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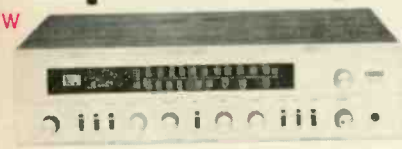

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Radio-TV and Science and Electronics EXPERIMENTER

April/May 1969

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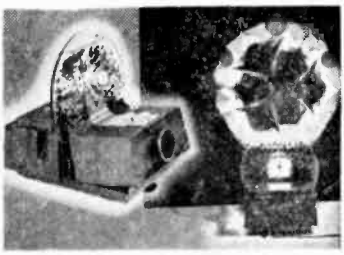

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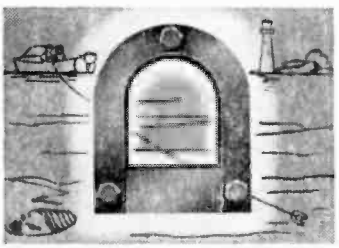

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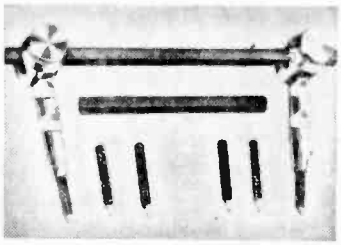

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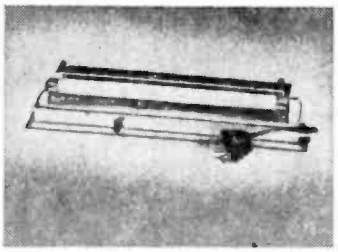

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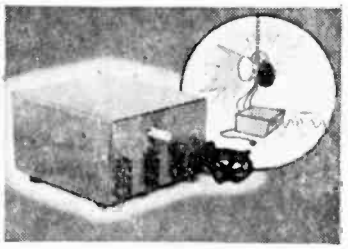

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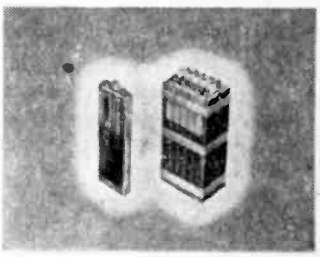
70,007HP	12½"	2⅛"	65.85 F.O.B.



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April/May 1969
Vol. 26/No. 2

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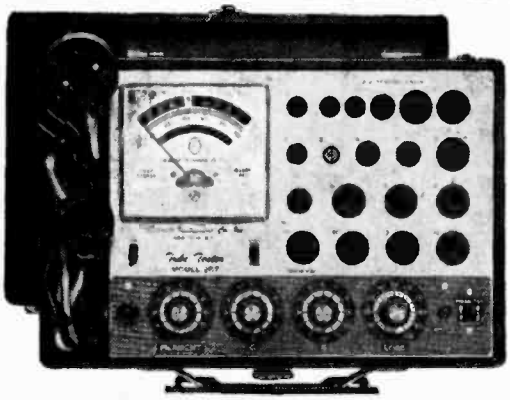

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INTRODUCING...

How wide is the world of electronics? Just try to imagine a rocket shot or space probe without the transistor or vacuum tube. Can you picture a large business in today's complex world trying to keep its inventory or make its payroll without an electronic computer and memory bank? Think of the setback recent medical advancements, TV broadcasting and consumer product development would suffer if the electronic breakthroughs of the last five years were denied them.

In fact, each and every facet of our daily lives has been touched, assisted, supported or created by the application of electronics in some scientific or technological undertaking. As a reader of RADIO-TV EXPERIMENTER you may have read many of our feature stories on earthquakes, undersea research, heart machines, radio astronomy, air pollution, and others. Yes, you do not have to be reminded that your field of interest, electronics, is the working tool of the scientific community as well as being a science in its own right. You are fully aware of your interests in science and electronics.

There, we said it! SCIENCE AND ELECTRONICS—the new name-to-be for RADIO-TV EXPERIMENTER. Have we changed anything? Not really, for you see the editorial coverage for RADIO-TV EXPERIMENTER has been *science and electronics* for several years. Our most successful issues measured by your letters to us have been those heavy in feature stories on electronic application in scientific endeavors. Almost to the man the letters indicate our readers are practicing electronics hobbyists—amateurs, SWLs, CBers, experimenters, project builders—who expect to read about their hobby in this

(continued on next page)

Julian M. Sienkiewicz
EDITOR-IN-CHIEF

Science and Electronics

magazine and find our science coverage excellent and informing.

