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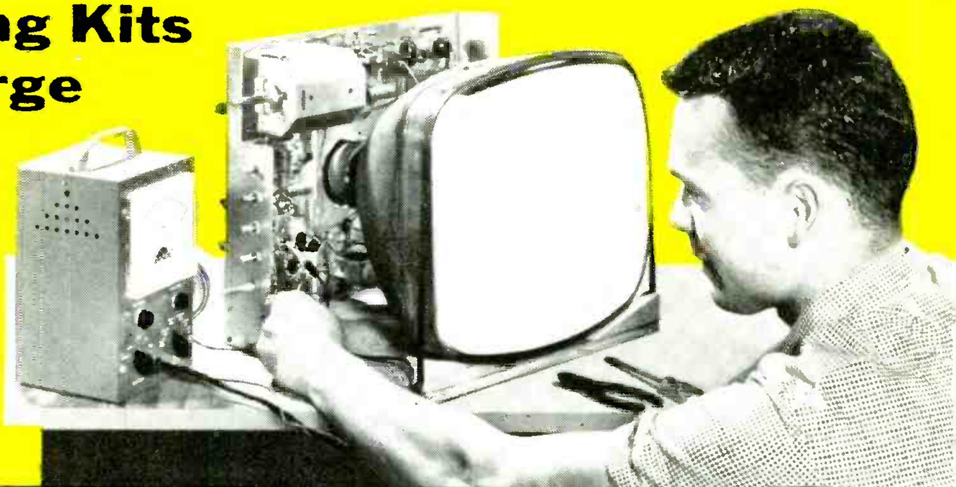

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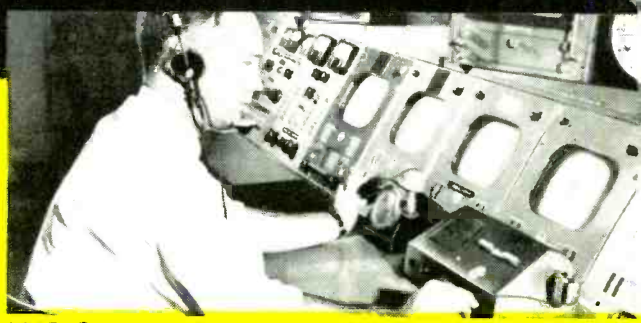

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November, 1961 A Fawcett Publication Vol. 4, No. 8

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Special Features

EI Projects

EI Kit Report

Regular Departments

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ELECTRONICS ILLUSTRATED is published bi-monthly by Fawcett Publications, Inc., Fawcett Place, Greenwich, Conn. W. H. Fawcett, Jr., President; Gordon Fawcett, Secretary and Treasurer; Roger Fawcett, General Manager; Roscoe K. Fawcett, Circulation Director; Donald P. Hanson, Assistant General Manager.
EDITORIAL AND ADVERTISING OFFICES: 67 West 44th Street, New York 36, N. Y.
ADDRESS ALL MAIL: Subscriptions, change of address, Form 3579 to Subscription Dept., Fawcett Bldg., Greenwich, Conn.; and all editorial and advertising to Fawcett Publications, Inc., 67 W. 44th St., New York 36, N. Y.
Second-class postage paid at Greenwich, Conn., and at additional mailing offices.
Subscription price $4.00 for 12 issues in the U. S. and possessions and Canada. All other countries $6.00 for 12 issues. Foreign subscriptions and sales should be remitted by International Money Order in U. S. funds payable at Greenwich, Conn.
Printed in U.S.A.

Member of: Audit Bureau of Circulations Magazine Publishers Association, Inc.

FEEDBACK from our readers

Write to: Letters Editor, Electronics Illustrated, 67 West 44th St., New York 36, N. Y.

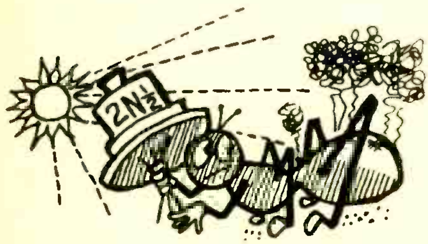
New Look

That New Look in your September issue really *is* something new. I like it. The contents is not bad, either. What are you trying to do, have something for *everybody* interested in electronics?

William Matthews
Tulsa, Okla.

Yes. And thanks for writing, Bill.

Small Point



I'm getting sick of all those miniaturization pictures. Every day you see a picture of a transistor dropped through a soda straw, a capacitor sitting on a gnat's wing or a resistor getting lost under its designer's hangnail. My company is doing a promotion on its transistor, 2N½, that should end all the nonsense. Our lead picture shows an ant using the 2N½ as a parasol, except the thing is so small that he's getting a sunburn.

Sid Prescott
Houston, Tex.

Young Fan

I am 12 and I read your magazine every month. I think you have better projects than anybody else in your field. I built your metal detector (April '61 EI) and it works fine.

Marc Finkelstein
Bronx, N. Y.

Congratulations, Marc!

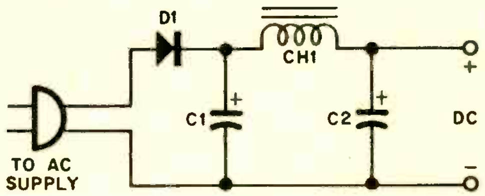
Swap Shop

It bugs me that other people are looking for old radio parts when that is what I have and wish I had modern equipment. I obtained a whole flock of old tubes (CX-310, SX-200-A, 27, 24, etc.) from a dealer's attic, and also got some pieces of equipment from his shelf. He went out of business in 1929. Anyone want to swap new for old?

Martin Wendell
Burr Oak, Mich.

Do any of EI's readers want antique tubes? Write directly to Mr. Wendell at the address above.

DC Power Supply



In your January 1961 issue you reported on the Olson T-281 variable AC 500-watt power supply.

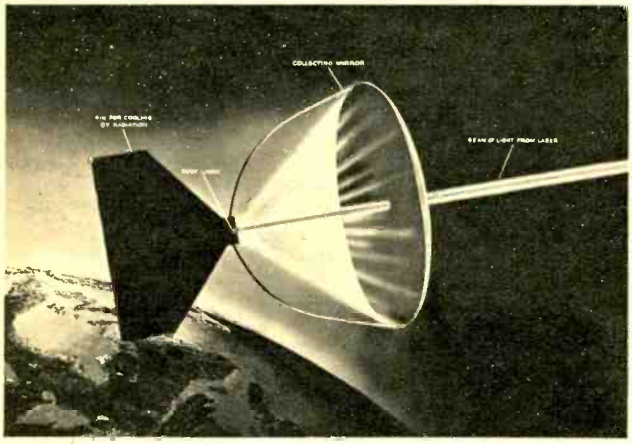
In the article you stated that by adding a rectifier and filter network you could convert the T-281 to a DC power supply up to 175 volts.

Can you give me the circuit, plus a list of the parts needed?

Walter F. Lynch
Syracuse, N. Y.

Glad to, Walt. Take a look at the schematic above. Here is the parts list: D1 is a 130 v., 750 ma silicon rectifier; CH1 is a choke of 1 to 10 henries, 200 ma or higher; C1 and C2 are 20 to 40 mf, 250 v. electrolytic capacitors. The rectifier is plugged into either of the unit's two AC outlets. As mentioned in our report, the Olson unit has an AC output adjustable to 140 v. at 500 w. DC output can be run up to about 175 v.

. . . electronics in the news



Heliograph, Modern Version . . . Yet another system of jam-proof light-beam communication for outer space is being developed in the laboratories of the American Optical Co., Southbridge, Mass. The unique feature in this system is that it is sun-powered. Its heart is a ruby laser (a term derived from Light Amplification by Stimulated Emission of Radiation), which is to be located at the focal point of a large solar collecting mirror. This system is somewhat like a searchlight in reverse. The immense energy focused on the ruby rod causes it to emit a thin beam of light which can be modulated for communication. Both satellites and moving space vehicles may make use of the system, which is to have a range in the millions of miles.

—o—

Baby Talk . . . Electronics has extended itself further into the field of obstetrics. A team of doctors at Marion County General Hospital and Indiana University Medical Center has perfected a device that picks up the heartbeat of an unborn baby several hours before delivery and instantly reveals any fetal distress that may occur. Electrodes are attached to the patient's body as well as to the fetus. The signals are monitored visually on an oscilloscope and audibly through an amplifier. A tiny radar-like blip keeps popping up on the screen, while a meter indicates the heartbeat rate. But it doesn't tell whether it's a boy or girl.

—o—

Moonshine . . . Sunlight is strong enough to actuate even the crudest of photocells, whereas moonlight is too weak to make any impression on the most sensitive. In an effort to make use of the moon's reflection, the Thomas J. Watson Research Center of IBM has developed a new cell sensitive enough to respond appreciably to moonlight, yet rugged enough to withstand direct sun rays. This new Moonlight Photodetector is an unusual combination of a silicon semi-conductor in a liquid electrolyte of sulphuric acid. The process is being developed primarily for the optical sensing systems of satellites, enabling scientists on the ground to keep better track of space flights anywhere in the solar system.

[*Continued on page* 10]

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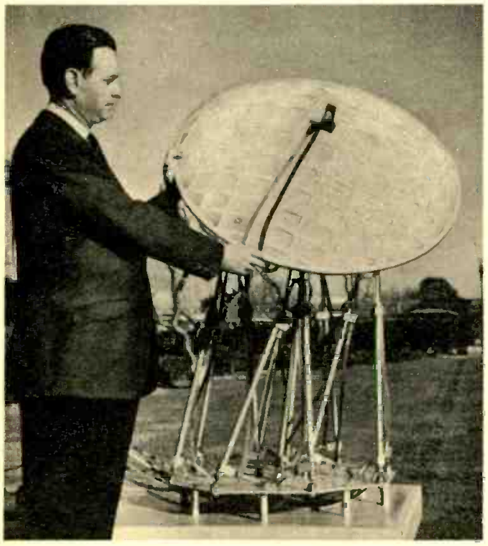
To order, circle No. 5 in coupon

. . .News

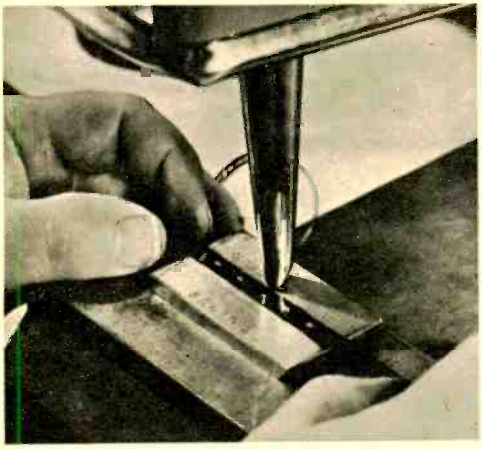
Drag Race . . . The dish antennas that are used for radar, satellite spotting and point-to-point communications are highly vulnerable to winds, due to their large size and mountaintop locations. Sylvania has challenged nature's forces with a rigid new lightweight foam material that reduces the problem of wind drag as much as two-thirds. The weight of a conventional metallic reflector of 60 feet diameter is at least 15 tons, but the Sylvania material brings the antenna's weight down to only three tons.



The 12 legs at the base of the dish structure are long hydraulic cylinders grouped into four tripods. Coordinated changes in the length of the legs, controlled by a servo-mechanism, cause the antenna to move through any desired search or track pattern.

—o—

Sound Goes to Work . . . Ultra Sonic Seal, a method of bonding plastic films and synthetic fabrics has been developed by Kleer-Vu Industries, Inc., New York City. The sealer head (see photo), driven by a powerful RF generator, vibrates at the rate of about 20,000 times a second, making contact with the surfaces being joined. The vibration generates just enough molecular heat to



make a firm bond without burning the material.

—o—

Thermoelectricity . . . has been put to practical commercial use by Westinghouse in a new water cooler. Completely silent, with no moving parts, it works on a century-old principle that electricity

passing through the junction of certain dissimilar metals causes the temperature either to rise or fall, depending on the direction of flow (see THERMO-ELECTRICITY, September '59 EI).

Broadsides

Pamphlets, booklets, flyers, application notes and bulletins available free or at low cost.

A booklet describing **TVI Causes, Effects and Solutions** may be obtained via a request on company letterhead from Television Interference Aids, 1110 Lake Blvd., Annandale, Va. Send a 9x12-inch stamped, self-addressed envelope.

Crystals and other precision-made equipment and their accessories are listed in International Crystal's free 1961 catalog. Technical information, typical circuits and illustrations are included. 18 N. Lee, Oklahoma City, Okla.

A catalog describing **25 electronic courses** given by International Correspondence Schools is available from ICS, Scranton 15, Pa. Hi-fi, computers, and communications are among the fields covered.

A Case History in Progress is the title of a Sylvania booklet discussing their new epitaxial germanium and silicon mesa transistors and epitaxial silicon mesa diodes. Free from Sylvania Electric Products, Inc., 1100 Main St., Buffalo 9, N. Y.

Stancor's new **replacement transformer** catalog lists electrical and physical specifications for 870 units. Catalog S-106 is available free from any Stancor distributor or by writing to Stancor, 3501 Addison St., Chicago 18, Ill.

Frequency and time standard systems are described in Hewlett-Packard's Application Note 52. Available free from H-P, 1501 Page Mill Rd., Palo Alto, Calif.

The **1961 Master Index** to all Supreme Publications' service manuals may be obtained for 25¢. The master index covers Radio Volumes 1-21 and TV manuals 5-18. Supreme Publications, 1760 Balsam Rd., Highland Park, Ill.

Electronic Marketplace

LOVE THAT IRON . . . Vertical vents in the nylon handle of the new Sidco soldering tool keep it cool even when used continuously. The photo is one of

Sidco's ad illustrations, and the model now is known as Hot Lips McGinty in our bailiwick. Sidco, Box 192, Venice, Calif.

—o—

Coaxial Stereo Earphones . . . are the ultimate for hi-fi buffs who like listening alone. In these Superex Model STM phones, each earpiece contains a separate woofer and tweeter which the manufacturer claims has a frequency response of 20 to 20,000 cps. An adjustable crossover network, in a separate unit, permits the user to regulate the sound in each phone. The phones are relatively light and have foam cushions that, in addition to providing comfort, shut out external noise. The price from Su-

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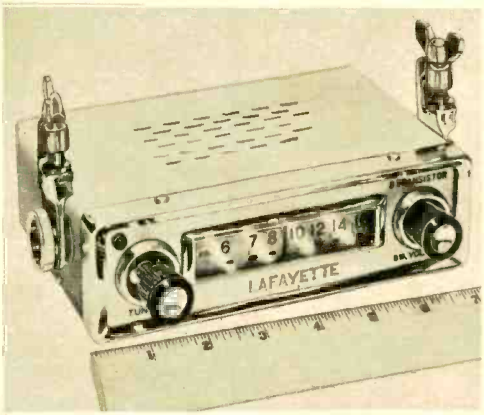
Marketplace

perex Electronics Corp., 4 Radford Pl., Yonkers, N. Y., is $29.95.

—o—

Compact Radio for Compact Cars . . . is Lafayette's newest addition to their auto radio line. This little (7 x 2½ x 4¾ inches) 8-transistor unit has automatic gain control, 3 IF and 1 RF stage and



comes complete with a built-in 4-inch speaker, noise suppressor capacitor and distributor suppressor. For 12-volt operation only. Radio is priced at $39.95 from Lafayette.

Marketplace

Beam Antenna Rotor . . . Streamlined, weatherproof and rugged, the "Ham-M" Rotor is designed specifically to support the large, multi-element beams favored by amateurs. It features a positive electro-mechanical brake that locks the antenna against whipping by the wind and a remote-control unit calibrated in increments of 5° for accurate positioning of the antenna. Full information available from Cornell-Dubilier, 50 Paris St., Newark, N. J. $119.50.

—o—

For Hams and SWLers . . . Collins has introduced their 51S-1 general coverage high-frequency receiver. An "all-wave brother" to the 75S-1 (which tunes only ham bands), this unit covers everything from 2 to 30 megacycles. The circuit is triple conversion from 2 through 7 mc and double conversion from 7 through 30 mc. The combination of crystal-controlled high-frequency oscillators and

permeability-tuned low-frequency circuits makes for a stable receiver. Complete specs available from Collins Radio Co., Cedar Rapids, Iowa.

—o—

Hi-Fi Hearing Aid . . . Dime-sized and completely self-contained, the Otarion Normalizer contains a subminiature acoustic chamber to give the user more normal sound than is furnished by most aids. The effect of the tiny acoustic labyrinth is to improve the clarity of low tones and speech patterns. The device fits flush in the ear and weighs only a fraction of an ounce. It has enough am-

Marketplace

plification to correct a hearing loss up to about 50 db. Otarion Listener Corp., Box 711, Ossining, N. Y.

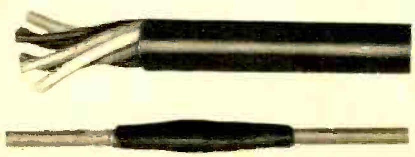
—o—

More Music Power . . . Fisher has announced a new integrated amplifier rated to deliver 110 watts (music power). The Model X-1000 employs two pairs of matched EL34's and offers the

following features: earphone connections to permit personal listening, rear-panel input for remote control, 18 inputs, low and high filters to eliminate turntable rumble and surface hiss, three DC power supplies, etc. Complete specs for the $329.50 unit may be obtained from Fisher, 21-21 44th Dr., Long Island City 1, N. Y.

—o—

Shrinkable Tubing . . . Sure to find many uses in electronic gear of all kinds is the new Alpha Shrinkable Tubing. The product is manufactured in diameters up to one inch. It slips easily over wires, terminals, small parts, etc. and when heat of approximately 135° C is applied it shrinks to a predetermined diameter to form a tight bond. Longitudinal shrinkage, however, is less than 10%. Alpha Wire Corp., 200 Varick St., New York 14, N. Y.



Marketplace

CB Handi-Talkie(s) . . . Raytheon has brought out a Citizens Band handi-talkie called the Ray-Ette. It comes in two models, the 11-transistor Super and six-transistor Regal, selling for $99.95 and $79.95, respectively. The Super has a superhet circuit and the Regal a super-regen circuit.

The Ray-Ette is a nice little handful at 15 ounces and dimensions of 5¼x2¾x

$1\frac{3}{16}$ inches. It has a plastic case and a 46-inch telescopic antenna. Input to the final stage is 50 mw and Raytheon claims ranges of five miles on water, two miles on land and "several blocks" in congested cities. The Ray-Ette operates on a rechargeable dry cell and the charger comes with the handi-talkie.

Raytheon Co., 411 Providence Turnpike, Westwood, Mass.

—o—

Smallest Video Tape Recorder . . . is completely transistorized, weighs about 450 pounds and can be readily transported. This console, introduced by the Sony Corp., Tokyo, is designed to operate with the Sony transistorized camera. It will have broad applications in the fields of commercial communication, industry, education, medicine and sports. For example, a hospital can tape an operation for future study, or transmit it over closed-circuit TV for viewing anywhere in the building.

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EI-11

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EI's SPECIAL REPORT ON

FM TUNER KITS

Here are the results of a monumental project in which

EI constructed and tested all major FM tuner kits.

Most comprehensive report of its type ever made!

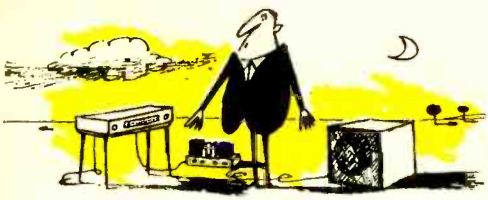
FM TUNERS
THEORY & PRACTICE

A discussion of FM broadcasting and tuner design, plus some technical factors a buyer must consider.

By John Milder

BY NOW, even the newest audiophile recognizes FM as *the* medium for high-fidelity broadcasting. The amplitude-limiting circuits built into FM sets effectively clip AM noise riding in with the FM signal. As for wide-range frequency response, the uncrowded FM band allows a station plenty of elbow room to transmit the full range of audio frequencies without disturbing its neighbors on the dial.

FM's only disadvantage for the average audiophile is its fairly short transmission range. This means that only a short distance away from the transmitter we get into the fringe area: hence,



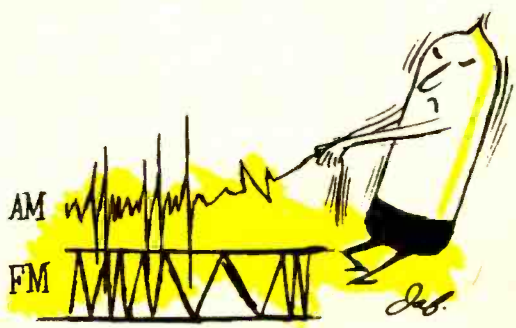
"A short distance away we get into the fringe."

an FM receiver must be sensitive enough to pick up and *use* signals of only a few *microvolts* strength. And now that stereo via FM multiplex is coming over the airwaves, even greater demands are placed on FM receiver sensitivity. Let's look at some of the ground rules for good performance from *any* FM tuner—kit or factory-wired.

FM tuners are necessarily complex, consisting of several sections. The first, usually called the front-end, selects and amplifies the desired station's frequency. In addition to latching onto the signal, it's important that the front-end produce as little noise as possible, since noise will be amplified right along with the signal. Any tube circuit introduces *some* noise, so manufacturers try for a maximum signal-to-noise ratio by techniques such as the plating of the front-end with silver or gold to increase conductivity, special grounded-grid or cascode circuits and low-noise tubes.

Before the strengthened signal leaves the tuner's front-end, a mixer/oscillator circuit (as in the standard AM superhet) converts it to an *intermediate frequency* (IF). The IF section's job is to get the signal (within the IF bandwidth) as strong as possible before it reaches the tuner's limiter and detector stages.

The last IF tubes frequently double as limiters—depending upon the strength of the signal reaching them. The limiter's function is to strip off the AM noise. To a great extent, the limiter's ultimate effectiveness depends on the signal-to-noise ratio obtained in earlier stages. Only the right com-



"The limiter's function is to strip off AM noise."

bination of front-end and limiter performance can provide the velvety background that FM is capable of.

Finally, the detector (ratio or discriminator) stage—which nobody has yet dubbed the "rear-end"—separates the audio content of the signal from the RF carrier. The big trend in this area is toward wider detector bandwidth. The wide-band detector generally has an easier time avoiding distortion when a broadcast station overmodulates its signal. In addition, a wide-band detector stage can ignore any slight tendency of a front-end to drift off station—thus eliminating the need for AFC.

Before we go on to look at the standards for good tuner performance, we should point out that the problem of drift—once the bugaboo of FM—has been pretty well licked. If a *narrow-band* detector is used in a tuner, there's usually an Automatic Frequency Control (AFC) circuit which locks in a station. Some manufacturers even throw in an AFC circuit in a wide-band tuner which theoretically doesn't need it. There have been arguments pro and con AFC, since some of the circuits tend to cause distortion and a loss of bass response. In any case, if AFC *is* used in a tuner, make sure that it can be temporarily "defeated" during tuning to prevent it from blocking out the weaker of two close signals.

A tuner's primary job obviously is to make the most of whatever FM signal is available. Therefore, the first yardstick for most audiophiles is a tuner's *sensitivity rating*. Specifications for a tuner's sensitivity are expressed in the *signal strength* (in microvolts) needed for a *given amount (db) of quieting action* (X microvolts for Y db of quieting).

"30 db of quieting is specified as the standard."

Until recently, there was no general agreement on techniques for rating sensitivity. But the Institute of High Fidelity Manufacturers now specifies 30 db of quieting as the standard and EI's ratings in this survey have been measured by this standard.

A tuner also must measure up in the virtues demanded of other hi-fi components. Wide-range audio frequency response is a must, as are low distortion (both harmonic and intermodulation) and a high signal-to-noise level. You'll find these figures on EI's spec chart. In addition, there are less obvious factors such as physical size, output, etc., which may be important in your setup.

Capture ratio becomes important if you live in an area that is about halfway between two FM transmitters that operate on—or near—the same frequency. If a tuner has a hard time deciding between the two stations in such a situation, you'll come up with nothing more than hash when you try to tune either one. Specifications for capture ratio tell you how much stronger one of the two signals must be in order for the tuner to latch onto it and ignore the second signal. The ratio is stated in db, and the lower the figure the better.

"Capture ratio . . . tuner decides between stations."

None of the units tested in this survey drifted enough (when correctly tuned to a station and limiting) to make the results worth noting. In all tested units the drift problem seems to be a thing of the past. And frequency response in every case was at least 20 to 20,000 cps, ± 2 db.

Among other general features worth noting, our chart indicates visual tuning aids (if any), the noise level and presence of an [*Continued on page* 32]

TECHNICAL SPECIFICATIONS

Tuner	Sensitivity: Home Aligned(A)	Sensitivity: Instrument Aligned	Distortion: Harmonic(B)	Distortion: I.M.	Capture Ratio	Signal-to-Noise Ratio	Wiring	Space for Mpix. Adapt.	Fuse
Radio Shack Realistic HK-200	No 4.5 µv.	4 µv.	0.78%	1.6%	7.8 db	56 db	pt. to pt.	No	No
Arkay FM-7	No —(E)	5 µv.	1.15%	1.85%	7.5 db	42 db	pt. to pt.	No	No
EICO HFT-90K	No 5 µv.	3.25 µv.	1.1%	2.4%	6.25 db	48 db	pt. to pt.	No	No
Heathkit FM-4	No —(E)	7.5 µv.	0.6%	1.35%	9 db	45 db	pt. to pt.	No	Yes
Lafayette KT-650	Yes 8 µv.	5.4 µv.	0.15%	0.9%	7.5 db	59 db	printed	No	Yes
PACO ST-35-PA	Yes 4.5 µv.	4.25 µv.	0.35%	0.3%	8.5 db	48 db	printed	Yes	No
Grommes 101 GTK	Yes 6 µv.	4.25 µv.	1.35%	3.6%	7 db	53 db	pt. to pt.	Yes	Yes
Allied Radio Knight-Kit 83YX732	Yes 2.9 µv. (H)	2.45 µv. (H)	0.35% (H)	0.29% (H)	6 db	59.5 db	printed	Yes	Yes
Dynatuner FM-1	Yes 4.75 µv.	3.25 µv.	0.25%	0.24%	5.2 db	50 db	printed	Yes	Yes
H. H. Scott LT-10	Yes 1.88 µv.	1.75 µv.	0.57%	0.91%	5.8 db	54 db	pt. to pt.	Yes	Yes
Harman-Kardon Citation III	Yes 3 µv.	1.95 µv.	0.1%	0.4%	5.4 db	64 db	pt. to pt., term. board	Yes	Yes

FOOTNOTES (A) Yes—aligned according to manufacturer's instructions. No—no home alignment instructions.
(B) 0.15% subtracted from readings to compensate for residual distortion in test equipment.
(C) Price includes cabinet unless otherwise noted.
(D) Pre-wired, pre-aligned RF, IF and detector stages; only power supply and switch require wiring.

output level control and where mounted.

"Compatibility" is a term frequently thrown around without much regard for its exact meaning. Were all tuners we tested compatible with any hi-fi setup? We can give a qualified yes. The two points of qualification are the high-frequency loss problem discussed in the Tech Editor's Test Bench and the possible inadequate audio output voltage of some tuners in some setups.

The audio output figures listed in the table were obtained by feeding in 1,000 microvolts of signal modulated 100%. Here again, EI's figures may not match the manufacturers'. Although the various techniques provide differing results, EI's table provides accurate comparisons among the tuners.

If you have an older amplifier with low gain at the tuner input jack you may run into trouble when hooking in one

FROM EI's TEST LABORATORY

Visual Tuning Indicator	Output Level Control	Output Circuit	Pre-Wired Front-End	AFC	Output Level	Size	Price(C)
None	None	Direct	Yes(D)	Switched (front panel)	1.5 v.	4⅜" high 9⅝" wide 6⅛" deep	$29.95 $34.88 wired
Eye Tube (EM 84)	Rear	Modified Cathode Follower(F)	Yes	Fixed	0.84 v. 3 v.(F)	4¼" high 12⅛" wide 7¾" deep	$39.95 $4.95 metal case
Eye Tube (DM 70)	Front	Cathode Follower	Yes	No	1.4 v.	3⅝" high 12" wide 8¼" deep	$39.95 $65.95 wired $ 3.95 metal case $12.50 wood case
None	Front	Cathode Follower	Yes	Switched (front panel) Internal Adjustment	1.25 v.	4$\frac{9}{16}$" high 13¾" wide 5½" deep	$39.95 $62.95 wired
Eye Tube (EM 84)	Front	Feedback Triode	No	Variable (front panel)	1.95v.	5" high 14" wide 11" deep	$54.50 $79.95 wired
Eye Tube (EM 84)	Rear	Cathode Follower	Yes(G)	Switched (front panel)	2.1 v.	5⅝" high 15⅜" wide 11¾" deep	$59.95 $69.95 semi-kit $89.95 wired
Eye Tube (EM 81)	None	Direct	Yes	Variable (front panel)	2.45 v.	4½" high 14" wide 9" deep	$66 (East) $69.30 (West) $79.95 wired ($89.95 with case)
Eye Tube (EM 84)	Rear	Cathode Follower	No	Switched (front panel) Adjustable (rear panel)	6 v.	5¾" high 15½" wide 16½" deep	$67.50
Eye Tube (EM 84)	Front	Feedback Triode	No	No	1.9 v.	4" high 13" wide 7½" deep	$79.50 $119.95 wired
Signal Strength Meter	Rear	Feedback Triode	Yes	No	1.35 v.	4⅜" high 15" wide 10⅛" deep	$ 89.50 $129.50 wired $ 12.95 metal case $ 24.95 wood case
Signal Strength Meter and Center Channel Meter	Front	Feedback pair	Yes (plus pre-wired IF strip)	Switched (front panel) Adjustable (rear panel)	1.95 v.	6" high 14⅞" wide 13" deep	$149.95 $229.95 wired $ 29.95 wood case

(E) Tuner worked before instrument alignment but sensitivity was too poor to permit a valid IHFM test.
(F) Choice of high or low impedances gives corresponding voltage readings.
(G) Pre-wired front-end is supplied only with partially assembled ST-35-PA.
(H) Measurements made with DSR circuit switched in.

of the two or three tuners on the table with the lowest audio output levels. This is particularly true if you are driving a low-efficiency, acoustic-suspension speaker. Note that the *gain* at the tuner input jack of the amplifier bears no relation to the power output capabilities of the amplifier. To be specific, even a 50-watt amplifier driving a low-efficiency speaker, when used with a low-output tuner, may *not* provide all the hum-free volume you would like—or need.

Multiplex jacks are present on all the tuners. However, all the facts are not yet in on requirements for reception of stereo. All manufacturers in EI's report say their tuner kits are adaptable to multiplex, but there is no guarantee that they will produce anything to fill the "multiplex adaptor" spaces some have marked out on their chassis.

