimum compromise be-



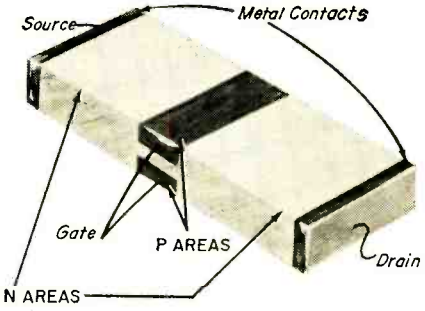
Epitaxial Mesa



Planar



Epitaxial Planar



Field-Effect

tween breakdown voltage and high-frequency characteristics.

Planar. As might be suspected from its name, the planar transistor is formed on a relatively flat surface or "plane," made by diffusing the emitter as well as the base regions. In practice, a layer of, say, *n*-type semiconductor material (generally silicon) serves as the collector. An oxide film is formed on the top surface to act as a mask to prevent the diffusion of impurities into the material. Base and emitter regions are then formed by removing portions of the oxide film and diffusing suitable *p*- and *n*-type impurities into the collector.

The base and emitter regions are formed in sequential steps, with oxidation and selective removal of oxide taking place prior to each diffusion step. Aluminum is deposited on both the base and emitter regions to provide low-resistance contacts. The final oxide film covers both junctions, preventing contamination and resulting in a *passivated* device with good electrical stability.

Epitaxial Planar. This type of transistor is virtually identical to the planar type, except for the addition of an epitaxial film, as discussed earlier. The manufacturing technique is similar to that used for conventional planars.

Both conventional and epitaxial planar transistors couple superb high-frequency response with excellent electrical stability. Their basic characteristics are similar to those of mesa types, except for increased power handling capablity and much lower leakage currents.

Field-Effect. A relatively new type, the field-effect device is a "transistor" only by definition, since its construction and operating principles are different from those of more familiar units. Even its electrodes have different names, being identified as *source*, *gate*, and *drain*, rather than as emitter, base, and collector. It has an extremely high input impedance (in the megohm range) and behaves somewhat like a low-voltage vacuum tube.

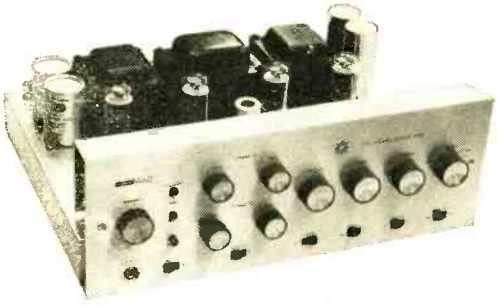
(Continued on page 100)

Hi-Fi Lab Check

Award Series—A50K Stereo Amplifier

Manufactured by Harman-Kardon, Inc., Plainview, L.I., N.Y.

Prices: $119.95 (kit); $12.95 (gray metal case); $29.95 (walnut veneer case).



MUCH LIKE a high-priced automobile maker, a hi-fi manufacturer might find himself in an embarrassing position upon entering the "compact" or moderately priced field. This could have been true in the case of Harman-Kardon—whose *Citation Series* includes the *luxury* stereo amplifiers and tuners of the kit market. Be that as it may, however, the moderately priced *Award Series* lives up to expectations and offers "something new" in kit assembly.

This "something new" is in the packaging, assembly process, and—of all things—in the liberal dose of tasteful "theory" that explains what is being wired and why. The builder can skip the theory if he wants, but we feel that he will miss a valuable by-product of kit construction if he does. After all, it's free (with the kit) and doesn't hurt at all.

The builder's first impression of the *Award Series* packaging is likely to be: "How de luxe can these things get?" The assembly manual folds out to form an easel and the resistors and capacitors are arranged, in order of use, on cards.

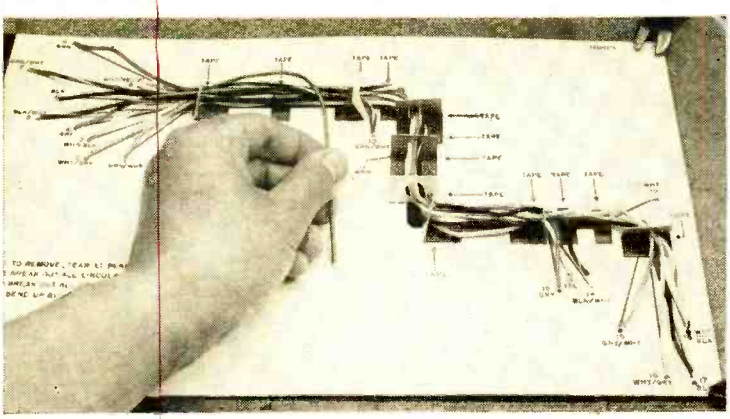
Wiring is straightforward, but here's a word of caution: don't skip the continuity tests—they're important. A kit assembled by the POPULAR ELECTRONICS staff was in working order after 10 hours and 15 minutes of construction time.

CIRCUIT REPORT: The A50K is an integrated stereo amplifier rated by the manufacturer at 20 watts per channel (1% distortion). Each channel consists of four 12AX7 triode sections, a single 12AU7 phase inverter triode section, and a pair of 7355 output tubes. A solid-state, high-voltage supply and d.c. heating of preamplifier filaments round out the circuitry.

Inputs are provided for the following: *Tape Head, Hi* and *Lo Phono* cartridges, *Tuner, Tape Amplifier,* and *Auxiliary.* A stereo headphone jack is part of the front panel control arrangement; inserting a phone plug into it disengages the speakers. Third channel output is provided at a low level to feed either a reverberation unit or a separate power amplifier.

Tape recording is facilitated by an output wired in after the preamp stages, plus monitoring inputs before the volume and tone controls. A novel *Blend* control (with indicator lamps) provides a means of judging the exact degree of channel mixing.

HIRSCH-HOUCK LAB CHECK: The power response of this amplifier is exceptionally flat. The A50K puts out as much

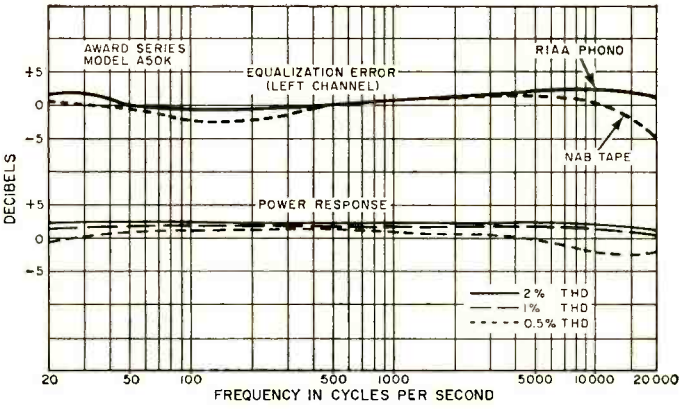


A jig or template is used to assemble the A50K's chassis wiring harness. Tie wires hold harness in shape as it is dropped into chassis. Leads are color-coded and offer a neat and orderly way of getting connections from front to rear of chassis without creating a "rat's nest."

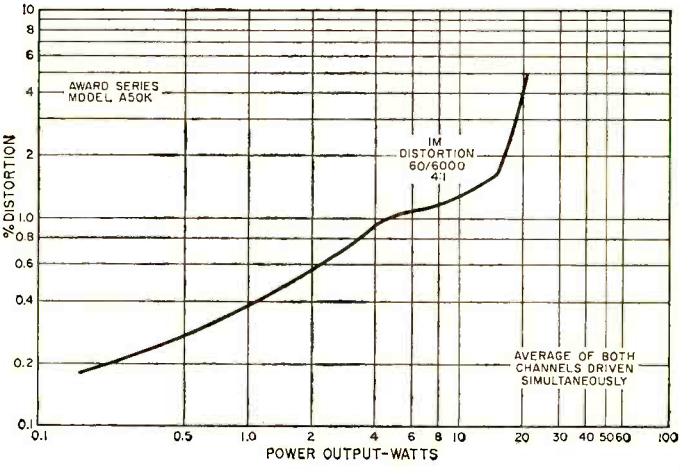
power at 20 cycles as it does at 1000 cycles, and almost as much at 20,000 cycles. This is insurance that low-efficiency speaker systems can be used without sacrificing orchestral instrument separation. Square-wave response is good, and the amplifier is stable with capacitive loads.

Tone control range and loudness compensation are modest, but seem adequate. The filters *(High-cut* and *Low-cut)* are excellent with sharp slopes. The scratch filter starts rather low, but presumably this would only be used on very bad recordings. Hum is inaudible with normal gain settings.

Maximum power output per channel from the A50K—with both channels driven—was 17 watts. This is a sine-wave measurement, not made to IHFM Music Power Standards. The top set of curves indicates that the equalization error was quite small.



Intermodulation distortion figures may be slightly higher than those given by the manufacturer due to the Hirsch-Houck Laboratories' method of testing.



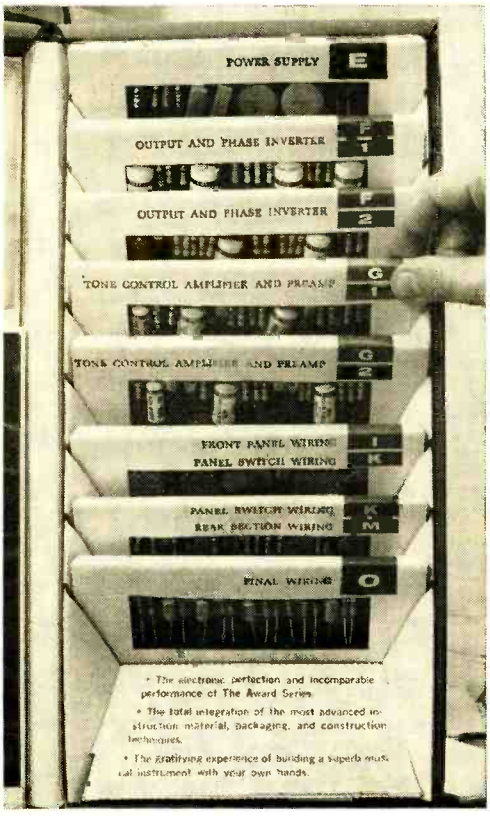
Hi-Fi Lab Check

A50K Amplifier (*continued*)

IN CLOSING: The A50K certainly represents *ne plus ultra* in kit packaging and comes equipped with one of the best instruction and assembly manuals we have seen. The POPULAR ELECTRONICS staff uncovered no errors in the manual and considered the 10-hour assembly time an excellent investment.

Sound-wise, the amplifier may seem slightly "bright" to users seeking jukebox bass. Instrumental definition will be particularly good, however, and if more bass is desired, the modest boost from the *Loudness* switch will be more than adequate at lower listening levels.

For more information from the manufacturer on the A50K, write to *Hi-Fi Lab Check*, POPULAR ELECTRONICS, One Park Ave., New York 16, N. Y.



Capacitors and resistors for the various steps in wiring the A50K are contained in small slip drawers. Each part is placed in the drawer in order of use.

Heathkit AA-121 Power Amp

Manufactured by Heath Co., Benton Harbor, Mich.

Price: $79.95 (kit).

THIS is the first of many Heathkit items that will eventually be reviewed in *Hi-Fi Lab Check*. It serves as an example of why Heath is one of the top names in kits, regardless of whether the application is hi-fi, test equipment, CB, ham, or home entertainment. With a Heathkit, you can depend on a clear-cut instruction manual, top-notch circuit design, and excellent value for your dollar.

The AA-121 is a power amplifier built to satisfy the cravings of the most power-hungry, low-efficiency speaker system. Very conservatively rated at 40 watts per channel, the AA-121 can be assembled in about 9½ hours.

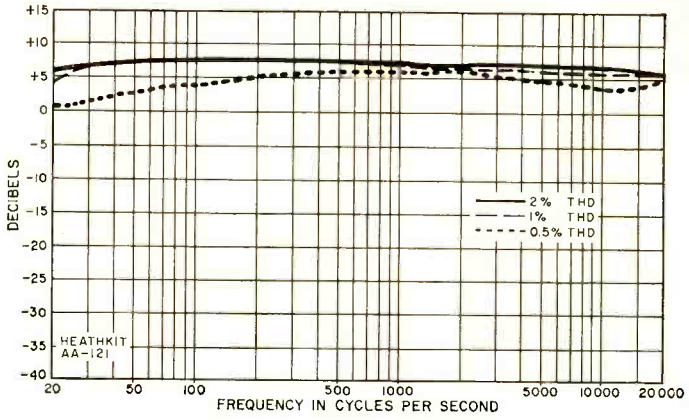
CIRCUIT REPORT: The two identical channels of the AA-121 consist of a 6AN8 pentode-section preamp and triode-section phase inverter, plus a pair of EL34 output tubes. The circuitry associated with the output tubes is patented by Heath and is referred to as "Ultra-Linear."

Solid-state high-voltage and bias rectifiers appear in the power supply. Fuse and Surgistor protection guarantee long life for the output tubes.

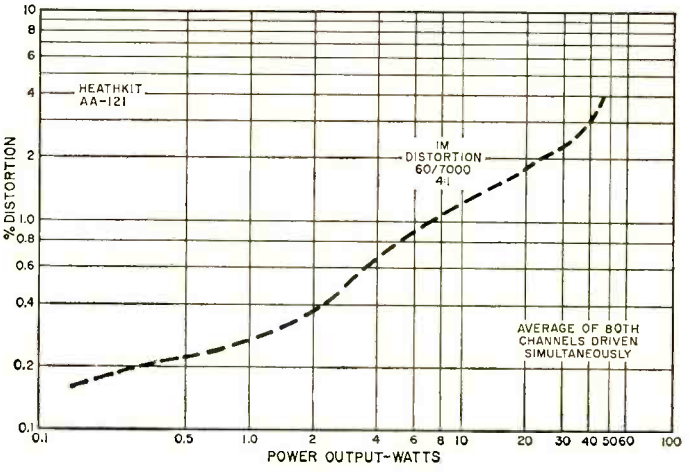
Input level controls are provided for each channel, and a slide switch ties both power amplifiers in parallel for monophonic operation. A center-channel speaker may be wired directly to the output connections. Phase reversal switching is also provided.