Hence, we've decided to change our name without a major change in face. Once past the cover you will be on familiar ground again. Everything will be much as it was in the past. In fact you may not find any major changes in this issue. However, you can expect us to add a few new columns in the next few issues. Watch for them—you will enjoy them and become regular readers of these columns.

So, let's take our hats off as the name RADIO-TV EXPERIMENTER is slowly erased from our covers during 1969 and SCIENCE AND ELECTRONICS takes its place. But please, no regrets. Although a great name is passing into history—the *oldest* name on the newsstands for a small-size electronics magazine —its new name, SCIENCE AND ELECTRONICS, will continue to serve its readers in the spirit and tradition of the old.

Look for a bright new future with SCIENCE AND ELECTRONICS, for with its new descriptive name many new readers interested in the varied esoteric corners of electronics and science will join our ranks. For with greater numbers, we, the Editors of SCIENCE AND ELECTRONICS, can better serve you. We will be able to increase our editorial staff and stable of contributing authors. Bigger and better stories; varied construction projects for hobby, home and lab; fun items just for relaxing; and just about anything the Editors believe you will enjoy seeing in SCIENCE AND ELECTRONICS.

To borrow a line from Dean Martin, "Keep those cards and letters coming, folks!" Every voice from our readers is important to us. Sometimes, only one letter starts the wheels moving to grind out a special feature or extraordinary construction project. All the letters summed up give us a good idea of the many faces of our readers. We cannot serve you unless you help us. Is there something you would like to see in SCIENCE AND ELECTRONICS? Let us know what it is! Just drop a note in care of the Editor. Remember, your letter is a contribution to the editorial material in SCIENCE AND ELECTRONICS of equal importance to any offering by the editors and writers who generate the stories you read and enjoy. Contribute your ideas, today! Type your thoughts on to a sheet of white paper and mail it to the Editor, SCIENCE AND ELECTRONICS, 229 Park Avenue South, New York, N. Y. 10003. Thank you. ■

One for Two

I've never seen a schematic for a single power supply that's suitable for a transistor stereo amplifier. If there is such a thing, how would you prevent cross talk between the two channels if you use a power supply common to both?

—D. J. R., Ridgewood, N.J.

It's being done constantly by manufacturers of commercial stereo equipment. The diagram shows the power supply section of the EICO 3566 FM stereo receiver. Current for the two push-pull output stages is supplied by the bridge rectifier and is not regulated. The same rectifier furnishes a regulated voltage to the tuner and multiplex circuits through regulator transistor Q12. Regulated voltages to the intermediate and preamplifier audio stages are furnished by the full-wave, center-tap rectifier (CR16 and CR17) through transistors Q13 and Q14.

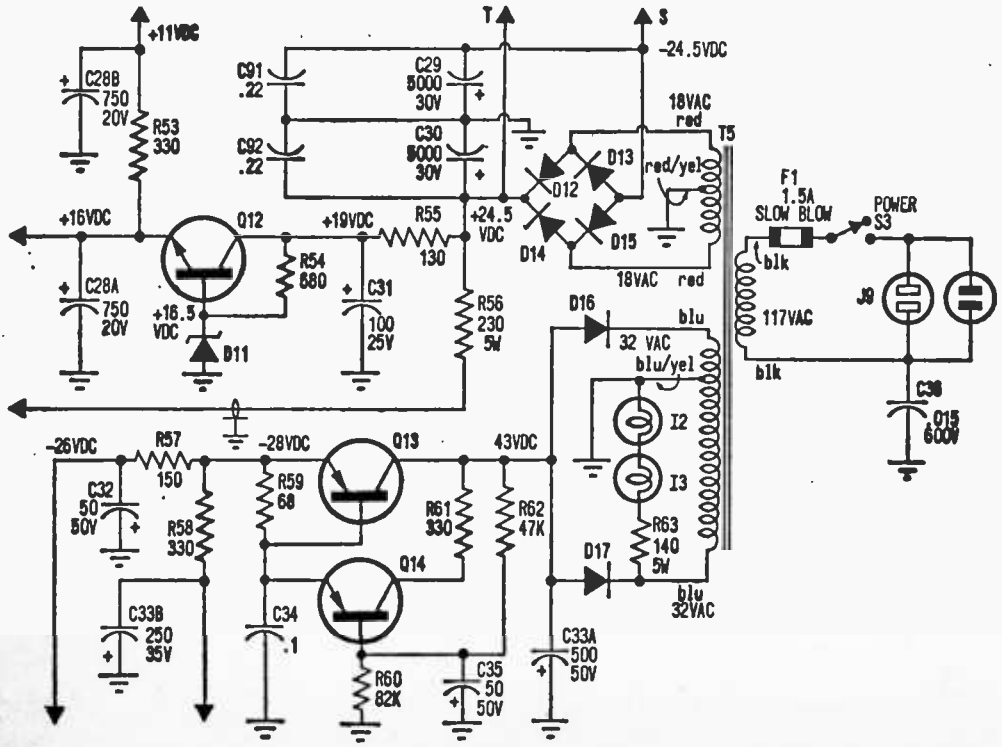
Cross talk results when the impedance of a power supply is not low enough. Impedance can be lowered by using very large filter capacitors —such as C29 and C30 in the schematic. Of course, the transistors help things out considerably by lowering the impedance electronically.