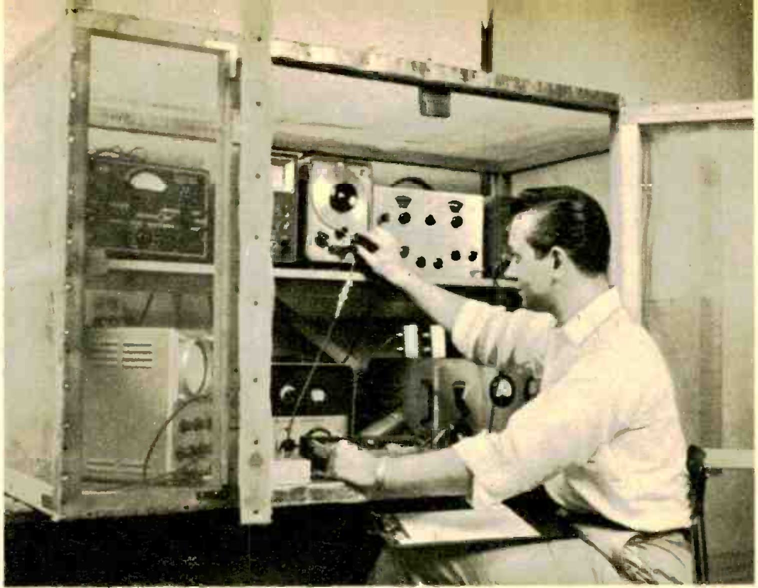
How EI's Tests Were Made

ABOUT six months ago, Electronics Illustrated, foreseeing the approaching approval of an FM multiplex system by the FCC, embarked on a testing project which we modestly describe as monumental. It was our aim to construct and test *every* FM tuner kit available.

Our testing program was planned as follows:

- Each tuner would be constructed according to the manufacturer's manual by a person of limited or average kit experience. He would make notes on difficulties experienced, ambiguities in the instructions, etc.
- The sets were then turned over to the Audio Workshop where they were checked for proper wiring. Any errors made in construction were rectified and the construction manual checked to determine whether the instructions or the builder was to blame. Bad connections were resoldered (this was the major cause of non-operation) and the tuners were then left to heat up.
- We were interested not only in how well the tuners performed under optimum alignment conditions but—more importantly—in how well they would function straight off the constructor's work bench (assuming they were built correctly). The manufacturer's *non*-instrument alignment instructions (if any) were followed. (Recently, techniques have been worked out for alignment of FM tuners without the usually required RF or sweep signal generator and VTVM. The tuner's built-in tuning eye or meter usually serves as the alignment indicator.)
- After the manufacturer's non-instrument alignment, performance measurements were attempted on each tuner. We say *attempted,* because among the tuners not providing a non-instrument alignment procedure there were several not sufficiently sensitive without instrument alignment for Institute of High Fidelity Manufacturers' figures to be obtained. The sensitivity of each tuner after home alignment or no alignment is listed in the chart (pages 32 and 33).
- The next step was an instrument alignment of each tuner using some of the finest professional equipment available. After alignment, the entire series of measurements was made again and the final results are noted on the chart.

It should be emphasized that our figures are not absolutes. As we state elsewhere, the tuner you build may be somewhat better—or worse—than the unit we constructed and tested. However, be assured that every effort was made to be certain that EI's test units were representative of the average production.



Harry Kolbe working on a tuner in the specially constructed shielded cage required by the test procedures.

WHO'S WHO: The bulk of the work represented by this report on FM tuner kits was carried out by EI's three Contributing Editors on Audio: Harry Kolbe, David Muirhead and John Milder. Kolbe and Muirhead are proprietors of the Audio Workshop at 732 Broadway in Manhattan's Greenwich Village. It is a test and development laboratory which EI employs regularly for construction and evaluation work. Milder is a well-known writer on audio and other technical subjects.

LABORATORY TESTS MADE BY EI

USABLE SENSITIVITY was measured for all tuners by the IHFM procedure to make possible direct comparison of all kits. Separate measurements were made after *home* alignment and after *instrument* alignment to indicate whether the inexperienced builder could hope for good performance without special alignment.

FREQUENCY RESPONSE was measured by IHFM standards with full allowance for the high-frequency de-emphasis built into all tuners.

HARMONIC DISTORTION was measured by IHFM standards.

INTERMODULATION DISTORTION was measured by Society of Motion Picture and Television Engineers (SMPTE) standards.

SIGNAL-TO-NOISE-RATIO (internal hum and noise) was measured by IHFM standards.

CAPTURE RATIO was measured by IHFM standards.

OUTPUT LEVEL was measured at 1,000 microvolts input (100% modulation).

INSTRUMENTS used for alignment and measurements included:

Hewlett-Packard: Model 400C AC VTVM; Model 400D/db AC VTVM;
Model 412A DC VTVM; Model 200CD Audio Oscillator
Measurements Corp.: Model 210A Standard FM Signal Generator;
Model 80 Standard Signal Generator
Barker & Williamson: Model 400 Harmonic Distortion Analyzer
Heathkit: Model OP-1 Professional Oscilloscope; Model AA-1 Audio Analyzer (IM Distortion)
EICO: Model 368 TV-FM Sweep Generator
Knight-Kit: AC VTVM

EI's Editors consider the IHFM standards the *best* now available. As presented in our chart, they allow a reader to make direct and valid comparisons between competitive units—which the varying test methods used by manufacturers do *not* allow. If you're interested in having a copy of the IHFM's booklet outlining FM test procedures, write to The Institute of High Fidelity Manufacturers, Inc., 516 Fifth Avenue, New York 36, New York. Ask for publication IHFM-T-100, the cost is $1.

reports on

INDIVIDUAL KITS

The **RADIO SHACK REALISTIC HK-200** is not only the least expensive, but unquestionably the easiest kit in this survey to build. It comes with everything mounted, aligned and pre-wired except the power supply, output and switching.

The front-end uses a 6BS8 as a cascade RF amplifier and a 6AB4 for mixing; a 12AT7 serves as oscillator and AFC tube. Two 6AU6's are used as IF amplifiers and a third serves as a limiter. The discriminator is a 6AL5 tube.

The Realistic instructions are as comprehensive as they need to be. The few construction steps are clear and accurate. It takes about an hour to make the few electrical and mechanical connections required. No alignment is needed when you've finished building the Realistic—it simply plugs in and plays.

Sensitivity for a unit in this price range is excellent and distortion quite low—under the right conditions. Neither figure could be significantly improved by instrument alignment.

When we first checked out the Realistic we obtained a disappointing harmonic distortion level of almost 4%. In addition, the frequency response test showed about a 3 db rise at 20 kc. Our test lab tried various remedies, and then it turned out that Radio Shack relies upon the capacity of the tuner's output cable (which we did *not* use in our tests) to supply a certain percentage of the required high-frequency de-emphasis. When the tuner was retested with its own output cable, the kc rise disappeared and the distortion figures dropped to those quoted in the chart. There may seem to be little connection between an output cable and HD. However, remember that the high-frequency boost resulting from the too-short cable also boosted the harmonics.

Summing up, the Realistic certainly gives you a lot of tuner for a little money.

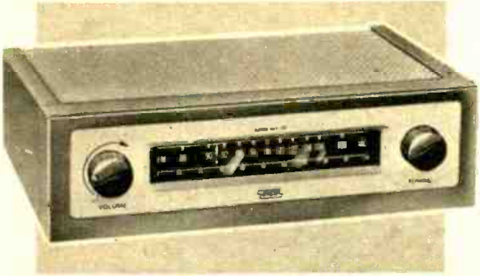
The **ARKAY FM-7**'s keynote is simplicity, and its design has few frills. The pre-wired front-end is followed by two 6AU6 tubes serving as straight IF amplifiers. A third 6AU6 sees double-duty as an IF amplifier and a single-stage limiter. A wideband ratio detector is used, followed by an audio stage that can be used either as a cathode follower or (for higher gain) a triode amplifier.

Packaging and instructions for the FM-7 are fair. The chief fault of its instruction book is that it is not specific enough. The novice kit-builder wants to know the *size* of every nut and lock-washer called for. And, since each numbered construction item often includes four or five steps, it would help to make their order clearer.

Some mechanical connections, such as the mounting of the tuning shaft and the stringing of dial cord, may be difficult for the novice, and some soldering points are hard to get at.

The front-end is prealigned, but IF and detector alignment measures are left to the builder, and instruments must be used. Without instrument alignment, reception is only fair. The FM-7's AFC circuit can't be defeated during tuning, which may make for a strong station's overriding a nearby weaker one.

The FM-7's performance is adequate if you're not in an FM fringe area.



The **EICO HFT-90**'s combination of high performance and simplicity has proved its appeal to kit builders well enough to remain virtually unchanged since its introduction. The sealed, pre-wired front-end (one of the first on the market) uses an ECC 85 grounded-grid RF amplifier and a reflex converter. The tuner has three stages (using 6AU6's) of IF amplification. The last of these also acts as the limiter. A 6AL5 ratio detector feeds the 6C4 cathode-follower output.

One of the first tuner kits to employ a wide-band ratio-detector, the HFT-90 (despite the absence of AFC) shows no evidence of drift.

The HFT-90 instruction book is specific and easy to follow. Like most other EICO kits, it uses conventional point-to-point wiring, with recommended lead lengths.

Actual construction goes pretty rapidly. The chassis layout is occasionally a little cramping, but there are none of those frustrating instances when the builder wishes he had an extra pair of hands.

The EICO's IF and RF transformers are prealigned at the factory, and you can expect the tuner to play as soon as it is plugged in—without the need of either home or professional alignment. But for extreme fringe areas, instrument alignment will pay important dividends in sensitivity.

A novel and effective "exclamation point" tuning eye also serves as the dial pointer.

The EICO's audio output is fairly low. This means only that the EICO may not adequately drive a low-gain amplifier connected to a low-efficiency speaker. With virtually any modern amplifier, the HFT-90's output level is more than adequate, even with inefficient speakers. To maintain the EICO's good signal-to-noise ratio, the tuner should be operated with its front panel volume control on full at all times. Volume level adjustment should be made at the amplifier.

The **HEATHKIT FM-4** puts a premium on simplicity and value. The new pre-wired and pre-aligned front-end of the FM-4 uses a 6GY8 triple-triode as an RF amplifier, oscillator/mixer and AFC tube. The two IF amplification stages use 6AU6's, and the limiter stage is also a 6AU6. One section of a 6BN8 serves as a ratio detector, and the other as a cathode follower output.

The FM-4 is well packaged and, as expected from Heath, the instruction book is thorough and well illustrated. A novice should be able to assemble the kit with ease. While the veteran kit-builder doesn't need to be told to "make sure that a large blob of solder does not form here," this is exactly what the newcomer has to know.

There are no really tough construction problems with the FM-4, but the small tuner chassis does require an occasional bit of kit-building agility. For the most part, though, construction goes easily and without a hitch. As usual, Heath provides some extra hardware to replace the parts most likely to be lost, and a nice little nut-driver to help out in tight spots.

The Heathkit plays from the moment of plug-in and the pre-aligned front-end helps keep distortion low. Obviously, in-

strument alignment pays dividends in sensitivity. Heath logically suggests that the novice either ignore alignment or turn it over to a qualified serviceman. Detailed instrument procedures are given.

While the FM-4 is certainly not a super-sensitive unit, it's hard to criticize the kind of value it provides for the economy-minded builder—especially the newcomer. Its front-panel volume control allows it to be hooked up directly to a power amplifier. The desired AFC level can be set internally and then switched on and off at the tuner's front panel. Styling is intended to match the older line of Heath units. Heath informs us that the FM-4 will shortly be restyled on the outside, but no circuit changes are contemplated.

The **LAFAYETTE KT-650** is a simple and well-designed kit which uses printed circuit boards and prealigned IF transformers and coils to aid construction. It is designed for good rather than exceptional sensitivity, and actually checks out better than the manufacturer's conservative sensitivity rating indicates.

The front-end uses a 6AQ8 dual triode which doubles as an RF amplifier and mixer. A 6BK7B serves as an oscillator and AFC tube. There are two 6BA6 IF stages and there are two stages of limiting, using 7543's. A 6AL5 is used in the discriminator stage and a 6AV6, with heavy feed-back around it, acts as a "plate follower" output stage.

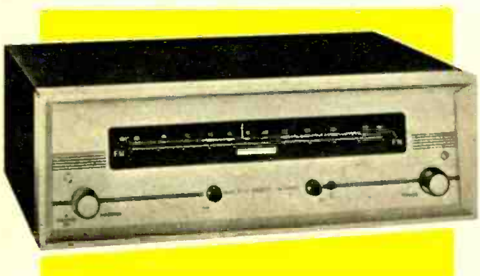
Lafayette's packaging is good and its instruction book thorough, with numerous pictorials. Parts are supplied in small envelopes with the numbers stamped clearly.

Actual construction is fairly simple, thanks to the well-planned printed circuit boards. Mechanical connections are relatively easy, and there is no need for the brute force approach at any time. The chassis is uncramped, and everything is accessible to the builder without acrobatics.

Although the front-end of the KT-650

is not prewired, Lafayette compensates with good instructions for alignment without instruments. The kit's tuning eye is used for this purpose, along with the ear of the builder. Results are good enough to overcome the lack of a preassembly.

As mentioned earlier, the KT-650 is rated conservatively in respect to sensitivity and actual tests revealed a microvolt more sensitivity than specified. Audio quality is excellent, with both harmonic and intermodulation distortion below 1%. The signal-to-noise ratio also ranked among the best. A front-panel level control permits the KT-650 to be used without a preamp, and audio output is fully adequate for this purpose.



The **PACO ST-35** kit is unusual in that it's available in two forms. As the ST-35, it's a conventional kit with printed circuit boards. As the ST-35PA, the boards are prewired. We tested the PACO ST-35PA kit. In both models all RF and IF coils are prealigned.

Up front, a 6AQ8 serves as a grounded-grid amplifier and mixer. A 6BK7 is used as an oscillator and AFC tube. The first two IF stages, using 6BA6's, provide straight IF amplification. The last two, using 6AU6's, double as limiters. The discriminator section uses a 6AL5, and a 12AU7 serves as audio amplifier and cathode follower output stage.

The packaging of the PACO is good and the construction book is excellent.

Although we received our unit with the RF and IF circuits prewired, the non-wired version is not likely to be troublesome. The PACO exhibited no really knotty construction problems. There are but few cramped connections, and the chassis is roomy and easy to work on.

PACO's alignment instructions, using only the tuner's tuning eye, are quite good and less than a microvolt sensitivity could be gained with instrument alignment. The harmonic distortion, however, was improved somewhat by the use of instruments. It was brought down from 1.6 to 0.35%. The ST-35's sensitivity should prove adequate for everything short of the most extreme fringe area. The audio quality is good, and the *on-off* AFC push-button on the tuner's front panel is convenient and does not degrade performance in any way.

Available too late for inclusion in this report, PACO has announced a new, less expensive ($42.95) tuner kit, the ST-25, which has a sealed, prealigned front end. One version (ST-26—$54.95) includes a small audio amplifier to allow direct connection to a loudspeaker.

The **GROMMES 101GTK** has no fancy trimmings but it's well designed and a good performer. In the pre-aligned front-end, a 6AQ8 serves as an RF amplifier and converter. Two 6AU6 IF stages follow and two more 6AU6's are used in the two limiting stages. Two 1N541 diodes serve as the discriminator and feed directly to the output jack. There is no separate stage of audio amplification. AFC is provided by a "varicap" diode and its level may be set by a front panel control.

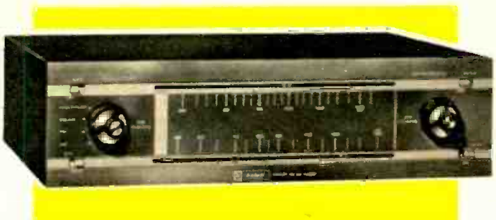
Packaging and instructions for the Grommes are fair. The instruction book is not quite specific enough for the novice kit-builder, and there should either be more pictorials or the present ones should be clearer. (One pictorial, for the front-end, did not correspond with the front-end in the kit itself.)

Although the tuner is well laid out and its chassis is uncrowded, there were some problems in construction. The mechanical assembly of the tuner required ingenuity and effort (from an experienced kit-builder). The tuner mounting bracket had to be bent and shims inserted between it and the chassis. The tuning shaft itself required some grease to turn smoothly. The chassis had to be drilled to accommodate

a trimmer capacitor. These problems sound more troublesome than they actually were, but it's nonetheless to be hoped that Grommes will remedy them. As it stands, the kit is not for beginners.

For non-instrument alignment of the Grommes you observe the tuning eye and listen for maximum interstation white noise through an amplifier and speaker.

Overall performance of the Grommes is good. Sensitivity is adequate for all but the toughest of fringe areas. The audio quality and audio output are adequate (2.4 volts) despite the lack of audio amplification stages. Note that this tuner lacks an isolation stage after the detector, and a long output cable should be avoided.



The **KNIGHT-KIT 83 YX 732** is straightforward in design, with the exception of one important feature: there's a special circuit labeled DSR (dynamic sideband regulation) which, when switched in, feeds back part of the discriminator's audio output to the tuner's front-end. Knight says the DSR cuts distortion due to overmodulation by the FM broadcast stations. We suggest it be left switched on at all times because it also substantially improves the sensitivity and distortion rating of the tuner. Both IM and harmonic distortion checked below 0.5%.

The Knight employs two stages of RF amplification using both halves of a 6AQ8. Another 6AQ8 serves as an oscillator mixer. Two 6CB6's serve as IF amplifiers, two 6AU6's as limiters and a 6AL5 is the discriminator.

The kit is well-packaged and the construction book is clear and easily followed. Both the front-end and IF stages use printed circuit boards, and there are few difficult solder connections.

Mechanical assembly, such as stringing the dial cord and mounting the tuning shaft is slightly time-consuming but not difficult.

Thanks to prealigned IF and RF transformers, the Knight performs very well with alignment by the builder. Only for extreme fringe-area reception is instrument alignment at all necessary.

Space is provided on the kit's extra-large chassis for later addition of an AM and/or a multiplex sub-section. All that is required for this purpose are the appropriate boards and a new panel (available from Knight). There's no need to change any of the circuits already built when adding either AM or multiplex. The unit illustrated here, by the way, incorporates an AM section and the new front panel.

As mentioned at the beginning of this report, Knight's novel DSR circuit is effective, and we think that it should be left switched on. In fact, we can't imagine any circumstance in which the user would want to deprive himself of the really exceptional gain in performance that DSR provides.

The **DYNATUNER FM-1** is the latest available of the tuners covered by our report. Third from the top in expense, it need take second place to none in terms of operating qualities.

The FM-1's instruction manual states that it is designed for *good* (but not top) sensitivity and extremely high audio quality with low distortion. And there's no doubt that the FM-1 fulfills its stated purpose. For example, our tests showed an I.M. distortion figure of less than a quarter of 1 per cent.

Behind the cathode-coupled front-end, (a dual-triode 6AQ8/ECC85), a triode/pentode 6AT8A serves as the oscillator/mixer. Four IF stages follow: the first two using 6BA6's; the second 6AU6's. Each IF stage also functions as a limiter when the signal reaches a high enough level. And there's sufficient gain in the receiver for the last limiter to be effective on input noise. The FM-1 also uses a balanced-bridge discriminator with a wide-band transformer and two matched semiconductor diodes. A 12AX7 serves as an isolating cathode follower (one triode) after the detector and the other triode as a "plate follower" audio output.

Packaging and instructions for the unit are good. And construction is remarkably simple—considering the high level of performance achieved. Printed circuit boards are used for the RF and IF stages. There are a few tight spots for the builder, but most connections are easy and uncramped. Unlike the other Dynakits, the components are not pre-mounted by Dynaco and there are some ambiguously numbered holes on the board. It's a good idea to double-check the component mounting for correctness before soldering. The circuit boards are sturdy, but some care is in order to develop the right soldering technique. Mechanical assembly is easy and fast.

All of the IF transformers, the discriminator transformer, and the slug-tuned coils on the RF board are pre-aligned close to optimum. But, like the other top-rated kits, final alignment is to be done by the user at home and without test equipment. Dynaco supplies full instructions for alignment procedure, which is accomplished by using the tuner's eye and your ear. Although the procedure takes time, it is well worth it. Note it involves working on a live chassis and in some steps quite close to the high-voltage B-plus. Reasonable care should be exercised to avoid shock.

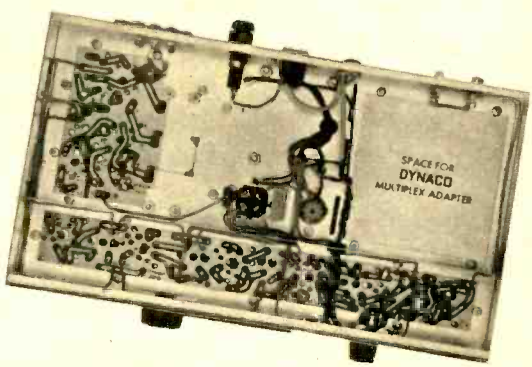
The results of the recommended home alignment steps are close to what can be obtained with instruments—close enough to make instrument alignment unnecessary. (Our lab obtained only a microvolt and a half more sensitivity and 0.3% less distortion with instruments.)

Our only reservation about the FM-1 concerns its high operating temperature. This is a "hot" tuner in more than one sense. While its heat generation probably won't do any harm to the components inside, adequate ventilation is a must for this unit. Since it's small, the Dynatuner tempts the user to slip it into a convenient cubbyhole in a bookshelf or elsewhere. Don't do it—failure to give it adequate breathing room may shorten the life of components.

Although the Dynatuner's sensitivity is good, its audio quality is unquestionably its real calling card. According to the manufacturer, the balanced-bridge discriminator, the low phase shift IF stages, and the cathode follower between the discriminator and de-emphasis network are the keys to the FM-1 tuner's remarkably low distortion figures. Whatever the reason, the unit's lack of harmonic and I.M. distortion is audible and impressive.

Dynaco will shortly have available a multiplex adaptor and a 10-watt amplifier. Both will sell for under $35 and either will fit in the space on the tuner chassis.

Underchassis view shows mounting of the two printed circuit boards. The component parts are soldered in place before the boards are installed.



The **H. H. SCOTT LT-10** is a remarkable combination of simplicity and excellent performance. Although it's the most sensitive tuner (by 0.2 microvolts) tested and rates among the top three in audio quality, it uses only five tubes (plus rectifier) and two diodes. And it's simple enough for the novice to tackle with no qualms.

Like most of the kits in this report, the Scott comes with a pre-wired, pre-aligned front-end. It is unique, however, in that its front-end is silver-plated for high conductivity. A 6BS8 is a cascode front-end and a 6U8 is a mixer-oscillator. Two 6AU6's provide the tuner's two stages of IF amplification, and a single 6U8 serves both as a last IF limiter and audio output stage. The wide-band detector circuit uses diodes.

Scott's packaging and instructions for the LT-10 are outstanding. All parts are mounted and identified in order on separate cards for each construction stage. All insulated lead wires are pre-cut to size and pictorials are big, color-coded, and easy to read. The novice can feel right at home here.

Construction is extremely simple. The kit is broken down into 12 assembly groups of a few steps each, and a separate diagram is provided for each stage. Except for the cases where connections are made from the pre-wired front-end, each stage has its corresponding card of parts. The chassis is extremely roomy and all connections —electrical and mechanical—are easily made. The soldering of the two heat-sensitive diodes is the only critical job.

All sockets, terminal strips, etc., are pre-riveted onto the chassis. This is both a time-saving and trouble-avoiding step. It's little appreciated how much difficulty can arise in high-frequency RF circuits from poor grounding. Scott's attitude is obviously that if they go through the trouble and expense to copper bond the chassis to insure good conductivity, they don't want poor grounding on the part of the kit-builder to lose the advantages realized.

The home alignment specified by Scott for the LT-10 is simple but effective. The tuning meter and, oddly enough, the pilot lamp, are the only visual aids needed to complete alignment, and the entire procedure takes a little over half an hour. Instrument alignment produced only a marginal gain in sensitivity, but did help cut down distortion slightly. Although a trifle low, the LT-10's output is adequate for any Scott or other modern amplifier.

It's hard to account specifically for the exceptional performance of such a basically simple circuit as the LT-10's, but exceptional it is. Scott has long been a proponent of wide-band design, particularly in the detector stage, and the bandwidth of the ratio detector in the LT-10 is actually 2 megacycles. Scott's combination of a silver-plated front-end and a chassis with copper bonded to aluminum also undoubtedly plays an important role in the LT-10's sensitivity—which checked out *better* than Scott's published figures. The tuner's sensitivity with both home and instrument alignment was the highest, by a slight margin, of any tuner tested. The achievement of 1.88 microvolts sensitivity *by a home alignment procedure without instruments* is an exceptional feat and a fine tribute to Scott's engineering.

The LT-110 kit, identical to the above, but including a built-in multiplex adaptor will be available shortly.

The novel packaging of the Scott kit enables the builder to construct the tuner in its shipping box.

The **HARMAN-KARDON Citation III** tuner, like the Citation preamps and amplifiers, is aimed at the well-heeled and demanding audiophile. It is the most expensive and most ambitious of the units tested for this report, and its overall performance is unquestionably outstanding.

The Citation's front-end uses a 6CW4 Nuvistor for the first stage. A grounded-grid RF amplifier/mixer (ECC85) and an ECF80 triode-pentode, serving both as oscillator and first IF amplifier, are located on the Citation's pre-wired IF strip. The second and third IF amplifiers are 6AU6's and two stages of limiting are supplied by 6BN6 gated-beam limiters. The discriminator employs a pair of semiconductor diodes, and its output is isolated from the de-emphasis network by a cathode follower (one triode of a 12AX7). The audio output uses both sections of another 12AX7 in a "feedback couple" configuration.

Packaging and instructions for the Citation III are up to the standards expected from earlier Citations. They are both excellent—as they must be to tackle a unit of this caliber. All components are grouped separately and in order of their use on special mounting cards. Excellent pictorials for each construction stage and close-ups of important steps are included.

As for construction, the Citation attempts to make it foolproof in every practical way. In addition to the pre-wiring of the Nuvistor RF stage, the Citation III kit also includes a pre-wired and sealed RF/mixer-osc./IF assembly (see photo). And, as with the other Citation units, a terminal board is used (in the cathode-follower and audio sections) for accessibility and uniformity.

Except for a tight corner or two, there is plenty of working space in the chassis and no special demands are made on the constructor for agility in either the mechanical or electrical connections. Despite the pre-assemblies, the complexity of the Citation III insures that you are going to spend almost 20 hours putting the kit together. Take the kit in slow and easy stages—you'll avoid errors that way.

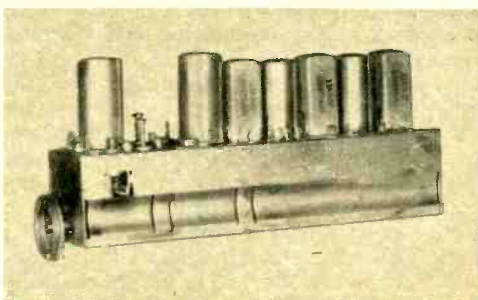
Harman-Kardon claims an audio frequency response three octaves above and below the audible range. Regardless of whether this kind of response is necessary, there's no denying the fact that the tuner's overall audio quality justifies the pains taken by its designers.

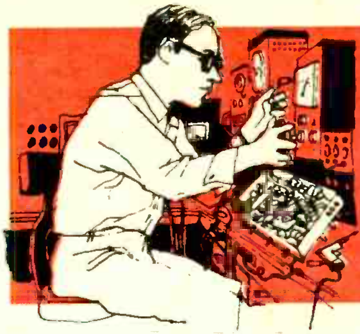
The Citation III incorporates a number of special control facilities not duplicated by any of the other kits covered in our report. In addition to the volume and tuning controls, the tuner's front panel sports an interchannel muting switch (and rear panel control to set the level of muting), an AFC on-off switch and a *local-distant* sensitivity switch to prevent front-end overload on strong stations. Two tuning meters are incorporated; one indicates the strength of the incoming signal, the other indicates channel center for precise tuning.

Home alignment of the Citation III is achieved with the aid of its two front-panel tuning meters. It is exceptionally effective and, as can be seen from our chart, little can be gained by instrument alignment. The tuner is as sensitive as any available and it is interesting to note that some of our tests produced slightly *better* results than Harman-Kardon's already superb specifications. Not that the improvement of 1 db in the signal-to-noise ratio or the 0.05 microvolt higher sensitivity has any real significance in terms of the performance of the tuner. But what our tests *do* demonstrate is that anyone constructing the H-K tuner kit need have no fear that his unit won't be the equal of a factory-assembled tuner.

The Citation III ran first or an extremely close second in every one of our tests. Its many refinements—both in circuitry and control functions—justify its premium price.

H-K's prealigned and sealed RF, osc., and IF strip.





Tech Editor's Test Bench

by Larry Klein

BESIDES the specific performance figures presented in our report, EI's experiences with the 11 tuner kits led us to some interesting generalizations.

For example, our tests showed that in general, the way to judge a tuner is *not* to count tubes but to look at the performance specs.

The audio output circuits show an interesting variety. There are three general types: the cathode followers, the "anode followers" and the outputs fed directly from the detector stage (see schematics below).

The cathode follower, most familiar to the hi-fi fraternity, provides good isolation between detector and output jack but has a gain of less than 1 and may be noisy.

The anode follower and "feedback pair" employs heavy feedback around one or a pair of triodes to achieve a gain of more than 1 and low distortion.

The third output method, direct coupling from the detector, is the least desirable. True, it does save the manufacturer a tube, but at the risk of high-frequency loss and distortion (through loading of the detector).

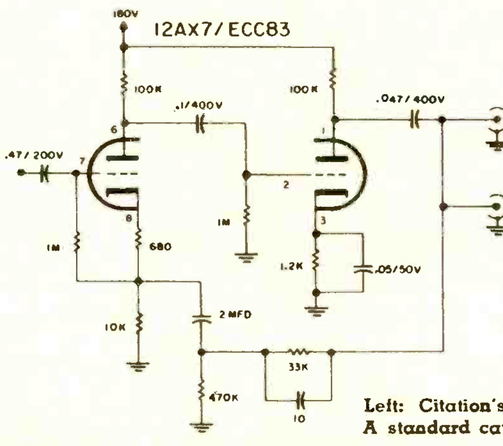
There's a limit to the length of shielded cable that can be used with direct coupling without chopping off the top end of the audio signal. You can get away with cable lengths of three or four feet without running into trouble. If you need greater distance between tuner and preamp, you had best choose a tuner with a cathode or anode follower. If the manufacturer has a recommended cable length or provides a cable—use it. The design of the output stage may require the capacity of the cable to achieve proper de-emphasis of the signal.

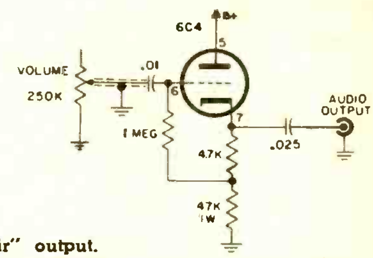
Professional alignment of the tuners provided some surprising data. On some kits sensitivity improved, on others distortion dropped. And with a few, the gains on *any* factor were minimal.

This means that it is possible (when the tuner has a wide-band detector, pre-aligned sub-assemblies and a well thought out home-alignment procedure) to achieve close-to-professional alignment without a shop full of test equipment. Note that every tuner did benefit to *some* degree from professional alignment. Whether the improvement is worthwhile or even audible depends on the individual tuner.

A few tuner kits now on the market

[*Continued on page* 102]





Left: Citation's "feedback-pair" output. A standard cathode follower is at right.

CIRCUITS FOR STEREO FM ADAPTORS

Two basic multiplex adaptor circuits have appeared. Here's how they operate.