HIRSCH-HOUCK LAB CHECK: This power amplifier met or exceeded all claims and specifications with one exception. Power output, sensitivity, hum and residual noise, channel-to-channel separation, and

Power response for the left channels driven. The 0 db level output of 47 watts. The total harmonic distortion (THD) figures were obtained with both channels driven. The 0 db level is equivalent to 10 watts.



Intermodulation distortion is measured against equivalent sine-wave power output in watts. Many manufacturers do not rate IM when both channels are in operation. Thus, the Hirsch-Houck figures may be 1% higher than those advertised.



harmonic distortion were all better than Heath advertises for the AA-121.

Intermodulation distortion (IM) was somewhat higher than expected, but this is probably due to our method of testing. In all tests on stereo amplifiers, measurements are made with both channels driven. Occasionally, this may result in slightly higher IM distortion figures. It is noteworthy that, under the same measuring conditions, the AA-121 delivers 47 watts per channel (as opposed to the manufacturer's claim of 40 watts per channel).

IN CLOSING: The AA-121 is a good power amplifier kit for the beginner who wants to build a top-quality component-style hi-fi system. The chassis is comfortably laid out and the symmetry of parts arrangement permits quick double-checking for possible errors. But you can't go wrong if you follow instructions.

For more information from the manufacturer on the AA-121, write to *Hi-Fi Lab Check,* POPULAR ELECTRONICS, One Park Ave., New York 16, N. Y. —30—

IN THE WORKS

The following items are already in the process of being assembled and/or tested, and will soon appear in Hi-Fi Lab Check:

EICO ST-84 Stereo Preamplifier

Fisher KX-200 Integrated Stereo Amplifier

Heath GR-21 FM Table Radio

Knight KU-45 "Audio Center"

Lafayette LA-250A Integrated Stereo Amplifier

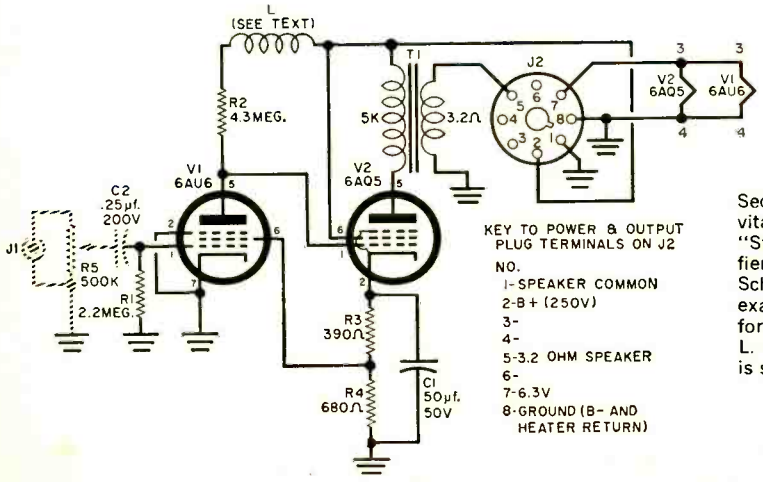
Paco ST-35PA FM Tuner

Scott LM-35 Multiplex Adapter

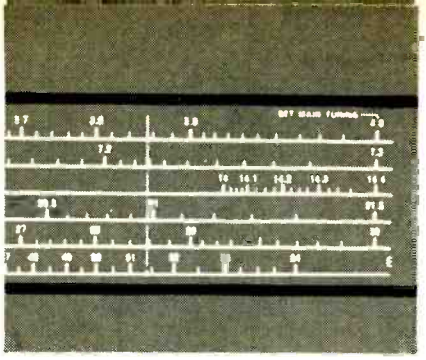
Add VITAMIN "L" to "STARVED CIRCUIT"

STRETCH a rubber band and it gets narrower. "Stretch" the gain of an amplifier with a "starved circuit" and the same thing happens—its frequency response gets narrower. The "Starved Circuit Amplifier" (see July 1961 POPULAR ELECTRONICS, p. 69) has a gain of about 25,000, but it also has a top limit of about 2500 cycles. While this is good enough to handle the human voice with clarity, music passing through such a narrow-band amplifier lacks "highs." By adding a little vitamin "L," however, the frequency response of this unit can be made equivalent to that of amplifiers costing much more.

In actual fact, the high-frequency response of the "Starved Circuit Amplifier" is seriously limited by the very component which is responsible for its tremendous gain—plate load resistor *R2*. Due to the extremely high value of this resistor, most of the signal at frequencies above about 2500 cycles is bypassed to ground by tube and stray capacitances. But placing an inductor (*L*) in series with the resistor will cancel this effect. The proper value of inductance will depend on the amount of stray capacitance in your particular amplifier, but will probably fall between 20 and 50 μh. —*Karl Anderson, KØJHC*



Secret additive (dubbed vitamin "L") will put the "Starved Circuit Amplifier" in the Big Leagues. Schematic diagram is exactly as before, except for addition of inductor L. Optional gain control is shown in shaded area.



Across the Ham Bands

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

TUNING IN SSB SIGNALS

THE OTHER DAY a young friend of mine reported that his recently purchased second-hand ham receiver (an inexpensive kit model) was "sick." Why? Because the phone signals he received were so distorted that he couldn't understand them—unless he turned the CW/Phone switch to the CW position. Of course, there was nothing wrong with his receiver; my friend was just hearing single-sideband (SSB) signals. More important, he had learned to make them intelligible—something that some SWL's and hams are slow to do.

The constantly increasing number of SSB stations appearing in the ham bands is due to SSB's superior "getting-out" ability, compared to conventional AM. But CW operators might logically question what value this ability could have for them. The truth is that the same techniques are used for receiving both CW and SSB signals. And being able to tune in the latter helps to get the best out of a ham receiver in any mode of operation.

Receivers capable of monitoring CW signals can be used for SSB signals, and the 75-meter ham phone band is a good place to listen for both. Let the receiver warm up thoroughly; if it has variable selectivity, turn the control to the 2- or 3-kc. position. Now, with the receiver set up for conventional AM reception, tune in a "sideband" signal—recognizable by its completely garbled sound—for maximum speaker volume or S-meter swing.

Retard the receiver's r.f. gain control, and advance its audio gain control full on. This done, advance the r.f. gain for comfortable speaker volume. Now turn on the receiver's BFO and carefully adjust the pitch control until the SSB sig-

Novice Frank Schnurstein, KN9IWG, of Forest Park, Ill. has worked 27 states and four Canadians on 40 and 15 meters. Frank transmits with a Hallicrafters HT-40 and uses Hallicrafters SX-140 and S-38E receivers.

John O. Battle, WN5CDQ, operates his Novice rig from a small building located behind his Terrell, Texas home. John's Globe Chief 65-A transmitter and National NC-109 receiver have put seventeen states in the logbook so far.

.....Novice Station of the Month.....

Iris Reeves, WH6ESL, 5216-B Ibis Ave., Ewa Beach, Hawaii, is the wife of a Coast Guardsman, the mother of four children, an enthusiastic Novice ham, and the first woman to win the "Novice Station of the Month" contest. Iris has worked 12 states, several Japanese (JA) stations, and other Pacific stations in three months on the air. She uses a Hallicrafters HT-40 transmitter and a Hallicrafters SX-140 receiver. You'll usually find WH6ESL on 7175 kc., but she also gets on 21 mc. occasionally. Iris is an active member of the Air Force Military Affiliate Radio System (MARS).

Iris will receive a 1-year subscription to P.E. for her photo. If you would like to try for a similar award, send us a picture of your Novice station—preferably showing you at the controls, and include with your entry some information about yourself, your equipment, and your activities. Entries should be sent to Herb S. Brier, POPULAR ELECTRONICS, P.O. Box 678, Gary, Indiana.

nal becomes intelligible. For further SSB reception, leave the pitch control at this predetermined position, and tune the receiver in the normal manner. Remember to use the r.f. gain control to adjust speaker volume.

Amateur SSB stations normally transmit lower sideband up to 7250 kc. and upper sideband on higher frequencies. This means that there are two possible adjustments of the pitch control for each SSB signal, depending upon whether upper or lower sideband is being transmitted. Once you determine the proper pitch control setting for the frequency range you are tuning, constant fiddling with the pitch control is largely a waste of time.

Sounds simple, doesn't it? The "catch" is that the tuning is very critical. With precise tuning, voices sound natural; mistuning by 50 to 100 cycles makes them sound like Donald Duck; and mistuning by much more than 100 cycles causes Donald to start talking Russian or Chinese. But with a little practice, acquiring the light touch required to tune in SSB signals is not too difficult.

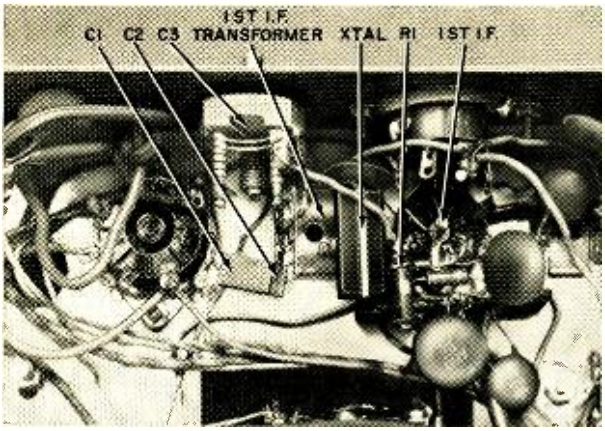
"Sweepstakes" Contest. On November 10-12 and 17-19, all U. S. and Canadian hams are invited to participate in the 29th Annual American Radio Relay League (ARRL) Sweepstakes Contest, using their favorite bands and mode of operation. The contest starts at 2300 GMT (1800 EST), Saturday, November 10, and ends at 0801 GMT (0301 EST), Monday, November 12; the same schedule is repeated the following weekend.

The rules in brief are to operate a maximum of 40 hours during the contest and work as many other hams as possible in the 72 ARRL "sections," exchanging message "preambles" with each station worked. (A request to the ARRL will get you a map of the 72 sections and a supply of "SS" log sheets by return mail.) Each "preamble" must contain the following information: number of the contact, station call letters, RST signal report, ARRL section, time (GMT), and date. You earn one point for each preamble sent, and another point for each one received, for a maximum of two points per station worked.

To figure your score, multiply your contact points by the number of ARRL sections worked; also, if your transmitter power is less than 150 watts, multiply again by 1.25 for CW or by 1.5 for phone contacts. Mail your score to American Radio Relay League, Inc., 38 LaSalle Rd., West Hartford, Conn.

RECEIVER CRYSTAL FILTER

All hams are familiar with the use of a quartz crystal to control the frequency of an oscillator. Comparatively few, however, realize that the characteristics that make a good frequency controller—high *Q* and excellent electromechanical stability—can also be applied

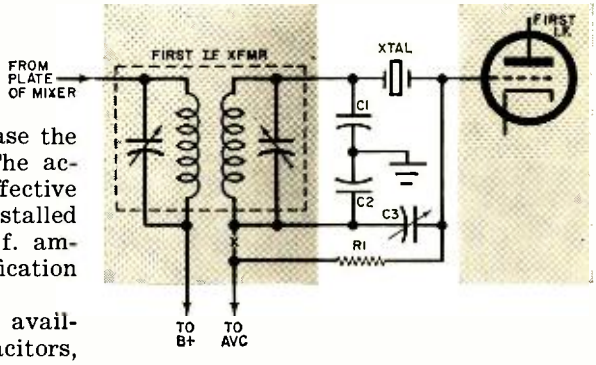


Circuitry of crystal filter as installed in a Heathkit AR-3 receiver. Both rotor and stator of C3 must be left ungrounded.

ADDED PARTS

C1, C2—47-μμf. ceramic capacitor
C3—10-μμf. midget variable capacitor (E. F. Johnson 15M11 or equivalent)
R1—470,000-ohm, ½-watt resistor
Xtal—455-kc., ± 0.05% quartz crystal (Texas Crystal TX455 or equivalent)
1—Crystal socket (Texas Crystal SSO-1 or equivalent)

Schematic diagram shows how filter circuit (white area) is wired between secondary of first i.f. transformer and grid of following tube.



in a simple crystal filter to increase the selectivity of a ham receiver. The accompanying diagram shows an effective filter of this type which can be installed in any receiver with a 455-kc. i.f. amplifier; the photo shows the modification carried out on a Heathkit AR-3.

The filter consists of a readily available 455-kc. crystal, three capacitors, and a ½-watt resistor. The capacitors, *C1*, *C2*, and *C3*, plus the capacitance of the crystal holder, form a capacitance bridge. When the variable capacitor is set to equal the capacitance of the crystal holder (thereby "balancing the bridge"), there is no output from the circuit. Now, when a frequency equal to the series-resonant frequency of the crystal is applied to the bridge input circuit, there is an output. Signals at this frequency are passed by the crystal to the first i.f. amplifier tube with little attenuation; but, because of the crystal's very high *Q*, the passband of the filter is not much more than a few hundred cycles wide.

A few construction hints may be helpful, although the photo and diagram are self explanatory.

Construction. After you break the connection between the secondary of the first i.f. transformer and the grid of the first i.f. tube, solder the junction of one side of *C1* and one side of the crystal to the part of the broken lead going to the first i.f. transformer. To the lead from the first i.f. tube, solder the junction of the other side of the crystal and one side of *C3* and *R1*.

A similar procedure is followed with the wire connecting the other side of the first i.f. transformer secondary and the a.v.c. circuit. Break this connection and solder the junction of *C2* and *C3* to the transformer side of the broken lead. The remaining end of *R1* is now soldered to the a.v.c. side of the broken lead. Connect the remaining leads from *C1* and *C2* to ground, and that's it.

In mounting capacitor *C3*, be careful not to ground either its rotor or stator terminal. Since adjustment of *C3* varies the shape of the filter's selectivity curve, it is helpful—but not absolutely necessary—to mount this capacitor where it is easy to reach. In the installation shown, the capacitor was mounted in the hole previously occupied by the Q-multiplier jack.