Wrong Tune

I have been having trouble with band 5 (12-30) MHz on my Star Roamer. I pick up nothing except FM broadcast stations. Also, the alignment is off. It's impossible to tune the coil because I can't locate a WWV signal. On the rare occasions when I can pick up WWV, I don't know whether it's the 15- or 20-MHz transmission. Could the trouble possibly be my 100-ft. antenna?

—D. R. H., Fullerton, Calif.

Yes, try a shorter antenna. To determine on which frequency you are receiving WWV check its proximity to a ham band. If you're close to the 20-meter ham band (14 MHz), it's the 15-MHz signal you are picking up. You might

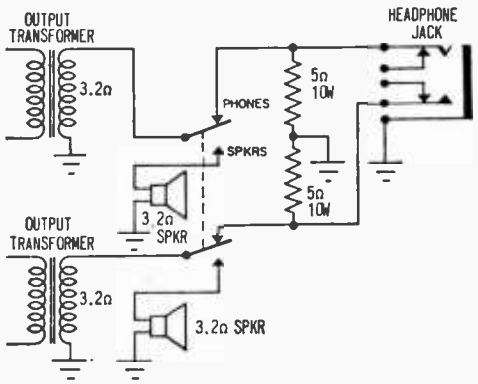


also consider building a crystal calibrator for your set—take a look at the Fall/Winter edition of *Electronics Hobbyist.*

Overkill

I have a Decca DP-252 stereo phonograph and would like to add an earphone jack. I also have a set of 8-ohm per channel stereophones which I've used with another set. With difficulty, I have been able to locate a five-terminal earphone jack (double shut-off switch) so that I can shut off the speakers while the earphones are used. A friend told me that I cannot connect this jack across my 20-watt amplifier because this would not only kill the earphones, but would also underload the circuit and thus kill the output transistors. Exactly how can I connect such a jack using these 8-ohm phones? I have enclosed a copy of the schematic.

—R. L. S., Las Vegas, Nev.



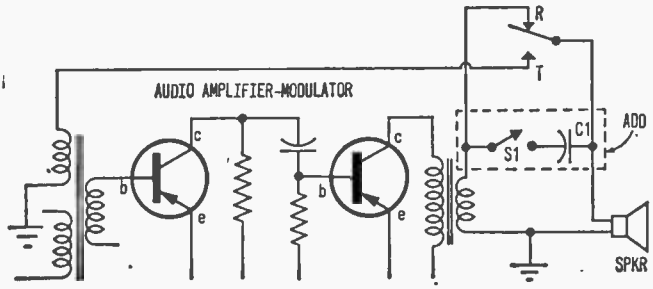
Not so. Your friend is suffering from a short circuit. To load the amplifier properly add a pair of resistors as shown in the diagram. But use a dpdt toggle switch to change from speakers to earphones and just ignore the switching capabilities of the jack. Since your amplifiers are designed to feed 3.2-ohm speakers, the 5-ohm resistors will help absorb part of the load. Just don't turn up the volume as loud; there may not be any damage, but your ears might suffer.

Talk Yourself Silly

Can you give me a circuit for adding a beep-tone call signal to my 80-milliwatt walkie-talkie? The call signal should work even when the unit itself is off, and draw power only when the beep is actually received or transmitted. My schematic is enclosed. Also, have you any suggestions on how to eliminate the telescoping antenna from a walkie-talkie and replace it with an antenna coil?

—G. J. D., Toledo, Ohio

Let's talk about the antenna first. At best the telescoping antenna is inefficient; an antenna coil would be worse, limiting your range to almost



nothing. To transmit a beep, try adding a regenerative feedback loop around the AF amplifier as shown in the diagram. Try various values for C1 and use a pushbutton for S1. To beep, press the transmit switch and hold it in while you press S1. If it doesn't beep, reverse the output transformers secondary leads. You must have the walkie-talkie turned on in order to receive a beep signal. Otherwise, how could you hear it? A dead circuit does no one any good.