By Harry Kolbe

SINCE the Federal Communication Commission gave its approval to the Zenith-General Electric system of stereo multiplex FM, several circuits have been developed for adaptors which when connected to your present FM tuner makes possible stereo reception. Two basic circuits were designed by GE and Zenith at the beginning, and now there are adaptations of both, plus some new ideas.

The basic concept of stereo FM was taken up in the September '61 EI so we shall confine ourselves here pretty much to a technical discussion of circuitry. Suffice it to say that to receive stereo FM you must have either a multiplex stereo tuner or a standard tuner with a multiplex adaptor (both amount to the same thing) to separate the composite signal into its right and left components. (Multiplex is a method of transmitting two or more channels of information on the same carrier.)

Matrixing and Time Division

The receiving process for stereo FM, can be best understood by looking first at the *transmission* end. One type of stereo transmission originates in a matrixing system. There is a main channel

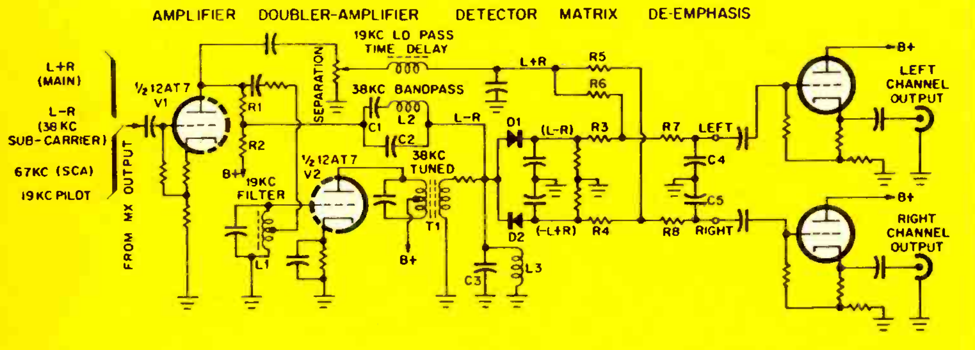


Fig. 2—General Electric stereo FM adaptor circuit.

signal which is the sum of the left plus the right (L+R) channels and also a subchannel or difference (between the left and the right channels—that is) signal (L—R). The difference signal amplitude modulates a 38-kc subcarrier. Sidebands appear as a result of the modulation—and then the carrier is suppressed.

In a second type of transmission, the time division system, the subcarrier modulating signal (L—R) is produced by a switching technique which samples first the whole L signal and then the whole R signal at the rate of 38,000 times a second (38 kc).

Signal Components

Both systems include a 19-kc pilot signal, whose uses we will discuss later, and also *may* include a 67-kc SCA (Subsidiary Communication Authorizations) signal (background music for stores, restaurants, etc.).

Although the operation of an FM tuner is the same whether the incoming signal is multiplexed or not, the signal available at the tuner's multiplex jack is quite different. It contains these components (see Fig. 1):

1. The main channel or sum (L+R) signal, which occurs between 50 cps and 15 kc.

2. The stereo subchannel or difference (L—R) suppressed carrier sidebands, which occurs between 23 and 53 kc.

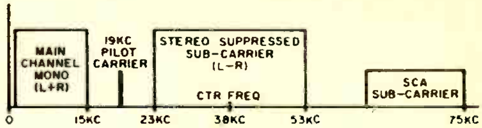


Fig. 1—Components of stereo multiplex signal.

3. A 19-kc pilot signal.

4. An SCA subcarrier, which occurs between 67 and 75 kc (optional).

The L+R signal (No. 1), de-emphasized and amplified, appears at the output jack of a normal tuner as a mono signal. The other components, attenuated by the de-emphasis network, are not audible. To recover the L—R (second channel) modulation you need a multiplex adaptor. As we said, several circuits to do this job have been developed but we will confine our discussion to the GE and Zenith designs.

General Electric Circuit

Let's look first at the GE circuit, which is a matrix type (see Fig. 2). The composite stereo-mono signal appearing at the output of the FM detector is fed via the tuner's multiplex output jack to the stereo adaptor. You will remember that this signal contains the components listed above.

The first stage (V1) of the adaptor amplifies the signal and provides isolation between tuner and adaptor. V1's output is fed [*Continued on page* 104]

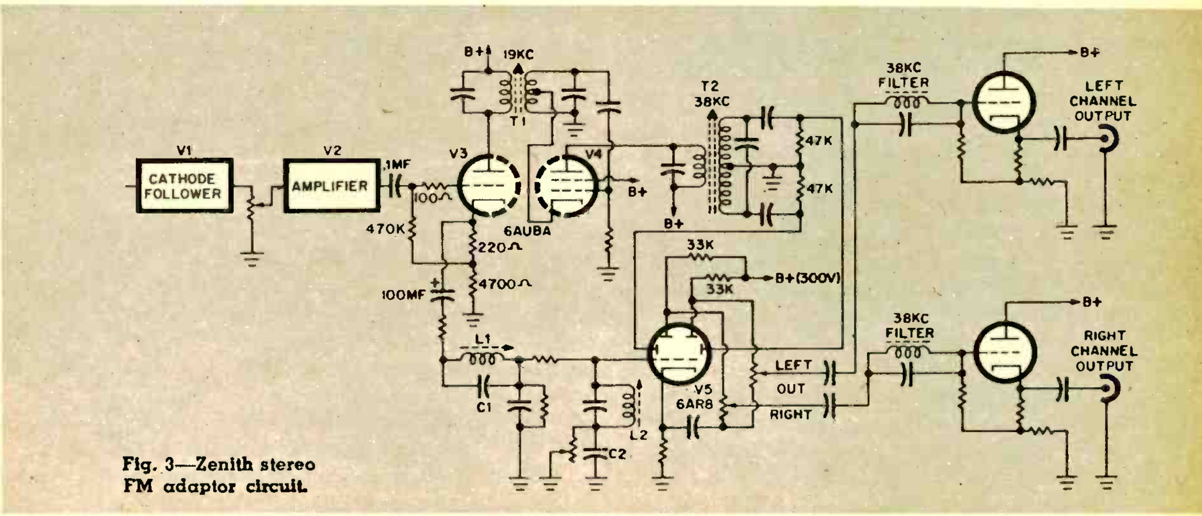
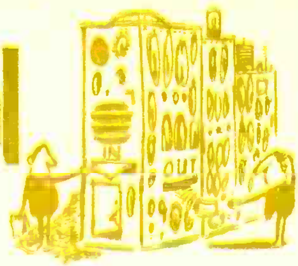


Fig. 3—Zenith stereo FM adaptor circuit.

ELECTRONIC BRAIN



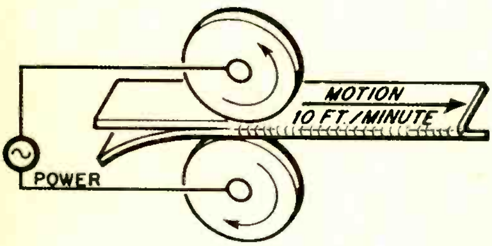
Have a question on electronics? Send it to Electronic Brain, Electronics Illustrated, 67 West 44th St., New York 36, N. Y. Enclose a stamped, self-addressed envelope for prompt reply.

Resistance Welding

What is a "resistance welder" and how does it operate?

Richard Klenner
Dubuque, Iowa

Resistance welding is the process of joining two pieces of metal together by passing a heavy current through them so that intense heat is generated at the spot where the desired joint is to be formed. A small portion of each piece melts and the molten portions flow together. When the current is turned off, the metal cools and solidifies and a permanent bond or weld is formed.



All resistance welding systems consist of three general components: a power source, a system of electrodes for applying power to the pieces being welded, and a control system for timing the application of power. The design of these components depends on the materials and the type of weld.

There are three general types of resistance welders. Spot welding, as its name implies, is a method of joining two metals by concentrating welding current on a relatively small area, using small electrodes. Seam welding (shown) involves the use of current carrying wheels that replace the small spot-welder electrodes. The third type is the projection method in which high pressures as well as high electrically-generated temperatures are used.

Iron Heating Time

I have two 30-watt soldering irons, one is a standard 117-volt AC job and the other operates on 12 volts DC. Shouldn't the 12-volt iron heat faster since it draws more current and has a lower resistance?

Maurice Gilbert
Montreal, Canada

Since both irons are rated at 30 watts, one will heat as fast as the other provided that the mass of the metal tip and the conductivity rates are the same.

As long as the product of the voltage and current is the same, the time required to produce a certain amount of heat is the same.

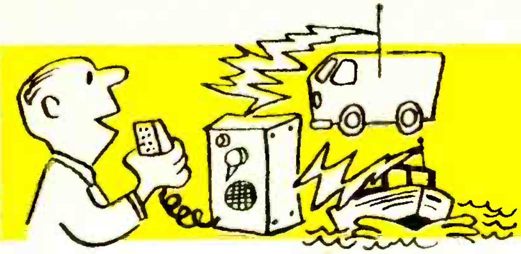
The design of the iron determines the heating rate. A 30-watt iron with a massive tip will require more time than a 30-watt iron with a very light tip to reach the same temperature. If conductivity is good, the heating element can transfer heat to the tip quickly.

Resistor Substitution

If a project parts list calls for a 10,000-ohm, ½ watt, 10% resistor, can I substitute a 1 watt, 5% resistor if I have one available?

Raymond Burke
Jackson, New Jersey

For all cases of resistor substitution, follow these rules: (1) Resistance value: Always use the resistance value specified; don't substitute larger or smaller values. (2) If you have available space on your chassis, you can always use a larger power rating than called for in the diagram. Never use a resistor with a lower rating. (3) You may always substitute a resistor of closer tolerance (such as 5%) for one of wider tolerance (20%), although this is rather uneconomical. Never substitute a wider tolerance, however.



CB CORNER

Citizens Band News and Comments

by Len Buckwalter, 1W5733

WANTED . . . Although a great variety of Citizens Band equipment can be found on the market, we CBers often have a need for some particular apparatus or design that simply cannot be purchased.

Take the owner of a brand-new mobile rig. He has a lot to be proud of . . . a shiny whip at the rear of his car and an impressive transceiver under his dash to draw the admiration of friends and neighbors. But after so long, the rig becomes important for what it does rather than for its appearance. At this point, the underdash mounting begins to irritate.

The favored mounting point is in the center of the dash, which is fine when you have just a driver and one passenger. But when you pack in three people the guy in the center just may complain while his legs get barked and his kneecaps start forced migrations.

There's another reason to question that center-dash location when the driver has to stretch to reach the transmit-receive switch and other controls. It makes for dangerous driving.

Some manufacturers have taken a step in the right direction with a push-to-talk microphone button and related circuitry. But we'd like to see them go one step further by removing the transceiver from the passenger compartment entirely (see sketch at bottom).

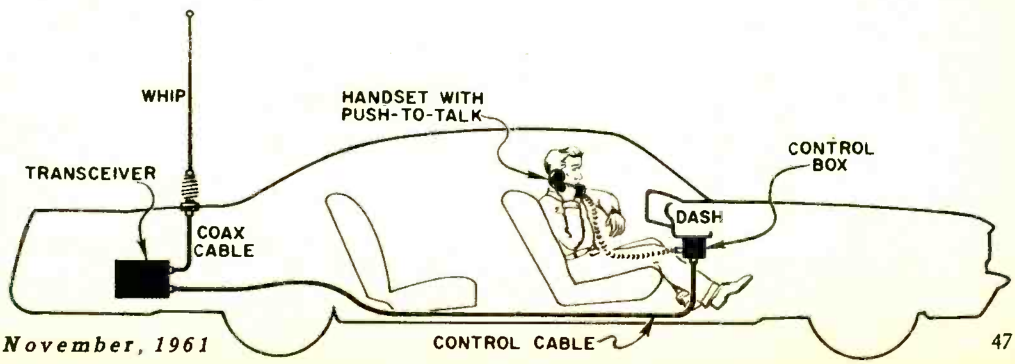
Take a look at a police radio installation and you'll find a mike or handset and tiny control box within easy reach of the driver. The transceiver is stowed in the trunk. This makes sense and leaves the under-dash free for (in private cars) an increasing number of other accessories.

The technical considerations for remoting a CB transceiver are not complicated. We could put the important controls (on-off, squelch, channel selector, volume) in a small box mounted on or close to the steering wheel column. A cradle would hold the handset (or mike if you want to use the loudspeaker). We'd mount the transceiver in the forward section of the trunk, close to the whip antenna. This would reduce noise pickup from the ignition system.

—o—

Pro Features . . . Don't misunderstand me. Over the past three years we've seen some marvelous advances—improved receivers, multichannel performance, etc.—that have lifted the transceiver out of the wireless mike class and *almost* put it into the same league with commercial communications gear. My point is: why stop at *almost?* As CB becomes increasingly important to the general public, the need for professional features emerges.

[*Continued on page* 112]



Win $100 in EI's ELECTRICITY Contest!

HAVE YOU entered EI's Electricity Contest? If not, sit down today and write us your answer to the question, "What is electricity?" If you *have* entered, try again! It's fun, it's easy . . . and the best answers win their authors $100. One winning answer is published in each issue.

Remember, you can use any source material desired, but your answer must be in your own words. Just follow the rules at right.

Entries for cash prize No. 4 must be received by November 1, 1961.

Below is our latest winning entry.

Rules: Entries will be judged on aptness of thought, clarity of expression and originality. Entries must be typewritten and double-spaced and may be no longer than two pages of 8½ x 11-inch paper. Ideally, a definition should be short. Print your name and address on your envelope and the first page of your answer. One entry per envelope. EI's Editors are the judges. Entries will not be acknowledged or returned.

Prizes: $100 will be paid the writer of the best definition. One winning definition will be published in each issue of EI. In case of ties, duplicate prizes will be awarded. Other entries of merit also may be published and will be paid for at the rate of $10 each.

Mail entries to: EI Electricity Contest, 67 W. 44th St., New York 36, N. Y.

WHAT IS ELECTRICITY?

"The nature of electricity is determined by the particles of the atom which carry a negative charge and are called electrons. These electrons orbit about a positive nucleus, composed mainly of protons (positive particles), in shells or energy levels. Each energy level can hold only a certain number of electrons. In the atoms of electrical conductors the outermost electrons, being farthest from the nucleus, jump easily from atom to atom. During their inter-atom trips they are called free electrons, and they move in a haphazard manner. When we make them move in an orderly manner we have a flow of electric current. To do so, we establish an excess of electrons at one end of a conductor and a deficiency of electrons at the other. The electron-deficient atoms at the positive end attract some of the free electrons in the conductor. Electrons flow in turn from the store of excess electrons at the negative end to replace those attracted by the electron-deficient atoms. This series of actions is due to the fact that an atom in its normal state is electrically neutral and it attempts to maintain this condition."

Dale P. Kingsbury
Mabel, Minn.

for on-the-nose RF accuracy

A Dual-Frequency Crystal Calibrator

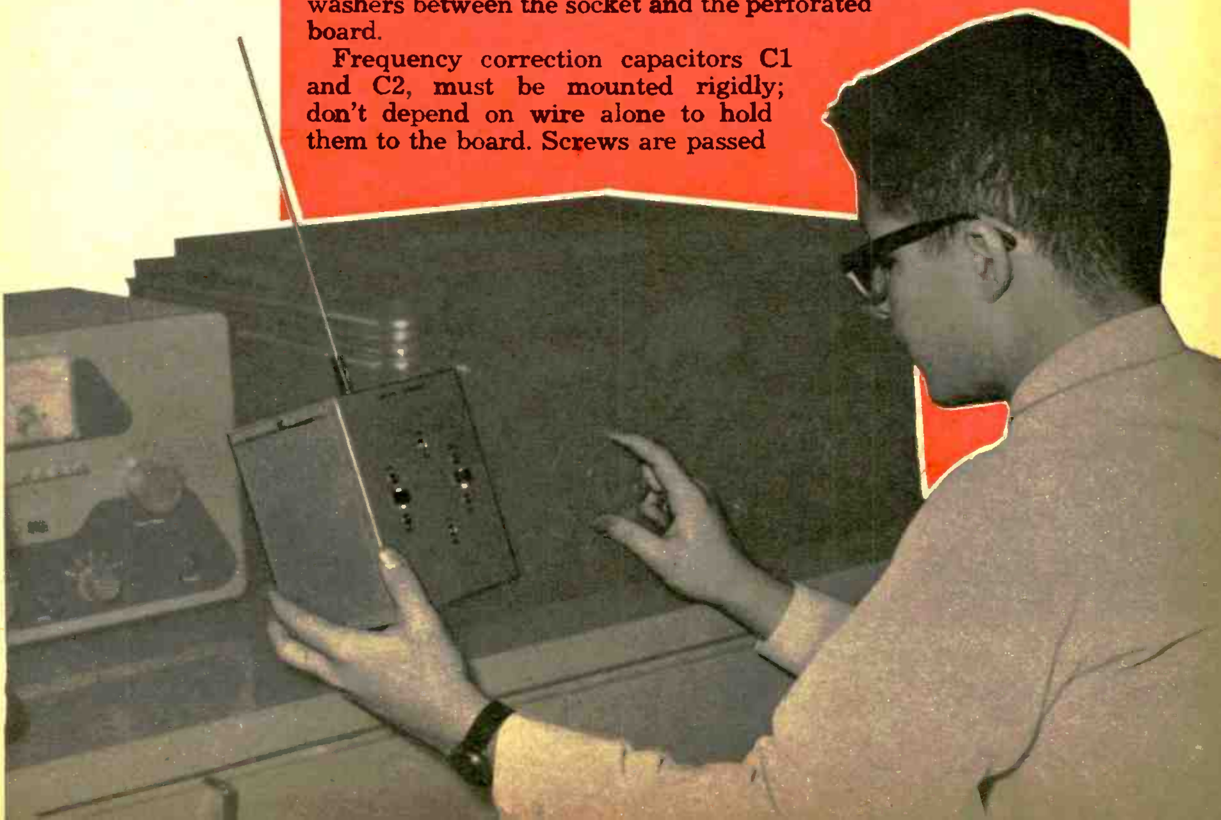
By Herb Friedman, W2ZLF

TO MANY, a crystal calibrator is just a means of complying with one of the FCC requirements. But for others, amateurs, experimenters and SWLs, the crystal calibrator is an important tool; useful for calibrating home brew receivers and converters, zeroing bandspread dials on communication receivers and insuring accuracy of test equipment. For the usual cost of a factory-wired single-frequency calibrator (about $15), you can build a calibrator having *both* a 100 kc and 1 mc output. Each output is independent and can be individually calibrated against WWV. The 1 mc output is of particular advantage on the very high frequencies since there is much commercial and home brew equipment for 6 meters (and some for 10 meters) using superregen receivers. The 1 mc markers will clearly indicate the band edges.

Construction

The major components are mounted on a piece of perforated board as shown in the pictorial. The crystal socket is mounted with a 4-40 screw using a ¼" spacer or stack of washers between the socket and the perforated board.

Frequency correction capacitors C1 and C2, must be mounted rigidly; don't depend on wire alone to hold them to the board. Screws are passed



through their solder tabs and the board and connection is made to the supporting tab by a solder lug or by wrapping wire around the mounting screw. Use a heat sink such as an alligator clip on the lead when soldering the transistors. Note that transistor Q2 (2N274) has four leads; the center shield lead is unused and should be cut short.

After the board wiring is completed, mount switches SW1 and SW2 and antenna jack J1 on the cabinet. Two 3/8" holes should be drilled to permit adjustment access to C1 and C2.

An L-bracket at each end of the board is sufficient for mounting. Take care that the adjustment screws of C1 and C2 *do not* touch the cabinet and that there is room for the battery. The antenna is made from an 8"-10" length of stiff wire.

Adjustment

Before applying power, adjust coils L1 and L2, aligning the bottom of the slugs with the lower coil winding. Remove the crystals from their sockets and connect up a 10 ma meter in series with the battery. Turn on the unit and if the calibrator is wired correctly the meter will show only a slight indication (about 150 microamperes). Install the 100 kc crystal and set SW2 to the 100 kc position; the meter will read about 3.5 ma. Adjust L1 for maximum current flow. The tuning is very broad and if after four turns there is no change in current, leave the slug where it is.

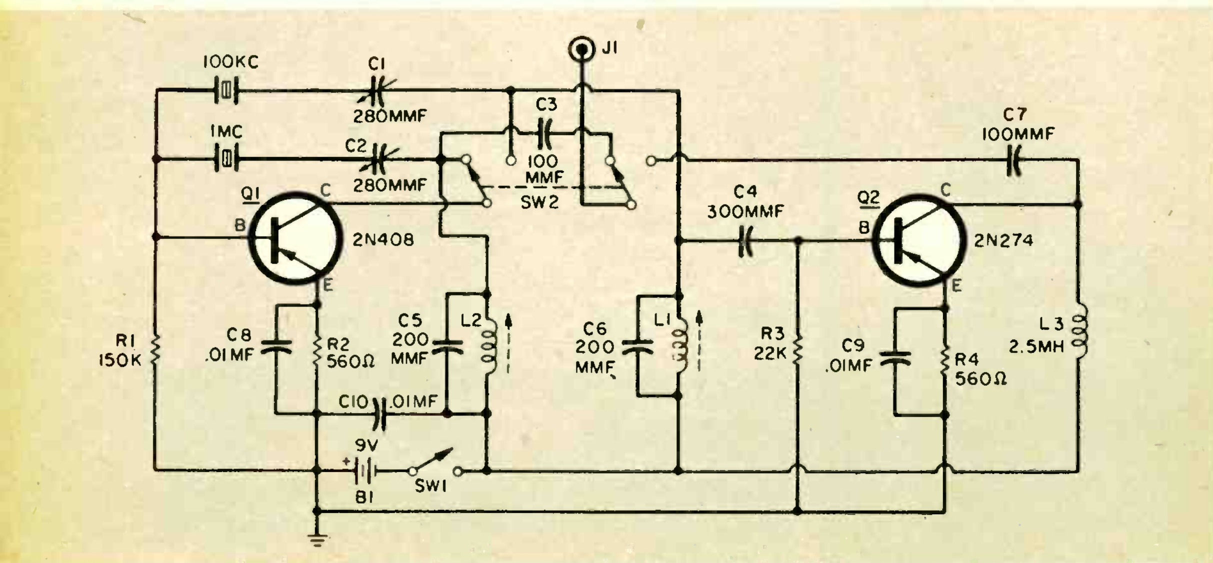
Next, plug in the 1 mc crystal and set SW2 to the 1 mc position. Repeat the above, adjusting L2 for maximum current. Disconnect the meter and the calibrator is ready for use.

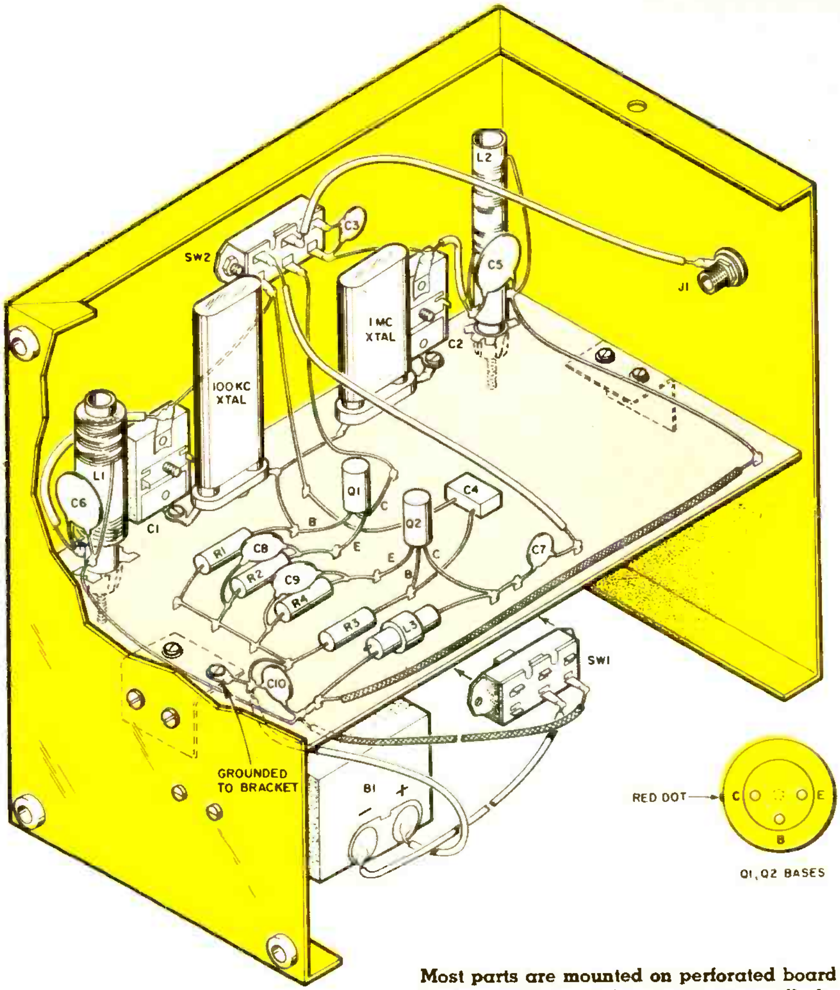
For precision use, the two outputs can be tuned against WWV. Tune in WWV at a frequency which provides a medium signal level. Turn on the calibrator set to 100 kc and let it warm up for about a minute. Couple the calibrator's signal into the receiver either by radiation or by direct connection. A distinct beat-note will be heard in the receiver. Using an insulated alignment tool, adjust C1 so the beat-note changes to a low growl and disappears. This is the correct setting for C1. Repeat the same procedure for the 1 mc crystal, adjusting with C2.

Checking Mobile Equipment

A mobile receiver or converter can easily be [*Continued on page* 101]

Separate crystals and calibration capacitors are used for each of the two fundamental frequencies.





Most parts are mounted on perforated board which is installed in cabinet using small brackets.

PARTS LIST

Resistors: ½ watt, 10%
R1—150,000 ohms
R2,R4—560 ohms
R3—22,000 ohms

Capacitors
C1,C2—25-280 mmf, trimmer capacitor
C3,C7—100 mmf ceramic disc
C4—300 mmf mica
C5,C6—200 mmf ceramic disc or mica
C8,C9,C10—.01 mf ceramic disc
S1—SPST slide switch
S2—DPDT slide switch
L1—2-18 millihenry slug tuned coil (Miller 6314)
L2—54-245 microhenry slug tuned coil (Miller 6196)
L3—RF choke, 2.5 millihenry
Q1—2N408 transistor
Q2—2N274 transistor
B1—9 V battery (largest that will fit cabinet)
J1—banana jack
Misc.—1 perforated board (Lafayette Radio MS-305); 1 cabinet 6"x5"x4"; 1 banana plug to fit J1; 2 packages flea clips (Lafayette Radio MS-263); 2 crystals (xtal) 100 kc, 1 mc plus sockets (Use Texas Crystal units as other types may not work properly.)

a high school student's Radio Telescope

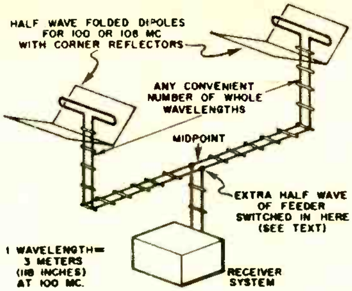
Celestial radio signals record themselves on a simple system that uses standard receivers.

By H. Mark Wahl

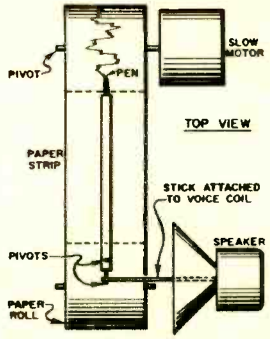
A RADIO telescope is essentially a receiver. It detects and records the emissions of objects whose atoms give off energy in the radio band of the electromagnetic spectrum.

The heart of a simple radio telescope I built as a high school student in Cheyenne, Wyo., is a standard FM receiver converted to AM (celestial static is AM) by eliminating its limiter and discriminator sections. Next, a tuned RF amplifier was placed ahead of it for higher sensitivity and gain. Then I connected a communications receiver to the IF output of the FM radio and tuned it to the FM set's intermediate frequency (10.7 mc). The SW set thus provided detection and audio output to two recorders.

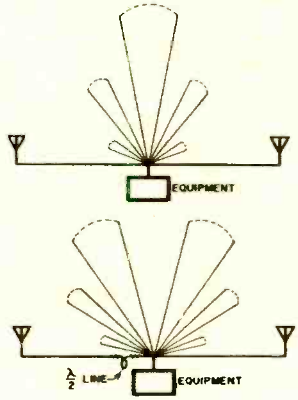
The first recorder employs a pivoted wooden arm which holds a pen against moving graph paper (see diagram) and at its other end is attached to a speaker voice coil. The coil moves in accordance



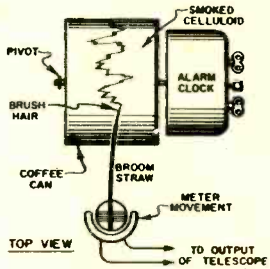
Dipoles are whole wavelengths apart. The extra feeder length is switched in and out on one side.



Stick holding a pen and attached to voice coil records celestial noise on moving graph paper.



Feeder switching above cuts main lobe in and out to make signal stand out from background noise.



Broom straw controlled by meter movement writes a 12-hour celestial-noise record on celluloid.

with the receiver output and these movements are recorded as a line on the graph paper.

The second recorder uses a meter movement with a broom straw tipped with a brush hair installed in place of a pointer. The brush hair moves back and forth on a piece of smoked celluloid wrapped around a clock-rotated drum, leaving an accurate trace.

All my receiving apparatus was mounted in a school locker (shown on opposite page). The door of the locker became the back of the cabinet. From the bottom, the equipment shown is the power supply, communications receiver, FM set, interferometer equipment (see below) and RF amplifier.

The antenna is all-important in this system, of course. I used two 108-mc folded-dipole antennas with corner reflectors, spaced about 100 feet apart for what is known as an interferometer effect. With this arrangement, the antennas can be made rapidly to receive and then not receive the radio source when a half-wavelength of extra feeder line is switched in and out of the lead-in of one dipole.

This is the way it works: the two dipoles are placed parallel and horizontal any convenient number of whole wavelengths apart to put their energy outputs in phase at the receiver. The feedlines must be of the same length.

With the two dipoles in phase, their pickup pattern has a strong lobe straight up. When an extra half-wavelength of feedline is switched into either feeder, the dipoles are thrown out of phase and the straight-up lobe simply disappears, leaving only the surrounding background noise. When this background noise level is subtracted by the receiver from the straight-up lobe, what you have left is a clear signal from a sky source. The system is relatively simple, but it works!

THE LISTENER

Notes for the short-wave listener and DXer

By C. M. Stanbury II

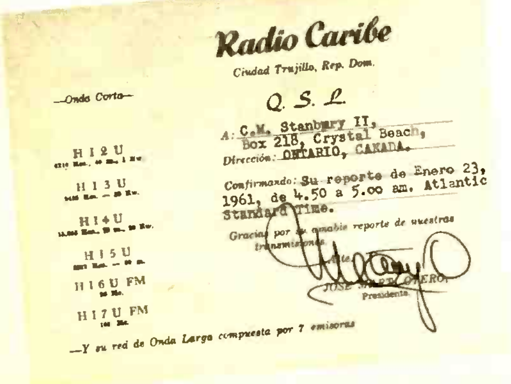
THE LIARS . . . Regular short-wave broadcasts began in the 1930's but short-wave listening did not come of age as a hobby until the Fifties. Prior to this, most writings on the subject consisted of a sales talk that can be summed up in one line, "listen to short wave and know the world." Just like that.