The crystal seen in the photo has solder terminals, but crystals mounted in

(*Continued on page* 109)

Transistor Topics

By **LOU GARNER,** Semiconductor Editor

WHILE most hobbyists and experimenters have worked with transistors and standard diodes, relatively few have used silicon controlled rectifiers—SCR's—in their projects. Yet these semiconductor devices have an almost unlimited range of applications. In fact, industrial and military manufacturers are employing SCR's in ever-increasing quantities.

Perhaps one reason experimenters use so few SCR's is that they're unfamiliar with the SCR's operation and circuitry. Actually, this is a multi-junction device which features an "all or nothing" conduction characteristic. Since it has an anode and a cathode, it acts much like a standard diode rectifier when in a conducting state—passing current freely in one direction and blocking current flow

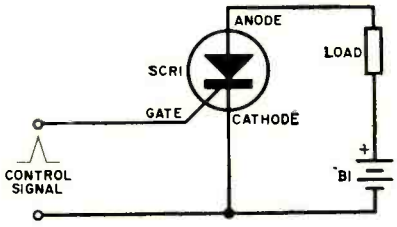


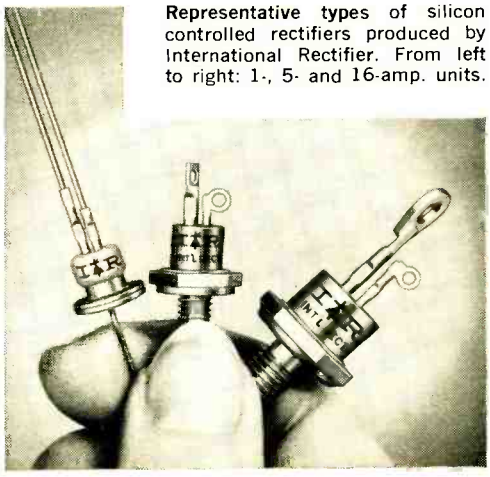
Fig. 1. Control signal applied to gate electrode causes silicon controlled rectifier (SCR1) to conduct, thus completing circuit between battery (B1) and load.

in the opposite direction. When in a non-conducting state, however, it acts much like an open circuit, blocking current flow in either direction.

A third electrode, or "gate," will "trigger" the device from a non-conducting to a conducting state when a small control (or signal) voltage is applied. In a sense, then, the SCR is a sort of solid-state electronic switch, roughly analogous to such gas-filled tubes as thyratrons and ignitrons. The control electrode (gate) serves as a simple trigger and doesn't have a linear control over the flow of anode-cathode current; for this reason, the SCR, unlike the transistor, can't be used as a standard amplifier.

A simple series circuit is shown in Fig. 1. Here, the SCR is connected between a source of d.c. power and a load device, such as a motor, solenoid, or lamp. Under normal conditions, and with no signal applied to the gate, the SCR acts as an open circuit, blocking the flow of current through the load. If the source voltage is increased, a point will eventually be reached at which the SCR will trigger (or "fire"), switching rapidly from a non-conducting to a conducting state. Thereafter, the SCR will continue to conduct as long as the source voltage is applied.

In practice, the source voltage is kept below the value at which "self-triggering" occurs. Under these conditions, the application of a small control voltage to the gate will trigger the device, switching it to a conducting state and



Representative types of silicon controlled rectifiers produced by International Rectifier. From left to right: 1-, 5- and 16-amp. units.

permitting the flow of a relatively large current through the load.

Once triggered, the SCR will continue to conduct as long as a d.c. voltage of the proper polarity is applied to its anode and cathode terminals. Therefore, it's common practice to use the device with a.c. power or to make some provision (such as a simple series switch) for opening the power source. With a.c. applied, of course, the unit switches "off" on alternate half-cycles and will remain off unless the control signal is reapplied (or applied continuously).

A typical experimental application for an SCR is illustrated in Fig. 2. Suggested by GE, this circuit employs an inexpensive SCR to control a small d.c. motor (as in a toy, for example). The SCR, in turn, is triggered remotely by a signal from a small r.f. transmitter.

As shown in the schematic diagram, the SCR is connected in series with the motor and the power source. The SCR's basic sensitivity is increased by deliberately biasing the gate to just below the unit's minimum triggering level. This is accomplished by voltage-divider *R1/R2*, with *R1* serving as a "sensitivity" control. A silicon diode, *D1*, is included in the biasing network to provide temperature compensation by varying the degree of bias with temperature changes. In operation, a burst of r.f. energy from a nearby transmitter, picked up by coil *L1*, increases the instantaneous bias on the gate, "firing" the SCR and turning on the motor.

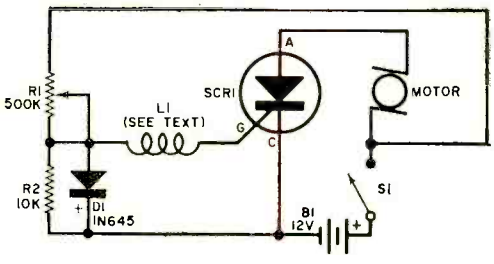


Fig. 2. Remote-control circuit employing a silicon controlled rectifier as the triggering device. Motor should be a 12-volt unit in order to match battery (B1).

The remote control circuit illustrated can be duplicated quite easily with readily available components. A GE Type C5F silicon controlled rectifier is used for *SCR1*, while *D1* is a type 1N645 diode. A standard potentiometer is suitable for *R1*, a ½-watt resistor for *R2*. A 12-volt battery is recommended for *B1*, and almost any small 12-volt motor can be used. The antenna coil (*L1*) should be chosen to suit the frequency of the control transmitter, with only a few turns needed in most cases. A variety of transmitters can be used for control purposes . . . typically, a CB unit, a low-power ham rig, or, in some cases, even a wireless broadcaster. The effective range varies with the power of the transmitter used, but will ordinarily be limited to well under 50 feet.

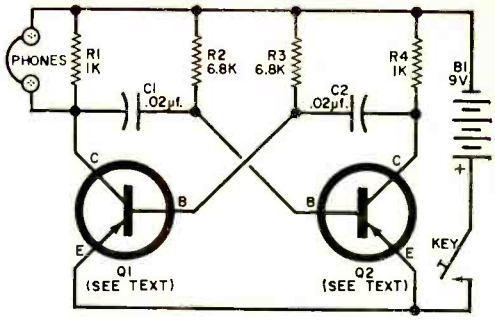


Fig. 3. Code practice oscillator built by reader Ron Raymer employs two pnp transistors in a standard multivibrator circuit. Layout is non-critical.

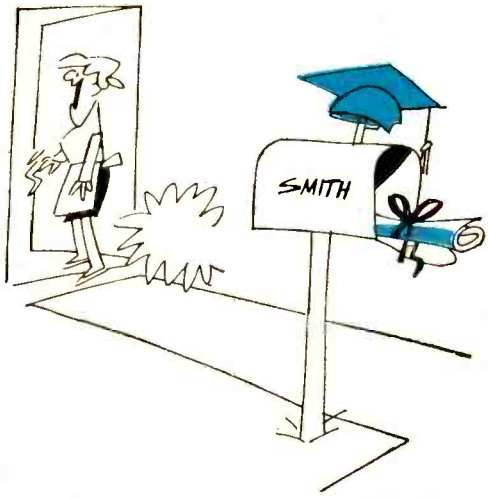
Several companies have published quite comprehensive manuals covering such topics as basic theory, manufacturing techniques, technical specifications, design methods, and suggested circuits for silicon controlled rectifiers. For further information on the SCR, write to such firms as the General Electric Co. (Genesee St., Auburn, N. Y.) and the International Rectifier Corp. (1521 E. Grand Ave., El Segundo, Calif.).

Readers' Circuits. As a construction project, the code practice oscillator (or CPO) rates high with both beginners and "old-timers." A necessity for anyone learning the radiotelegraph code, the CPO is also a useful device to have around the home workshop—it makes a handy signal source for checking intercoms, p.a. systems, and other types of audio amplifiers.

The circuit shown in Fig. 3 was submitted by reader Ron Raymer (1317 Conkling Ave., Utica, N. Y.). Ron's CPO is essentially a collector-coupled multi-

(*Continued on page* 106)

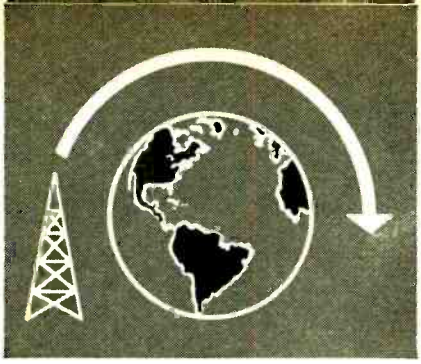
Hobnobbing with Harbaugh



"Fred! You passed your electronics correspondence course!"

Correspondence Schools

"Then it says, 'Congratulations; you have just assembled your instructor.' "



Monthly Short-Wave Report

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

SWL "FIELD DAY" LISTENING TEAMS

MANY SWL's as well as hams are enthusiastic about the "Field Day" held in June of each year and sponsored by the American Radio Relay League and affiliated amateur clubs. This is the occasion when amateur operators —either singly or in groups—work as many stations as possible within a given time limit and try to outscore each other.

The ARRL "Field Day" is 27 hours long (from 1600 on a Saturday to 1900 on the following Sunday, both times in EST), and the hams can operate no more than 24 consecutive hours out of the total period. Power for the various receiver and transmitter sites must be produced on the spot by gasoline or diesel generators, batteries, or other forms of "emergency" equipment.

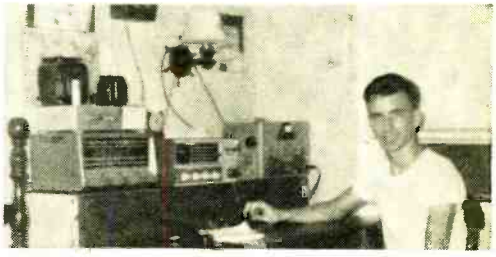
For the past several years, groups of SWL's have also banded together on Field Day to form listening teams. Some groups monitor only amateur stations while others devote themselves to monitoring the short-wave broadcast bands. Quite often, also, local ham clubs will find jobs for SWL's, ranging from custodian of the coffee pot to log-keeper, or messenger. (No actual operating is permitted unless a person is a licensed amateur.)

Field Day, 1963, is still a long way off, but this is a good time for groups of DX'ers who intend to form listening teams to make their plans. If you want to organize such a group, here are some of the specific details that will need your attention.

It stands to reason that the more operators you have in your group, the more successful you may be. On the other hand, just you and a buddy can do a bang-up job of monitoring that might make larger groups sit up and take notice. Now is the time to determine how many operators you will have.

Work up a schedule that will allow each operator an equal amount of time to listen and to log. This schedule should be set up to suit the convenience of the various operators and not necessarily that of the head man; as boss of the crew, you will have to fill in whenever others are not available. Make up a list

Stephen Jamour, WPE3ATN, of Philadelphia, Pa., DX's with a Hallicrafters S-107 aided by a Heath Q-Multiplier. Other equipment in his well-stocked shack: two more Hallicrafters receivers (S-38 and S-38D), a National NC-66, Knight "Ocean Hopper," and an Emerson "Vanguard 88" transmitter.



Walter Schulz, WPE3AYB, is also located in Philadelphia, and also combines SWL'ing and hamming (his ham call is K3OQF). On the short waves, he uses a Hallicrafters S-38E receiver with a Heath QF-1 Q-Multiplier; he has 50 countries heard, 16 verified. Walter transmits with a Heath DX-20.

Bill McFarland, WPE4EVM, of Tuscaloosa, Alabama, listens with a Lafayette HE-10 and a Zenith "Trans-Oceanic" receiver. Bill's antenna is 100′ long.

of the equipment available, work out antenna details, and get your log books ready. And, perhaps most important, determine *where* your activities will take place. An empty garage is ideal in case you have sudden thunderstorms. A "pup" tent or two will make the situation more realistic.

Assign various jobs to all hands for those times when they are around but not operating, and assign these jobs on a "no work, no operating" basis. Log-keeping is an important detail. Also, you'll want to assign someone to keep the food and soft drinks coming. And don't overlook a rather special item if you operate outdoors—bug spray.

Last but not least in the factors to be considered is the availability of power. We know of one SWL group that really went all out for one of these exercises; they depended completely on generators to supply current. But first-year Field Day'ers might find it advisable to settle for commercial a.c. operation.

Make your tentative plans now, in cold weather, so that you'll be ready for that big weekend next June. And be sure to let us know how you make out!

(*Continued on page* 111)

ENGLISH-LANGUAGE NEWSCASTS TO NORTH AMERICA

All of the stations that are listed here specifically beam English-language newscasts to the U.S.A. at the times indicated. The times may vary a few minutes from day to day.

COUNTRY	STATION	FREQUENCY *(kc.)*	TIMES *(EST)*
Australia	Melbourne	11,710	0745, 1016
Bulgaria	Sofia	9700	1900, 2000, 2300
Canada	Montreal	15,190, 11,760	1800
Czechoslovakia	Prague	7345, 9550, 9795, 11,990, 15,285	2000, 2330[1]
Denmark	Copenhagen	9520	2100, 2230
East Congo	Leopoldville	11,755	1630, 2100, 2230
England	London	17,860 15,375 15,300 11,780	1100, 1200 1800, 1900 0930, 1100, 1200 2100, 2200
Hungary	Budapest	11,890, 9833, 9770 9833, 9770, 7220	1900 2230
Italy	Rome	11,905, 9575	1930, 2205
Lebanon	Beirut	15,295	1600
Netherlands	Hilversum	11,730, 9715, 6020 6035, 5985	1630 (ex. Sun.) 2030 (ex. Sun.)
Portugal	Lisbon	9740, 6025	2105, 2305
Spain	Madrid	9363, 6130	2215, 2315, 0015
Sweden	Stockholm	17,840 11,805	0900 2045, 2215
Switzerland	Berne	11,865, 9535, 6165	2030, 2315
USSR	Moscow	9650, 9630, 9620, 7320, 7290, 7240, 7220, 7200, 7180, 7170, 7150[2]	1700, 1900, 2000, 2100, 2300, 0000, 0040
West Congo	Brazzaville	11,725	2015
West Germany	Cologne	9605, 6140 9735, 6110	1920 0000

1. At 2330, 11,745 kc. replaces 15,285 kc.

2. Not all channels are in use at any one time.

BUILD 20 RADIO CIRCUITS AT HOME with the New PROGRESSIVE RADIO "EDU-KIT"®

Reg. U. S. Pat. Off.