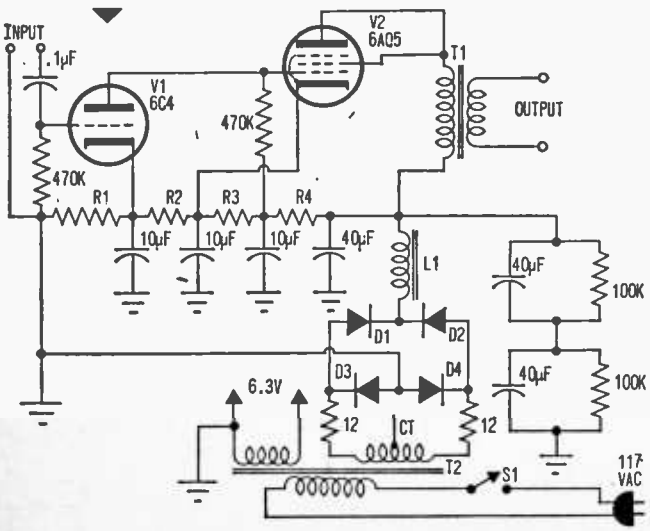
Lofty Amp

Can you give me a circuit of a Loftin-White amplifier that uses currently available tubes. The only one I have seen employs type 27 and 45 tubes which are no longer available.

—E. E., San Jose, Calif.

You can use a 6C4 (or other triode) for V1 and a 6AQ5 (or some other beam or power pentode tube connected as a triode) for V2 in the circuit shown. Output transformer T1 should have the proper impedance ratio for matching V2 to the speaker you intend to use. Power transformer T2 should have a 350- to 550-V secondary and 6.3-V filament winding. The rectifiers (Q1, Q2, Q3, Q4) should be silicon diodes having a high PIV rating. Filter choke L1 should have low DC resistance and an inductance of 10 Henries or more.

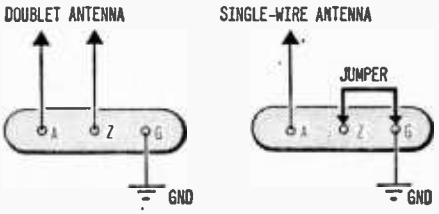
Breadboard the circuit first and try different values of resistors for R1 through R4 until the DC voltage between the grid and cathode of V1, as measured with a VTVM, is the value specified in your tube manual. Do the same for V2. Since current flow through R1 and R2 will be high, you may have to use high-wattage wire-wound resistors.



Two For One

My old Zenith radio has three terminals labeled A, Z, and G. I know A stands for antenna and G stands for ground, but what is Z for?

—B. G. P., Riverside, Calif.



It's another input terminal for use with a doublet antenna connected as shown in the diagram. When a doublet is not used, connect a jumper between Z and G. Remember, a doublet should be cut for the approximate middle range in the band of frequencies you intend to receive. Any book on ham radio will explain how to do this.

Mysterious Orient

I am the master of a foreign vessel and would like to be in touch with my ship when I am engaged in business on shore. I want to communicate with my ship at distances up to 35 miles away. Also, I would like to install an amateur station. If you had the choice, which installation would you prefer?

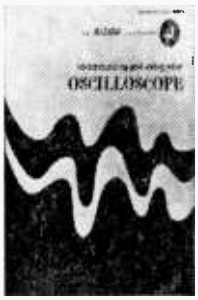
—E. A. S., Hong Kong

For your purposes a base SSB (single sideband) transceiver on your ship and a portable SSB transceiver, both operating in the high-frequency range, would undoubtedly provide the communication facilities you need. There is so much amateur equipment available. We suggest you get a catalog from one of the large mail-order houses and look it over. ■

BOOKMARK
BY BOOKWORM

Another Good Buy! Edited by William A. Stocklin, Editor of ELECTRONICS WORLD. Allied's new book *Understanding and Using Your Oscilloscope* covers one of the most useful and versatile of electronic test equipment. A clear writing style is maintained for easy understanding by students and beginners as well as the veteran technician.

Subjects include basic theory of the oscilloscope, its many uses, interpretation of wave forms and operation with associated equipment.