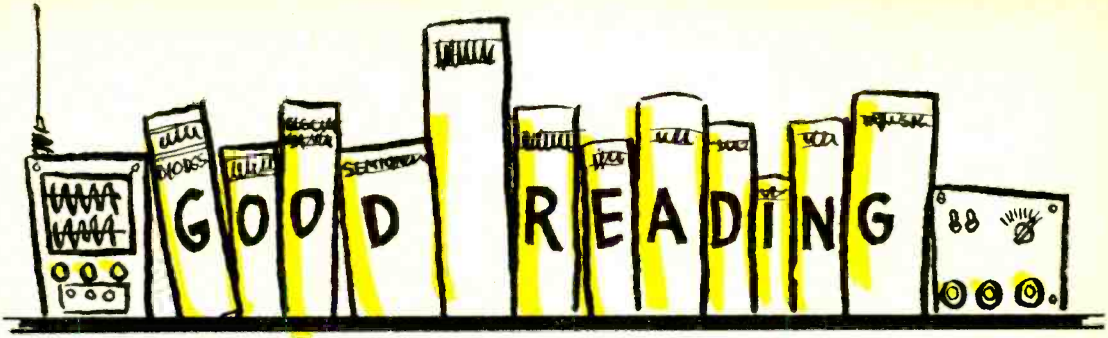
A lot of people who, one would suppose, wanted to know the world fell for the line. Not a few soon discovered that successful listening involves more than just owning a set, so they simply quit. Those who became serious listeners—who were interested in more than QSL cards and understood something of the potentials of short wave—exerted little influence on the field, unfortunately. Not many people in North America have ever viewed short-wave broadcasts as a medium for the exchange of ideas, of international understanding, of education and all the other worthy goals. Consequently, relatively few (when you consider total population) ever have bothered to listen.

As a matter of fact, when you examine the short-wave picture in detail, you find few broadcasters anywhere who have even tried for those high goals we mentioned. Such stations as Radio Moscow and, two decades ago, Hitler's radio outlets, have shown how far away from the truth you can get.

A good many SW services are judged merely by their QSL service, with quality and quantity of information being viewed as secondary considerations. And some who *do* seek information in SW broadcasts tend to swallow it whole, even when it's from Moscow or Peiping.

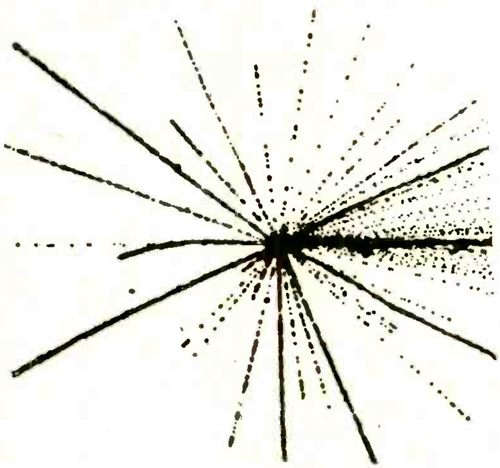
However, most of us are getting craftier about interpreting what we hear or don't hear on the air. We know few things are quite as they seem, or are described, and that rare is the station that sticks strictly to the truth, East or West. Had Raphael Trujillo's assassination occurred ten years ago it is doubtful that many listeners who tuned in Radio Caribe (see QSL card at bottom) on the afternoon of last May 31 would have made much of the fact that nothing but music and commercials were being transmitted and all news programs had been [*Continued on page* 99]





THE INTELLIGENT MAN'S GUIDE TO SCIENCE. Two Volumes: The Physical Sciences and The Biological Sciences. By Isaac Asimov. Basic Books, New York. App. 850 pages each. $15 a set

Here are two valuable volumes for anyone interested in the world and the universe around him. Isaac Asimov, an excellent, fluent writer with several fine science books to his credit, has now made it possible for anyone with the necessary curiosity to learn easily and enjoyably most of the facts now known about man and his universe. Separating the physical and biological sciences into two volumes, he spreads out a vast panoply of knowledge for easy inspection. The illustration below, from the book, shows the smashing of a silver atom by a cosmic ray. The lines are



tracks left by the resulting 95 nuclear fragments.

Despite the ambitiousness of Mr. Asimov's project, there is nothing that should be forbidding to the average intelligent reader. The writing itself is crystal-clear and the contents are beautifully organized for the reader with no vast scientific background.

Mr. Asimov begins at the beginning—with the molecule and the atom. And in both volumes he builds his subjects so well that they seem to fall effortlessly into place in your mind, as if they had sneaked in when you weren't looking. What does he cover? Everything from nuclear physics to psychoanalysis; everything from the birth of the solar system to the future of man and his earth in it. If you're interested in filling in the gaps in your knowledge of science, forget the encyclopedia and concentrate on these two volumes. They are far and away the best books of their kind, and they are unlikely to be challenged for a long time to come.

BASICS OF ANALOG COMPUTERS. By Thomas D. Truitt and A. E. Rogers. John F. Rider, New York. 400 pages. $12.50

For those who feel that computers are trying to be too human these days, *analog* computers are more fascinating than their *digital* relatives. The analog computer does more than count, it learns by example and parallel, and can make uncanny predictions based on what it knows. The authors of this book know their subject well and present it clearly. And the book itself is as packed with facts as any computer. But the illustrations are another matter. There are just too many of them at times. They get in the way. There is plenty of useful, important information here, but a picture is not *always* worth a thousand words.

ABC'S OF RADAR. By Alan Andrews. Howard W. Sams & The Bobbs-Merrill Co., New York & Indianapolis. 112 pages. $1.95

Now that radar has gone civilian in so

[*Continued on page* 103]

High-Flying Ham

El's Contributing Editor on Amateur Radio goes on a memorable flight into the blue with KØDWC.

By Robert Hertzberg, W2DJJ

THE altimeter in the cockpit of the C-97 Stratotanker read 15,000 feet as the giant plane droned eastward over Pennsylvania. Back in the passenger compartment, an Air Force officer wearing the three stars of a lieutenant general sat at a small console containing a single sideband transceiver. He adjusted the equipment for the 15-meter ham band, pressed the button on a hand microphone and spoke into it.

"CQ 15, CQ 15. this is K Zero DWC mobile, K Zero DWC mobile."

The transmission lasted hardly five seconds. As he released the button a babel of voices boomed out of the speaker.

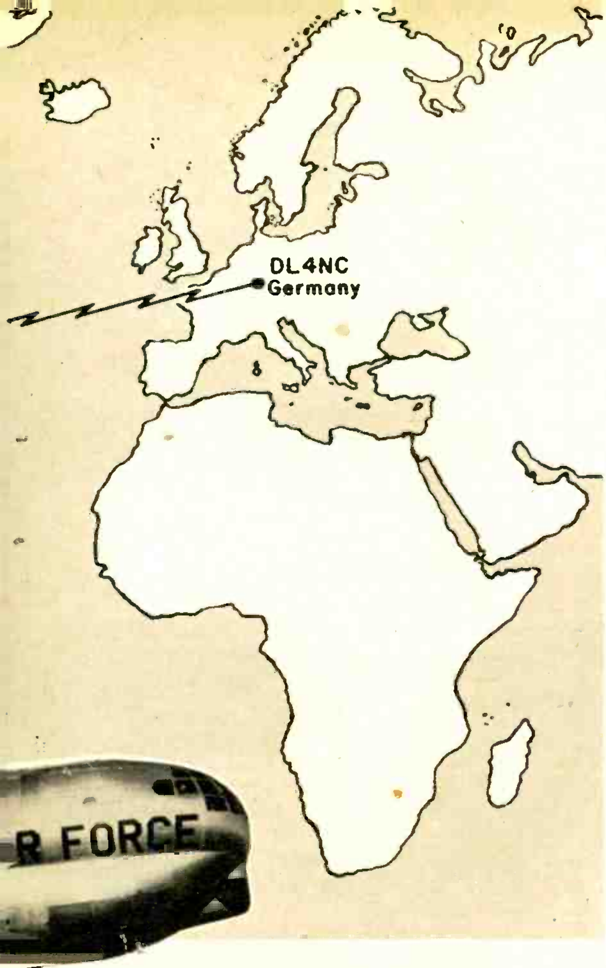
"One at a time, boys," said the officer. "Kurt, did I detect your fine Irish accent in there?"

"Hello, Butch, glad to hear you on again," came the reply, with a marked Swedish inflection. "Yes, this is W2ZXM maritime mobile. Heard you were sick, Butch. How are you feeling?"

"Okay now, Kurt. Where are you?"

"We're in the Pacific about 600 miles northwest of San Francisco."

The sea-going W2ZXM was Capt. Henrik Carlsen, skipper of a freighter



Gen. Griswold, the high-flying ham, operates his transceiver on C-97 on Omaha-Washington hop.

named Flying Enterprise II. A few years ago he achieved fame when he stayed on his sinking Flying Enterprise I until the last moment.

Other strong signals rattled the speaker.

"K Zero DWC mobile, this is DL4NC. Butch, I thought you'd like to know that you're coming in fine in Germany."

As the general scribbled call letters in his log, two other stations popped in.

"K Zero DWC, this is KZ5AA. There's nothing wrong with your signals in the Canal Zone, either."

"Hey, Butch, add me to the list. This is KL7DKU, Kodiak, Alaska."

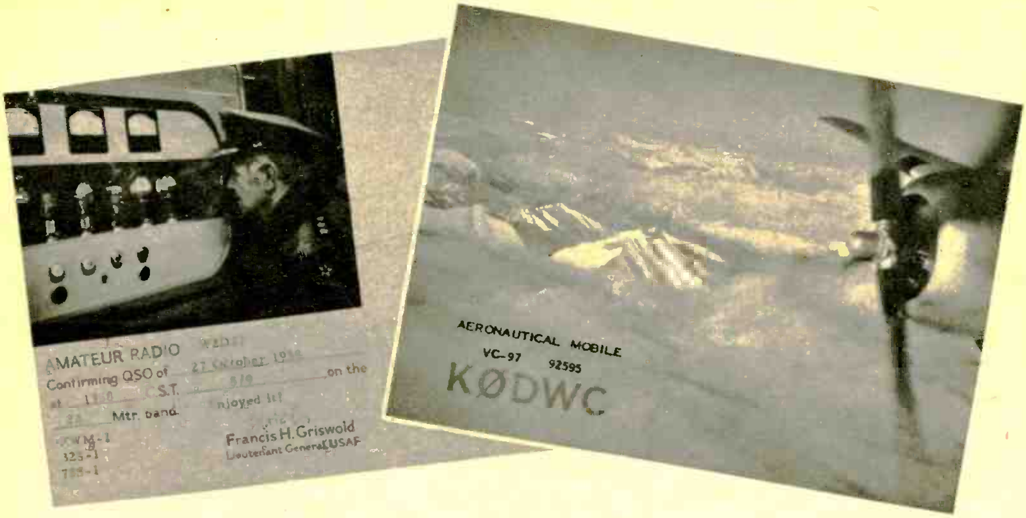
And so it went. The officer sat there in his airplane three miles in the sky and talked to friends all around the world.

This high-flying ham, universally known as Butch to fellow amateurs, is Lt. Gen. Francis H. Griswold, 57-year-old Vice-Commander in Chief of the Strategic Air Command. I was interviewing him one day recently at SAC headquarters at Offutt Air Force Base, near Omaha, when he was summoned to a conference with the Chief of Staff in Washington. Since I was there on a two-fold mission—to discuss his ham radio activities, as well as SAC's communication facilities—he offered me an airborne demonstration of his equipment. My official travel authorization was not long in coming, needless to say.

The fun started hours before take-off when Butch took me to the hangar to show me through the C-97 he would use. The C-97 is a transport version of the KC-97 flying tanker. (A typical tanker version of the plane is shown in our lead illustration.) Gen. Griswold's plane is much like a lot of other C-97's, except he has installed a compact ham station, which operates independently of the Air Force communications equipment used by the flight crew.

The day was bitterly cold, so the doors of the hangar were shut tight. Butch flipped on the transceiver just to see if it was hooked up and we nearly flipped ourselves when W2KR roared in with, "Butch, is that you?"

He'd made a Nebraska-to-New York contact from inside a shielded building, and with just an unmodulated signal. As I already knew, and was soon to



Coveted four-color QSL card from "Butch" shows plane flying over mountains and inside shot on back. The author received this card after 1958 contact.

have proved to me again, Butch is a popular guy on the amateur bands. Dozens of hams seemingly lie in wait for him and when they hear any signal near his known haunts they automatically assume (or hope) it's KØDWC.

The four quick contacts on 15 meters which I described earlier (and are indicated on our map at the head of this article) were the most spectacular communications on our flight, but activity on 20 meters was more continuous. From take-off at 10:24 until landing four hours later, with a short break for a sandwich lunch, we took turns working the scores of hams who were anxious to obtain KØDWC's prized four-color QSL card.

We talked to locals in Nebraska, Iowa, Illinois, Indiana, Ohio and Pennsylvania as the plane passed almost over their antennas, and to others in California, New York, Canada, Florida, Alabama and Massachusetts. Via phone patches by cooperating ground stations, Butch spoke to a friend in Cedar Rapids, Iowa, and to his daughter in Washington. Through W2KR, who seems to be on the air all the time, I got

[*Continued on page* 100]

KØDWC works a station from shack on the ground at Offutt AFB, Neb. He uses Collins equipment.

EI's Bob Hertzberg (lower right) takes a turn at the mike while on flight with Gen. Griswold.

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Edgar Wesatzke

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

Rev. Enoch P. Sanford

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

Louis A. Tabat

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

Alvin Spera

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

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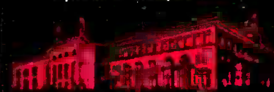

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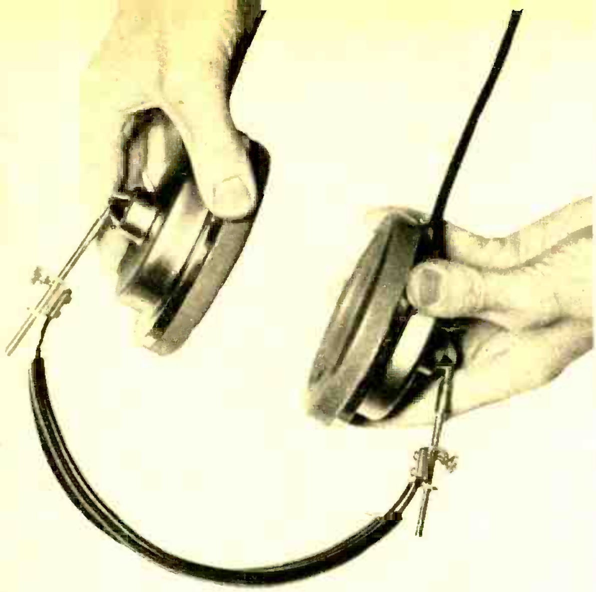
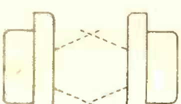


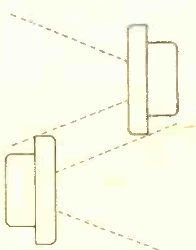
Phasing Stereo Headphones

JUDGING by the number of hi-fi earphones appearing on the market, private listening to stereo must be gaining in popularity. Here's a quick and simple way to test these phones for optimum phase relationship.

Turn up the volume just enough so you can hear the music clearly with the phones about 12" away from your ears. Hold the phones as shown above and in Position **A** with about 2½" or 3" between the phones. Now, while maintaining about the same spacing between the phones, reposition the earpieces as shown in **B**. If the volume increases at **B** and fades at **A**, then the phones are out-of-phase. The out-of-phase phones fade at **A** because the sound waves cancel. When both phones are in-phase, there will be little or no change in volume.



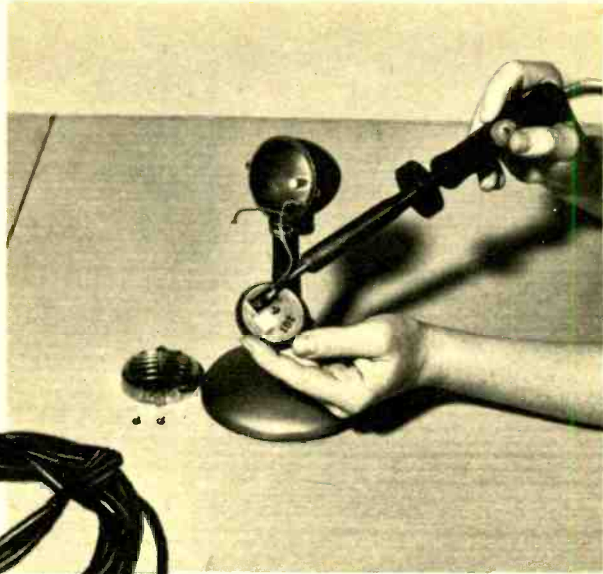
POSITION A
(HEAD-ON)



POSITION B
(BY-PASS)

If the headphones are out-of-phase, reverse the connections to one of the earpieces.

—*Art Trauffer*



Unsolder the defective cartridge. Be sure to indicate which is ground lead wire.

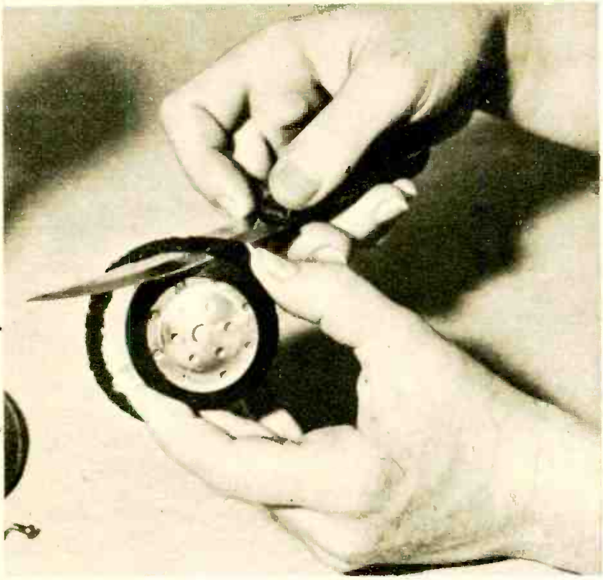
REPAIR THAT MICROPHONE!

By David Herman

SINCE a substantial part of a microphone's cost is in the case itself, you can save considerable money by rebuilding mikes whose cartridge is defective instead of re-buying the entire unit.

The inexpensive ($6.47) and rugged Shure R5 controlled magnetic cartridge is particularly suited for replacement service as it has a thick rubber rim which can be trimmed to fit a variety of microphone cases. Practically immune to heat and humidity, the R5 has a smooth frequency response, suitable both for recording and public address use. And by removing the cartridge's plastic damping cover you can cut its bass response to produce a communications microphone with a sharp, crisp quality. The R5 has a *minimum* mounting diameter of 1⅞″ so make sure (before purchase) that it will fit the mike case.

The Shure R5 is stocked by most large parts suppliers or it can be ordered through your local Shure microphone dealer.

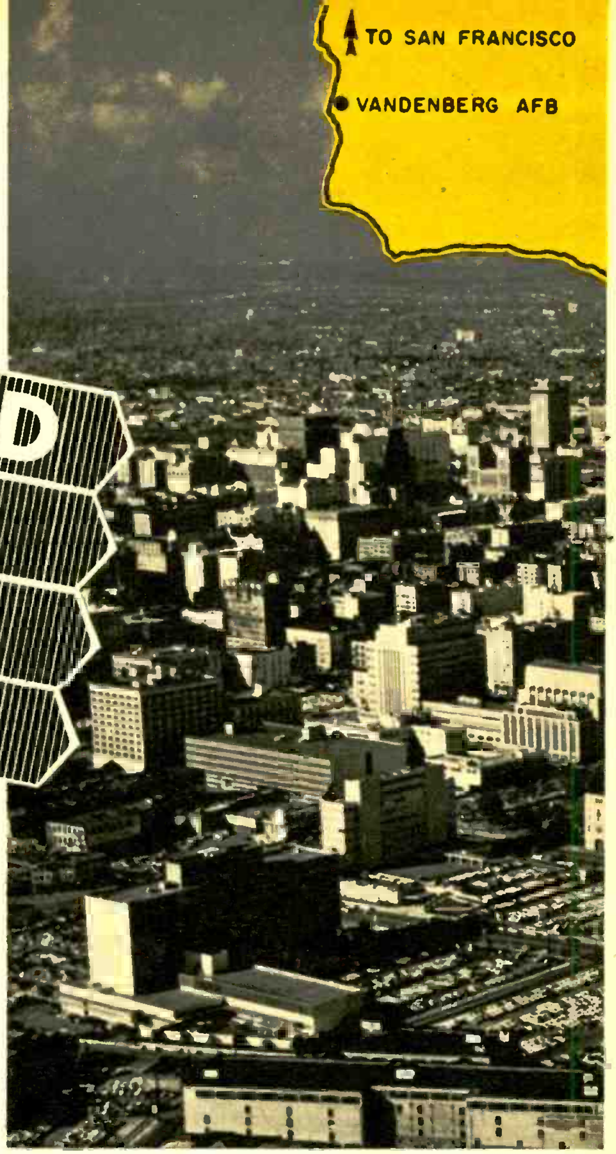


Part of rubber rim is trimmed away with sharp knife. Make certain R5 has snug fit in case.

Position cartridge in case and glue shock mounts in place. New shocks may be made of excess rubber.

Solder both leads to new cartridge making sure that ground lead is connected to correct lug. Although cartridge is not heat-sensitive, it's best to use long-nose pliers to carry off the heat.

SHOULD YOU GO WEST?



Southern California could be a true land of opportunity for you.

By James Joseph

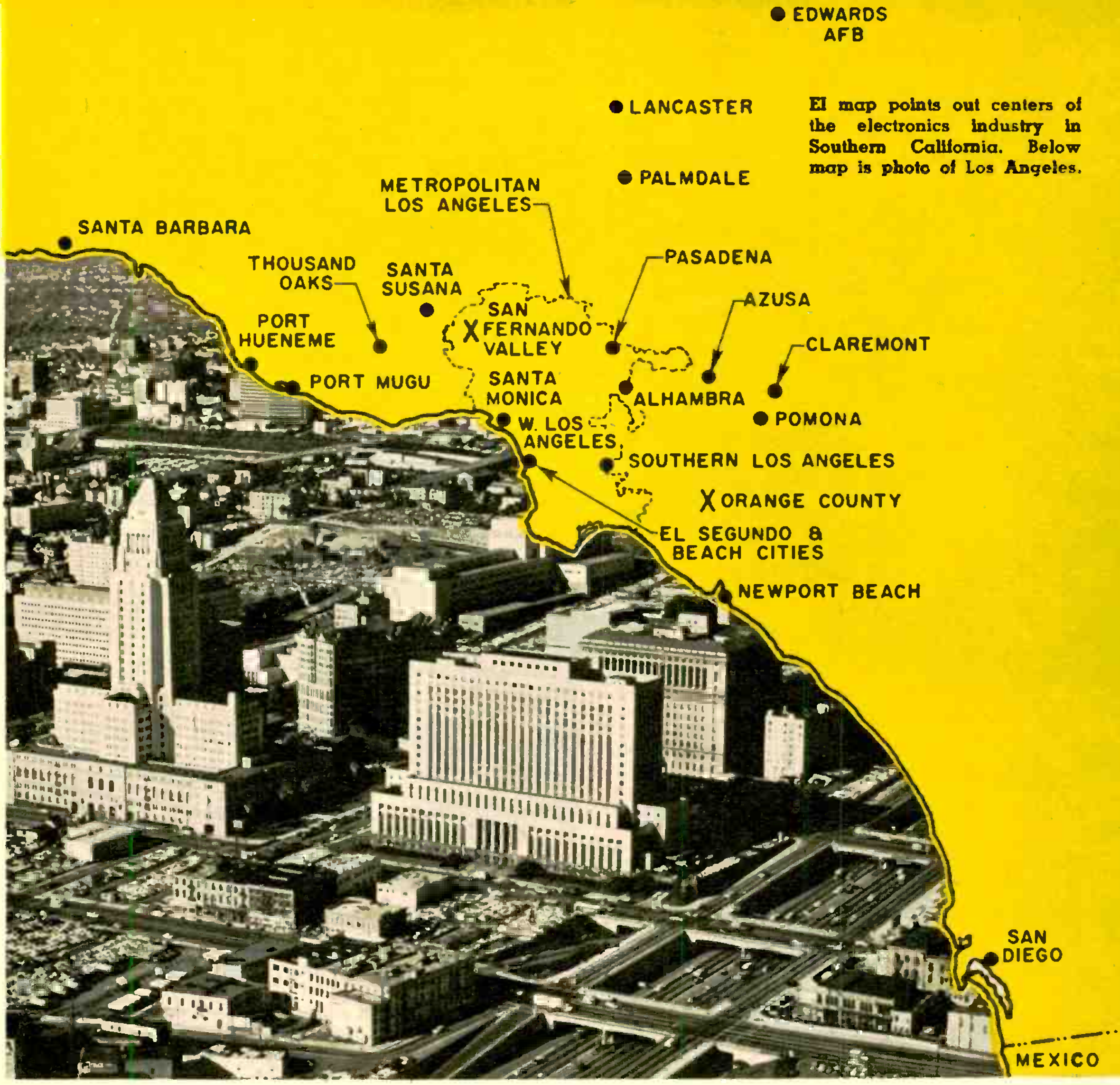
IF YOU work in electronics or are considering employment in the field, you've probably wondered about the opportunities waiting for you in one of the country's great military-civilian electronic complexes—such as Southern California.

We've all read about the wonderful things that can happen if you throw away your muffler, stock up on sun-tan lotion and head for the "land of electronic opportunity." Southern California boasts more than 500 electronic plants employing 130,000 technicians, engineers and high-level thinkers. Each year the electronic companies do about a billion and a half dollars worth of business, some 15% of the nation's electronic total.

But should *you* go west?

EI has conducted a survey in depth in the Southern California electronics industry—from Santa Barbara to the Mexican border—and we've arrived at some important facts for anyone who considers following the trail of the covered wagon. Items:

- Electronics is the brightest spot in the darkening Southern California employment picture.
- Military electronics is growing at a rapid rate in Southern California.
- Service shops and manufacturers of consumer products are feeling the



EI map points out centers of the electronics industry in Southern California. Below map is photo of Los Angeles.

pinch of too much competition.

Although the Department of Labor has classed much of Southern California a labor surplus area (more than 6% unemployment), *electronic* employment jumped 10% in 1960 and an increase of 5% is foreseen for 1961.

Declares one industry expert: "Any technician or engineer worth his salt can find his niche in the Southern California marketplace."

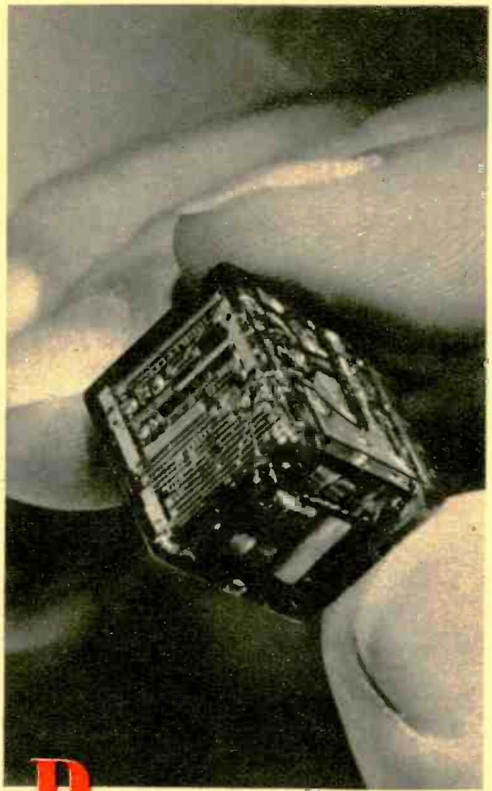
But the area is a paradox. Its electronic industry is expanding and diversified—and also narrowly specialized. Defense work dominates.

Still, in the non-military field, thousands of electronic technicians man TV-movie consoles in the movie capital, cater to an exploding population that demands intercoms and hi-fi and automatic garage-door openers, and set up all kinds of small shops on a shoestring. Last year, according to the Los Angeles Chamber of Commerce, 650 new businesses (a good many of them electronic) opened their doors every day in their domain.

Defense electronics must be considered the backbone of the business in the land of waving palms and orange groves. Fully 65% of Southern California electronics is military-oriented. Currently more than 16% of the U. S. electronic budget goes to California firms. Only

SANTA BARBARA

Electronic production worker at Hoffman plant assembles part of an airborne navigation system.



POMONA

Research in Southern California is indicated by solid-state amplifier from the Convair factory.

LOS ANGELES

Technician watches test firing of rocket engine on TV at a Rocketdyne facility near Los Angeles.

CANOGA PARK

Thompson Ramo Wooldridge plant, in San Fernando Valley, typifies beauty of industrial sites.

"... any technician or engineer worth his salt can find his niche in Southern California ..."

the New York-Newark complex gets a bigger hunk.

On the other side of the coin, independent TV-radio servicemen find competition fierce and the buck harder and harder to come by. "1960 was pretty sour," says Burbank's Ralph Johonnot, a director of the California State Electronic Association, made up largely of servicemen.

Johonnot figures Southern California's 4,600 independent shops netted an average of only $5,000-$7,500 last year. His diagnosis: too many shops in the big metropolitan areas. "Get out of the big towns and you'll do fine," he says. "But in town there's a shop or a guy working from his garage on just about every block."

By contrast, wages are high and opportunity ripe for the job-seeking technician with know-how and experience. Top-flight technicians earn $250 and more a week, although starting pay for an experienced hand is more apt to be in the $100-$150 weekly bracket.

Many research firms (California is a hot-spot for research and development) insist on from five to seven years experience in their specialty. Examples: computer circuitry, semi-conductors, solenoid check-out, telemetering systems installation.

Another facet of the picture shows that hundreds of firms stake promising technicians to a degree via night school at such first-class engineering schools as Cal-Tech, UCLA and the University of Southern California. If you graduate with a C average your company pays the cost.

Take technician John C., who hired on as a components tester with a major electronics firm at $125 a week. John enrolled at a local university, spent nearly eight years getting a BS in electrical engineering at his employer's expense and was boosted promptly to $800 a month (engineer's salary) upon graduation. He now earns more than $12,000 annually. John's is an unusual case, however. The *average* engineer with ten years of experience earns $11,716.

Southern California newspapers are fat with ads crying for the electronically skilled technician. Here's a sampling:

"Senior Electronic Technicians . . . R&D test and analysis of high-power amplifier and instrumentation in audio and sub-audio range. Degree not necessary. Top rates, full employee benefits."—Ling Electronics Division, Anaheim, Calif.

"Testing, troubleshooting and repairing such electronic products as small scale digital computers, high speed data printers. Desired: high school grads with additional electronic training."—Clary Corp., San Gabriel, Calif.

Such technician jobs have a wide salary range, partly because of great differences in duties performed. Here are some average hourly wages:

Electronic systems tester—$2.75-$3.12.