A Practical Home Radio Course

only **$26.95**

Training Electronics Technicians Since 1946

Now Includes

- ★ RECEIVERS
- ★ TRANSMITTERS
- ★ SQ. WAVE GENERATOR
- ★ SIGNAL TRACER
- ★ AMPLIFIER
- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ EXCELLENT BACKGROUND FOR TV
- ★ SCHOOL INQUIRIES INVITED
- ★ Sold In 79 Countries

YOU DON'T HAVE TO SPEND HUNDREDS OF DOLLARS FOR A RADIO COURSE

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL.

You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 20 Receiver, Transmitter, Square Wave Generator, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the complete price of $26.95. The Signal Tracer alone is worth more than the price of the entire Kit.

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment.

Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are 20 Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector Circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 20 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, volume controls and switches, etc.

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

FREE EXTRAS

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

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

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

PRINTED CIRCUITRY

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

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

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

UNCONDITIONAL MONEY-BACK GUARANTEE

ORDER DIRECT FROM AD—RECEIVE FREE BONUS RESISTOR AND CONDENSER KITS WORTH $7

- ☐ Send "Edu-Kit" postpaid. I enclose full payment of $26.95.
- ☐ Send "Edu-Kit" C.O.D. I will pay $26.95 plus postage.
- ☐ Rush me FREE descriptive literature concerning "Edu-Kit."

Name.....

Address.....

.....

PROGRESSIVE "EDU-KITS" INC.

1186 Broadway, Dept. 598-D, Hewlett, N. Y.

Hello-o-o-o There!

By
JOHN T. FRYE
W9EGV

a Carl and Jerry Adventure

A COLD November rain beat against the windows of the room Carl and Jerry occupied in the H-3 Residence Hall of Parvoo University. Jerry was studying alone in the room, but now the door opened and Carl came in wearing a glistening wet yellow slicker. He stood expectantly just inside the door until his chum turned around in his chair and looked at him curiously.

Carl deserved the curious stare. A rapid squeaking sound like the voice of a bat came from him, and little objects of some sort darted rhythmically back and forth across the lenses of his horn-rimmed glasses.

"What on earth is the matter with your glasses?" Jerry demanded.

"Oh, so you noticed my lens-wiper invention," Carl said casually, reaching into his pocket and doing something that stilled the sound and the flickering movement in front of his eyes. "I thought you might not," he added as he carefully unclipped a spidery mechanism from the heavy frames of his glasses.

"It's really quite simple, something any near-genius could have thought up," he said modestly. "This little PM fractional horsepower d.c. motor drives two reversing screws from the level-wind mechanisms of old fishing reels. A bracket attached to each traveling pawl riding in the screw thread carries the little rubber wiper blades back and forth across the lenses. The whole thing clips to the frame of the glasses, and the battery and switch are carried in my pants pocket. Raindrops don't bother me at all now, and I'm sure snowflakes won't either. It takes a little will power, though, to keep from batting your eyes every time the wiper blades cross in front of them. . . What do you think?"

"I think you better throw that thing on the floor and let me hit it with a shovel," Jerry retorted. "Our reputation for sanity on this campus is not too good anyway, and it will never stand the strain of something like that. You've not been wearing the goofy thing around the campus, I hope."

"I was wearing it on plaque patrol down along the river, but if the students and faculty can get used to seeing those seniors sporting their scraggly beards, they shouldn't flinch at any idiosyncrasy," Carl retorted.

"What kind of patrol were you on?"

"Plaque, spelled p-l-a-q-u-e. Oh, I forgot you didn't know about that. Last night some guys from H-2 stole a big bronze plaque out of our trophy case. Someone spotted them going out the door with it, and a gang of H-3 boys set off in pursuit. The 'thieves' took off in their car with our men in another car

(*Continued on page* 92)

New Products

COLOR TV RECEIVER KIT

A color television receiver in easy-to-build kit form, the CK-321 has a 21" screen. All critical circuits are fully prewired, adjusted, and tested, and simplified instructions enable you to build the set even without previous electronics experience. You have the option of either a self-contained 10-watt hi-fi audio system, or a cathode follower circuit for use with an external hi-fi system. With the hi-fi system, the price of the kit is $439.00; with the cathode follower circuit, $419.00. (*Transvision Electronics, Inc.*, Yonkers, N. Y.)

FM PORTABLE RADIO KIT

Vernier tuning, a tone control, and a big (4" x 6") speaker are some of the features you get in the Heathkit GR-61 portable FM receiver. Weighing six pounds, this battery-powered unit has a push-pull output stage and a phone jack for private listening. In addition to the built-in whip antenna, there are terminals for connecting an outside antenna. The case is suntan simulated leather with a beige grille to match that of the Heath XR-2L portable AM receiver. The kit sells for $54.95, plus $1.10 for the battery. (*Heath Co.*, Benton Harbor, Mich.)

HOME FIRE ALARM SYSTEM

Lafayette's new ML-290 automatic fire alarm system for use in the home consists of six thermostatic detector switches, a two-horn alarm signal, 150 feet of control wire, a manual test button, mounting staples, and battery. The detector switches are U.L.-approved, and each covers an area of up to 400 square feet. Additional switches and signals may be added if desired. Price of system, $29.95. (*Lafayette Radio Electronics Corp.*, 111 Jericho Turnpike, Syosset, L. I., N. Y.)

(*Continued on page* 90)

Shop at with

Xmas Shopping is Easy with Heathkit!

With a Heathkit Catalog you can relax and enjoy Christmas shopping—gift giving without ever leaving your living room! You'll find a Heathgift for everyone on your list, regardless of interest, from beginner to experienced technician. And you give so much more with Heathgifts, for you save two ways—by buying direct from Heath and by buying in kit form. Savings that total 50% or more!

Heathgifts are fun to give, fun to own, and they're fun to build . . . so much so that you'll be tempted to build them all before giving! Simple instructions enable you to complete any kit in your spare time—in a matter of hours—and they are unconditionally guaranteed to perform to factory specifications.

So give the best in electronic kits, give Heathgifts. Call or write our gift counselors if you need help or give a Heathgift certificate. Begin making your Heathgift List today and place your own name at the top!

Buy Now— No Money Down!

Here's help for your Xmas Budget! Order your Heathgifts now, and any purchase of $25 to $600 can be paid for later on Heath's liberal time-pay plan. *No money down!* Take *as long as 18 months to pay!* You'll find complete details in the new Heathkit catalog. Make out your Heathgift order and mail it today!

NEW 23" High Fidelity TV Kit—None Finer at Any Price!

SAVE $10, order GR-52, TV chassis & cabinet.....**only $249.95**

SAVE $6, order GR-62, TV chassis & wall mt.....**only $189.95**

OPTIONAL U.H.F. TUNER: Add at any time! Tunes U.H.F. Ch. 14-82. Mounts inside TV chassis. Complete with knobs and adapter strip. Factory assembled and aligned, ready to install.

GRA-22-3, no money dn., $5 mo.....**$27.95**

An outstanding TV value! Exclusive Heathkit advanced-design features include latest TV circuitry to bring you *both* Hi-Fi picture and sound! Incorporates the finest set of parts & tubes ever designed into a TV receiver. Easy to build too! . . . all critical circuits (tuner, I.F. strip & Hi-voltage sections) are supplied as factory-built, aligned and tested sub-assemblies, ready to install. The rest is easy with two precut, cabled wiring harnesses and circuit board. 70 lbs.

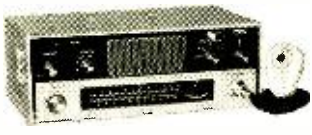
Kit GR-22, no money dn., $16 mo. .**$169.95**

BEAUTIFUL MODERN CABINET: Styled to match Heathkit AE-20 Hi-Fi Cabinets in rich, walnut solids and veneers. Complete with picture tube mask, chassis mounting board and extended-range 6" x 9" speaker for GR-22 TV set. Measures 36" W x 32⅜" H x 20½" D.

GRA-22-1, no money dn., $9 mo.....**$89.95**

"CUSTOM" TV WALL MOUNT: For rich, attractive custom wall installations. Includes cut and drilled board for TV chassis. Unfinished white birch. Measures 19⁹⁄₁₆" H x30⁵⁄₁₆" W x 1¹¹⁄₁₆" D. 13 lbs.

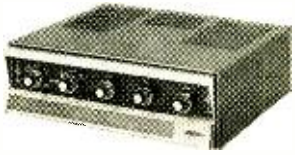
GRA-22-2, no money dn., $5 mo.....**$25.95**



NEW Deluxe CB Transceiver

4-tone selective call circuitry; 5 crystal controlled transmit & receive channels; variable receiver tuning; built-in 3-way power supply for 117 v. ac, 6 or 12 v dc; and more! Most complete CB unit ever designed!22lbs.

Kit GW-42, no money dn. **$119.95**

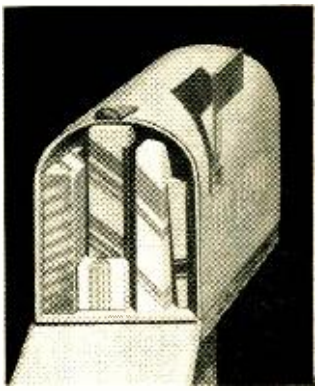


NEW Advanced Transistor Stereo Amplifier

Smooth power—superb dynamic range! 100 watts IHFM Music Power rated, 70 watts Heath rating. 13 to 25,000 cps response @ rated output. 28-transistor, 10 diode circuit. 28 lbs.

Kit AA-21, no money down, $13 mo.**$134.95**

Home and Save
HEATHKIT®



NEW 10-Transistor FM Car Radio

88 to 108 mc coverage; better than 1.25 microvolt sensitivity; AFC for drift-free FM reception; tone control. Factory-assembled tuning unit; easy circuit board assembly. 7 lbs.

Kit GR-41 . . . no money dn., $7 mo. . . **$64.95**

Hear It for Yourself!

Send for this Heathkit organ demonstration record . . . listen to the beautiful voices, rich mellow tone and astounding range of expression offered in this sensational instrument. Send just 50c to cover cost of handling and postage on this 7"—33⅓ rpm record. **Ask for record GDA-232-3.**

ANOTHER HEATHKIT FIRST!
A Real 2-Manual Organ for Only $329.95

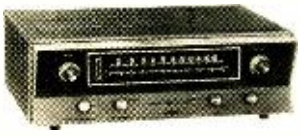
The exclusive Heathkit version of the all-new Thomas Transistor Organ now, for the first time, offers you a real two-manual organ at the market-shattering low price of only $329.95 in easy-to-build kit form! Compares in features and performance with assembled units costing well over $700. Features two 37-note keyboards; 10 true organ voices; 13-note pedal bass; variable vibrato; expression pedal; variable bass pedal volume; manual balance control; correctly positioned overhanging keyboards; built-in 20-watt peak amplifier and speaker system; beautifully factory assembled and finished walnut cabinet.

Kit GD-232 (less bench) . . . no money dn., as low as $22 mo. . . . **$329.95**

NEW FM Portable Radio

10-transistor, 2-diode circuit; vernier tuning; AFC for drift-free reception; tone control; 4" x 6" speaker; built-in antenna; prebuilt tuning unit. Battery lasts to 500 hrs. 6 lbs.

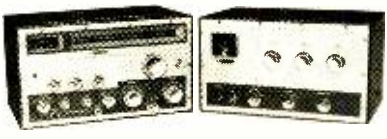
Kit GR-61 . . . no money dn., $6 mo. . . **$54.95**



NEW FM/FM Stereo Tuner

Stereo Indicator light; phase control for max. separation and lowest distortion; adjustable AFC for drift-free reception; bar-type tuning indicator; filtered outputs for stereo tape recording. Factory assembled tuning unit. 16 lbs.

Kit AJ-12 . . . no money dn., $7 mo. **$69.95**



NEW Heathkit SSB "Six Pack"

A brand new SSB exciter and linear amplifier for six meter operation; 125 watts P.E.P.! Only $289.90 for the pair . . . less than the cost of most transverters. Loaded with extras for maximum efficiency and operating convenience!

Kit HX-30 Exciter **$189.95**
HA-20 Linear **$99.95**

World's Biggest VTVM Value!

Measures AC volts (RMS), AC volts (peak-to-peak), DC volts, Resistance and DB. Has 4½" 200 ua meter, precision 1% resistors and 11 megohm input. Slim, all-purpose test probe incl. 5 lbs.

Kit IM-11 Special Value Price, ... **$24.95**

HEATHKIT by Daystrom

PLEASE SEND FREE 1963 HEATHKIT CATALOG

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Address

City Zone State

HEATH COMPANY
Benton Harbor 10, Michigan

Order direct by mail or see your Heathkit dealer

Ship Parcel Post Express C.O.D. Best Way

Ordering instructions: Fill out the order blank, include handling & parcel post according to weights shown. Express orders shipped delivery charges collect. All prices F.O.B. Benton Harbor, Mich. A 20% deposit is required on all C.O.D. orders. Prices subject to change without notice. Dealer and foreign prices slightly higher.

ITEM	MODEL NO	PRICE

Products

(*Continued from page* 87)

HOLLOW-SHAFT NUTDRIVERS

Hollow, hex-shaped shafts of hard tempered steel and twist-proof, unbreakable handles are among the features of the improved "Hold-E-Zee" nutdrivers. Produced in nine different sizes, for 3/16" to ⅝" nuts, the drivers' hex-shaped shafts hold the nuts securely and allow you to use a wrench to apply extra torque for those really tight ones. Stubby versions are also available for ¼" and 5/16" nuts. Prices range from 85 cents to $1.75. (*Upson Brothers, Inc.,* Rochester 14, N. Y.)