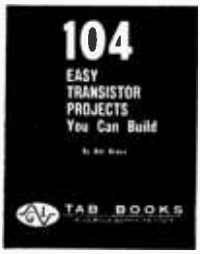
Soft cover
128 pages
75¢

Chapter headings are: History of the Cathode Ray Tube; Basic Oscilloscope Principles; Interesting Oscilloscope Applications; Oscilloscope Controls, and How to Adjust Them; How to Select an Oscilloscope; Auxiliary Equipment; Oscilloscope and Test Equipment Kits.

The author, "Bill" Stocklin, is an old friend of this ol' Bookworm. Bill's writing efforts have always been classic products for the experimenter's bookshelf. You can get your copy direct from the publishers, postpaid—Allied Radio Corp., 100 N. Western Avenue, Chicago, Ill. 60680. ■

The Numbers Game! *104 Easy Transistor Projects You Can Build* by Bob Brown is a brand-new circuit/projects book for hobbyists, experimenters, hams, audiophiles, technicians—in fact, for everyone with an interest in electronics. If you would like to have a high-gain telephone pickup, a wireless mike, an electronic megaphone, a CB receiver, light dimmer, fence charger, or any one of 104 other useful devices, you can build them yourself, at very little cost, and have a lot of fun in the process. What's more, you will learn a lot about transistor circuits (including FETs and SCRs). *(Turn page)*

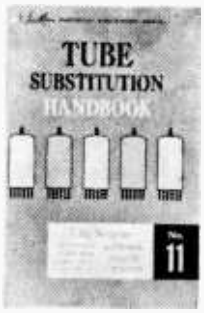
A complete schematic diagram is included for each device, along with a parts list, plus a brief description of its operation and application, and notations concerning any critical points. All schematic diagrams are large enough to be easily



Soft cover
224 pages
$3.95

read, and parts are listed in a standard format, to simplify identification and ordering correct components. Most circuits use parts which are readily available from any electronics parts distributor, and in most cases values are non-critical, making it easy to use substitutes from the "junkbox" or discarded receivers. Get your copy direct from the publisher, Tab Books, Blue Ridge Summit, Pa. 17214.

They Still Use Tubes. Many times a serviceman or home repairman does not have a certain tube type, and he has to substitute its equivalent. To find the proper substitute, chances are he will turn to the *Tube Substitution Handbook*, by the Howard W. Sams Engineering Staff. Now in its 11th edition, it contains an up-to-date listing of over 10,000 direct substitutes for all types of American and foreign receiving and picture tubes, making it the most complete, up-to-date

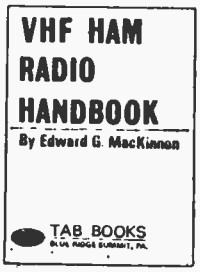


Soft cover
96 pages
$1.75

direct tube substitution guide available. This completely revised edition includes a cross reference of all American receiving tubes, a list of picture tubes and recommended substitutes, a cross reference of miniature tubes, industrial substitutes for receiving tubes, substitution listing for communications and special-purpose tubes, and a cross reference of American and foreign tubes.

Actually, *Tube Substitution Handbook* is two books. One is the full-sized (5½ x 8½") edition, for the workbench. The second is pocket-sized, for the tube caddy. Available at a slight additional charge of only 50¢ when purchased with the full-sized edition, the pocket-sized book contains exactly the same information as the larger version. . . . it is *not* an abridged edition. Copies are available from electronics parts distributors and bookstores throughout the country, or from the publisher, Howard W. Sams & Co., Inc., 4300 W. 62nd St., Indianapolis, Ind. 46268.

Looking for Room. Here is a brand-new book that reveals the many VHF-UHF techniques in practice today, to escape the crowded lower frequency amateur bands—it's *VHF Ham Radio Handbook* by Edward G. McKinnon. Written for the ham who takes pride in contributing to the advancement of the art, the content begins by explaining the differences between VHF and lower frequency gear (such as vacuum tube limitations, lead inductance, wavelength factor, etc.). An entire chapter is devoted to propagation



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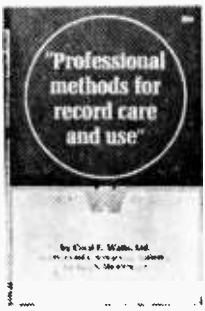
176 pages
$3.95

phenomena, including tropospheric propagation, effect of the aurora, sporadic E-layer skip, and 6-meter moon-bounce communications. Transmitting equipment for 6 and 2 meters, a 432-MHz tripler, and several modulators are described in another chapter. For those readers who want to use existing equipment, detailed instruction showing how to modify the *Hi Bander*, *Gonset II*, *Heath Seneca* and *Heath Sixer* are included.