Electro-mechanical engineering associate—$3.10-$3.23.

Electronic production technician—$2.47-$2.72.

Precision equipment assembler—$2.50.

Let's look at the case of a technician in non-military electronics. His name is Harold W., he's 31, married and has four kids. Three years ago Harold and his family piled in their car, bid good-by to Minneapolis and headed for Los Angeles. After a month of job-hunting he landed a berth as service TV technician for Packard-Bell Electronics in Los Angeles.

With only a trade-school background and almost no previous electronics experience, Harold now finds himself one of two bench technicians in the P-B shop, backstopping the company's field TV repairmen. He is happy and solvent.

Fresh-from-college electronic or electrical engineering grads (with degree) easily latch onto $500 to $550 a month to

[*Continued on page* 102]

HI-FI DOCTOR

Stereo— STRAIGHT TO YOUR EARS

IF you take a glance through the family snapshot album, you'll probably come across a picture of someone —maybe *you*—sporting a set of old-fashioned earphones as he digs the latest (1920) Paul Whiteman offering on the family crystal set. Thanks to stereo, though, earphones have been making their way out of family albums and ham shacks into the living room.

There are two good reasons for the resurgence of earphones in the stereo era. First, there's the matter of *privacy*. With a headset, you can crank the gain as high as your cranium can take it, without disturbing wives, children, or neighbors. Secondly, there's the undeniable fact that stereo via earphones *sounds* great—sometimes better than it does by way of speakers in a living room.

For the audio purist, stereo via earphones isn't the *real thing*. He contends that phones are meant strictly for listening to *binaural* recordings—made with a pair of mikes spaced as far apart as the average pair of human ears. And he feels that today's stereo recordings, with microphones as much as twenty feet apart, don't yield the proper perspective via earphones. After all, he asserts, *whose* ears are twenty feet apart?

Although this kind of logic is tough to dispute, the fact remains that earphone-stereo is phenomenal—perspective error or no. With stereo phones clamped on your head, you're no longer in your living room; you're right *in* the studio or hall where a recording was made. The impact is incredible; every subtlety that usually gets lost between the speakers and your ears is *there* to hear!

Most of today's crop of stereo headphones (such as the Koss, Lafayette, and Olson, etc.) actually contain a pair of small loudspeakers, intended for connection to the speaker output terminals of stereo power amplifiers—usually by way of a junction-box that contains resistors to prevent headset overload.

For low-cost, quality stereo, you might refer to an article by Harry Kolbe in the September, 1960 EI. There you'll find an under $5 build-it-yourself gadget that will match a pair of the new 8-ohm phones to the outputs of stereo *preamps* tuners, or recorders. If you're on a budget, this procedure can temporarily save you the cost of a stereo power amplifier and a second speaker system. And the listening quality of this arrangement is so good that you may put off buying that stereo power amp for quite a while.

Army surplus stores frequently have a stock of old "bomber-pilot" phones. Some of the latter, with their big, padded earpieces, will give you wide-range stereo with a minimum outlay of cash. But they're not all of the same quality, and there's usually no way to find out *before* you buy them. One remedy for the strident sound of some of these headsets is to unscrew the cap—take out their cardboard or plastic inserts—and substitute pieces of speaker grille-cloth.

Another short-cut is supplied by the older high-impedance headsets. These you can connect to the preamp without a matching box. Companies like S. K. Brown, Permoflux, and AKG still produce them.

If you'd like to follow up the question of stereo *vs* binaural perspective, there's an illuminating article in the Apr. '61 *Journal of the Audio Engineering Society*—"Stereo Earphones and Binaural Loudspeakers." The author discusses the theory of perspective, provides schematics of networks that will convert a stereo recording for binaural listening.

SOUPING UP A LEMON

HI-FI CLINIC

I have bought a Japanese tape recorder selling for $29.95 and I think it's a lemon. I want to incorporate a miniature level meter, an AC erase circuit, and tone controls in it. Also, how can I increase its output?

Charles Hile
Tiffen, Ohio

The Hi-Fi Clinic would like to ask you a question; why did you buy a $29.95 tape recorder in the first place? These little jobs are *not* lemons—they're fine, but only for the purpose their manufacturer intended them; that is, voice recording.

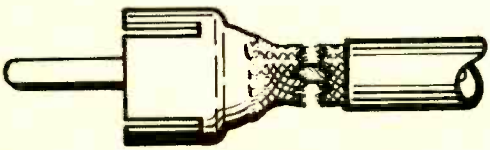
Even if the various modifications you inquire about could be made on your machine, this would do nothing about its inherent flutter, wow, noise, distortion and limited frequency response. To attempt redesign of your recorder to bring it up to the standards of a $200 machine would probably cost you far more than $200 worth of time and effort.

Intermittent Hum

I am bothered by a very loud hum that occurs whenever I move the shielded cable that connects my tuner and amplifier. I can eliminate the hum by placing the cable in just the right position, but if I move it a fraction of an inch, the hum starts up again. Any ideas?

Alan Vogel
Huntington, N. Y.

There's a break in the shielding of the cable, probably right at the point where the shield braid is soldered to the phono plug. You can tell at which end the break is by close inspection, but the odds are if one end has let go, the other one will follow shortly thereafter.



Rather than attempt to re-solder the plug, I would suggest that you cut the old plugs off, get a new pair of phono plugs and make up a new cable. You can prevent repetition of the problem by wrapping a couple of inches of plastic tape around the shielded leads at the point where they enter the plug.

New Stereo Preamp?

I now have a 20-watt integrated monophonic amplifier and I'd like to go to stereo. Should I purchase a stereo preamp or can I get away with buying only another amplifier?

Martin Aronstein
Louisville, Kentucky

I would suggest purchasing a stereo preamp for a number of reasons: first, you will have the additional facilities useful with stereo program sources, such as *stereo reverse, balance* and the like. Secondly, the output of some stereo cartridges is low in relation to monophonic cartridges and your mono preamp stage probably lacks sensitivity.

Assuming that you purchase the stereo preamp, you can adapt your integrated amplifier to function as a basic amplifier in one of two ways. One method is to set your tone controls at their flat position; the loudness control, if any, off or at minimum; and the volume control at maximum. Then take one of the leads from your stereo preamp and plug it into the *auxiliary* input. You will then be able to adjust the tone, volume, etc., from your stereo preamp.

If your integrated amp has a *tape output* jack you may be able to use this as an input to the power amplifier section of your unit. The advantage in using the *tape output* jack is that the preamp stage and the tone and volume controls are bypassed. Run a shielded cable from one output channel of the preamp to the *tape output* jack of your amplifier, then check to see if the tone and volume controls are operating.

NEW RULES FOR CB

What do those changes in FCC regulations really mean to the guy with the mike? Here's the answer.

By Len Buckwalter, 1W5733

THE birth of the Class D Citizens Band in September 1958 stirred up a large amount of enthusiasm . . . and almost as much confusion. Early regulations spelled out only basic features of the band, setting off endless speculation on how far one could go in terms of range and kinds of communication. After a wait-and-see period that lasted about 18 months, the FCC has made clear its answers to those questions in a spate of amendments to Part 19 of the regulations which are found in a group of the agency's Transmittal Sheets. If you are keeping your Part 19 regulations up to date—and you should be if you hold a CB license—it is a good idea to place all the pages in a looseleaf notebook and then add the Transmittal Sheets as they come out, as pictured below.

Most of the new amendments are concerned with improper use of the Citizens Band. Some are strictly technical. All reflect the

New rule limits transmissions to 5 consecutive minutes, to be followed by 2 minutes of silence.

enormous growth of CB and the need to keep the service of value to the greatest number of users.

To bring the limits of operating range into sharper focus, the rules have undergone some substantial rewording. The words "groundwave" and "skywave" are new additions to Part 19. They state clearly that CB is restricted to transmission via groundwave, that part of the signal which travels horizontally between two units. The range on groundwave is upwards of 20 miles, depending on the height and efficiency of your antenna.

Skywaves, which are signals reflected from the ionosphere, can cover hundreds of miles when conditions are right, but their use is illegal for CBers.

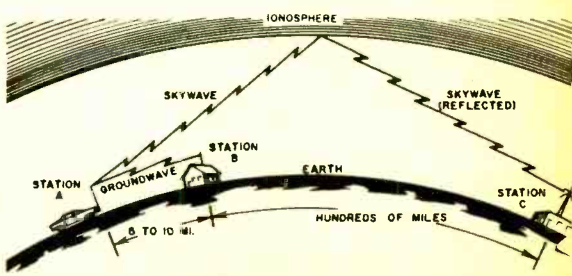
It's easy to recognize skywaves. First sign is when you hear stations with call letters outside your area (revealed by the first number in the call letters). These signals can sound like locals but are audible only a few hours a day. They also are subject to fading, growing alternately weak and strong over several seconds. The skywave path is usually a two-way street and contact *is* possible, but by law can be made only in an emergency or distress situation.

A not-so-obvious change has crept into the section on Permissible Communications. The original law made little distinction between what or what kind of stations were involved in communications. Now it's more precise, saying that CB is "primarily to communicate with other units of the *same* station . . ." This is obviously a crackdown on neighborly, indiscriminate conversation. However, if you have a *definite message* to send to a station bearing different call letters it's still perfectly acceptable.

The commission has taken a firm stand on CQ, the general call used in ham radio. Their opinion is now written into the rules. Although it specifically forbids calling an unknown or random station, it does leave the door open for an important kind of call in CB radio—one that is not addressed to a known station. It might be termed a *limited-general* call. Let's say that you are on vacation in an unfamiliar part of the country, looking for a motel. There is no reason why you can't send out a call to unknown motels in the area for information. This can be extended to include contact with a local CB station for route instructions or other information. In each case you don't know the call of the stations, but there is a valid message to send and CB radio is the ideal medium for it.

New paragraphs have shown up in the rules to limit the time you have for transmitting a message. The original wording left it up to the operator to decide the "minimum practicable transmission time." To prevent excesses, there are now limits which affect two types of transmissions: that of a single station, or the back-and-forth exchange between two units. In neither case may the talking time be more than five consecutive min- [*Continued on page* 100]

The terms "skywave" and "groundwave" have now entered CB rules. Skywave use is illegal.



The Ham Shack

By Robert Hertzberg, W2DJJ

Q CUTIES . . . In the International Q code, QSO means, "I can communicate with . . . direct (or by relay through . . .)." Pronounced "kewso,"

this abbreviation normally pertains to any station-to-station contact on the air. Not so long ago I was puzzled to hear the expression, "eyeball kewso," and it took me five minutes of eavesdropping on a QSO to realize that it meant a meeting in person. But now we can report still further progress, Q-wise—a new Q card. It's a QSL card that confirms an eyeball QSO (see cut).

—o—

Patch Traffic . . . It is common to hear a sort of a footnote attached to directional CQ calls that runs, "with phone patch traffic for . . ."

Since telephone companies everywhere are fussy about their instruments and discourage subscribers from attaching things to them, some hams are reluctant to use patches. Actually, there is no need to worry on this score. The patch units now on the market can be connected in about three minutes and do not disturb the normal operation of the phone.

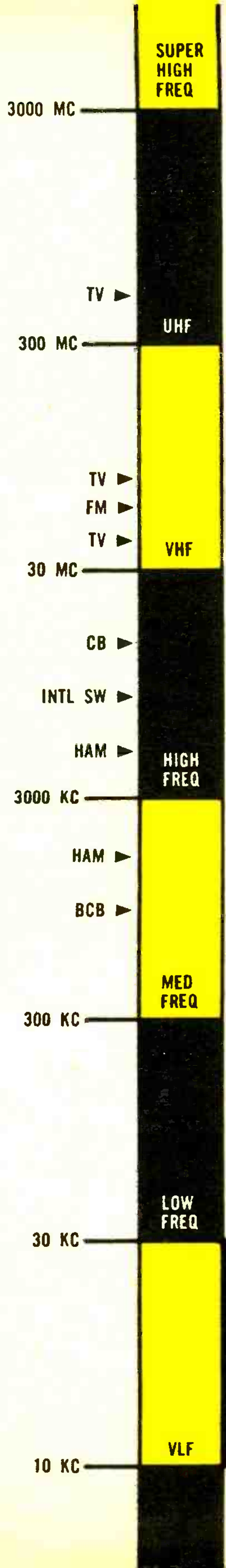
Unofficially, the telephone companies welcome patches for a darned obvious reason: they produce a great deal of extra business in the form of toll calls.

Just as obviously, the phone people must remain officially opposed to patches. To give an okay would be a sure invitation to the destruction of a lot of equipment.

—o—

Flying Hoop . . . An odd-looking mobile antenna that resembles a basketball goal (see photo) is seen on the streets and highways with increasing frequency. The rig is for 2- and 6-meter

mobile operation. It's called the halo and is more effective than a straight whip. Our photo shows a halo sported by K8EGR. [*Continued on page* 103]



the incredible BASEMENT of radio

Eerie whistles and hisses are companions to CW stations working on the VLF band.

By Tom Kneitel, 2W1965

EERIE . . . weird . . . a jungle . . . wild . . . those are some of the words used to describe the goings-on in radio's fantastic basement—the segment of the electromagnetic spectrum known as Very Low Frequency (VLF). The basement begins at 30 kc and goes down.

The inhabitants of these frequencies are indeed strange. Among them, for instance, is a 2,000,000 watt station of the U.S. Navy which is 40 times more powerful than the biggest commercial station in the country. But even the Navy's behemoth is flea-powered compared to the strangest broadcaster of them all, Mother Nature, who runs about one *thousand million* watts down in the VLF reaches. The old girl puts out some interesting programs, too. You don't get Jack Benny or Elvis Presley, but you do hear some weird whistlers, the dawn chorus, the hiss, echoes, risers, clicks and (in the words of the Naval Research Laboratory) "other unusual emissions." You also can hear "joint-venture" transmissions, those initiated by man and taken over by nature.

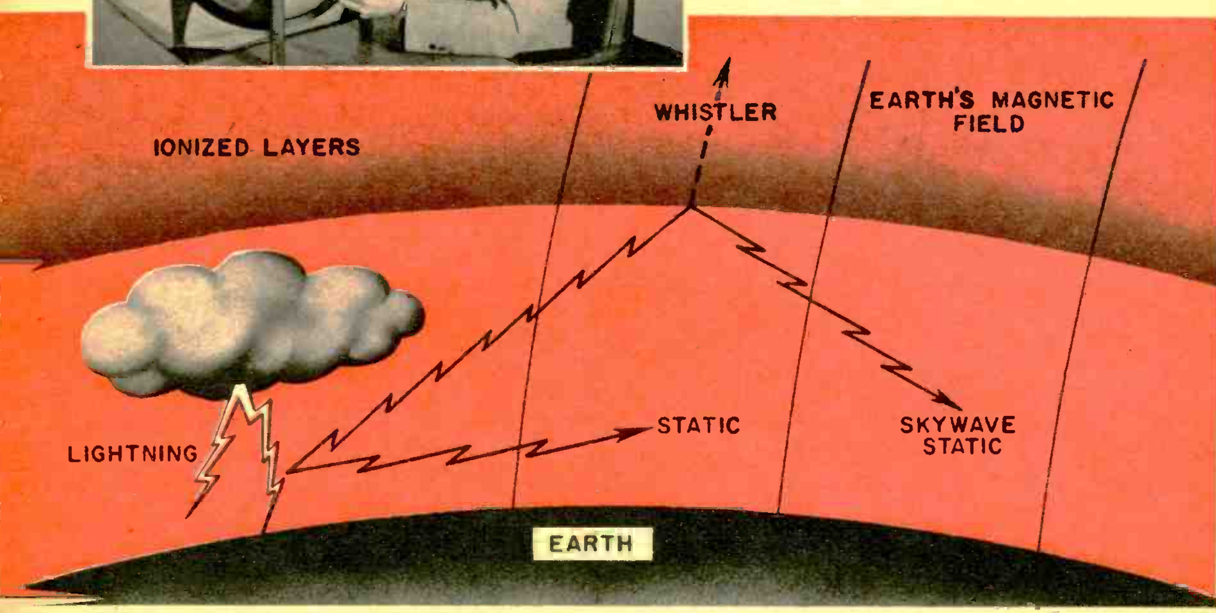
To get down to specifics, several stations operate regularly from 30 kc down to about 14.5 kc, and experimental transmissions have gone below that. Obviously, some type of narrow-band, continuous-wave (CW) transmission is required. The 3,000-cycle bandwidth for voice transmissions would leave room for only about five stations between 15 and 30 kc.

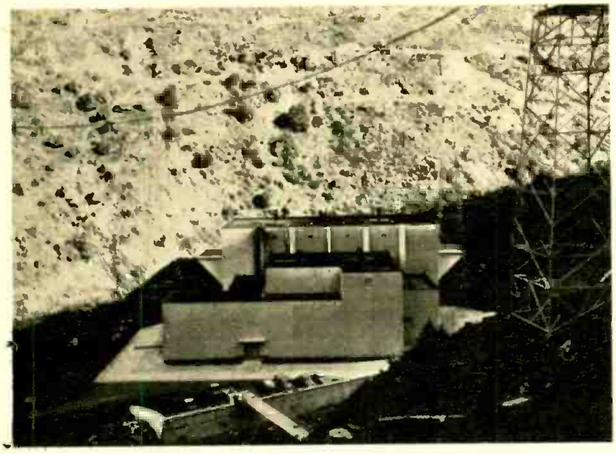
However, it is the strange noises which really set the VLF band apart and make it interesting to monitor. These random signals have come under close observation recently and it has been found that they are caused by natural phenomena, some known and some only guessed at.

The most frequently heard signals are eerie descending shrieks called whistlers. They're caused

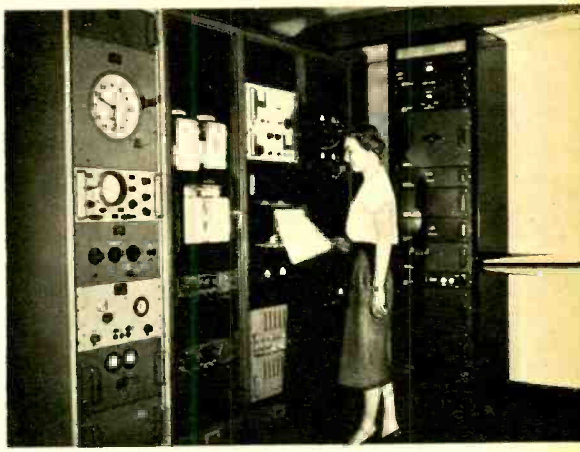
A forest of towers occupying a whole peninsula marks Navy's new two-megawatt station, NAA, at Cutler, Me. Station's huge VLF antenna is supported on 21 towers up to 900 feet tall. Seventeen appear in this picture. Ships as far away as the Mediterranean receive NAA.

The route of the whistlers is shown by looping stick held at left by Harold Dinger of Naval Research Laboratory. Whistlers are generated by lightning (see diagram below) and bound from one hemisphere to the other. Behind Dinger is Navy's whistler monitor equipment.





Navy's NLK (Big Jim) is famous VLF station at Jim Creek, Wash.; this is transmitter building.



Control room with quartz-crystal clock (left) at NBA, Navy time station in the Canal Zone.

by the sudden release of about one thousand million watts of peak power into the radio spectrum by a lightning discharge.

To show how whistlers are born we'll start with a burst of lightning. As it flashes it radiates energy in all directions, its groundwave signal causing static on ordinary radios. Some of the lightning's energy bounces off the ionosphere and comes to earth as skywave static. But, most importantly for VLF, some energy penetrates the ionosphere and, being electromagnetic in character, starts traveling upward parallel to the earth's magnetic field (remember the dotted field lines in your physics textbook?). Following these lines, the lightning's signal goes tens of thousands of miles into space and comes to earth at the corresponding latitude in the opposite hemisphere, then bounces back to the point of origin. The trip is made at a speed of 186,000 miles a second.

But what goes out as static comes back as something else—a whistling tone of descending pitch. This is because the original static covered all radio frequencies but during the long trip the high frequencies travel faster than the low ones and return first, followed immediately by the others, causing a descending pitch. Sometimes whistlers bounce back and forth several times along the arc, creating echoes.

As many as 150 whistlers a month have been recorded, with peak activity in March and October between 11 P.M. and 7 A.M. EST. Whistlers are studied at several sites, among them Stanford University, the National Bureau of Standards Laboratory at Boulder, Colo., and the Naval Research Laboratory in Washington.

Although a good audio amplifier hooked to a large loop antenna can enable even a home experimenter to hear whistlers, the Naval Research Lab employs a long omnidirectional antenna fed into a rig with an amplification factor of 1,000,000. The equipment tunes down to .8 kc (800 cycles), lowest radio frequency yet achieved.

Much remains to be learned about whistlers. Not long ago Professor M. G. Morgan of Dartmouth set sail for Deception Island in Antarctica in a project in which scientists hope to transmit artificial whistlers. [*Continued on page* 114]

DX GUIDE TO VLF

Call	Kc	Location
NAA	14.8	Cutler, Me.
NLK	15.3	Jim Creek, Wash.
NSS	15.5	Washington, D.C.
GBR	16	Rugby, England
NPM	16.6	Honolulu
NBA	18	Summit, C.Z.
NPG	18	San Francisco
GBZ	19.6	Criggon, Wales

For the man who has everything . . .

and needs help to get rid of it . . .

The Panic Button

By Fred Maynard, Motorola, Inc.

SAY YOU'RE the hard-pressed Madison Avenue type. You worry about everything . . . about the winter house, the summer house, the three cars, the two boats, the wife, the kids, the girl friends. Sweat pops out on your brow, your grey flannels get greyer. What do you do next?

Relax . . . and just press your handy Panic Button. Help is on the way. In fact, everybody in the office will be on the way to your sweatbox to find out what the heck the racket is. So you pass on all your problems to them and stop worrying.

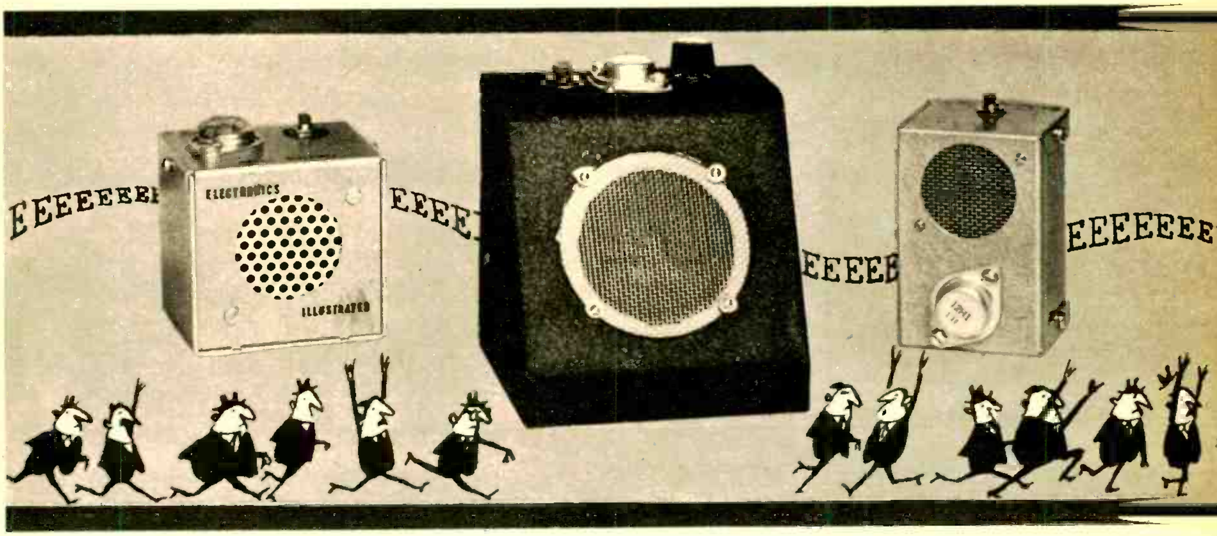
The original version of the Panic Button was an electronic siren hardly as big as a giant-size Miltown box. With an ingenious transistor circuit, a homemade coil and a handful of standard parts, it produces the piercing wail of a true siren. As a novelty, it attracts attention everywhere—if that's your life's aim.

However, the Panic Button also has a serious side. The fact that its circuit does produce a true siren wail makes it applicable for police, Civil Defense and other emergency duties. On a police car it can be combined with a small PA system to form a dual-purpose unit. Its output is sufficient to drive an efficient PA horn large enough to alert a whole area. And the Panic Button's cost is a fraction of the selling price of an air siren.

Construction

You may build the button in any box large enough to contain the parts. You can see some of the versions in the lead photos. The author's model is built in a 3¼″ x 2⅛″ x 1⅝″ Minibox.

Inductor L1 can be wound in a few minutes. The core is a ¼″ diameter 2″



long iron stove bolt with two nuts. Screw one nut about 1½" from the head end. Next, cover the bolt with a layer or two of plastic electrical tape to protect the wire from the sharp threads. The coil should be scramble-wound between the nut and the head of the bolt keeping an even distribution of wire over the winding area. The turns should be kept fairly tight since loose turns may result in "ragged" sound.

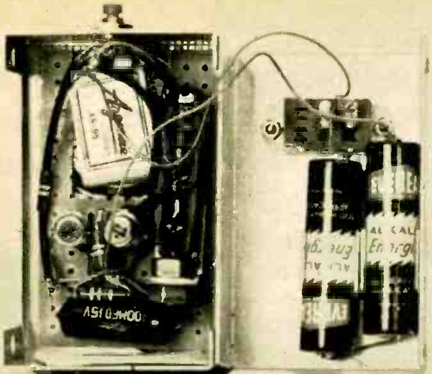
Start at the nut end of the bolt and wind 150 turns of No. 28 or 30 cotton or nyclad insulated wire. Bring out a 2" loop in the wire (for the center tap) and then continue to wind 150 more turns in the same direction. Wrap the coil with a layer of tape and mount it on a bracket or directly to the cabinet with the spare nut. The 2" loop tap goes to the negative battery terminal.

Circuit Operation

The oscillator comprises C1, Q1, L1, R1, and R2 in a conventional Hartley oscillator with inductive collector to base feedback. The Hartley oscillator alone, however, would produce a sine wave and would sound more like a whistle than a siren. The siren effect is achieved by choosing the proper values of C1, R1, and R2 which establish a quench frequency determined by their time constant. The quenching frequency is highly sensitive to the voltage at the junction of R1 and C2, rising to a high frequency as the voltage increases.

The charging voltage at the junction of R1 and C2 is dependent on the time constant of R3/C2. In other words, R3 controls the rate at which the frequency of the tone rises. When SW1 is closed, the voltage across C2 starts to rise and continues to do so, as long as SW1 remains closed, causing the sound to rise in frequency. Eventually equilibrium is reached and the pitch remains constant. When SW1 is released, C2 discharges through R1 and R2, the voltage at the junction of R1 and C2 falls, and

For ear-splitting volume an inexpensive PA trumpet such as the Olson Model S-350 may be used.



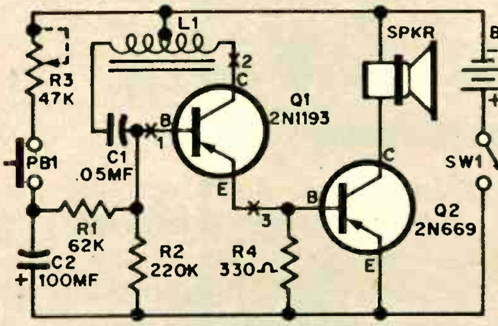
Inside view of one of the more compact versions of the Panic Button. Components are mounted on a perforated board with a cutout for the loudspeaker. Arrangement not critical.

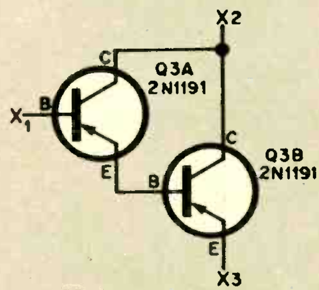
the frequency of the sound lowers gradually. The rate of rise and decay can be varied by changing the value of R3 or C2. The pitch of the tone can be changed by using a different value for C1. Both the speed at which the sound rises in frequency and the upper limit of its frequency are dependent on the battery voltage. You can experiment with different part values to achieve the most desirable effect with the battery selected.

Almost any audio transistor will produce oscillation in this quenching circuit. However, the dynamic range of the siren tone will be greater if a high-gain transistor such as a 2N1193 is used. An even greater dynamic range can be produced by using two low-gain transistors, such as 2N1191s, in place of Q1, in the Darlington amplifier configuration shown in the schematic. However, this may require further changes in the values of R1, R2, and C1.

The oscillator output is emitter-follower coupled to the base of Q2. For best results, the impedance of the speaker voice coil should be in the range of 45 to 100 ohms. Ten-ohm speakers work well but deliver less audio power, somewhat thinner quality sound, and cause a much higher current drain on battery B1. B1 can be from 3-9 volts; greater volume and a higher pitch is attained with a higher voltage.

If a three-transistor circuit is built and a 10-ohm voice coil speaker is used, it will be necessary to power the Button with at least size D flashlight cells. If only penlight cells can fit in the housing, it is necessary to use Alkaline Energizer cells, such as Eveready E91, to supply





PARTS LIST

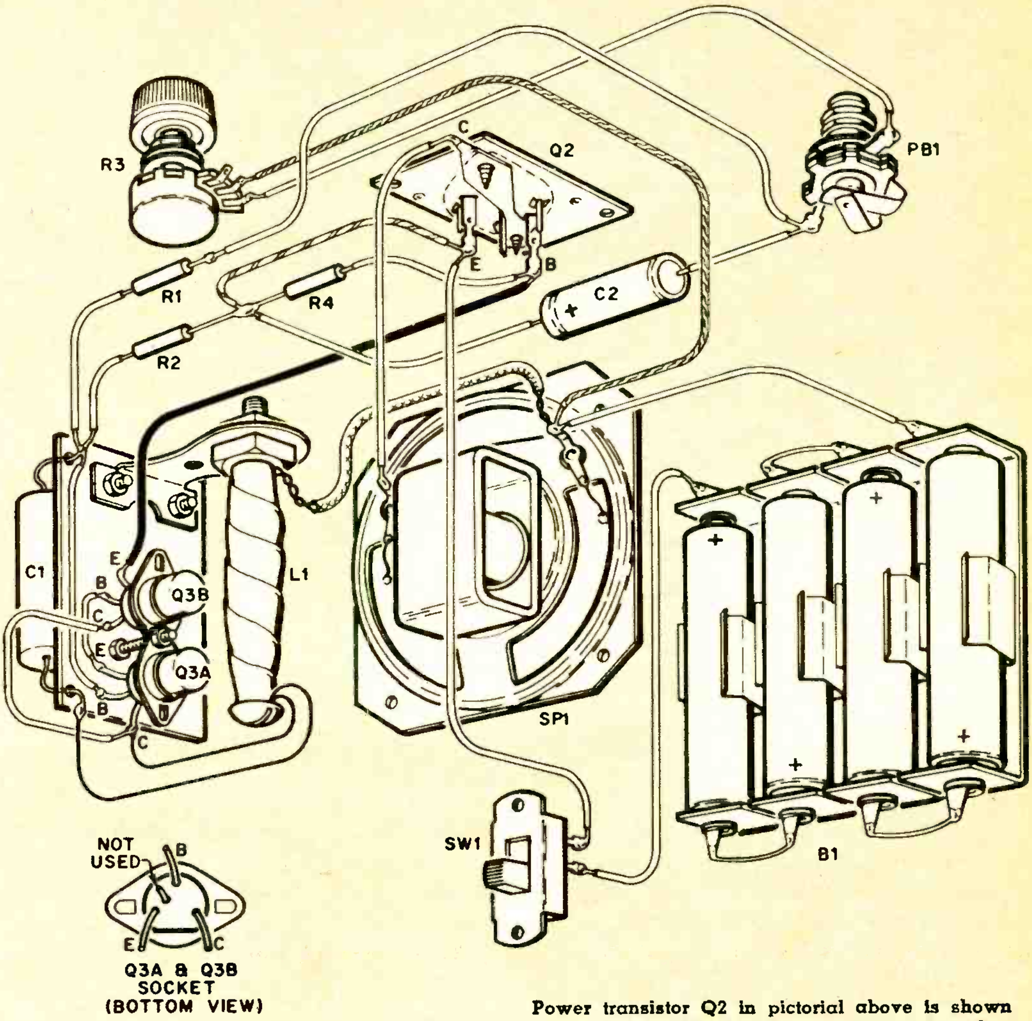
Resistors: ½ watt, 10%
R1—62,000 ohms
R2—220,000 ohms
R3—47,000 ohms (see text)
R4—330 ohms
Capacitors
C1—.05 mf, 100 volt or higher paper or ceramic
C2—100 mf, 15 volt electrolytic
PB1—SPST push button switch
SW1—SPST slide switch
Q1—2N1193 transistor (Motorola)
Q2—2N669, 2N554 or 2N176 power transistor (Motorola)
Q3A, Q3B—2N1191 transistors
L1—Special coil (see text)
Spkr—100-ohm miniature speaker (Quam 22A06Z100) Available from Allied Radio and other distributors
B1—3 volt to 8 volt (see text)

For greater dynamic range transistors Q3A,B may be used instead of Q1. The two-transistor d.-c. circuit is inserted at the numbered points.

the necessary current. Since the standby current (SW1 closed, PB1 open) of the 3-transistor, 10-ohm voice coil speaker circuit is over 300 ma, SW2 should be turned off when the siren is not in use.