TUBE TESTER

Available in both kit and factory-wired form, the Paco T62 tube tester lets you check just about any tube—miniature, nuvistor, novar, octal, loctal, TV picture, battery, and even many industrial and European types. Tests can be made for inter-element shorts, cathode emission at optimum preselected plate loads, gas content, and grid emission. The tester sells for $49.95 in kit form and $67.95 wired. (*Paco Electronics,* 70-31 84th St., Glendale 27, L.I., N. Y.)

TRANSISTORIZED MEGAPHONE

American Geloso's Model 2581 power megaphone can be heard up to 500 yards away. The transistorized "Amplivoice," which operates from six C-type batteries lasting up to 6 months with ordinary usage, is constructed to withstand rugged, outdoor use and is resistant to large extremes of temperature or humidity. The microphone is of the dynamic type, and the unbreakable speaker cone is made of high-impact nylon plastic. Acoustical qualities are said to be excellent, the sound remaining clear and sharp even under extreme amplification. Price, $89.95. (*American Geloso Electronics, Inc.,* 251 Park Ave. South, New York 10, N.Y.) —30—

CONTINENTAL '100' (EL 3585) shown on top: transistorized 7 lb., battery portable • records 2 hours on 4" reel, from any source • plays back thru self-contained speaker as well as radio, TV or record player • response: 100-6000 cps • tapes interchangeable with other 2-track 1⅞ ips machines • constant-speed operation • complete with **dynamic microphone.**

CONTINENTAL '200' (EL 3541) shown bottom right: 4-track stereo head output direct to external stereo preamp for portable high fidelity tape-deck applications • completely self-contained for 4-track mono record and playback • mixing facilities • lightweight, compact • dynamic microphone.

CONTINENTAL '300' (EL 3542) second from top: 4-track stereo playback (tape head output) • self-contained 4-track mono record-playback • 3 speeds • mixing facilities • dynamic microphone • self-contained phono/P.A. amplifier/speaker system • ideal for schools, churches, recreation centers, etc.

CONTINENTAL '401' (EL 3534) bottom left: Four-track stereo and mono recording and playback • 4 speeds • fully transistorized • completely self-contained, including dual recording and playback pre-amplifiers, dual power amplifiers, two loudspeakers (second in lid) and dual element stereo dynamic microphone • can also be used as a quality hi-fi reproducing system, stereo or mono, with tuner or record player • frequency response: 60 to 16,000 cps at 7½ ips • wow and flutter less than 0.4% at 7½ ips • signal-to-noise ratio: —40 db or better.

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IN CANADA AND THROUGHOUT THE FREE WORLD, NORELCO CONTINENTAL IS KNOWN AS 'THE PHILIPS'.

Hello-o-o-o There!

(*Continued from page* 84)

right behind them. Finally, they were cornered down along the river; but the plaque was not with them. They had ditched it somewhere.

"Fellows from H-3 went over the route the thieves had followed almost inch by inch without finding the plaque," Carl continued, "and it was decided that the jokers must have heaved it into the river which runs parallel to the road for a half mile or so. We're keeping a constant patrol of that stretch to make sure the thieves don't recover the thing before we have a chance to find it. They probably know exactly where they threw it, but we don't. Given a chance, they could sneak in there, fish it out, and be one up on us."

"How do you intend to locate it? A half mile of swollen muddy river is quite a haystack."

"That's what's bugging us. We've messed around some with rakes and grabhooks, but that's pretty discouraging. The thieves were in a convertible, and a fellow standing up in it could have sailed the plaque quite a distance out into the river. If the plaque lit on its face, there would be a good chance of hooking the wire across the back of it; but the odds are 50-50 it lit on its back in that soft mud at the bottom, and a rake would pass right over it."

"How about diving?" Jerry suggested.

"The water is too cold and too muddy. You can't see in more than a couple of inches of the stuff; so you'd just have to feel for the plaque. Remember: it can be anywhere along that half-mile stretch and anywhere from five to seventy-five feet from the bank. Several fellows say they will dive for it when we locate it, but they simply can't invite pneumonia searching for it."

"Hm-m-m, it seems we have ourselves a challenging problem. Since the thing is bronze, of course no sort of magnetic detection will work."

"Yeah, we thought of that. I guess what we need is some sort of cheap and dirty sonar."

"Say that again!" Jerry exclaimed as

new and available now!

"MESSENGER TWO" CB TRANSCEIVER

"TONE ALERT" SELECTIVE CALLING SYSTEM

- **10 channels at flip of a switch – illuminated indicator!**
- **Increased sensitivity, high adjacent channel rejection!**
- **New . . . high efficiency noise limiter circuit!**
- **Provision for plug-in selective calling system!**

Here's the new "Messenger Two" – with everything you've ever wanted in CB transceiver! Basic circuitry is patterned after the popular "Messenger". Highly efficient circuit design makes full use of maximum legal power . . . delivers a penetrating signal that "outperforms 'em all!" Looking for maximum receiver sensitivity? This unit is hot – pulls in signals you wouldn't know were around with less sensitive equipment . . . and adjacent channel rejection is tops! Tired of noisy receiver? New, noise limiter circuit in the "Messenger Two" lets you know what QUIET really means in a CB rig! Positive acting "squelch" and automatic volume control circuits – 10 channel coverage – push-to-talk microphone. Only 5⅝" x 7" x 11⅜", easy to install anywhere.

Cat. No. 242-162 115 VAC and 6 VDC.....**$169.95**
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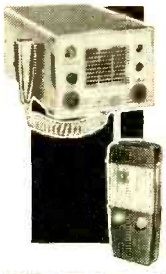
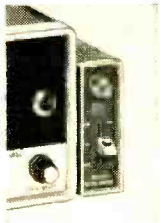
5 CHANNEL "MESSENGER" TRANSCEIVER . . . Now at a new lower price, the big seller in the CB field! Excellent sensitivity and selectivity – punches out a power-packed signal! "Squelch" circuitry.....
Priced from **$129.95 NET**



1 WATT AND 100 MILLIWATT "PERSONAL MESSENGERS"—Compact, 11 transistors and 4 diodes. Superhet receiver with exclusive tuned RF amplifier gives twice the sensitivity and 40% more range than similar units with conventional circuitry—more output than similar units with same rated inputs! Priced from **$109.50 NET**

SEE YOUR DEALER-DISTRIBUTOR AND ASK FOR A DEMONSTRATION



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The ultimate for any CB installation – designed for serious industrial, police and emergency use. Mutes speakers on your units until one calls another – then automatically your stations receive audio note and indicator light flashes "on", remaining lighted until call is answered. Eliminates annoyance of hearing "skip", electrical noise, or transmissions not meant for you!

- Not a kit, ready to go! Plugs into "Messenger Two", fast hook-up to your existing equipment!
- Sharp selectivity guards against random triggering which broad response units can't prevent!
- Wide range of tones permits 37 different systems to operate on the same channel without overlap. Plug-in reed locks unit "on # channel"—no missed calls due to "wrong" position on selector switches!
- Universal mounting bracket for left, right, or remote mounting under dashboard or desk!
- Tone signal heard beyond normal voice communication distance, increasing coverage by miles!

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his eyes took on their glazed, deep-thought appearance.

"I said I guessed we needed some sort of cheap and dirty sonar."

"Precisely! And I know exactly where we can get it. Come on. Let's find someone with a car who can drive us to my cousin's about twenty miles east of here."

WHEN you are in your late teens, the thought is father to the deed and the gestation period is very short. A little more than two hours later Carl and Jerry were back in their room checking out a piece of compact electronic gear Jerry had wheedled out of his cousin.

"My cousin uses this electronic depth-finder on his boat," Jerry explained. "He and I were playing around with it on the Tippecanoe River last summer. It's really a simple form of echo-ranging sonar. That's why your remark reminded me of it."

"How does it work?" Carl wanted to know.

"Behind the rim of this circular transparent screen, as you can see now that I've taken the cover off, a motor whirls a neon tube on the end of a radial arm. The circular path of the neon bulb is marked off in feet. See these contacts that close briefly every time the neon bulb passes behind the '0' mark here at the top of the dial? When they close, they feed a short pulse of 200-kc. signal through a cable to this transducer that's mounted to the boat so it's in the water and pointing downward. The pulse is simultaneously fed through a transistorized amplifier to the neon bulb and makes it flash behind the '0.'

"Sound from the transducer travels down to the bottom of the lake or stream and then is reflected back up into the transducer that now makes like a microphone instead of a speaker. The resulting electrical pulse feeds through the amplifier to the neon bulb and causes it to flash a second time. Since the neon bulb travels around the face of the dial at a controlled and known speed, the angular rotation between the first and second flashes is a function of the time it takes the sound to go from the transducer to the bottom of the lake and back. The speed of the motor and the markings on the dial are such that the depth of the water is indicated directly in feet by the

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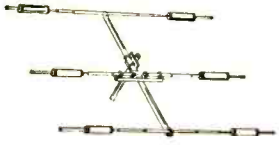

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NEW!

MOSLEY TA 3340 TRAPMASTER is now available as a complete package ready to install. Package contains TA-33 and TA-40K complete with all parts and hardware.

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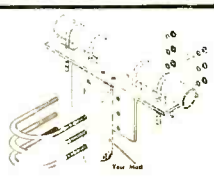
ALL MOSLEY ANTENNAS CONSTRUCTED OF:

- *6061T6 Heavy Gauge Aluminum!*
- *100% Rust/Corrosion Proof!*
- *High Grade S. Steel Hardware!*

See our ad in the December issue for Mosleys free gift offer.



NOTE: A Model AK-60 Mast Plate Adapter for 2" OD Mast is available. Complete with aluminum angle and hardware.

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location of the second flash of light."

"How fast does the motor turn?" Carl asked.

"Let's see; one complete revolution of the neon bulb indicates a maximum depth on this scale of 120 feet. Sound travels through water at about 4800 feet per second. A round trip from transducer to bottom and back would be 240 feet, requiring 1/20 second. So-o-o, the motor must be turning at 1200 rpm, and we are taking 20 soundings per second. At this frequency you'll notice that the persistence of human vision makes the flashing light seem almost continuous."

"I understand how the thing yells 'Hello-o-o-o-there' at the bottom and times the echo coming back to see how deep the water is, but I don't see how it's going to help us much."

"Don't be too sure about that. Put a pillow on the floor and lay that 45-rpm record on top of it."

By the time Carl had done this, Jerry had the instrument working; and when he held the transducer a foot or so from the floor, it indicated around five feet. "Get that disgusted look off your face," he told Carl. "Remember that sound travels more than four times as fast in water as it does in air; so the instrument is indicating correctly. Now watch that second light closely as I move the transducer over the end of the pillow and finally pass it directly over the record."

As the transducer moved over the pillow, the sharply defined echo light became wider and less sharp. Jerry reduced the gain of the amplifier until this effect was even more pronounced. However, when the beam of sound reached the record, the light became much sharper and brighter with the more distinct echo returned from the hard surface of the plastic.

"Fine!" Jerry exulted. "It works exactly as I hoped. When my cousin and I were fooling around in the clear water of the Tippecanoe, I noticed that any large rock on the bottom gave a clearer, sharper echo than did mud or soft sand. Results with the record and pillow confirm this. Tomorrow morning we'll hook the thing on a boat and see what we shall see."

IT WAS STILL RAINING in a desultory fashion the next morning, which was Sunday; but that didn't stop the plaque hunters. The depth-finder was installed on a small wooden boat powered by a quiet electric outboard motor. Carl operated the boat; Jerry kept watch on the depth-finder; and another boy, Frank, was along to do the diving. Several other fellows from H-3 followed along on the bank as Carl zigzagged back and forth, slowly moving downstream.

They had been operating less than fifteen minutes when Jerry gave a sharp cry: "I'm getting an echo!"

Carl worked the boat back and forth across the spot until it was determined that the object on the bottom was about the size of the plaque. Then Frank peeled off his clothes down to his swimming shorts and dove into the muddy water; in a few seconds he came up gasping for air and brandishing the top off a garbage can.

"You and the gadget have to do better than that," he exclaimed to Jerry through chattering teeth as they helped him over the side.

They continued working the stream like a bird dog while the boat was allowed to move gradually backward down the river. In the next hour they had three more false alarms from, respectively, a discarded license plate, an old pie tin, and a metal STOP sign. It began to rain harder, and a cold wind sprang up out of the northeast.

"I dunno if we're going to do any good or not," Frank said dejectedly. "There's a lot of trash down there. Maybe those clowns never threw the plaque into the river at all."

"Hold it!" Jerry interrupted. "Move back to the right a bit, Carl."

As Carl maneuvered the boat according to Jerry's instructions, Frank punched around on the bottom with a long pole at the point where the depth-finder was returning a hard echo.

"Well, it could be the plaque—or a thousand other things," he finally said as he crossed his arms and grabbed the bottom of his sweat shirt.

A few seconds later he went over the side and was gone for what seemed a long time. Then a strong arm shot up out of the water beside the boat, and the hand brandished the missing plaque as though it were Excalibur! A gleeful shout went up from the boys on the bank who had stuck faithfully with them all the while.

AS the boat headed for the bank, the three passengers had forgotten all about the cold and the rain and the mud. Success was theirs! The "enemy" had been vanquished! They were savoring the wise words of Emerson:

"Success in your work, the finding of a better method, the better understanding that insures the better performing is hat and coat, is food and wine, is fire and horse and holiday! At least I find that any success in my work has the effect on my spirits of all these." —30—

Satellites On The Air

The following satellites, launched by the United States and the Soviet Union, were reported to have beacon and telemetry transmissions as of September 12, 1962. The satellites are listed by their code names, according to frequency; because some transmit on more than one frequency, they appear more than once.