The final section contains 25 additional projects—some for the less experienced operator and others for the more knowledgeable one. Included are circuits for medium and low-power transmitters, receivers, preamps, filters, RF amplifiers, a field strength meter, noise generator, and oscillators for 50, 144, 220, 432, and 1296 MHz. Truly a book every ham will want to own. Get your copy by writing directly to Tab Books, Blue Ridge Summit, Pa. 17214.

Get in the Groove. The latest Cecil E. Watts booklet *Professional Methods for Record Care and Use* supplies the combined experience of professionals for record care and use. The text explains the newest methods used in cleaning records, and the proper care of the stylus, turntable and cleaning tools. Discover how to eliminate static problems and the relationship between light tracking pressure and record cleanliness. The author gives full details on how

to handle records, how to play records with record changers, how to clean the stylus, how to rejuvenate records and how to store them. Although the booklet salutes record care products sold by the publisher and excludes all others,



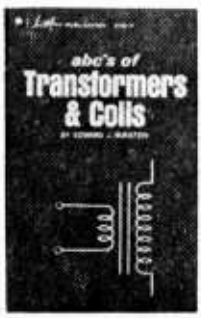
Soft cover
20 pages
50¢

your ol' Bookmark believes you must read this booklet if you own a hi-fi record player. Want a copy? Then write to Elpa Marketing Industries, Inc., Thorens Building, New Hyde Park, N. Y. 11040.

All Wrapped Up. Since transformers and coils appear in almost all electronic equipment, it is necessary to know how they work in order to understand how circuits operate. In a style easily understood even by a beginner, *ABC's of Transformers and Coils* (2nd Edition), by Edward J. Bukstein, does just this. It explains the basic principles of inductance, transformer and coil construction, inductor applications, and methods of testing inductive components.

In addition, there is a chapter on magnetic-core memory and logic circuits, as well as new sections of toroidal and ferrite-bead inductors. An understanding of these developments is vital in today's expanding world of computers.

Important mathematical relationships and formulas are presented, but not as a substitute for adequate verbal explanation. Anyone who works with electronic equipment, beginner or professional, will find this book useful and instructive. Copies are available from electronic parts distributors and bookstores throughout the country, or from the publisher, Howard W. Sams & Co., Inc., 4300 W. 62nd St., Indianapolis, Ind. 46206.



Soft cover
96 pages
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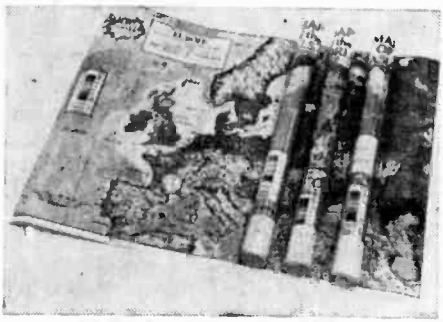
Make With a Mallet

Here's a new construction system—a method of assembling square steel tube furniture and fixtures with the use of just a mallet. The system, called Apton, has three basic components: square steel tube; a tough styrene type collar; and a series of seven different joint formations. The tube can be either ordered in the desired lengths or cut to size with an ordinary hacksaw. You assemble Apton by sliding a collar into the end of a tube, inserting the tapered arm of joint into the collar and tube, then driving the joint solidly home with a soft-faced mallet. The tube is made in 1- and ¾-in.-square sizes in lengths up to 8 ft. In black matte finish, the 1-in. size is 37¢ a foot; the ¾-in. goes for 32¢ a foot. For further information write for a brochure, "Planning and Building with Apton," from Dexion, Inc., 39-27 59th St., Woodside, N.Y. 11377.

Hobbyist designed furniture made from Sexion Square Sheet Tubes

Feelie Maps

Of special interest to hams and SWLs, these full-color, three-dimensional wall maps are electronically thermoformed to produce authentic, sculptured representation of touchable hills, mountains and valleys. Based on maps prepared by the Army Corps of Engineers, they measure 21 x 27 in., they depict political boundaries as well as cities, mountain ranges, waterways. So track your SWLing around the world in three dimensions! Available individually (United States, Europe, Asia, the World) for $2.95 each, or the full set of four for $9.95. Send your order in to Phyllis Lee Enterprises, Dept. RT3, 11 Raines St., Melville, N.Y. 11746.