An ideal housing for a king size Panic Button is a $5.95 intercom sub-station sold by McGee Radio Co., 1901-07 McGee St., Kansas City 8, Mo. The catalog number is M-45. The sub-station contains a 4" speaker and an output transformer with a 45-ohm primary. In addition, it includes a small chassis and a spring-loaded DPST switch that can be used for PB1.

When Q2 is connected to the primary of the transformer, its load is 45 ohms instead of 10 ohms; a much better match. Also, the battery drain will be lower. The chassis as supplied will easily accommodate all the Panic Button's components.



Power transistor Q2 in pictorial above is shown mounted in a Motorola power transistor socket. Home wound coil L1 is installed on small bracket.

CB'ers! Build this

TONE CALL/SQUELCH

TCS receiver is shown installed on side of Lafayette transceiver. Tone call generator is bolted beneath author's home-built mobile rig mounted under car's dashboard.

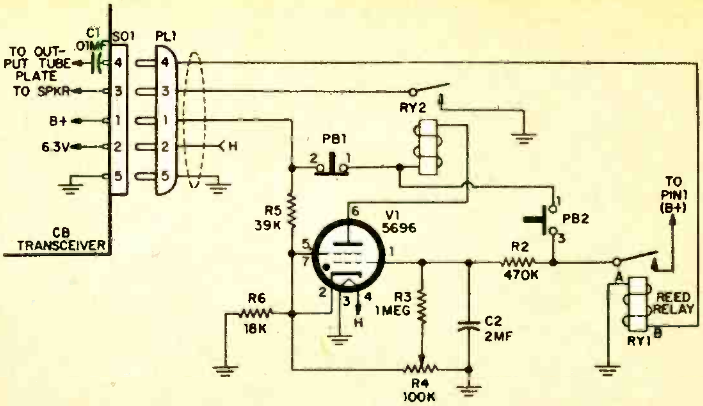
By Morris Goodman, 2W1855

MOST CITIZENS Band squelch circuits don't really do what you would like them to. Sure, you can adjust the squelch to kill background hash, but your rig still faithfully delivers every call coming through on your channel. And nothing can be more annoying than to have to listen to the chatter cluttering up the channels when all you want is one short message from your man in the field.

EI's Tone Call Squelch adaptor solves the above problem simply and inexpensively. With our TCS there's absolute silence when your CB unit is switched to standby: another station switches on your set only when its operator wants to call you specifically. And you don't have to mutilate your equipment since the TCS's two units are built on separate chassis and mounted externally.

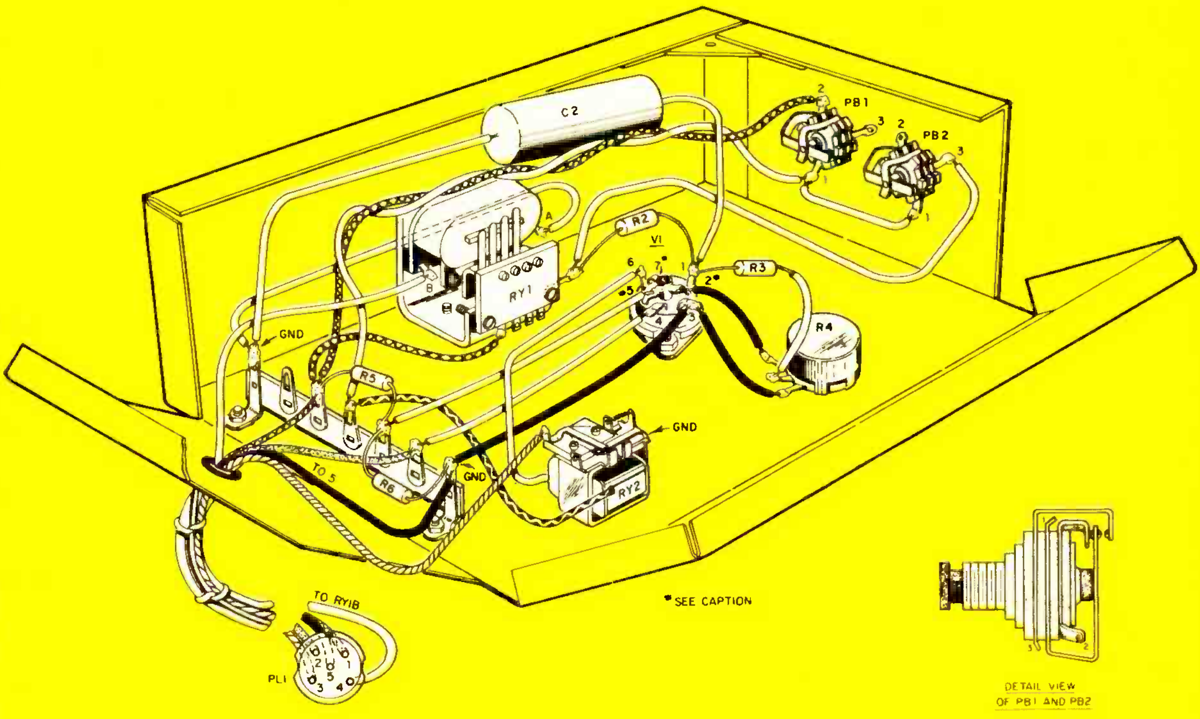
With the TCS system the base-station receiver is left in the *receive* position with the noise limiter and squelch controls set normally with one exception. One speaker lead is opened and its circuit is completed through a relay in the TCS unit. When the remote station wants to call you he presses (for about five seconds) a button on his TCS call unit. This transmits a tone at a specific

FIG. 1
Schematic of TSC receiver is shown at right. In pictorial of unit below, VI's socket pins 2, 5, and 7 are soldered to socket's center post, but not grounded. RY1 is insulated from the chassis with fiber washers. Detailed view of PB1 and PB2 is drawn to show electrical action rather than the mechanical relation of the contacts. PL1 and SO1 are numbered in the schematics and pictorials as per the manufacturer's numbers stamped on the units.



RECEIVER PARTS LIST

Resistors: ½ watt, 10% unless otherwise specified
R1—47 ohms, 20% (see CB output stage schematic)
R2—470,000 ohms
R3—1 megohm
R4—100,000 ohm potentiometer, linear taper (firing time adjustment)
R5—39,000 ohms
R6—18,000 ohms
R —33,000 ohms or value needed for 135 v. at SO1, pin 1
C1—.01 mf, 400 volts capacitor (see CB output stage schematic)
C2—2 mf, 200 volt paper or oil capacitor
PB1—SPDT push button (connected as normally-closed SPST)
PB2—SPDT push button (connected as normally-open SPST)
RY1—Resonant reed relay. Any frequency in the 200 to 425 cycle range. Available from Gyro Electronics Co., 36 Walker St., New York 13, N. Y. for $8.95 postpaid. Gyro will supply a TCS kit for $24.95 postpaid less battery and mic. plugs
RY2—SPST or SPDT relay, 8,000 to 10,000 ohm coil
V1—5696 or 2D21 thyratron tube
SO1, PL1—5-pin miniature plug and socket
Misc.—7-pin miniature socket, 2"x4"x6" aluminum chassis, rubber grommets, screws, wire



DETAIL VIEW OF PB1 AND PB2

frequency which closes your TCS speaker circuit relay. Once the speaker is activated it is not necessary to transmit the tone again during subsequent transmissions because the circuit is self-locking.

Then you operate your station normally, with the noise limiter and the squelch circuits working as before. After you have cleared your message, you simply press reset button PB1 and the TCS is on standby again. To call from your station, you press bypass button PB2, which closes speaker relay RY2, and then proceed as usual.

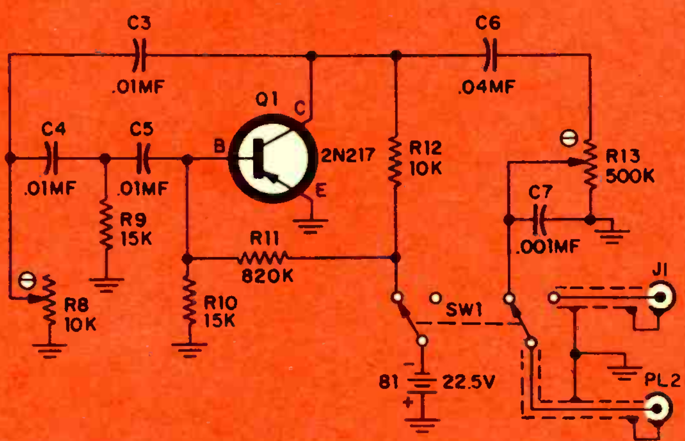
The heart of the TCS system is a tone-selective device called a resonant reed relay. This relay uses a thin steel reed as an audio-frequency-sensitive armature which responds to only one frequency: its resonant frequency. A frequency as little as ten cycles away from resonance will not operate the reed.

Receiver operation can be understood by referring to Fig. 1. When the unit is set for *standby*, thyratron tube V1 is held non-conducting by the negative voltage (with respect to the cathode) on grid 1. Relay RY2 in V1's plate circuit, therefore, is open and the speaker disconnected. When the actuating tone is transmitted by a calling station it is picked up by the receiver and is passed on to RY1 by C1 connected to the plate of the CB unit's output tube. The tone voltage causes the reed of RY1 to vibrate, which connects a positive voltage to the grid of V1. When the negative cut-off voltage is overcome, RY2 closes and completes the speaker circuit. Since V1 remains conductive even though its grid goes negative again, RY2 remains closed. To reset RY2, V1's plate voltage is momentarily interrupted by depressing PB1.

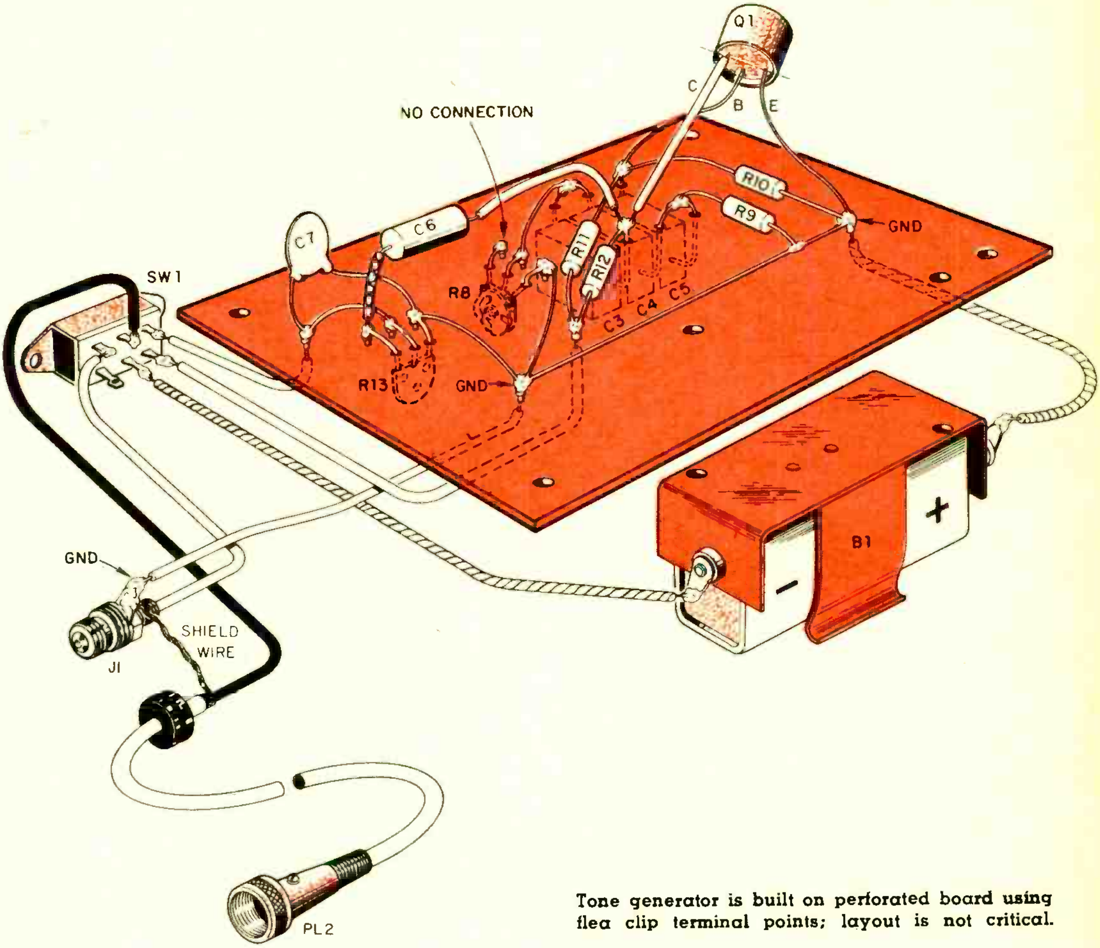
When the base station wants to initiate a call, PB2 is depressed. This momentarily connects a positive voltage to the thyratron grid and turns on the speaker. Because the reed responds intermittently to speech frequencies, a long time [*Continued on page* 108]

TONE GENERATOR PARTS LIST

Resistors: 1/2 watt, 10%
R8—10,000 or 20,000 ohm linear calibration type or miniature potentiometer (tone adjustment)
R9,R10—15,000 ohms
R11—820,000 ohms
R12—10,000 ohms
R13—500,000 ohm calibration type or miniature potentiometer (output level adjustment)
Capacitors: 50 volts or above
C3,C4,C5—.01 mf mica* capacitor
C6—.04 mf paper or disc
C7—.001 mf paper or disc
Q1—2N217 transistor or equivalent
SW1—DPDT slide switch
PL2—Plug to match mike jack on transceiver
J1—Jack to match microphone plug
B1—22.5 volt battery (Burgess U-15 or equiv.) and holder
3"x5" perforated chassis board
Aluminum box to house subassembly
*May be necessary to change these values to reach the resonant frequency of RY1. Increasing the value of the capacitors will lower the frequency of the tone output and vice versa. The values given produce a frequency of about 375 cycles.



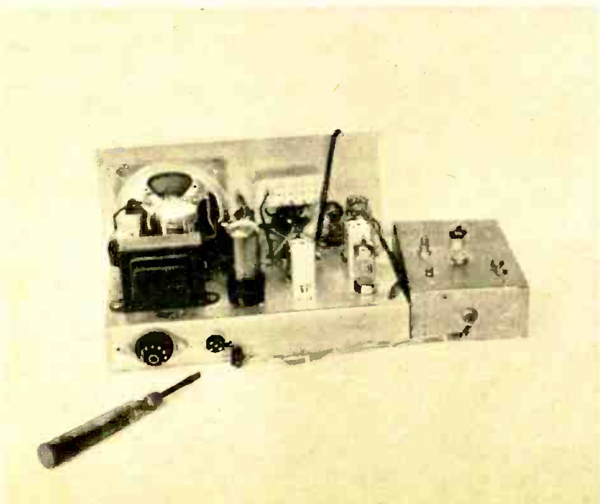
Schematic of transistor tone generator shows simplicity of the design. Phase-shift oscillator provides a stable sine-wave tone signal.

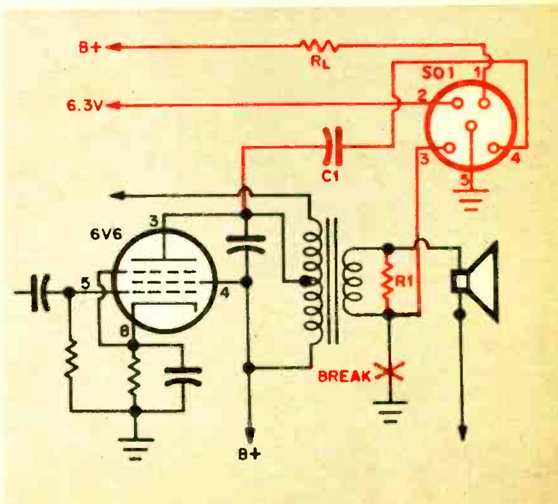


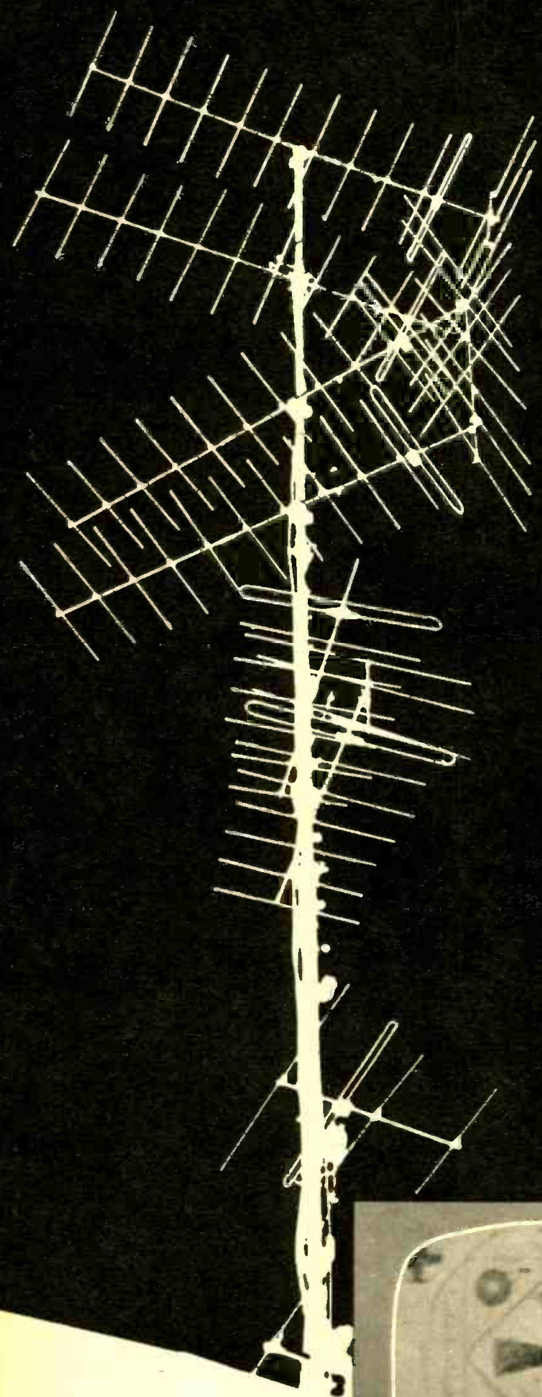
Tone generator is built on perforated board using flea clip terminal points; layout is not critical.

Five-prong socket SO1 is shown installed on the rear apron of a Lafayette Model-15 CB transceiver.

Wiring added to CB output stage is in red. Resistor R_L is selected to provide about 135 volts B+.

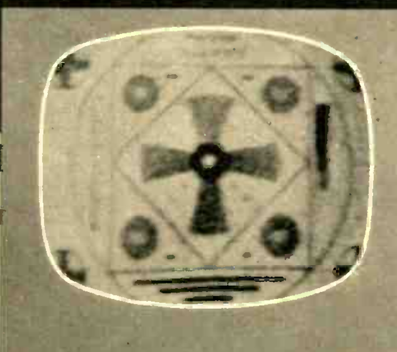




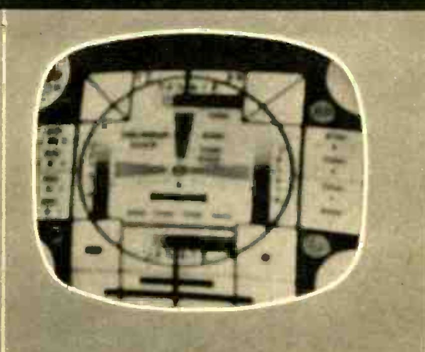


EUROPE'S TOP TV DXer

TV from Tokyo? From Moscow? A Belgian hauls in 26 stations with 80-ft. antenna.



BUCHAREST



BELGRADE

FEW people have ever heard of Rekkem, a tiny hamlet in the West Flanders section of Belgium hard on the French border, but one Rekkem resident is making a name for himself as a TV DXer.

His name is Jacques Herreman and he is a young dye factory worker, which is why he took up this exciting new hobby. Jacques came down with lead poisoning on his job and had to lay off 18 months. To while away the time, he bought a 21-inch TV set and put a fringe-area antenna on top of the humble Flemish row house where he lives. One night a storm damaged the antenna and, in fixing the trouble, Jacques accidentally souped up the rig.

Where he and his neighbors had once been content with TV from nearby Lille and Brussels, Jacques now began bringing in strange programs with foreign languages he could not understand. It was all Greek to him until one night he picked up the faint image of a young girl on his screen. When she faded, on came a stocky, gesturing man whom Jacques recognized as Nikita Khrushchev. He was receiving Moscow!

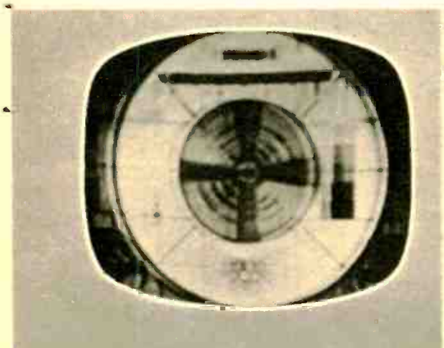
Amazed at this accidental success at TV DXing, Jacques Herreman realized his antenna was the secret and put up an 80-foot mast holding eight elements which, by splitting, can become a 13-element layout (shown on preceding page).

Most of the DX images Jacques received with his big antenna were only faint patterns, never good enough to enable him to read station identifications.

Herreman records TV audio on tape and disc and photographs the images on screen in background.

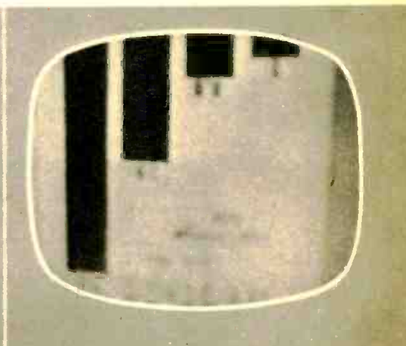
His solution was to purchase both disc and tape recorders to capture the audio and to set up a 2¼ x 2¼ camera to photograph the images on his screen. Armed with photographs and recordings, Jacques began writing to TV stations all over Europe to confirm his reception.

Although troubled by differences in scan systems and weak signals, Jacques in two years of night-and-day DXing was able to receive (and verify) signals from 26 stations in such countries as Portugal, Spain, Hungary, Yugoslavia, Sweden, England, Russia, Rumania and, most amazing of all, Japan (Tokyo). And he has other signals to be traced. A few of his images are shown here.



STOCKHOLM

MOSCOW



TOKYO

EI KIT REPORT

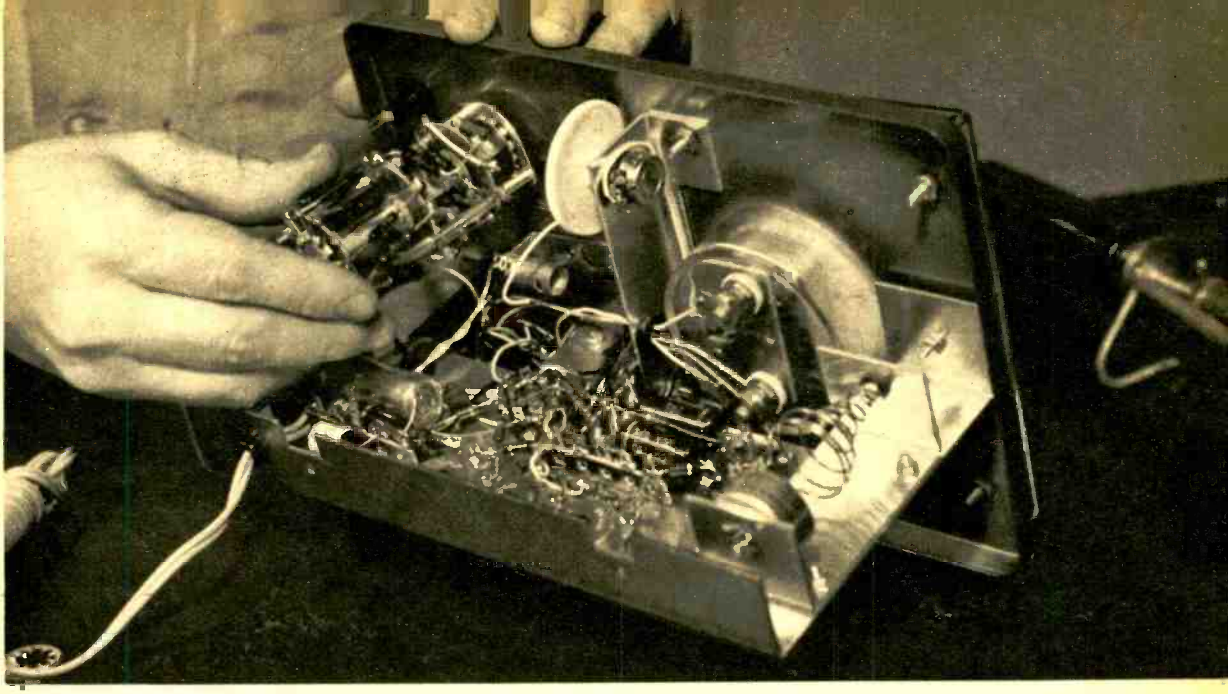
HEATH

VACUUM-TUBE VOLTMETER

AN ELECTRONICS man's best friend is his vacuum-tube voltmeter. It's dependable, versatile, and under some circumstances, far more accurate than the standard volt-ohm-milliammeter. Hams, experimenters, technicians, in fact everybody in the game, sooner or later, end up buying, borrowing or building a vacuum-tube voltmeter.

A **VTVM's virtues** are derived from the fact that its meter movement is driven by a tube—*not* by the circuit under test. This means that the VTVM, unlike the VOM, won't act like a shunt resistor and pull current away from the circuit it's measuring. And when you're working in high-frequency, high-impedance circuits only a meter that doesn't load the circuit can guarantee an accurate reading.

A second advantage of the VTVM is that it is burn-out proof. Let's clarify exactly what this means. If you are careless enough



Vertical chassis arrangement makes for open construction and facilitates wiring procedure. Here, range switch is about to be installed in final step.

to apply voltage to the ohmmeter section of your VTVM, there's going to be a small puff of smoke and several of the ohms range precision resistors will bite the dust. How does the burn-out proof claim enter in here? Well, if you were to pull the same stunt with a VOM, you would not only have the resistors to replace, but probably an expensive meter movement as well. In the VTVM, the tube driving the meter movement is biased so that no matter how much voltage is applied to it (via the test probes), the current through the meter can't rise above a certain level. As far as the voltage ranges are concerned, unless the overload is extreme, the voltage divider resistors won't be damaged.

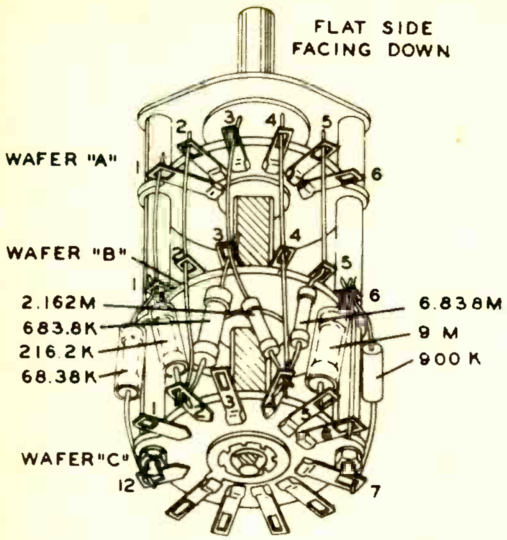
The circuit of the IM-10 is straightforward and conventional. DC voltage to be measured is applied across a series of voltage-dividing resistors (10 megs worth, with another 1 megohm in the probe). A range switch taps off a portion of the voltage and applies it to the grid of one triode of a 12AU7. The two triodes of this tube are arranged in the conventional balanced bridge configuration. The meter—a 200 microamp job—is connected between the cathodes of the two triodes so that a signal applied to the grid of one upsets the balance and causes current to flow through the meter movement.

The AC rectifier is a 6AL5 in a half-wave doubler configuration. On the high AC ranges, a voltage divider (a tapped sequence of series resistors) holds the voltage within the input ratings of the tube. The DC output of this circuit is proportional to the AC peak-to-peak input voltage, and is fed to the 12AU7 bridge for the actual measurement.

There are no peak-to-peak scales on the meter face (a silly omission in our opinion), but since the circuit *does* respond to P-P voltage you can multiply any AC reading by 2.83 to get its peak-to-peak value.

Several physical innovations in the Heath unit are worth noting. The first thing that hits your eye is the meter movement—it's a big 6″ job. And unlike the large movements used by some of Heath's old-time competitors, this meter is well damped. The needle won't oscillate wildly every time you try to take a full-scale reading and it won't beat itself to death if you have it stored in the back of your service vehicle.

The recessed thumb knobs for zero and ohms adjust are an excellent idea,



Heathkit's foldout pictorials of sub-assemblies such as range switch help avoid wiring errors.

not just from the viewpoint of physical appearance but because there's no chance of upsetting your zero adjustment by inadvertently grabbing the wrong knob.