Explorer VII*	19.990 mc.
Cosmos II (Sputnik XII)	20.005 mc.
Discoverer XXXVI	20.005 mc.
Cosmos V (Sputnik XV)	20.008 mc.
Transit IVA	54.000 mc.
Cosmos II (Sputnik XII)	90.011 mc.
Cosmos VI	90.023 mc.
Courier IB	107.970 mc.
TIROS I	107.997 mc.
TIROS III	108.000 mc.
Vanguard I*	108.022 mc.
TIROS III	108.030 mc.
Telstar	136.050 mc.
Transit IVA	136.200 mc.
TIROS IV	136.230 mc.
TIROS V	136.235 mc.
Injun SR-3	136.500 mc.
OSO I	136.744 mc.
TIROS IV	136.920 mc.
TIROS V	136.922 mc.
Alouette	136.980 mc.
Transit IVA	150.000 mc.
Transit IIA	161.990 mc.
Transit IIA	215.990 mc.
Midas IV	228.200 mc.

*Signal may be very weak

At least four more satellites are in orbit and may be transmitting. However, these are so-called "secret" satellites launched by the U.S. Air Force.

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.

Little Hums of Hi-Fi

(*Continued from page 48*)

all readings of hum with the meter connected in this position—that is, between the power amplifier(s) and the speaker(s). Actually, you're much less interested in specific numbers of volts or decibels than in whether you get "more" or "less" hum when you make various adjustments. For the most part, your tests should be read on the most sensitive range of the meter. But it's always wise to start a couple of ranges above and sneak down, to avoid bending the needle or otherwise damaging the meter. All tests should be made with all volume controls at minimum setting.

Thus equipped for hum measurement, what's the procedure in detail? There are at least two categories in which you can operate to good advantage.

Hum Null Controls. Some of your components are undoubtedly equipped with hum null controls on the back panel. You've probably already made a finger or screwdriver adjustment "by ear," and you may be vaguely unhappy about the inaccuracy of your result. With the aid of the meter, you can readjust these controls. There'll be a pronounced swing of the needle as you turn the control shaft, and you should have an easy time adjusting the control for absolute minimum hum.

Polarity Reversal. The big test, the one that can result in the most satisfying job of hum elimination, is for proper plug polarity. In the early days of hi-fi, most components came through with literature which suggested, among other things, that you should try reversing the power plug in the wall for minimum hum. This warning is rarely included in current literature, but the need for it is just as present as it ever was. *Any audio component will show a somewhat better or worse hum reading on the meter when its power plug is reversed.*

Whether a component is plugged directly into a wall socket or into an a.c. outlet on another component makes no difference. The plug on each component —power amplifier, preamp (if self-powered), turntable, tape recorder, FM tun-

er, multiplex adapter (if self-powered)—should be tested in both of its positions.

Holding the Minimum. Having set yourself up to operate with an absolute minimum of hum, how can you freeze this happy situation into a condition of permanence? (The tape recorder may need to come out of its regular location for a portable application somewhere else; some other component may need to come out for tube testing or general servicing; spring cleaning or decorating may require major if not complete disassembly of the system.)

The answer is to code each plug—with colored nail polish—just as soon as its minimum hum position has been established with the meter. A red dot on the top edge or the top face of the plug will get it back into its socket with the correct polarity.

And, finally, how about that new component you'll be adding to your system sooner or later? Obviously, this will be another job for the a.c. VTVM. —30—

Transistors

(*Continued from page* 69)

A typical field-effect transistor consists of a bar of, say, *n*-type semiconductor material (such as silicon) which has had *p*-type impurities introduced into opposite sides, creating *pn* junctions and forming an *n*-type channel between the two *p*-type regions. Metallic contacts are made at opposite ends of the bar to serve as the *source* and *drain* electrodes, while the *p*-type regions become the control electrode or *gate*.

In practice, the application of a reverse bias to the gate develops an internal electrical field which limits the current flow between the source and drain electrodes. Since the gate is reverse-biased, it presents a high input impedance to an external signal source.

As this is written, the field-effect transistor is still considered a developmental device. If it becomes popular, there is a good chance that a variety of construction methods will be developed for it, just as they have for more familiar transistors. —30—

On the Citizens Band

(*Continued from page* 63)

years of age, wants badly to get on the air. After much pestering, a duly licensed CB'er loans the teen-ager a transceiver and makes him one of his "units." The youngster, possibly not completely aware of the rules, uses the rig in amateur fashion and collects a bunch of QSL cards. The only trouble is that his benefactor is now liable for loss of license plus a possible fine—even a jail term!

Warning to all licensees with several "units": Do you know exactly how your units are being used? Do you retain full control over your units when someone else is using them?

New Equipment. Sonar Radio's new Model "G" CB transceiver is a ruggedly constructed unit with eight crystal-controlled channels. Other features include

a dual-conversion, tunable receiver for all 23 channels, high-level push-pull Class B modulation, "S"-meter, adjustable squelch, crystal spotting switch and illuminated panel.

From where we sit, the Model "G" appears to be a top-performing unit. We've closely examined the older Model "D,"

COMMUNICATIONS FAIR

November 28—*December* 2

New York Coliseum

You won't want to miss the latest in CB, ham, SWL, and business radio equipment which will be displayed at the first International Communications Fair on the above dates. The editorial staff of POP'tronics will be in attendance . . . and we hope to see you there.

and found it in all ways one of the best we've ever seen. Both units feature compact construction and an excellent wiring layout.

Still Plagued With TVI? If your rig incorporates a TVI filter, or you have an external unit and you're certain it's doing its intended job but TVI complaints still roll in, check your antenna mast or the mast of a nearby TV antenna. If you find corrosion at the joint of the mast sections, there's a possibility that the mast itself is acting as a harmonic generator. Some types of aluminum corrosion behave just like a crystal diode, and diodes are excellent harmonic generators. A 5′ mast section, especially when it's topped by a TV antenna, can act as a pretty fair CB antenna.

Cleaning up the trouble is simple, once you find the mast causing it. A number of lubricants can be used to improve the electrical continuity between mast sections and dissolve the corrosion. A silicone-graphite mixture is best. You can obtain this at any gunsmith's or sporting goods store under several trade names—it's used to lubricate guns and make action smoother. "Liquid Wrench" also works well, but since it doesn't incorporate graphite, corrosion can build up again after it dries out. As a matter of fact, even a combination of household oil, sandpaper and elbow grease will do the job, if you don't mind taking the mast apart.

Club Notes. The Citizens Radio Assn. of Southern California, in operation for about three years, has recently elected a new slate of officers, and among the extra-curricular activities they have planned are dances, dinners and a golf tournament.... Bob Ballinger (18B7620) and Jerry Rosenthal (KHA3221), of Chicagoland's Citizens Radio League, showed the officials of the Road America International June sports car sprints at Elkert Lake, Ill., how CB could make their jobs easier. A transceiver was placed at the control point while a mobile unit toured the course and reported conditions. It used to take half an hour to start each race, but CB cut this time to minutes. . . . Working with local police, The Citizens Radio Club of Worthington, Ohio, has come up with an ex-

cellent emergency program. Members are given police-supervised training. In a number of "dry runs," they have managed to show how much CB can help local law enforcement groups. —30—

RFD-100

(*Continued from page* 62)

nant frequency of the oscillator tank circuit. Each time you adjust the loading coil, repeak tuning capacitor *C2*.

Since the characteristics of transistors tend to vary from unit to unit, it will pay you to buy two or three CK722's so that you can select the one which gives the strongest signal. Or you may want to try a 2N104, 2N107 or a 2N188A transistor, if you have them as spares. Frankly, most low-power *pnp* transistor types will do the job.

When the transmitter is working at top efficiency, turn on the modulator. Set the gain control just below the point where the audio signal shows evidence of distortion on a receiver located at least a hundred feet from *L2*. Tune the entire broadcast band to make certain that the transmitter is radiating a clean signal and causing no interference to any stations serving your locality.

WARNING. When working with the RFD-100, keep in mind that even though it requires no license it must still be operated in accordance with FCC rules—including the one prohibiting obscene, indecent and profane language. Never transmit call letters of any kind. Employ the device for a constructive purpose or not at all. Remember, the broadcast band is no place for idiotic shenanigans or horseplay of any kind!

Users of the RFD-100 should become familiar with "Part 15—Incidental and Restricted Radiation Devices" contained in Volume II of the *Rules and Regulations of the Federal Communications Commission*, available from the Government Printing Office, Washington 25, D.C., for $2.00. —30—

Transistor Topics

(*Continued from page* 79)

vibrator using *pnp* transistors (*Q1* and *Q2*) in the common-emitter configuration. The earphones are shunted across one of the collector load resistors (*R1*).

In operation, *R1* and the phones serve as the collector load for *Q1*, while *R4* serves in a similar capacity for *Q2*. Base bias currents are furnished through *R2* and *R3*, while capacitors *C1* and *C2* provide the cross-coupling needed for multivibrator action. Operating power is furnished by a single 9-volt transistor battery (*B1*) controlled by the hand key.

According to Ron, his circuit is noncritical, with regard to both layout and exact part values. Transistors *Q1* and *Q2*, for example, can be types 2N222, CK722, 2N107, or 2N1265. The resistors are all ½-watt units. Either paper or ceramic capacitors can be used for *C1* and *C2*, and working voltage isn't critical. Standard magnetic earphones are recommended.

Ouch!!! A large manufacturer recently encountered an unusually large number of rejections in a group of transistorized subassemblies being produced for a military application. Tests indicated that the rejections were due to defective transistors, even though all transistors were pre-tested when received. From the nature of the defect, the manufacturer was able to determine that the transistors had been punctured by extremely high voltages.

After a considerable number of tests and much head-scratching, the manufacturer finally determined the cause of the trouble. It seems that the transistors were being damaged, quite accidentally, by assembly line workers in the process of handling the units.

How? Well, the typical worker sat on a stool which was varnished and therefore completely insulated. Generally, the worker would pick up a transistor, perform a given operation, then turn on the stool, and put the unit down. The mere act of turning on the stool generated as much as 2000 volts which, discharged through the transistor as it was placed back on the bench, punctured and

ruined the device. Result: rejections.

If you've ever scuffed your feet on a wool carpet and then touched a metal object, such as a radiator or metal handrail, you can understand the problem! Static electricity can be shocking—and, in the manufacturer's case, can "kill" transistors.

News from Overseas. The Sony Corporation in Japan is now producing a transistorized television receiver featuring a 5″ picture tube. Dubbed the "Micro TV," the Sony set uses 24 transistors and 20 diodes. It requires less than 13 watts when operated on line current, measures only 7⅝″ x 4½″ x 7¼″ overall, and weighs 8 pounds.

An English manufacturer, Ardente Acoustic Laboratories, Ltd. (London), has developed a subminiature amplifier weighing only 0.05 oz. and occupying only 0.045 cubic inch. A 3-stage amplifier, the tiny instrument uses three transistors, five capacitors, and six resistors, and has a specified power gain of 4000.

Product News. The Sonotone Corp. (Elmsford, N. Y.) has introduced a new transistorized hearing aid. Dubbed the Model 55 "Wisp," it incorporates 129 components into a ¼-oz. package small enough to nestle behind the ear. Employing three transistors, the instrument features a temperature-compensated circuit which regulates performance automatically when the model 55 is subjected to sudden changes in temperature. The unit's mercury battery has an operating life of 40 to 50 hours.

Available in both kit and factory-wired form, the Model 1064 battery eliminator and charger by EICO Electronic Instrument Co., Inc. (33-00 Northern Blvd., Long Island City 1, N. Y.) features an extra-low ripple output. Other features include two d.c. voltage ranges, 0-8 and 0-16 volts; current ratings of 10 amps continuous, 20 amps intermittent on the lower range, and 6 amps continuous, 10 amps intermittent on the higher range. Equipped with both current and voltage meters, the 1064 is designed for standard a.c. line operation and draws 150 watts. It sells for $43.95 as a kit, and $52.95 wired and tested.

Dubbed the "Micro-Listener" Model 0-21, what is claimed to be the world's smallest R/C receiver has been introduced by Otarion Electronics (Post Rd.,

Ossining, N. Y.). Measuring only 1" x 1¼" x ⅝" overall, the Micro-Listener requires only three volts for operation. This tiny receiver is designed for use with any standard tone transmitter, and carries a list price of $29.95.

That about covers the semiconductor front for now, fellows. I'll be back next month, as usual. —*Lou*

Oscillator Quiz Answers

(*Quiz on page* 46)

1-H The COLPITTS oscillator uses a parallel-resonant tank circuit, and a capacitance voltage-divider to provide the feedback voltage. The Colpitts oscillator is electronically equal to the "ultra-audion" oscillator common to UHF circuits.

2-A The series-fed HARTLEY oscillator employs a parallel-tuned tank circuit with a tapped coil to supply the feedback path.

3-I A CLAPP oscillator is a version of the Colpitts circuit in which a capacitor is added in series with the inductance in the tank circuit. The Clapp oscillator is quite stable under varying input voltages.

4-G The ELECTRON-COUPLED oscillator employs a multi-grid vacuum tube with the cathode and first two grids operating in any conventional manner, and in which the plate circuit load is coupled to the oscillator through the electron stream. The drawing shows a tetrode version using a series-fed Hartley oscillator.

5-J The PIERCE oscillator is a crystal version of the Colpitts oscillator.

6-C A MULTIVIBRATOR is a form of relaxation oscillator employing two RC-controlled triodes.

7-E The DYNATRON oscillator uses the negative resistance characteristic of a tetrode tube to cancel the resistance of its tank circuit in order to sustain oscillations.

8-B The BLOCKING oscillator is a form of relaxation oscillator using a plate transformer to provide the feedback voltage.

9-F The PHASE-SHIFT oscillator uses three cascaded RC sections to provide the feedback voltage.

10-D The TUNED PLATE-TUNED GRID oscillator has parallel-resonant circuits in both plate and grid circuits, the necessary feedback being obtained by the plate-to-grid interelectrode capacitance.

Across the Ham Bands

(*Continued from page 77*)

standard FT-243 holders work equally well.

Adjustment and Operation. To adjust the receiver, set capacitor *C3* approximately ¾ open and tune in a broadcast station or other steady signal. While keeping the incoming signal at a very low level with the receiver's r.f. gain control, adjust the i.f. transformers for maximum output. Now, set capacitor *C3* for maximum receiver selectivity and touch up the i.f. transformers again.