Phyllis Lee 3-Dimensional Maps

Seated One Day at the Organ

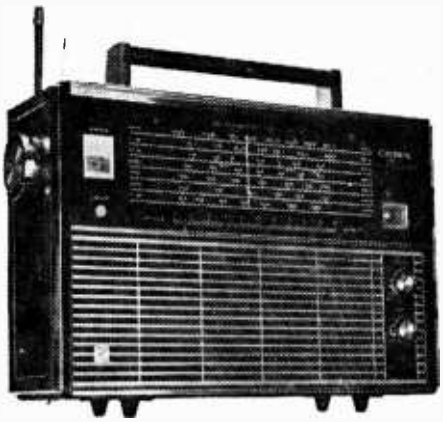
Allied has a spinet organ, a *Schober,* in kit form, which is easy to assemble. It's small enough to fit in any home music room and quite reasonably priced at $599.50. Nearly all the wiring has been arranged on 14 printed circuit boards numbered for easy component placement and step-by-step instructions with giant illustrations are included. There are 14 distinct voices, usable singly or in any combination. The voice levers light up when in use, and there's a built-in spring-type reverberator. Manual ranges overlap, but lower manual goes lower for accompaniment and upper manual goes higher for melody—each keyboard has right pitches for its purpose. Pedals produce one complete octave starting from three octaves below middle C. Expression pedal (swell shoe) gives instant-to-instant volume control. Circuitry has 93 transistors and a 25-watt rms sine wave output. It plays and fully reproduces bass down to 32.7 Hz, and the sound reproduction system consists of a 12-in. bass speaker, 6 x 9-in. treble and crossover network. The sanded, walnut-veneer console and bench are ready to as-

Knight-Kit KG-388 Spinet Organ

semble—screws and glue included—and it measures 34 x 38 x 22¼ in. The model KG-388 is fully described in the 1969 catalog, free from Allied Radio Corp., 100 N. Western Ave., Chicago, Ill. 60680.

Seven Bands and Portable

A deluxe portable radio, the Model TRF-2600W covers AM, FM, aircraft, longwave, marine, and two police bands. It has 40 transistors and diodes, flywheel-controlled slide-rule tuning, illuminated dial and band indicators, battery condition meter, tone control, and 8-step telescoping directional antenna. Equipped with



Crown TRF-2600W 7-Band Portable Radio

a 4x6-in. speaker, the unit also has an earphone socket for private listening. It operates on six D batteries or on AC; power output is 1500 mW. The cabinet is finished in black leatherette with carrying handle. The TRF2600W measures 10⅞ x14$\frac{1}{16}$x4$\frac{7}{16}$ in. and weighs 7.1 lb. Price, includ-

ing earphone and batteries, is $169.95. Write for more details to Crown-Industrial Suppliers Co., 755 Folsom St., San Francisco, Calif. 94107.

For "State of the Art" Kids

Edmund Scientific has thought up two new kits to help stimulate science fair participation among the youngsters. Called Show and Tell Kits, the $5 (Stock No. 70,982) job includes a sharkstooth fossil, jumping metal disc, magnetic doggie and spinning ball, centripetal force puz-

Edmund Scientific "Show and Tell" Kits

zle, plastic fibre optics, lenticular, and six more items. The $10 Deluxe Show and Tell Kit (Stock No. 70,983) has all the starter kit items plus 18 more, specially selected to stimulate interest in nature and science, math and physics. Order by sending your check or money order to Edmund Scientific Co., Edscorp Bldg., Barrington, N.J. 08007.

Sound Box that Fools the Eye

Now you can astonish your friends when they accuse you of having nothing in your attache case but a ham sandwich. Open it up and dazzle them with the Crown CTR9650S, a 10-transistor-diode battery/AC-operated compact cassette tape recorder. You can even record with the case closed and the microphone concealed! An external button control starts and stops the tape. Five piano keys are used for mode functions. Other features—tone and volume controls, AC pilot lamp, automatic level control, digital tape counter, record level/battery condition meter, and pop-up cassette ejector. There's also a tape repeater which repeats 15-second segments of recordings in progress or completed recordings—great for dictation, transcribing and "letter-writing" purposes. The speaker is a 4-in. dynamic, and there is storage space for three cassettes. Frequency response: 100 to 10,000 Hz. CTR9650S is priced at $119.95, which includes a dynamic mike and small accessories. For more info, write Crown-Industrial Suppliers Co., 755 Folsom St., San Francisco, Calif. 94107.