Construction is simple and straightforward, with few pitfalls, none serious. Parts and hardware were all present and easily accounted for. The manual contains drawings of all parts so that even those who don't know a resistor from an orangoutang would have no trouble. All parts and mounting holes matched and the fold-out pictorials and other illustrations are almost exactly where needed in the text. (You can't take either of these two points for granted in the kit world.) Total construction time came to about seven hours.

Subassemblies are used in the IM-10, and you can get at almost everything with ease. No jamming of the soldering iron into remote chassis corners, no scorching parts already mounted. We might warn you that the transformer leads are very brittle—careful. The instructions neglect to warn you to dress transformer leads downward toward the chassis at terminal strip C (p. 13), and this caused a small delay when it was time to install the filter capacitors.

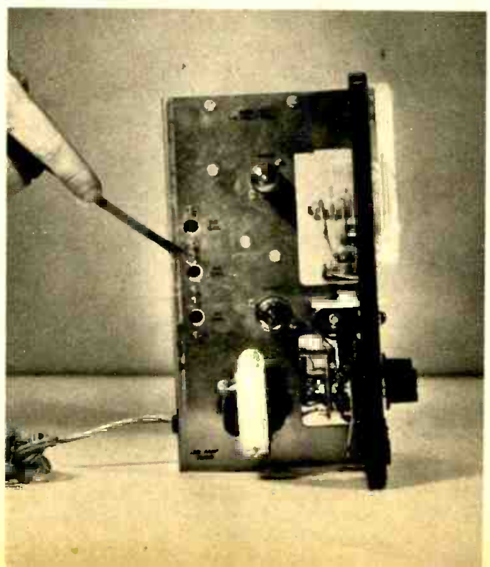
When you get into final assembly and wiring (p. 16) it might make the next steps easier if you temporarily remove the pilot lamp socket from the front panel and bracket assembly. Don't unsolder anything—just remove the nut and push the lamp socket out of your way.

Another instruction (p. 16) says, "connect the red wire coming from point E on the 8 wire harness to lug 7 . . . If you don't find point E on the Pictorial 6 refer back to Detail 2A.

In the range switch wiring, the instructions sometimes order "S-2" (*solder two wires here*) at switch lugs that have only a single bare wire threaded through them. Don't get confused, Heath is referring to the one wire—coming and going.

Calibration as outlined in the instruction manual is quick and simple. A fresh 1.5-volt battery is used as the calibration standard for DC, and the AC line serves for the AC ranges. The process is simple and a meter calibrated with these two "standards" would be quite accurate enough for general work. For greater accuracy (which the instrument is certainly capable of), leave the unit on for 48 to 72 hours and then take it down to an electronics laboratory or meter repair shop, where high-accuracy standard meters are available. You shouldn't be charged more than a few dollars for calibration and you'll have a meter that's right on the button.

Completed VTVM showing the three clearly marked calibration controls along the rear edge.



HI-FI RECORD GUIDE

by Warren DeMotte

BASIC LIBRARY FOR BEGINNERS II

IN this issue we'll wind up our piece on buying a basic record library, the first half of which appeared in the preceding issue.

The sound of a symphony orchestra is so rich, so colorful and stimulating that a basic record library usually is built around symphonic music. The nine symphonies of Ludwig van Beethoven are the heart of the symphonic literature, and the Fifth, in the key of C

Minor, is the most typical and popular. This is the symphony whose four-note opening theme symbolized "Fate knocking at the door" for the composer. As their rhythmic pattern also spells the letter "V" in Morse code, the four notes stood for Victory in World War II, and were sounded often to inspire the Allies in their struggle against the Axis.

Fritz Reiner leads the Chicago Symphony Orchestra in a powerful rendition of this symphony, well recorded, and Josef Krips conducts the London Symphony Orchestra in not quite so powerful a performance, but better recorded.

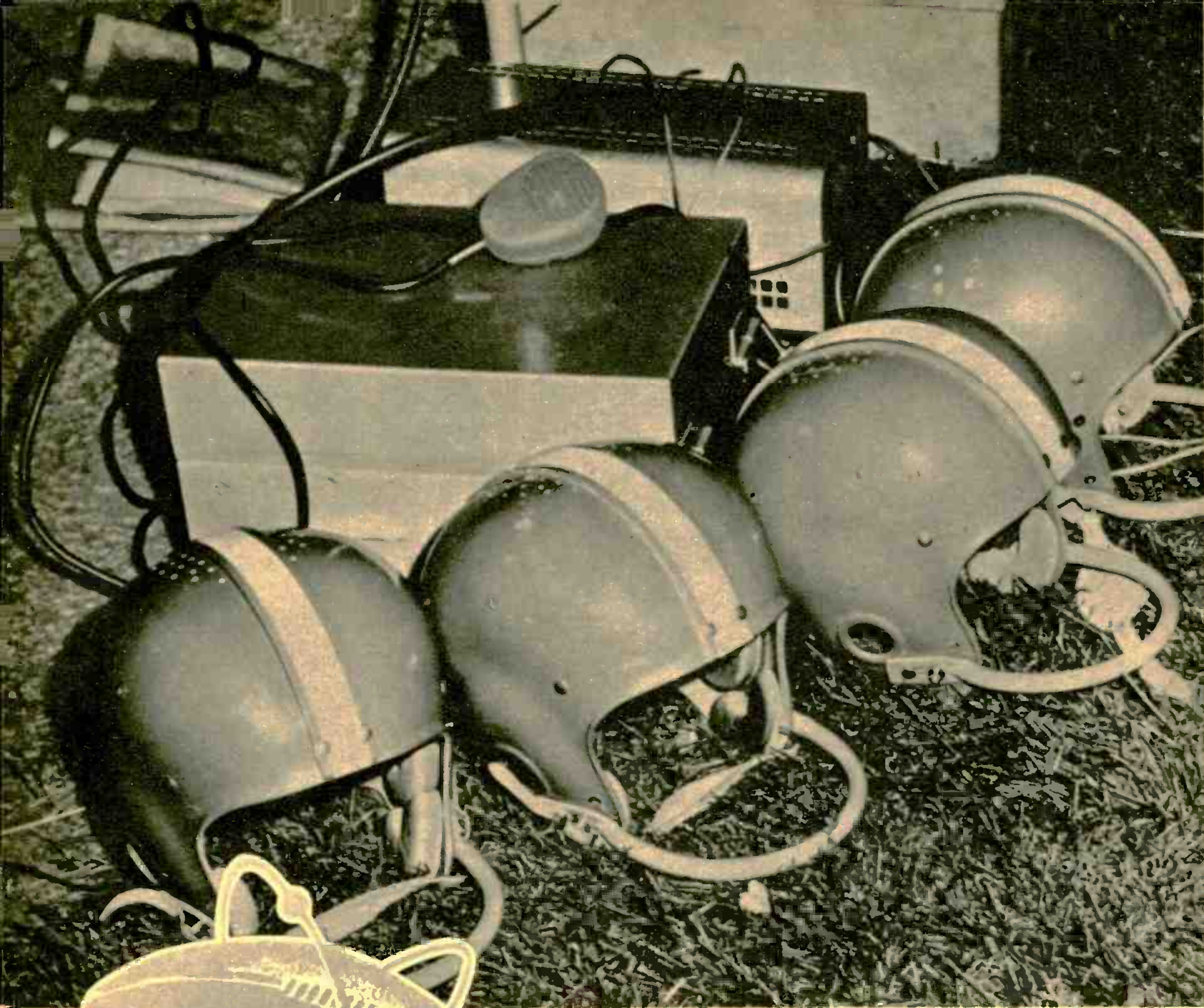
Offering somewhat more profundity and no less excitement than the Fifth, Beethoven's Third Symphony, the Eroica, is perhaps an even wiser choice for the basiç library. The mightiest performance on records is by Toscanini and the NBC Symphony Orchestra (see cut), but the recorded sound is not particularly faithful to the original. Excellent sound and a worthy performance are available in the recording by the Cleveland Orchestra under George Szell.

Of the fifty-odd symphonies familiar to the experienced concert-goer, probably none is loved more than Franz Schubert's Unfinished Symphony. Its two great movements are poignantly beautiful. Again, Toscanini provides a magnificent reading with less than admirable recording, while Paul Kletzki and the Royal Philharmonic Orchestra perform admirably and are recorded with distinction.

For formal perfection, no symphony surpasses Wolfgang Amadeus Mozart's 40th, in G Minor. It is a miracle of balance, exaltation and passion. Otto Klemperer leads the Philharmonia Orchestra in an inspired performance, well recorded. Less nobly interpreted, but not inconsequential, is the version by Leopold Ludwig and the London Symphony Orchestra, which has the added virtue of being paired with an equally estimable performance of Schubert's Unfinished.

The C Minor Symphony of Johannes Brahms, his First, was hailed on its appearance as the successor of Beethoven's mighty Nine. Its majestic measures are given a vital reading by Toscanini, recorded this time with reasonable fidelity. More vivid sound, though, is accorded the somewhat less compelling utterances of Leonard Bernstein and Antal Dorati.

The melancholy melody which opens the slow movement of Peter Ilich Tchaikovsky's Fifth [*Continued on page* 116]



PIGSKIN ELECTRONICS

How well your alma mater does on the gridiron may depend on the number of electronic gadgets it has.

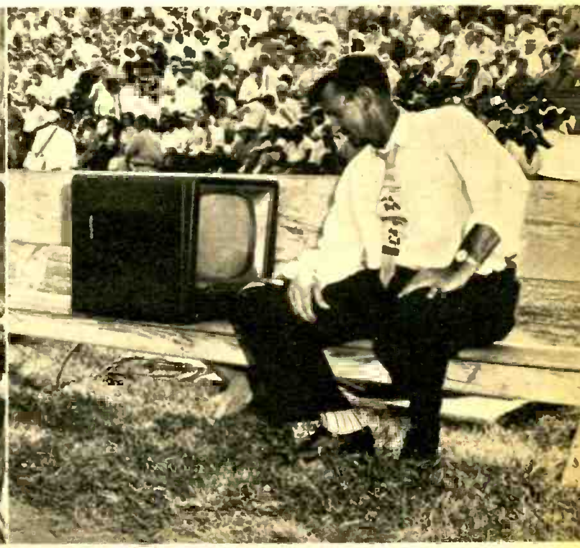
By Alan D. Haas

IN FOOTBALL it's getting so it doesn't matter whether you win or lose, or even how you play the game—just so long as your electronic gear doesn't conk out in the last quarter. For football, like many other fields, has seen a major invasion of electronic gadgets and gimmicks. When your quarterback drops the ball nowadays you can always blame it on a short circuit in his helmet receiver.

Over the past half-dozen years the

A special electrically-driven, fast-developing camera shoots movies at a Rutgers-Columbia U. game. Footage is processed as fast as it is shot, and then . . .

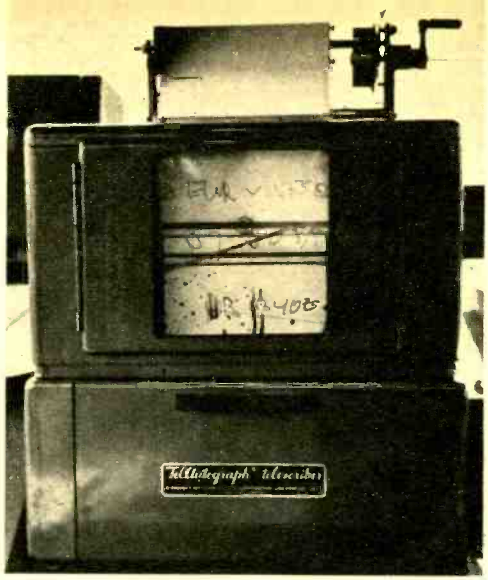
. . . between halves the movie is viewed by the players in their locker room. Coach points out mistakes and opportunities. A standard projector is employed.



In a noble Kansas U. experiment a closed-circuit TV camera in press box fed images of game to . . .

. . . a 21-inch receiver being watched by coach on bench. This was first use of CCTV in football.

Pro player Joe Schmidt lugs mike, amplifier and a radio-equipped helmet as he goes to the field.



L. A. Rams use Telautograph to relay diagrams of plays from spotter in stands to coaching bench.

gridiron has seen the water bucket and the towels joined on the sidelines by two-way radio, closed-circuit TV, video tape, Telautograph machines and instant-developing movie cameras. The coach consults with his electronics engineer before he plans field strategy.

Both the pro teams and college elevens have experimented with electronic gadgetry. A few devices have been declared illegal but others have sprung up to take their places.

As far back as 1954 the University of Kansas installed a closed-circuit TV camera in the press box and a monitoring receiver on the coach's bench. With both ground-level and bird's-eye views of the game, the coach figured he could see exactly what his boys were doing. As it turned out, the Jayhawks didn't have a very good season, TV or not.

Perhaps the most famous user of electronic gimmicks was coach Paul Brown of the professional Cleveland Browns. He set up a four-watt short-wave transmitter on the bench and installed a tiny receiver in the helmet worn by quarterback Otto Graham. With this system Brown could whisper all kinds of orders into Graham's ear. Opponents started screaming about unfair play and all that sort of thing and the commissioner eventually banned the system.

Two other pro teams, the Lions and Cardinals, buried huge induction coils along the sidelines. Signals pumped into the underground coils were picked up by helmet receivers. Trouble was, opponents could listen in.

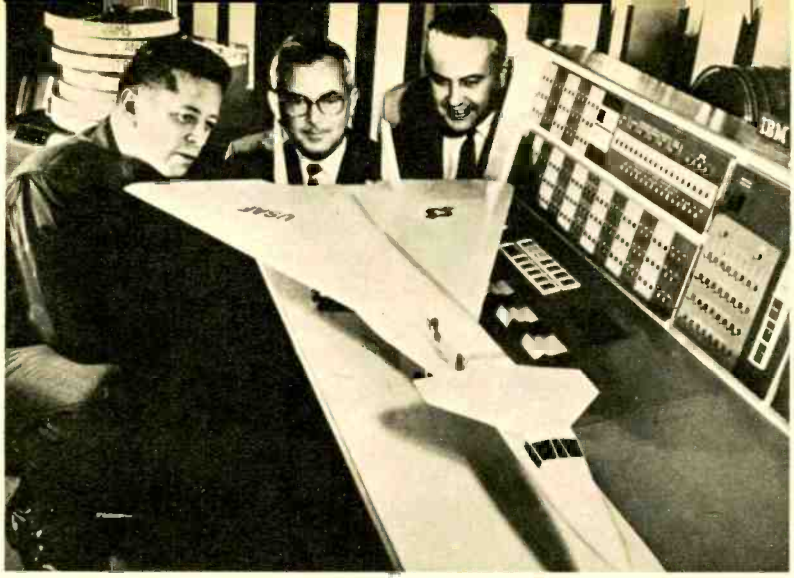
Not long afterward, the Los Angeles Rams installed a Telautograph machine, a device in which a pen writing on a roll of paper duplicates the actions of another pen some distance away. The Rams put the writing end of the unit in the stands and the receiving end on the coaching bench. A scout, viewing the game from on high, sent play diagrams down to the coach.

Last season Columbia University used an electrically-driven movie camera which developed the film as it was exposed. The coach sat atop the stands with the camera to review plays seconds after they were run off, and then showed the film to players in the locker room between halves.

Princeton and other Ivy League colleges are known to employ complicated computers to analyze football plays.

Several colleges have arrangements whereby video tapes of televised games are lent to the coach after it's all over. A few schools have gone this one better by getting hold of video tapes showing future opponents in action.

If the trend continues, football players may learn to have more fear of saboteurs with wire-cutters than of opposing teams.



Although the triple-sonic B-70 bomber has never left the ground, test pilot Al White (left) and his two associates know pretty much how it will fly because of work by computer on which model sits in this photograph. The computer not only helped design the ship, but has test flown many versions of the rakish plane.

THE B-70's INVISIBLE FLIGHT

THE first model of America's newest bomber, the triple-sonic B-70 Valkyrie, has never been built but the futuristic-looking aircraft already has made countless flights and practiced take-offs and landings for hours.

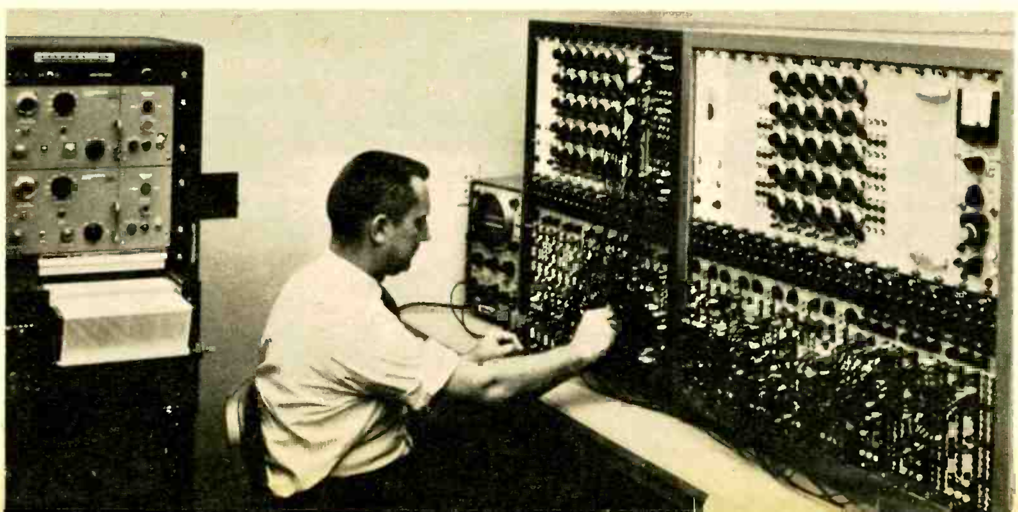
These flights were not of the usual kind, however, and no one could see them. They were all confined to the electronic circuits of computers.

The B-70 is the first aircraft not primarily designed by engineers. Instead, various performance requirements were fed into electronic brains, which then figured out the necessary design.

Computers also worked the other way. They took off, flew and landed a good many test designs worked out by engineers (and cracked up not a few faulty models).

Many computers were used in the B-70 design job, most of them large and incredibly expensive. One exception was a desktop computer employed by Cleveland Pneumatic on the braking system. This brain, designed at the University of Michigan and built by Applied Dynamics, is only about as large as a refrigerator and a stripped-down version costs as little as $2,000.

This relatively small desktop computer assisted in design of the B-70's complex braking system.



Continued from page 54

cut out. But, as it was, we believe many SWLers sensed that something was wrong in the Dominican Republic long before the official announcement came at 4:45 P.M. EST.

—o—

Cuban Catch . . . In addition to fascinating listening, that Cuban invasion produced one DX catch that was pretty wild. At 1932 (7:32 P.M.) EST Radio Caribe (a mortal enemy of Castro) announced that Cordona, a rebel leader, would go on the air at midnight via a transmitter in the Escambray Mountains and proclaim his own provisional Cuban government. This report later was repeated by U.S. news services.

At 2350 (11:50) the station did come on as Radio Cambre, using 7000 kc, right at the bottom of the 40-meter amateur band. One of the American DXers who heard it was Marv Robbins of Omaha. First part of the transmission was instructions for troop movements and the last couple of minutes (which I heard) consisted of anti-government messages.

Then a strange thing happened. Cordona turned up the following morning in New York, making it impossible for him to have broadcast live from the Escambrays at midnight. There seem to be four possibilities: the broadcast was a recording, someone substituted for Cordona, the broadcast came from the Dominican Republic (and Cordona flew out immediately afterward), or some Latin American ham is a practical joker.

—o—

Who's on First? . . . Let's return to the Dominican Republic's Radio Caribe. Officially, Caribe is a private station with plenty of commercials, although all press and radio services there are tightly controlled by the government. In the past, Caribe seems to have carried out some strange jobs, in addition to its usual broadcasting duties.

In the winter of 1959-60 a widely-heard short-wave station was the clandestine Radio Liberacion de Venezuela, operating around 9505 and 6090 kc. Its campaign against the Venezuelan government was climaxed by an attempted assassination of the President.

After this little cutthroat business failed the plot was laid to none other than the Dominican Republic's El Jefe, the late Raphael Trujillo. The Republic eventually was kicked out of the organization of American States, partly because of this incident. The question immediately arose as to who had been running Radio Liberacion de Venezuela and where its transmitter was located.

Liberacion vanished from the air early in the summer of 1960 and then on the same frequencies appeared HIX Radio Nacional Dominicana. HIX is the traditional call for government stations down there. But HIX also lasted only a few weeks and by mid-summer its frequencies were taken over by Radio Caribe, the Republic's "private" station.

All this seems to boil down to the fact that just one transmitter was involved in these goings-on. HIX and Caribe apparently were just different names for the same station, and it also appears certain that the Venezuelan rebel radio broadcasts came straight from the same place.

After becoming Radio Caribe, the station broadcast in many languages, including English programs for U.S. consumption. Most of these broadcasts attacked the U.S. State Department for trying to cut off windfall sugar profits for the Dominican Republic after the Cuban sugar ban.

After the sugar deals were worked out Caribe stopped most of its foreign language broadcasts and stuck mostly to Spanish.

The station continues to grow technically. It took over Radio Deportive Handicap with operations on 49 meters (6210 kc) and the broadcast band (860 kc), and then its 31-meter transmitter was moved to 9485 kc, just below the 31-meter band, to avoid interference. At last report, new Caribe channels had appeared at 15050 and 3322 kc, and a little later the studios were damaged by fire in a riot.

With such a varied history and the promise of offbeat doings in the future, Radio Caribe bears watching.

New Rules For CB

Continued from page 73

utes. This must be followed by a two-minute silent period to check traffic on the channel. This procedure allows others to dispatch messages. If, after two minutes, the channel is clear, you may occupy it for an additional five minutes, if needed.

Now we come to one of the most welcome revisions in the old CB rules. It opens up a new area of service in the Class D band by permitting the combination of CB radio with commercial telephone-answering services.

According to the old rules in Part 19, a CB station was permitted to provide any person with radio service on a voluntary, no-charge basis. But any shared or cooperative use of the band was prohibited. This last point is the important one. It prevented a telephone-answering service from notifying you of a phone call via CB radio.

To make the combination, you must send a letter to the FCC requesting permission for this proposed use of the band. It must state that you will have access to and control over the equipment. This does not mean you personally have to operate it, but that you hold the license and bear the responsibility for its proper operation. In brief, you can place one of your CB units at the telephone-answering office and instruct someone to contact you when the need arises. All this must be on a non-profit basis, although the cost of the CB facility may be shared.

Changes in the technical part of the rules finally settles the controversy over who may build and tune a CB rig. These changes are found under Operator Requirements. No longer do you have to hold a first- or second-class commercial license to perform some of the superficial adjustments to your set. Part of the burden is placed on the manufacturer. Factory-wired equipment must be designed so that normal transmitter adjustments will not result in improper operation. This would include off-frequency, excessively powerful and false emissions. For kit-built units, the manufacturer must provide a sealed crystal oscillator. The rest of the circuit may be constructed in the usual kit fashion.

The changes in regulations accomplish two things. First, they keep the non-technical person out of the critical portion of the circuit, the crystal oscillator. Secondly, they allow the CB licensee to tune a transmitter into an antenna without having to enlist the services of a licensed specialist.

The fact that the FCC has made some ten changes in Part 19 indicates the law is by no means fixed. Its constant state of flux points up the substantial growth and problems of CB radio. Watch for future amendments. They are bound to reflect the FCC's intent to keep the band operating in the "public interest, convenience and necessity."

High-Flying Ham

Continued from page 58

a message to my wife telling her when to expect me.

Butch is a native of Erie, Pa. He attended Columbia University and Ohio State, enlisted in the Air Corps in 1928 and earned his wings in 1929. He spent the next ten years performing normal squadron duties in Michigan, Illinois, Virginia and Hawaii. Fliers of that period were required to know code pretty well, so he had no trouble qualifying for a license when he became interested in the ham game in 1938. His first call was W3IXM, issued when he was at Langley Field, Va. As he transferred from station to station, he acquired W2NRV, W6UFT, KG6AAF, KG6BN and W4OTZ.

When World War II broke out, the then Major Griswold was one of a group of experienced professional airmen whom the Army Air Corps pushed up the ladder almost overnight. In 1942 he went to England to serve with the Eighth Air Force, and before the end of the conflict in Europe he was a brigadier general. By 1952, Butch had become a major general, and then in 1957 a lieutenant general. He has been at SAC since 1954.

Although a high-ranking officer with

awesome military responsibilities, KØDWC is without pose or guile. When he contacts a new station his standard introduction is, "My name is Butch." If someone asks him what he does, he replies, "I'm in the Air Force." Many a young airman or soldier, operating at some MARS (Military Affiliate Radio System) station, is flabbergasted later to learn that the friendly Butch he chatted with for five minutes is a three-star general.

Butch has been one of the important proponents of single sideband communications and is given credit for helping make SSB popular on the ham bands. In 1956, while on a routine inspection trip in the Pacific, the general and several cooperating hams demonstrated the effectiveness of SSB as airborne communications equipment by maintaining virtually continuous contact with the United States while his plane was aloft over the Pacific. He used standard ham equipment, such as he has today in his base shack at his quarters at Offutt. During a 15,000-mile flight, the men made more than 1,000 amateur contacts with 26 countries, including Little America, and collected much valuable technical data. That the Air Force was impressed by this feat is indicated by the fact that it has gone all-out for SSB for a variety of air-to-air, air-to-ground, and ground-to-ground communications.

Over the years, Butch has used a good many different planes and pieces of radio gear. His equipment in the C-97 was a standard transceiver which Collins makes for the Air Force. His antenna was merely a single wire running from nose to tail, which is not very classy, but when you get it several miles high, what a reach it has! In his ground shack, the general has a Collins 75A-4 receiver and KWS-1 transmitter, the same equipment he once used in a plane.

As Vice-Commander in Chief of SAC, General Griswold is on what amounts to continuous alert. This wouldn't seem to leave much time for anything other than eating and sleeping. But somehow he does find time, not only for time-consuming amateur activities, but for hot cars and fancy cameras.

Crystal Calibrator

Continued from page 51

checked for calibration without removal from the car. The calibrator with its antenna is placed several inches from the mobile antenna; a distinct hush will be heard in the receiver at the calibration points. If the mobile receiver is equipped with a BFO so much the better. Up at 6 meters, it may be necessary to connect the two antennas with a clip lead.

A mobile VFO's calibration can be checked by zero-beating the received calibrator marker frequency against the VFO. Tune in a marker (e.g.: 7 mc) and adjust the transmitter's oscillator until zero-beat. The VFO is then set for 7 mc. The same procedure is used for other frequencies.

Using a similar procedure, the calibration of RF signal generators can be checked. The output from a signal generator is fed into a receiver with the output of the calibrator and the generator is calibrated at zero beat. With a broadcast band range generator a standard radio can be used as the receiver.

At very high frequencies where the calibrator's output is reduced, run a wire from the calibrator to an alligator clip on the insulation of the "hot" antenna wire. In some instances, such as calibration of an FM tuner, the calibrator will have to be connected directly to the receiver's antenna terminals. For maximum stability, always ground the case of the calibrator to the equipment under test. Using the 1 mc output, an FM tuner dial can be adjusted or marked "on the button" across the dial.

How It Works

Oscillator transistor Q1 has an anti-resonant feedback path connected between collector and base. At 100 kc, the low-Q coil L1, has low output and requires the use of amplifier Q2. Since the base-emitter conduction of Q2 has a diode action, a signal rich in harmonics is produced. At 1 mc, high-Q coil L2 becomes the oscillator tank coil and the high 1 mc output does not require amplification. This permits the use of low-cost transistors and stock coils.

Should You Go West?

Continued from page 69

start. Thereafter, they can expect an average $50 monthly salary boost each year. In ten years they probably will be getting from $900 to $1,000 a month.

To get a clearer picture of your chances in Southern California you should know something about the area. In brief, it is swarming with people (6,800,000 in Los Angeles and Orange County alone) and growing like a weed. The electronics complex is a big one, stretching all the way from Vandenberg Air Force Base on the north to the Mexican border 300 miles away, and from the Pacific to Edwards AFB, 100 miles inland. Scattered in this piece of countryside are no less than 17 electronic hubs, each with its own specialties. The map at the head of this article indicates the more important centers. Let's talk about some of them in detail:

The San Fernando Valley is defense-oriented. Here is Lockheed's huge Burbank Division, an aircraft plant with a large electronic payroll. At nearby Canoga Park is Rocketdyne, with 5% of its 11,000 employees in electronics. Rocketdyne's rocket-test facility at Santa Susana employs 1,000—of which 300 are in electronics. There are smaller electronic plants by the hundreds.

In southern Los Angeles the Downey complex includes North American Aviation's Autonetics Division, engaged in design-production of electronic components for the Hound Dog missile, guidance systems for the Minuteman and fire control circuitry for F-104 fighters.

The fastest-growing electronic complex is centered around Anaheim, Fullerton, Buena Park and Santa Ana in Orange County. It runs the gamut from consumer hi-fi (Altec Lansing Corp., Anaheim), instruments (Beckman Industries, Fullerton) to controls (Borg-Warner, Santa Ana).

Around top universities (UCLA in West Los Angeles and Cal-Tech at Pasadena) have grown up modern-day think factories, heavily keyed to electronic research and development.

San Diego is transitioning from air-frame assembly (Convair) to Navy and space electronics (Convair and the Navy's electronic laboratory).

Many hard-hit plane makers are going into electronics. The Autonetics division of North American Aviation is one example. Ryan Electronics in San Diego, a division of Ryan Aeronautical Co., now turns out navigation gear, radar systems and missile guidance controls.

Southern California's defense-heaviness doesn't worry most experts because the area is one of the brain-centers of U. S. missiledom, particularly space electronics. "And," says one expert, "space electronics can go in only one direction . . . straight up."

If you hanker to follow the sun it's a good idea to contact the Western Electronic Manufacturers Association, 1435 South La Cienega Blvd., Los Angeles 35, and obtain their directory ($2), which has thumbnail sketches on all the major companies.

The Sunday edition of the Los Angeles Times ($2 a month by mail) has a veritable electronics call-board in its classified section and will give you a good idea of what's going on in the hiring line at any given time.

As the employment agency executive said, it's best *not* to land cold in California. Send out queries by mail first. Besides having a job ready when you get there, many companies will pay your moving expenses . . . and you're in a better bargaining position at a distance.

To sum up, Southern California does offer many opportunities to men in electronics. Whether *you* should become a 1961-style wester is for you to decide.

Tech Editor's Test Bench

Continued from page 43

are not covered in our survey. Some are about to be discontinued, according to their manufacturers. Others are not widely distributed. And a few are, in our opinion, not of high enough quality to merit testing.

The tech spec table needs a few extra words, particularly in regard to sensitivity and distortion figures. When dealing with a distortion reading of less than 0.5%, the residual distortion in the test instruments starts to become significant. And, in general, it's extremely doubtful that most audiophiles could hear a difference between two units which check out below the 1% mark.

If you compare EI's test results with manufacturer's specs you'll come across discrepancies. These can be accounted for in several ways. For one, several companies have not yet accepted the Institute of High Fidelity Manufacturers' standards.

On the matter of I.M. (inter-modulation) distortion figures quoted in the chart: for technical reasons we did not use IHFM standards but, since the figures were all derived by the SMPTE (Society of Motion Picture and Television Engineers) technique they can be compared validly.