When the set is operated with the crystal filter in the circuit, signals occupy a fraction of the space on the receiver dial that they would otherwise occupy—with a corresponding decrease of interference if the bands are crowded. You'll notice that the filter reduces the receiver gain a little, but the reduction isn't serious, unless the gain was "marginal" to begin with. You may, if you wish, bend over a corner of one of capacitor *C3*'s rotor plates to disable the filter when *C3* is fully meshed.

News and Views

Charles F. Lindell, KN3SEF, 153 Orchard Ave., Emsworth, Pa., likes to operate between 1:00 and 4:00 a.m. In six months of candle-burning, he has knocked off 43 states—40 confirmed—plus a handful of Canadians on 80 and 40 meters. An EICO 720 transmitter feeds a shortened dipole, electrically lengthened, with a Mosley loading coil on 80 meters; a straight dipole handles 40 meters, and a Hallicrafters SX-111 does the receiving. In daylight Chuck keeps the telephone company's equipment in working order. . . . **Steve Landis, WV2WUU,** 616 Avondale Ave., Haddonfield, N.J., just discovered that he comes "from a long line of hams"; his grandfather was 3TC 45 years ago! In his first week on the air, Steve's Hallicrafters HT-40 transmitter, Hallicrafters S-108 receiver, and 80-through-6 meter vertical antenna put 14 states in the logbook. Wonder how this compares with Gramp's DX record? . . . **Lowell Davis, WA2ZQX/WV2ZQX,** 2152 East 16th St., Brooklyn 29, N.Y., spent two months on 6 meters with an 8-watt transmitter feeding a 5-element beam. In this period, he worked 23 states. But Lowell is now on 80 and 40 meters, using an EICO 723 transmitter to feed a "long wire" on 80 meters and a dipole on 40 meters; the receiver is a Hallicrafters S-38C. Lowell's best catch so far is Wyoming on 40 meters; better yet, the on-the-air code practice is bring-

ing the day he will pass his General Class exam closer and closer.

John L. Griener, K5PKA, River Road, Covington, La., runs less power than most Novices—35 watts to an old Lysco transmitter—but this fact hasn't slowed him down too much. In four years, mostly on 40 meters, John has made 3700 contacts in all states and in 82 countries. The contact he is most proud of is a Liberian station worked on 40 meters with four watts input. Besides his WAS certificate, John has a WAC (worked all continents) and a 35-wpm code proficiency certificate. He works many 40-meter Novices; so if you need a Louisiana contact, John'll sked you. . . . **Milt Perkins, WN8EBM,** 1121 Quarry Ave., Grand Rapids 4, Mich., has made 180 contacts in 23 states in his 7-week Novice career. A Lafayette KT-320 receiver couples the ionosphere to his ears; either a Globe Scout transmitter or a homebrew 35-watter feeds his 40-meter dipole antenna. . . . **Graham T. Hall, K1VBN,** 75 Forest Ave., Seekonk, Mass., and his father—same name, same address—reversed the usual procedure. Graham, Jr., has had his General ticket for a couple of months; Graham, Sr., just received his Novice and Technician licenses (KN1WYN/K1WYN) a few days ago. With a Viking Ranger II transmitter, a Clegg 99'er, and a Hammarlund HQ-170C receiver, the father-son team operates on most of the bands between 6 and 80 meters.

Steve Skinner, WNØBYS, 3518 Lakin Ave., Great Bend, Kansas, agitates the ionosphere with a Heathkit DX-40 transmitter feeding a 40-meter dipole 35' high. He receives on a Heathkit GR-91, which has heard answers to Steve's calls from 32 states (including Hawaii) and a couple of Canadians. . . . **Ronny Berry, WN5BUG,** La Porte, Texas, can't understand why so many Novices neglect to tune off their own frequencies after calling "CQ." As he says, they miss a lot of answers by not doing so. Ronny's Knight T-60 transmitter, Drake 2B receiver, and doublet antennas for 80 and 40 meters have allowed him to exchange greetings with 29 states.

Tom Thomas, WV6WPG, 8012 San Huerto Circle, Buena Park, Calif., has had his Novice ticket for about four months and has already passed his General exam, but the ticket hasn't arrived yet. Tom works 40 meters with the Hallicrafters twins (HT-40 transmitter and SX-140 receiver). His antenna is a Mosley V-4-6 vertical. His best DX is Hawaii. . . . **Barry Ford, WV2ZZI,** 7 Pearl St., Penns Grove, N.J., runs 75 watts into a DX-40 transmitter. His receiver is a Hallicrafters S-85. As for antennas, he can take them standing up or lying down—he has a 40-meter horizontal doublet and a multiband vertical. So equipped, Barry has worked 31 states, Canada, Germany, and Puerto Rico. He'll help anyone interested to get a ham ticket; his phone number is AX9-1894.

Will we read *your* "News and Views" here next month? Send them to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P.O. Box 678, Gary, Indiana. For now, 73,

Herb, W9EGQ

Short-Wave Report

(*Continued from page 82*)

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. When sending reports, please include your call letters and the make and model number of your receiver. Beginning with this issue, we will list the receivers used by monitors whenever the information is available.

Aden—An Arabic station noted on 6095 kc. may be the Aden Broadcasting Service although this has not been confirmed. English was heard at 0030.

Afghanistan—Here is the complete schedule from Kabul. English is broadcast at 0530-0600 to the Far East on 15,225 kc., and to S.E. Asia at 0600-0630 on 15,135 kc. The Eng. Third Program is on 4040 kc. at 0900-0930. Other xmsns: Arabic at 1300-1330 and French at 1330-1400 on 15,225 kc.; Urdu at 0830-0900 on 4040 kc.; and Russian at 1230-1300 on 9705 kc.

Belgium—Brussels has discontinued Eng. programs to N.A. According to a spokesman for the station, the service did not appear to draw enough listeners to warrant the expense.

Colombia—*R. Santa Fe*, Bogota, is now a 24-hour station on 4965 kc. It is heard well around 2100 with an ID every few minutes. Reports should be sent to P.O. Box 9339, Bogota.

HJGV, *Transmisora Independencia*, Tunja, Boyaca, listed as being inactive, has been noted on 4985 kc. evenings with Spanish music.

Ethiopia—The schedule for the External Service from *R. Addis Ababa* reads as follows: on 17,775 kc. at 1010-1050 in Arabic to Near East; on 15,345 kc. at 1310-1330 in Eng. and at 1330-1350 in French to Europe; and on 11,955 kc. at 1510-1530 in Eng. and at 1530-1550 in French to W. Africa. The Home Service is given on 6185 and 7290 kc. at 2300-0030, 1100-1300, and 1400-1500 with Eng. at 1115, and on 7290 and 9610 kc. at 0500-0700 with Eng. at 0515.

Formosa—The Broadcasting Corp. of China, Taipei, lists these Eng. xmsns: at 2145-2245 on 17,890, 15,345, 11,860, 11,825, 7130, and 6095 kc.; at 0510-0555 on 11,860, 11,825, 9685, 7130, and 6095 kc.; and at 0730-0825 ("The Dragon Show") on 15,225, 11,860, 11,825, 9685, 7130, and 6095 kc. The station

welcomes reception reports and they should be sent to: The Dragon Man, *Voice of Free China*, New Park, Taipei, Taiwan (Formosa).

France—This is the complete French schedule for Paris: at 0100-0145 on 6145, 7240, 11,885 kc. to Polynesia and New Caledonia; at 0200-0300 on 11,885, 17,765, and 21,580 kc. to Africa; at 0500-0530 (to Antilles) and at 0715-0745 (Africa) on 17,765 and 21,580 kc.; at 0800-1000 on 15,245, 17,765, and 21,620 kc. to Far East; at 1015-1115 on 17,765 and 21,620 kc. to Madagascar and Reunion; at 1130-1300 on 9755, 11,845, and 15,245 kc. to Middle East; at 1230-1245 (to 1250 Monday to Friday) on 15,160 and 17,850 kc. to Canada; at 1430-1500 on 9560 kc. to Antarctica; at 1500-1600 on 9755, 11,845, and 11,885 kc. to Africa; at 1800-1830 (to Far East) and at 1830-2000 (to Antilles) on 9560 and 11,885 kc. Paris relay stations operate at 0014-1800 on 6175 kc. to Europe and Africa; at 0200-0230 on 11,845 and 21,620 kc. to Africa; at 0400-0500 (Sundays) on 7160 kc. to Europe; at 0850-1200 (Sundays) on 21,580 kc. to Africa; at 1315-1345 on 15,160 kc. to Canada; and at 1400-1425 on 11,845 and 15,130 kc. to Africa and the Middle East.

Greece—The Hellenic Telecommunications Organization, Ltd., Athens, was logged recently on 8210 kc. This is a telephone station with the call-sign SZK43. The verification listed the frequency as being 9290 kc., however. Reports may be sent to 15 Stadion St., Athens, Greece.

Haiti—Stations 4VEH and 4VEC operate at 0600-0900 in Eng. and at 2000-2300 in Eng. on Fridays, Saturdays, and Sundays. From Monday to Thursday they operate at 0600-0900 and at 2000-2015 in Eng. on 9770, 6120, and 1035 kc. (the latter is a medium-wave channel often noted in Eastern U.S.A.). All reports should be sent to: Mrs. Kent Ragsdale, Shortwave Department, 4VEH, Box 1, Cap Haitien, Haiti, West Indies.

Kuwait—Kuwait has been found on 15,150 kc. at 1535-1600 with music and Arabic news and heard from as early as 2100 to 2230 with music and commercials, some of which are in English. The ID is given as "This is Kuwarteh." These loggings were made in Louisiana and Michigan.

Lebanon—Beirut is strong to N.A. in Eng. at 1600-1615 on 15,295 kc. with news and some music. The N.A. xmsns continue in Arabic to 1640 and then in Spanish to 1655. Other xmsns: to Africa at 1330-1455 (Eng. at 1330-1345) on 11,715 kc.; and to S.A. at 1500-1655 (no Eng.) on 15,225 kc. Reports are welcomed and should be sent to Lebanese B/C System, Department of Overseas Services, Beirut 1, Lebanon.

Liberia—ELWA, Monrovia, is scheduled as follows: to N.A. on Tuesdays only at 1956-2230 on 9660 and 11,825 kc. and to S.A. at 1657-1945 on 15,155 kc.; daily except Sunday at 2357-0300 and 0557-0830 to Nigeria on 11,975 kc.; at 0112-0430 on 4770 kc. (no beam shown); at 0112-0430 to W. Africa on 3225 kc.; at 0742-1945 to Liberia on 3225 kc.; at 0842-1330 to Nigeria on 11,790 kc.; at 1027-1300 to the Congo on 15,155 kc.; at 1309-1430 to the Near East on 15,155 kc.; at 1357-1730 to West Africa on 4770 kc.; and at 1433-1630

to N. Africa on 15,155 kc. A recent logging indicates that 11,980 kc. is in use in the Home Service at 0200-0300; Eng. to 0245.

Malaya—*R. Malaya* is noted mornings from 0800 to 1030 s/off on 7200 kc. with music, news, sports, and commercials. There is some QRM from Peking.

Mozambique—CR7BV, Lourenco Marques, is fair to good at 2315 with music and Eng. time checks on 4834 kc., a move from 4847 kc. They are listed for 4840 kc.

Netherlands Antilles—The strongest xmtr ever built for a religious station will be constructed by *Trans-World Radio* in the Dutch West Indies, probably at Curacao. It was reported in this column (August and October issues) that *Trans-World Radio* had applied for a permit to construct a station near Vega Baja, Puerto Rico. The latest information is that the station will operate with 250 kw. on the short waves and 100 kw. on the broadcast band, in 22 languages.

Pakistan—Karachi was noted in the 16-meter band (probably on 17,745 kc.) at 2000-2031 with Eng. dictation-speed news. This broadcast may have been on an unannounced, unlisted frequency nearer 17,870 kc.

Peru—All America Cables & Radio, Inc. confirmed reception of OCB74, 12,150 kc. This is a utility station used at times for telephone communications. Having an irregular schedule, the station may be off the air for long periods. Reports go to Casilla 2336, Lima, Peru, and return postage is not required.

Sarawak—According to the latest schedule received, *R. Sarawak*, Kuching, carries Eng. daily at 1755-1915 on 4950 and 7160 kc., on Tuesdays at 2300-0030 on 7270 kc., Saturdays and Sundays at 0000-0130 on 7270 and 7160 kc., at 0530-0700 on 4950 kc., at 0800-0930 on 4950 kc., and at 0930-1000 on 4950 and 4835 kc. During the school year there is a xmsn at 2000-2130 on 7160 and 7270 kc. London news relays are given at 1800 and 0800; a newscast from Melbourne is broadcast at 0000; and home news is given at 0600.

Singapore—The complete Eng. schedule for the BBC Far Eastern Station, in various beams to N., E., and S. China, Hong Kong, Korea, Japan, Vietnam, Laos, Cambodia, Indonesia, Burma, Thailand, India, Ceylon, and Pakistan reads as follows: on 7110 kc. at 0410-0530 and 0600-0615; on 7135 kc. at 0900-1150; on 9555 kc. at 0700-0715; on 9690 kc. at 0800-0845 and 0915-1150; at 9725 kc. at 0410-0530 and 0600-0615; on 11.750 kc. at 0410-0530, 0600-0630, 0800-0915, and 1130-1150; on 11,955 kc. at 0410-0600, 0800-0815, and 0915-1150; on 15,310 kc. at 0410-0630, 0800-0845, and 0900-0915; on 15,435 kc. at 0630-0815; and on 17,755 kc. at 0410-0630.

South Korea—*The Voice of Free Korea*, Seoul, sent this Eng. schedule: 2230-2300 and 0530-0600 on HLK5, 9640 kc.; and 0030-0100 and 0230-0300 on HLK41, 15,125 kc. Reports go to Korean Broadcasting System, 8 Yejang-dong, Choong-ku, Seoul, Korea.

Sudan—Omdurman has been noted on 4993 kc. (a move from 4988 kc.) from 2300 with Arabic ID, then into chanting.

Sweden—This is the latest and complete

Eng. schedule from Stockholm: to Eastern N.A. at 0900-0930 on 17,840 kc. and at 2045-2115 on 11,805 kc.; to Western N.A. at 2215-2245 on 11,805 kc.; to Africa at 1245-1315 and 1445-1515 on 11,705 kc. (on Saturdays and Sundays at 1415-1515 there is a combination Eng., French, and German program); to Europe at 1700-1730 on 6065 kc.; to the Middle East at 1115-1145 on 11,705 and 15,240 kc.; to S. Asia at 0945-1015 on 17,845 and 15,420 kc.; and to the Far East at 0730-0800 on 17,845 and 15,155 kc.

Uganda—Kampala operates as follows: at 0450-0600 (Saturdays to 0900, Sundays at 0415-0900) on 7195 and 7110 kc.; at 0950-1500 on 4976 kc.; at 0950-1045 on 5026 kc.; at 1100-1500 on 3340 kc.; and at 2300-0000 on 4976 and 5026 kc. The last xmsn listed has been

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Bruce Dean, *WPE1CGL*, Needham, Mass.
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William Stevens, *WPE3OZ*, Jeanette, Pa.
Tommy Thompson, *WPE4AIP*, S. Boston, Va.
(Hallicrafters S-38E)
Grady Ferguson, *WPE4BC*, Charlotte, N. C.
(Hallicrafters SX-28)
Chuck Edwards, *WPE4BNK*, Fort Lauderdale, Fla.
(Hallicrafters SX-71)
John Brunst, *WPE4BQ*, Neptune Beach, Fla.
Ricky Anderson, *WPE4DIV*, Gainesville, Fla.
Buford Reynolds, *WPE4EMF*, Nashville, Tenn.
(Heath GR-91)
Billy Fields, *WPE4EPP*, Macon, Ga.
(Hammarlund HQ-129X)
Tom Breeden, *WPE4EQX*, Atlanta, Ga.
(Hammarlund HQ-100C)
Alfred Stankus, *WPE4EZP*, Miami, Fla.
Eugene Dalrymple, *WPE4FAQ*, Summerville, Ga.
(Hallicrafters SX-110)
Thomas McNiff, *WPE4FEW*, Arlington, Va.
Robert Livingston, *WPE4FIA*, St. Petersburg, Fla.
Johnnie Adams, *WPE5AFU*, El Dorado, Ark.
(1934 RCA Model 121)
William Bing, *WPE5AG*, New Orleans, La.
Robert Davis, *WPE5AUR*, San Antonio, Texas
Rickie Williams, *WPE5BLV*, Shreveport, La.
(Hallicrafters S-120)
John Rowbotham, *WPE6BFB*, Palos Verdes Estates, Calif.
(Hallicrafters S-118)
Geolirey Ashford, *WPE6CWE*, San Carlos, Calif.
(National NC-183)
Gary Payne, *WPE6DHU*, Fresno, Calif.
(Heath AR-3)
Chuck Bennett, *WPE6DTN*, Tustin, Calif.
(National NC-125)
Jean-Charles Seigneuret, *WPE7BBN*, Bellingham, Wash. *(Hallicrafters S-38E)*
Jerry Walker, *WPE8AOQ*, Bethel, Ohio
Tim Shaw, *WPE8BUV*, Bay Village, Ohio
(Hammarlund HQ-145X)
Bill Tuttle, *WPE8DKO*, Wayne, Mich.
(Knight Span Master)
Wayne Benkinney, *WPE8EEI*, Flint, Mich.
Frank Ruzicka, Jr., *WPE8EHV*, Aurora, Ohio
David Algeo, *WPE8ELZ*, Dayton, Ohio
(Jubilate 5161W)
Eddie Fisher, *WPE8EVK*, Barnesville, Ohio
Dick England, *WPE8FV*, Columbus, Ohio
Billy Wambach, *WPE9AT*, Evansville, Ind.
Wayne Willenberg, *WPE9BZQ*, Indianapolis, Ind.
Don Griffith, *WPE9CGF*, Evansville, Ind.
Heimo Kraemer, *WPE9CQN*, Mundelein, Ill.
(Arvin 9598)
Royse Cramton, *WPE9DLG*, Maywood, Ill.
Larry Mahl, *WPE9DPU*, Michigan City, Ind.
Michael Peters, *WPE9EEC*, Burnett, Wis.
(Philco 39-31)
Phil Cutler, *WPE9EFL*, Barrington, Ill.
(Knight Span Master)
George Curtis, Jr., *WPE9EGT*, Chicago, Ill.
(Hallicrafters S-119)
John Beaver, Sr., *WPEØAE*, Pueblo, Colo.
(National NC-109)
Scott Zucker, *WPEØBTN*, University City, Mo.
(Lafayette HE-40)
Jim Phelps, *WPEØCGE*, Davenport, Iowa
(National NC-109)
John Reasoner, *WPEØCLU*, Ames, Iowa
Ernie Emmerton, *WPEØCRS*, Point Lookout, Mo.
Larry Lehmer, *WPEØCRW*, Council Bluffs, Iowa
(Heath GR-91)
Bob Arbore, *WPEØCVQ*, St. Paul, Minn.
(Knight Space Spanner)
David Stanton, *VE3PE1KM*, Huntsville, Ont.
(Philips B782)
Gary Cooper, *VE3PE1MX*, St. Catharines, Ont.
(Hallicrafters 5R10A)
Michael Berry, York, Pa.
Bernard Brown, Derby, England
Craig Caston, Granada Hills, Calif.
Lester Commodore, New York, N. Y.
Bruce De Vlieger, Vestal, N. Y.
Marlin Field, Benton Harbor, Mich.
John Gunzberger, Dayton, Ohio
Douglas Herda, Hales Corners, Wis.
John Jackson, Los Angeles, Calif.
Richard Lindenberg, Creve Coeur, Mo.
(Lafayette KT-320)
John Marco, Elmont, N. Y.
(Grunow All Wave)
Louis Marseilles, APO, New York (Somme, France)
Bill Miller, South Bend, Ind.

noted with Eng. news from 2300 on 4976 kc., but the 5026-kc. channel is generally unreadable due to intense QRM.

USA—Definite word has been received on WINB, Red Lion, Pa. (last mentioned in our August column). The station was recently dedicated and tests are due to begin shortly on 11,885 and 17,888 kc. with 50-kw. power. A religious outlet, the station is owned by World International Broadcasters, Inc., and the Rev. John Norris, licensee of medium-wave station WGCB, Red Lion, is president. Programs will be beamed to the Mediterranean, Near East, the Scandinavian countries, White Russia, and South America.

Here's an item that will be of interest to medium-wave DX'ers. It has been reported that the Westinghouse Broadcasting Co. is going to drop its WBZA xmtr in Springfield, Mass. For 41 years WBZA has relayed the programs of WBZ, Boston, into the Western areas of the state. A spokesman for the firm indicated that a proposed purchase of WINS, New York, necessitated the discontinuance of WBZA due to an "interpretation of the maximum ownership rule" of the FCC.

Vatican City—The Vatican Radio is being heard well at 1000-1015 and 1315-1330 with Eng. newscasts on 11,740 kc.

West Congo—The complete Eng. schedule for *R. Brazzaville* reads: to N.A. at 2015-2100 on 11,725 kc.; to the Far East at 0930-1000 (except Sundays) on 21,500 and 17,720 kc.; and to Africa at 0015-0100 on 17,720, 15,445, 11,725, 9730, 7105, and 5970 kc., at 0330-0400 on 21.500 and 15.445 kc., at 1200-1230 on 21,500, 11,725, 9730. 7105, and 5970 kc., at 0600-0630 on 21,500, 11,710, and 7105 kc., at 1400-1500 on 15,190 kc. (this is well heard in the USA), and at 0500-0530, 0600-0615, and 0700-0715 on 15,445 and 11,970 kc.

SHORT-WAVE ABBREVIATIONS

BBC—British Broadcasting Corporation	kw.—Kilowatts
Eng.—English	N.A.—North America
FCC—Federal Communications Commission	QRM—Station intererence
ID—Identification	R.—Radio
kc.—Kilocycles	s/off—Sign-off
	xmsn—Transmission
	xmtr—Transmitter

West Germany—*Deutsche Welle (The Voice of Germany)* has this new Eng. schedule: to N.A. at 1920-2000 on 6145 and 9605 kc., at 0000-0040 on 6110 and 9735 kc., and at 1530-1610 on 9735 and 11.795 kc.; to the Far East at 1620-1700 on 7290. 9735, and 11.795 kc., and at 0350-0430 and 0800-0830 on 15,275, 17,845, and 21,705 kc.; to the Middle East at 0230-0340 on 15.275 and 17.845 kc., and at 1040-1110 on 17.815 and 21,705 kc. There is also a xmsn in French to N.A. at 2000-2040 on 6145 and 9605 kc.

Clandestine—*Imre Nagy Radio* broadcasts to Hungary on 6218 kc. at 0500-0900 and 1200-1700.

R. Libertad, 15,048 kc., is heard in Spanish at 0700-1100 and 1755-0000. The theme from "Victory At Sea" is frequently played at 1858-1900. No Eng. was noted. —30—

POPULAR ELECTRONICS

November 1962 Advertisers Index

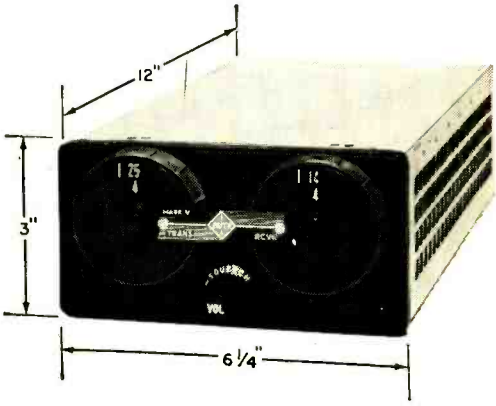
Every Day From 108 to 132

(*Continued from page 45*)

Receiving Equipment. There are several manufacturers of aero band receivers. The most active is Nova-Tech (1721 Sepulveda Blvd., Manhattan Beach, Calif.) with the highly publicized five-band "Air-O-Ear" receiver (Model 711WN). Not only will this receiver tune the aero band, but it also covers the l.f. range signals (200-400 kc.), AM broadcast band, plus two short-wave bands.

Gonset (801 S. Main St., Burbank, Calif.) and Hallicrafters (4401 5th Ave., Chicago 24, Ill.) also manufacture aero band receivers. In each case they are single-band receivers. The Gonset unit is known as Model 3156-B and the Hallicrafters set as Model CRX-3. All three of the above cost in the neighborhood of $100.00.

An antenna for the aero band should be vertically polarized. Each of the receiver manufacturers mentioned above sells tuned antennas, although there is no reason why you shouldn't construct your own "baby-size ground plane" if you wish. Plans for two different aero band antennas can be obtained free from the POPULAR ELECTRONICS editorial offices—be sure to include a stamped, self-addressed envelope when you request them. —30—



The transmitters and receivers used on private airplanes are almost incredibly small. This unit, a NARCO "Mark V," is crystal-controlled for 90 transmitting channels and 190 receiving channels!

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

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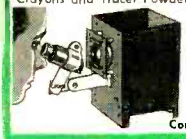

SPECTROSCOPE (at left). Analyze the spectra of glowing gases. See and identify the Fraunhofer Lines. Measure the wave length of light rays. A quality instrument featuring an easy-to-read built-in scale and a powerful condensing system for a bright spectrum. Equipment includes an Alcohol Burner and a 2 Watt Neon Spectral Lamp. Full instructions cover theory and use.

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UNIT 3 ANALOG COMPUTER — $3.95

ELECTRONIC COMPUTER. Electronically multiplies, divides, calculates powers, roots, logarithms. The problem is set up on the scales of two linear potentiometers and the answer is found by listening for the null point on the third potentiometer. Powered by two flashlight batteries (not included). Assembles in minutes — no soldering. **Comes with Headphone, three sets of scales and complete instructions. Only $3.95 Postpaid.**

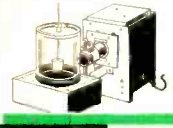
UNIT 4 PHOTOELECTRONIC RELAY — $7.95

COMPLETE PHOTO-RELAY UNIT. Supersensitive Crystal Photocell; rugged Electronic Amplifier; Double Throw Relay; large 1⅞" diameter Condensing Lens; Mounting Board, Cabinet; Hardware; Hook-up Wire; Solder and complete instructions for easy assembly (soldering required). Features automatic "on and off" or holding circuit operation; Sensitivity Control; Plug-in Outlet for controlled circuit. Use it for door announcers, counters, alarms, day-night light switches, etc. Operates on 115V AC. **Complete Photo-Relay set-up. Only $7.95 Postpaid.**

UNIT 5 TELESCOPE AND TRANSIT — $5.95

TELESCOPE with combination **ALT-AZIMUTH** and **EQUATORIAL MOUNT.** 44X erect image, 22X astronomical telescope, 28" long. Four ground and polished Lenses. Ramsden Eyepiece gives large field. **SURVEYOR'S TRANSIT LEVEL** adapts from alt-azimuth mount. Has vertical and azimuth scales, Spirit Level and Leveling Platform. A practical instrument for laying out foundations, ditches, fences, etc. Also used as a range finder. **Telescope, Mount, and Transit** (everything except the wooden legs of tripod) **complete with full instructions . . . only $5.95 Postpaid.**

UNIT 6 ATOMIC ENERGY LAB — $5.95



ATOMIC CLOUD CHAMBER WITH PROJECTOR ILLUMINATOR. See the vapor trails of speeding alpha and beta particles, and of cosmic rays from outer space. **SPINTHARISCOPE** gives a dramatic magnified ringside view of exploding atoms. **ELECTROSCOPE** — metal housed with Scale and Magnifying Viewer. Measures background radiation and tests sample sources. **SAFE RADIOACTIVE MATERIALS.** Alpha Source in handy container and Uranium Ore (U_3 Us 0.229%). **Full instructions and explanations open up the fascinating field of nuclear physics. $5.95 Postpaid.**

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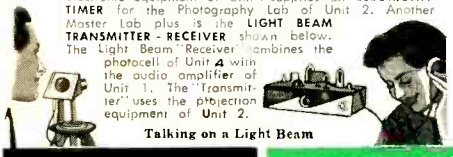

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