When you buy a tuner, is its quality going to check out with the figures in our chart? The answer is *maybe*. In electronics, as in other areas, a law of randomness comes into play. The tuner you construct may work slightly better—or slightly worse than the one we built because of a tube with extra high gain, closer coupling in an IF transformer or any of a hundred chance factors.

Occasionally, because of some snafu at the factory, a "pre-aligned" subassembly won't be. This, however, is something that can happen even with factory-wired equipment. In short, you run no special risk of getting a lemon when you buy a kit.

The instruction manuals were quite good and would guide the novice step-by-step toward successful assembly of the kit selected. When our reviewers found fault with the instructions, the manufacturer was notified.

When we tested the units built by novices, we found bad solder connections far outnumbered wiring errors as the cause of non-operation. And it seems *printed-circuit boards are no guarantee of good soldering.*

We have not given construction times for the kits, except when unusually high or low. In general, you can figure on about eight hours before plug-in time.

Ham Shack

Continued from page 74

Sideband-ese . . . Virtually identical letters have arrived from several readers reporting the reception of mysterious garbled signals on the upper ends of the 15-, 20-, 40- and 80-meter phone bands.

"I hear lots of other stations loud and clear, so my receiver must be okay," writes Steve Rickman of Columbus, Miss. "Is this stuff some kind of scrambling?"

No, Steve, you have merely made the acquaintance of SSB, which stands for single sideband suppressed carrier. It's a form of voice transmission in which either the upper or the lower sideband resulting from voice modulation *and* the carrier wave are suppressed in the transmitter, leaving just one sideband—a single sideband—to be transmitted. This signal occupies less than half the space of conventional double sideband (DSB) emissions and is less subject to fading, yet it contains exactly the same voice intelligence.

The trick at the receiving end is to turn on the BFO (beat-frequency oscillator), normally used only for code reception, and to tune carefully.

Most lower-priced all-wave sets and many communication receivers made before 1950 are not satisfactory for SSB because their BFO's are not sufficiently adjustable or stable enough to hold the narrow signal. With a regular SSB receiver the sideband voice loses its monkey-chatter characteristics and booms through with clarity.

Good Reading

Continued from page 55

many ways, for purposes like traffic control and weather forecasting, a new book on the subject is particularly welcome. This slim volume contains a wealth of information, covering everything from basic theory to specific receivers, oscillators, and antenna systems. Clearly written, and well illustrated, it's worth having just for keeping up to date on an interesting part of electronics.

Circuits For Stereo FM Adaptors

Continued from page 45

via a capacitor and resistor to a 19-kc filter (L1), which allows only the 19-kc pilot to pass to the grid of V2. V2 serves as a doubler-amplifier, which amplifies the pilot signal and then doubles its frequency to 38 kc at T1.

Since the 38-kc signal is derived from the 19-kc pilot transmitted by the FM station, it is identical in phase and frequency to the 38-kc subcarrier generated (and then suppressed) at the station's stereo modulator. In fact, the signal developed by V2 is called the recovered subcarrier. The secondary of T1 couples this recovered subcarrier to the detector.

Returning to the first stage, the output of V1 also is fed through a voltage divider (R1 and R2) to a 38-kc bandpass filter (L2, L3, C1, C2, and C3). The bandpass filter allows only the L—R signal (23-to-53 kc) to pass on to the subcarrier detector.

In still another operation, V1's output is also applied via a potentiometer (which functions here as a separation control) and a 19-kc filter network which passes only the L+R signal to the matrix circuit. In addition to filtering the L+R signal, the network provides a time delay to keep the L+R signal in step with the L—R signal, which falls behind because of its longer circuit path.

At the input of the subcarrier detector (D1 and D2) the recovered subcarrier (from T1) is combined with the L—R signal from the 38-kc bandpass filter. The result is a completely reconstituted subcarrier identical to the modulated subcarrier originally formulated at the transmitter.

The sidebands now are detected in the usual way by diodes D1 and D2. Note that the diodes are connected in opposite polarity. Each detects (converts to audio) the L—R signal. However, the output phase of D1 is positive, resulting in $+(L-R)=L-R$, while D2's output is negative, resulting in $-(L-R)=-L+R$, or R—L.

The output of the detector (L—R and —L+R) is fed to one side of the matrixing bridge composed of R3, 4, 5 and 6. The opposite side of the bridge is fed by the L+R signal from the time delay network. In the matrixing bridge an algebraic addition of the input signals occurs in the following manner: $(L-R)+(L+R)=2L$ and $(-L+R)+(L+R)=2R$. It is important to note that the amount of stereo separation depends on how well the bridge is balanced.

One standard de-emphasis network (R7 and C4) is inserted in the left channel output and another (R8 and C5) in the right channel output. The output impedance of the detector is high, so there is a cathode follower at each channel output to prevent excessive loading of the detector.

Zenith Circuit

As shown in Fig. 3, Zenith uses a time division technique. Their adaptor switches alternately between the left and right stereophonic program channels, sampling *each* 19,000 times a second (which adds up to 38,000 cycles—38 kc—per second).

Although the time division technique of stereo transmission is substantially different from the matrix system, the transmitted signal is the same and so is the output signal that appears at the multiplex output jack of the FM tuner.

The input stage of the Zenith adaptor is a cathode follower (V1) whose high input impedance prevents loading of the tuner's detector. The second stage (V2) is a straight amplifier. The third (V3) is a semi-cathode follower with its plate circuit connected to the primary of T1. T1, slug-tuned to 19 kc, appears as a very high impedance to a signal of that frequency. To all other frequencies T1 is a dead short to B+, and V3 is merely a cathode follower.

The secondary of T1 (also tuned to 19 kc) serves as the tank circuit of Hartley oscillator V4. In order to lock in V4 to the desired frequency (19kc), the pilot frequency (which appears at V3's plate because of T1's high primary impedance at 19 kc) locks in V4 and forces it to oscillate at exactly the same phase and frequency as the pilot signal.

The plate of locked oscillator V4 feeds the primary of T2, which is tuned to 38

[*Continued on page* 108]

Profiles in Electronic Engineering Technology

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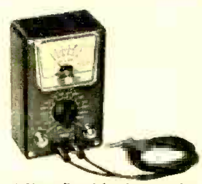

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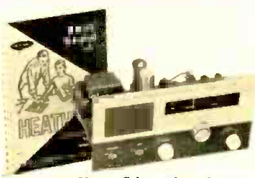

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Circuits For Stereo FM Adaptors

Continued from page 104

kc and, therefore, picks up the second harmonic of the 19-kc pilot frequency. Considering V4's operation, it might be called a locked-in doubler oscillator whose output in effect is a 38-kc switching signal. And, since V4 is locked in on the 19-kc pilot, the 38-kc harmonic switching signal (to be used in V5) is identical to the original 38-kc switching signal generated at the FM transmitter's stereo time-division modulator.

Returning to the modified cathode follower (V3), the remaining signal components—the L+R signal, the L—R signal and the SCA subcarrier—appear at the cathode. These components feed a 38-kc bandpass filter consisting of L1, L2, C1 and C2. The series arm, L1 and C1 of the filter is the low-pass section which prevents the passage of the 67-kc SCA subcarrier. The shunt arm, L2 and C2, prevents the passage of the 19-kc pilot but allows the passage of the 23-to-53 kc L—R signal and the 15-to-50 kc L+R signal. In addition, the other resistors and capacitors in the network provide the standard 75-microsecond de-emphasis.

Demodulation by Deflection

The fifth stage of the adaptor is the stereo demodulator. V5 is a special type of beam deflection pentode (all grids not shown in Fig. 3). It has a pair of deflection plates placed parallel to the path of the electron beam and a pair of output plates perpendicular to the beam. Normally, the electron beam would travel from the cathode through the grids to the space between the output plates. By energizing the deflection plates, the beam can be deflected to one output plate or the other.

In this circuit, the deflection plates are connected to the secondary of T2. Since the doubler oscillator has developed a 38-kc signal in the primary of T2, the deflection plates reverse in polarity at a 38-kc rate. As a result, the electron beam is switched from one output plate to the other at this rate—38,000 times a second.

The output of the bandpass filter is fed to the control grid of the beam deflection tube. Because the phase relationships between the L and R components of the L+R and the L—R signals, the electron beam coming from V5's output plates looks like the R signal at one moment and the L signal the next. The result is the reproduction of the original L channel signal at one plate and the R channel signal at the other. Each is exactly like the original signal at the transmitter.

Now that we have recovered the original left and right stereophonic program channels, all that remains is to feed these signals through cathode followers to the output of the adaptor. The cathode followers are required for proper operation of the 38-kc rejection filters (traps) inserted between the demodulator and the output. If a large 38-kc component appeared at the output of the demodulator along with the R or L stereo signal it might introduce problems in a hi-fi system. This is particularly true when a tape recorder is connected to the output of the adaptor. The 38-kc component might beat with the bias and erase frequency of the recorder and cause "birdies" and whistles on the tape.

CB Tone Call/Squelch

Continued from page 85

constant (C2, R2) is added to the thyratron grid circuit. This prevents the short speech bursts from overcoming the negative cut-off voltage and makes it necessary for the tone to be transmitted about five seconds before the TCS operates. This time requirement can be adjusted by potentiometer R4, which varies the negative voltage on the grid of V1. The less the voltage difference between the grid and the cathode, the shorter the time required to activate the TCS.

Construction is quite simple. RY1 is insulated from the chassis with rubber grommets because the reed contacts are electrically connected to the relay frame. With the speaker disconnected during

[*Continued on page* 110]

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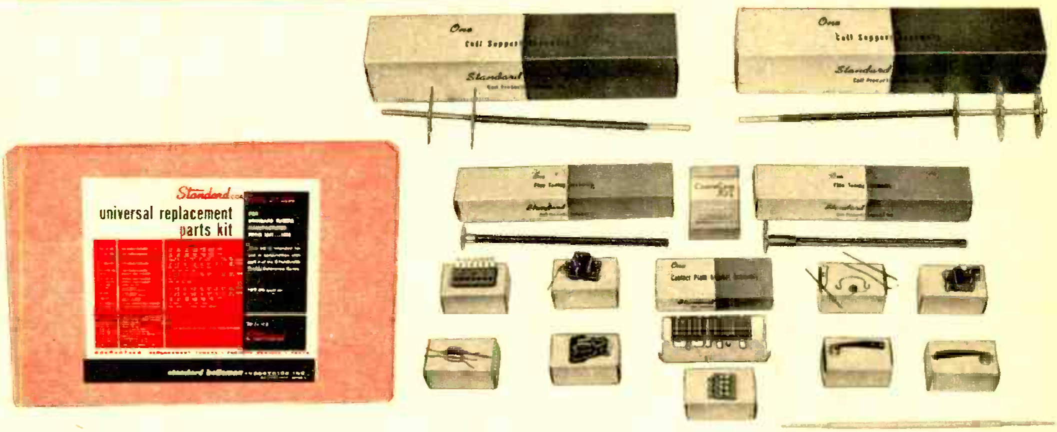

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Circuits For Stereo FM Adaptors

Continued from page 104

kc and, therefore, picks up the second harmonic of the 19-kc pilot frequency. Considering V4's operation, it might be called a locked-in doubler oscillator whose output in effect is a 38-kc switching signal. And, since V4 is locked in on the 19-kc pilot, the 38-kc harmonic switching signal (to be used in V5) is identical to the original 38-kc switching signal generated at the FM transmitter's stereo time-division modulator.

Returning to the modified cathode follower (V3), the remaining signal components—the L+R signal, the L—R signal and the SCA subcarrier—appear at the cathode. These components feed a 38-kc bandpass filter consisting of L1, L2, C1 and C2. The series arm, L1 and C1 of the filter is the low-pass section which prevents the passage of the 67-kc SCA subcarrier. The shunt arm, L2 and C2, prevents the passage of the 19-kc pilot but allows the passage of the 23-to-53 kc L—R signal and the 15-to-50 kc L+R signal. In addition, the other resistors and capacitors in the network provide the standard 75-microsecond de-emphasis.

Demodulation by Deflection

The fifth stage of the adaptor is the stereo demodulator. V5 is a special type of beam deflection pentode (all grids not shown in Fig. 3). It has a pair of deflection plates placed parallel to the path of the electron beam and a pair of output plates perpendicular to the beam. Normally, the electron beam would travel from the cathode through the grids to the space between the output plates. By energizing the deflection plates, the beam can be deflected to one output plate or the other.

In this circuit, the deflection plates are connected to the secondary of T2. Since the doubler oscillator has developed a 38-kc signal in the primary of T2, the deflection plates reverse in polarity at a 38-kc rate. As a result, the electron beam is switched from one output plate to the other at this rate—38,000 times a second.

The output of the bandpass filter is fed to the control grid of the beam deflection tube. Because the phase relationships between the L and R components of the L+R and the L—R signals, the electron beam coming from V5's output plates looks like the R signal at one moment and the L signal the next. The result is the reproduction of the original L channel signal at one plate and the R channel signal at the other. Each is exactly like the original signal at the transmitter.

Now that we have recovered the original left and right stereophonic program channels, all that remains is to feed these signals through cathode followers to the output of the adaptor. The cathode followers are required for proper operation of the 38-kc rejection filters (traps) inserted between the demodulator and the output. If a large 38-kc component appeared at the output of the demodulator along with the R or L stereo signal it might introduce problems in a hi-fi system. This is particularly true when a tape recorder is connected to the output of the adaptor. The 38-kc component might beat with the bias and erase frequency of the recorder and cause "birdies" and whistles on the tape.

CB Tone Call/Squelch

Continued from page 85

constant (C2, R2) is added to the thyratron grid circuit. This prevents the short speech bursts from overcoming the negative cut-off voltage and makes it necessary for the tone to be transmitted about five seconds before the TCS operates. This time requirement can be adjusted by potentiometer R4, which varies the negative voltage on the grid of V1. The less the voltage difference between the grid and the cathode, the shorter the time required to activate the TCS.

Construction is quite simple. RY1 is insulated from the chassis with rubber grommets because the reed contacts are electrically connected to the relay frame. With the speaker disconnected during

[*Continued on page* 110]

Continued from page 108

standby, the output transformer primary of the CB receiver can develop voltage high enough to arc over, so a 47-ohm resistor (R1) is connected across its secondary to prevent this.

The TCS chassis is secured to the base station receiver cabinet with sheet metal screws and is mounted so that its controls are accessible.

The tone generator that supplies the triggering signal for the reed relay must be stable. And because it is self-contained, the tone generator can be incorporated in any CB unit simply by fitting its output cable with a plug to match the mike jack on your transceiver and plugging your mike into the tone generator's input. Mica capacitors are recommended for the circuit because of their better thermal stability. The DPDT *microphone/tone* switch (SW1), when in the *tone* position, turns on the tone generator and connects it to the transmitter microphone input. In the *microphone* position, SW1 turns off the generator and reconnects the microphone to the transmitter. Since the tone generator is used intermittently, its battery should last for its shelf life.

In order to avoid the tone overmodulating the transmitter, the 500,000-ohm pot (R13) adjusts the output voltage of the tone signal to the same relative value as that of the microphone. There is sufficient signal available from the generator to drive a carbon microphone input circuit also. The tone signal is a fairly pure sine wave, free from sideband splatter.

Another potentiometer, R8, adjusts the tone frequency to the resonant frequency of reed relay RY1. These controls are mounted inside the box because, once set, no further adjustment should be required. Several inexpensive PNP transistors were tried as Q1 in the generator and all gave good results.

The tone generator is installed beneath the mobile transmitter (the author's home-built rig is shown in the photos) so that switch SW1 is easily accessible. A short length of shielded audio cable is run to the original microphone input plug and a duplicate microphone receptacle is mounted in the tone-generator box and the microphone is connected to it. If your transmitter is a type with the microphone cable wired in, it's a good idea to install jacks and plugs.

Aligning the TCS:

• Connect the squelch unit to the receiver and turn it on. Depress *reset* button PB1. RY2 should open, silencing the receiver. Check the voltages at V1. With the tube non-conducting (RY2 open), the plate voltage (pin 6) should be somewhere near +135 volts. The grid voltage (pin 1) should be adjustable (with R4) from 0-30 volts positive (as measured from grid to ground with a VTVM).

• If RY2 does not remain open, increase the negative voltage on the grid of V1 (as measured to the cathode, pin 2) with control R4 until it does.

• Depress *bypass* button PB2 and RY2 will close, turning on the speaker. Turn up the volume of the receiver about three-quarters and tune in some strong signals. While these noises and signals are coming in, depress *reset* PB1 and the speaker should cut out. Now see whether the strong signals cause V1 to fire. If they do, increase the cut-off voltage with R4 as above.

• Have your partner set up the remote unit within sight and transmit a tone signal to you. Have him adjust the frequency pot (R8) in the tone unit until the resonant frequency of RY1 is found. This is indicated by the widest swing of the reed. R4 usually will not need resetting after these adjustments are made. A tone signal of about five seconds duration for firing the TCS has been found to give the most satisfactory results.

• With the remote station at a distance, have him adjust the tone input level potentiometer R13 so that the transmitted signal does not overmodulate the transmitter.

Be sure to leave the volume of the receiver turned up reasonably high during standby, since the audio amplifier of the receiver supplies the signal to the reed relay. Those of you who question the legality of the system are referred to 19.32 of "Rules and Regulations."

CB Corner

Continued from page 47

Selective Call . . . Read the available literature on CB equipment and it conveys a distinct impression that you use it like a telephone. Not really . . . the telephone user only hears calls directed to his number, not all the large volume of traffic flowing within 20 miles of his location. But this is the case with CB.

The squelch on many CB rigs does a fine job of quieting atmospheric noise in the loudspeaker but opens the receiver to any station on the channel. These unnecessary sounds are distracting in the business office and annoying to the housewife who has the transceiver on for many hours a day anticipating a stuck-in-traffic call from her husband.

The FCC provides for tone signaling on the Class D band. Why not make a *selective* tone-operated squelch available as a commercial accessory to those who need it? (EI, realizing the need, has presented this project on page 82.

When installed on a transceiver, the tone squelch-call circuit is activated only when a signal bearing the correct tone is received. A possible answer to the problem of assigning different tones to a larger number of stations would be the use of two or three tones in combinations.

To avoid chaos in a neighborhood with several radio-controlled garage door openers, manufacturers have resorted to selective tone signaling. How-about a system for CB radio ?

—o—

Increased Cost . . . Remote operation and selective call for transceivers are just two of the features that could improve the effectiveness of CB radio. If the cry of increased cost is raised, we point to the existing demand for high-performance sets by users who lean heavily on the benefits of CB radio. Both these recommendations lend themselves to packaging as optional extras, available to those who require them.

If any CBer wants to sound off on equipment improvements, we'd like to hear from him. Address your comments to the CB Corner in care of EI.

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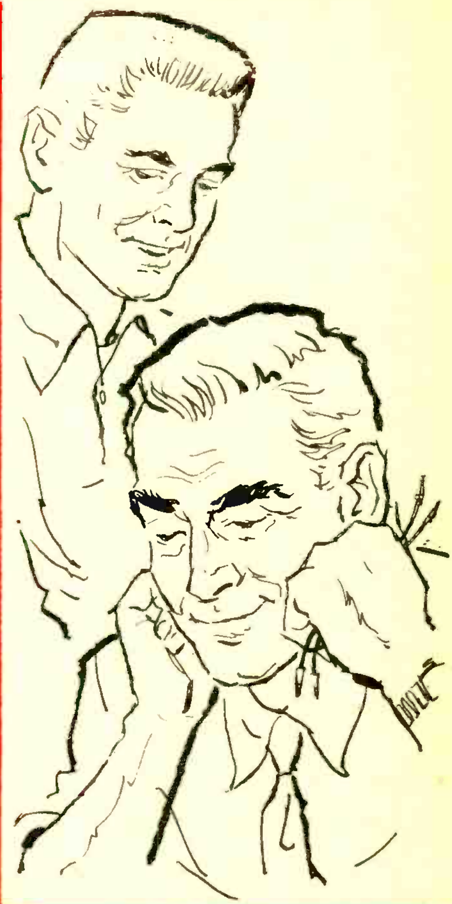

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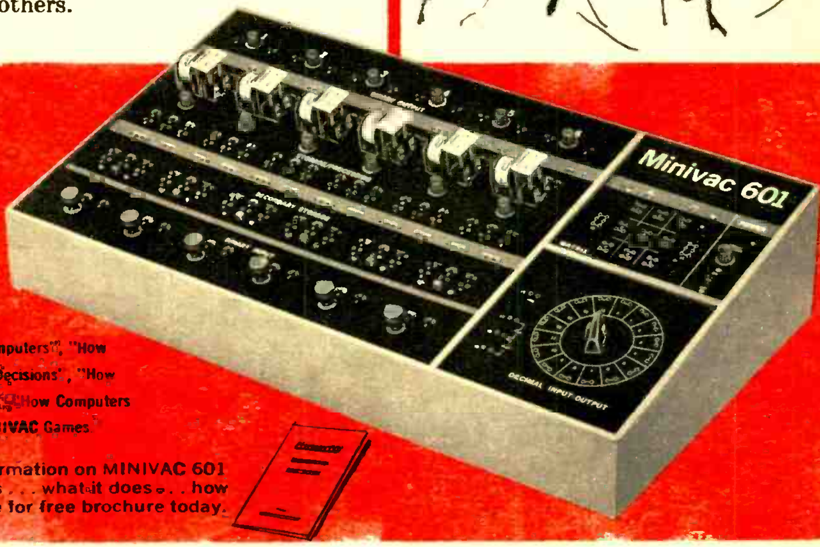

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The Incredible Basement of Radio

Continued from page 77

One of Professor Morgan's reasons for going so far for his experiments is that a full-wave antenna for whistler frequencies is more than 30 miles long.

The professor has a plan for stringing five cables across the horseshoe-shaped island and using the sea surrounding the horseshoe as the transmitting antenna. You also get a better quality of whistlers at the poles. The pole-to-pole magnetic field lines are longer than anywhere else and the whistler signals, in traveling so far, become spread out and the highs return relatively far ahead of the lows.

But whistlers are only part of the VLF zoo. Related to whistlers are strange signals called the dawn chorus, a sound like the twittering of birds in the morning. Then there is the hiss, which sounds like air coming from a tire; risers and other assorted clicks, tweeks, and chinks. These sounds are for the most part still unexplained. Scientists speculate that some are caused by streams of minute particles which flow from the sun and spiral down to the earth.

The "joint-venture" VLF signals are generated by such things as nuclear explosions and missile launchings. During a nuclear explosion signals result from the severe motion of atomic particles. In missile launching, the vertical column of ionized gases which follows the bird into the air is both transmitter and antenna, sending signals which are heard over great distances.

On the man-made side of the VLF picture we find what is probably the most unusual transmitting station ever built. It is a Navy installation at Cutler, Me., which went on the air early this year with the historic call letters NAA, first used in 1912 by a high-power Navy rig at Arlington, Va. But the original NAA and all the stations built since then couldn't hold a candle to the Cutler transmitter, which has a power rating *in excess* of 2,000,000 watts. With an antenna efficiency of more than 50 per cent, the new NAA, operating at 14.8 kc (wavelength: 20,270 meters or 12.6

miles), can transmit to ships in the Atlantic, Arctic or Mediterannean. It even has the ability to get messages to submerged submarines since VLF has a high salt-water penetration factor.

Because of the long wave-lengths, VLF antennas tend to be immense. NAA occupies a whole peninsula of 3,000 acres. Its antenna consists of two arrays shaped like six-pointed stars and mounted on 26 towers ranging in height from 800 to 980 feet. The towers themselves carry no signals. Only the cables between them are parts of the antenna.

Each array covers a square mile.

Probably the most famous VLF transmitter is Navy station NLK at Jim Creek, Wash. Dubbed "Big Jim," NLK runs 1,000,000 watts and operates on 15.3 kc 24 hours a day.

A few months ago the Navy started transmitting time signals from another new VLF station, NBA, at Summit in the Canal Zone. Its frequency is 18 kc.

All the Navy's VLF stations have an N prefix on their call letters. The only other regulars on the band are two British stations with G prefixes, although new stations pop up from time to time, usually doing experimental work.

VLF noise is highest in the summer but most CW signals are so strong that it is no problem. Best time for DXing is between 4 and 7 A.M. local time.

As for equipment to monitor VLF, you may have to do some digging. Most rigs are available only on the surplus market. But it is a relatively simple task for most electronic tinkerers to work up a one-tube autodyne or TRF receiver that will pull 'em in.

If you'd rather investigate the surplus market than roll your own, some of the rigs are: U.S. Navy Models RE, RBL, and RAK; RCA's AR-8510; Wireless Specialty Co. IP500, and World War I Navy antiques SE-1420 and SE-143. If you've got a lot of loot and an uncontrollable desire to dig VLF, you can always get yourself a spanking new British Racal RA-17.

For years researchers have been trying to enlarge the usable portion of the radio spectrum at the upper end. Now many realize that through the use of "macrowaves" the spectrum may be expanded at both ends.

Hi-Fi Record Guide

Continued from page 91

Symphony made the same success in Tin Pan Alley that it always makes in the concert hall. The Philadelphia Orchestra's performance of the symphony under the baton of Eugene Ormandy is broadly lyrical and recorded with its sound intact.

Equally compelling is the recording of Dmitri Shostakovich's First Symphony by the Symphony of the Air under Leopold Stokowski. This composition, written in 1925 when the composer was only 19, is an amazingly accurate musical portrait of the temper of modern times.

One of the masterpieces that ushered in the modern age of music was Igor Stravinsky's Le Sacre du Printemps, the Rite of Spring. This strongly-rhythmed ballet score provoked a riot at its first performance, but it has since become an enticing entry on concert programs and provided an episode in Walt Disney's Fantasia. Ernest Ansermet has been associated with Le Sacre for many years and his most recent recording of it is lucid and vigorous.

Tchaikovsky's First Piano Concerto, in B Flat Minor, and Rachmaninoff's Second, in C Minor, are among the most immediately appealing in the repertoire, and hence among the most popular. Vladimir Horowitz and Toscanini joined in a tremendously exciting performance of the Tchaikovsky for a War Bond benefit concert in 1943. This was recorded, but the sound, of course, suffers from the circumstances under which it was captured. Better sound, if not nearly as much incandescence, is offered in the recording by Van Cliburn and Kiril Kondrashin, which was made immediately upon the young American's return from his triumphant visit to Russia. Freddy Martin never had it so good!

The violin is the closest rival of the piano as a solo instrument. Mendelssohn and Tchaikovsky composed the two most popular violin concertos, and they are paired on one disc in attractive performances by Isaac Stern, backed by Eugene Ormandy conducting the Philadelphia Orchestra.

From Classical to Jazz is not the long step today that it once seemed, particularly when the step is to the reflective, intense music-making of Miles Davis. His Kind of Blue offers a satisfying program of imaginative modern jazz conceptions. At the other end of the jazz spectrum, Phil Napoleon's Memphis Five treats us to lively revivals of traditional Dixieland favorites.

Vocal stylists are always appealing, though personal preferences are especially strong in this area. However, few collectors will gainsay the eminence of Ella Fitzgerald and Frank Sinatra. In Get Happy, she does delightful renditions of a dozen standard songs, and in Nice 'n' Easy, he demonstrates why he is still head of the pack.

On Broadway, Bob Merrill's Carnival is a big hit, and the Original Cast album indicates that he has come up with a potential classic. Anna Maria Alberghetti and Jerry Orbach transmit the same magic atmosphere via disc that they create in the theater. An older show, Leonard Bernstein's On the Town, has been reincarnated in a sparkling new production with several members of the original cast and the composer wielding the baton. Both of these albums present musical theater at its best.

Musical theater of another sort is the source of Leontyne Price's album of famous operatic arias by Giuseppe Verdi and Giacomo Puccini. The lovely voice, dramatic insight and emotional expressiveness of the young soprano are effectively displayed by the excellent record.

With Christmas not far in the offing, much seasonal music will be heard under varying circumstances. Not nearly enough of it, though, will be meaningful and worth listening to at any other time of the year. Fortunately, this is not so with the music on The Holly and the Ivy. These traditional and medieval carols are done with such exquisite taste that they are always a joy to hear.

So is George Frideric Handel's Messiah a joy—in a good performance. The late Sir Thomas Beecham's version is not one for Baroque purists, but it is an overwhelmingly rousing exposition of the grand old music. If the four-record album seems like too much of a good thing, a single record of excerpts is available and may suffice. And if you want a less aggressive statement of the score, with emphasis on its Christmas associations, Leonard Bernstein provides just that in an attractive disc which will round out your basic record library with a Merry Christmas and a Happy Near Year.

Records discussed in this column, with monaural discs listed first and stereo versions just below:

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		LSC-2343	5.98
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Beethoven: Eroica Symphony			
Toscanini, NBC Sym. Orch.	RCA Victor	LM-2387	4.98
Szell, Cleveland Orch.	Epic	LC-3385	4.98
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Schubert: Unfinished Symphony			
Toscanini, NBC Sym. Orch.	RCA Victor	LM-9022	4.98
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Mozart: Symphony No. 40			
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Mendelssohn: Violin Concerto			
Stern-Ormandy	Columbia	ML-5379	4.98
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Kind of Blue *Miles Davis*	Columbia	CL-1355	3.98
		CS-8163	4.98
Memphis Five *Phil Napoleon*	Capitol	T-1344	3.98
		ST-1344	4.98
Get Happy *Ella Fitzgerald*	Verve	V-4036	4.98
		V-64036	5.98
Nice 'n' Easy *Frank Sinatra*	Capitol	W-1417	4.98
		SW-1417	5.98
Carnival *Original Cast*	MGM	E-3946-OC	5.98
		SE-3946-OC	6.98
On the Town *Original Cast*	Columbia	OL-5540	4.98
		OS-2028	5.98
Leontyne Price *(Arias)*	RCA Victor	LM-2506	4.98
		LSC-2506	5.98
The Holly and the Ivy *Deller Consort*	Vanguard	VRS-499	4.98
Handel: Messiah *Beecham*	RCA Victor	LD-6409	23.92
		LDS-6409	27.92
Messiah (excerpts) *Beecham*	RCA Victor	LD-2447	5.98
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C	Radio and Television Servicing (V-3)	2 yrs. High School, with Algebra, Physics or Science	Day 9 mos. Eve. 2¼ yrs. (N.Y.) 1½ yrs. (L.A.)
D	Transistors	Radio background	Eve. 3 mos.
E	Electronic Drafting (V-11 V-12)	2 yrs. High School, with Algebra, Physics or Science	Eve. Basic: 1 yr. Advanced: 2 yrs.
F	Color Television	Television background	Eve. 3 mos.
G	Radio Telegraph Operating (V-5)	2 yrs. High School, with Algebra, Physics or Science	Day 9 mos. Eve. 2¼ yrs. (N.Y.) 1½ yrs. (L.A.)
H	Computer Programming (C-1)	College Graduate or Industry sponsored	Eve. 24 weeks Sat. 30 weeks
I	Technical Writing (V-10)	High School Graduate	Eve. 2¼ yrs. (N.Y.) 1½ yrs. (L.A.)
J	Automation Electronics (V-14)	Background in Radio Receivers and Transistors	Eve. 9 mos. (N.Y.) Sat. 44 weeks (N.Y.)
K	Digital Computers	Electronics background	Eve. 3 mos. (L.A.)
L	Preparatory Math & Physics (P-0)	1 yr. High School	Day 3 mos.
M	Preparatory Mathematics (P-OA)	1 yr. High School	Eve. 3 mos.

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