Crown CTR9650S Cassette Tape Recorder

TLC for Your Sides

This record cleaning and maintenance kit, called the Parastat, is meant for new records to be played with cartridges requiring very low tracking pressures of 2 grams or less. The density of the nylon bristles, the pointing angles used, and the natural resilience of the nylon produce countless oscillations as the myriad twists and turns of the groove are followed, so it's thoroughly and completely explored right down to the bottom and in the minute high fre-

Watts Hi-Fi Parastat

quency waveforms. Every trace of foreign matter is removed. According to its inventor, Cecil Watts, the key to the control of static is the attainment of the correct level of humidity at the working surface at the time of playing and cleaning. The Hi-Fi Parastat maintains a humid atmosphere within the case and activation immediately before use. The price of the kit is $15.00, and you can obtain more information from Elpa Marketing Industries, Inc., Thorens Bldg., New Hyde Park, N.Y. 11040.

Suitcase Full of Tape Goodies

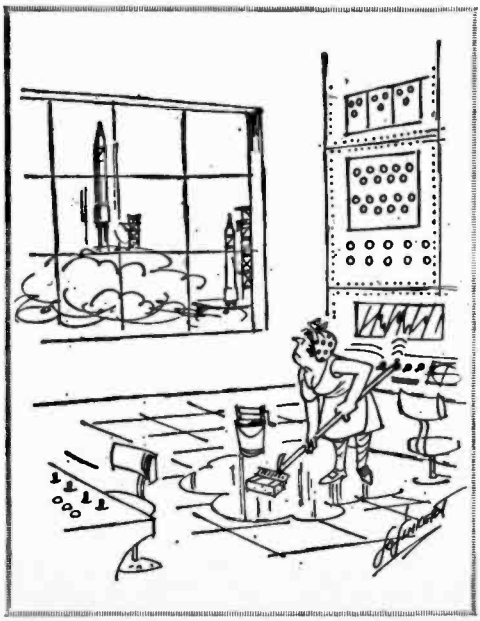
Robins Industries has thought up a starter kit for tape recordists, and they've put it in a vinyl attache case. All you need to go with it

Robins Tape Recordists Starter Kit

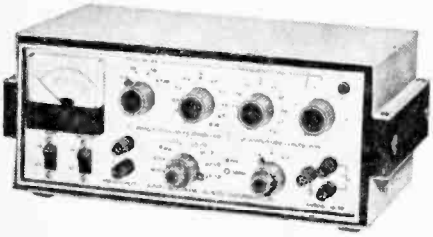
is a recorder. Included is a Robins-produced 28-page guide, "Tape Editing and Splicing." Also these basic accessories: a 7-in. reel of 1200 ft. of Robins' Brand 5 1.5-mil acetate tape, a 7-in. take-up reel, a splicer with splicing tape, 75 tape clips, six 7-in. tape storage boxes, 2 oz. of head cleaner and 2 oz. of head and guide lubricant, 180 self-adhering white title labels, and 3 tape editing and cueing pencils. The kit lists at $16.50 and you can inquire about it from Robins Industries Corp., 15-58 127th St., College Point, N.Y. 11356.

New Audio Gen

Here from Heath is the model IG-18, a solid-state sine-square wave generator, with a price-tag of $67.50. The new generator has a sine wave output range continuously variable from



1 Hz to 100 kHz using one multiplifier and two selector switches plus a vernier control. The IG-18 features 8 output voltage ranges from .003 to 10 V rms with an external load of 10,000 ohms or more, and 6 output ranges from .003 to 1 V rms (−62 to +22 dB) using the built-in 600-ohm load or an external 600-ohm load. Sine-wave output has less than 0.1%



Heath IG-18 Sine-Square Wave Generator

distortion from 10 Hz to 20 kHz. The square wave section has a frequency range from 5 Hz to 100 kHz at 0.1, 1 and 10 V (P-P) switch-selected outputs, with a rise time of less than 50 nanoseconds. Sine and square waves are available simultaneously. The unit is equipped with a dual-primary transformer for 120/240 VAC operation and a 3-wire line cord for added safety. And it has the tasty Heath styling. For more specs. write the Heath Co., Benton Harbor, Mich. 49022.

Everyman's VOM

This is a volt-ohm-milliameter at a really nice low price, $11.95. Pocket-size and in kit form, the Knight-Kit model 646 has an easy-to-read two-color scale. Sensitivity is 20,000 ohms per VDC, 10,000 ohms per VAC. Top quality shunts and multipliers give accuracy of ±2% DC full scale, and ±2% AC full scale. It has a tough metal case and a plastic cover for the meter, and it operates on a single 1.5-V penlight battery. There are oversize wiring diagrams and easy-to-follow instructions. Size: 5x3½x1¾ in. At all Allied stores, or write to Allied Radio Corp., 100 N. Western Ave., Chicago, Ill. 60680.

Knight-Kit 646 VOM

Patch Makes Dialogue

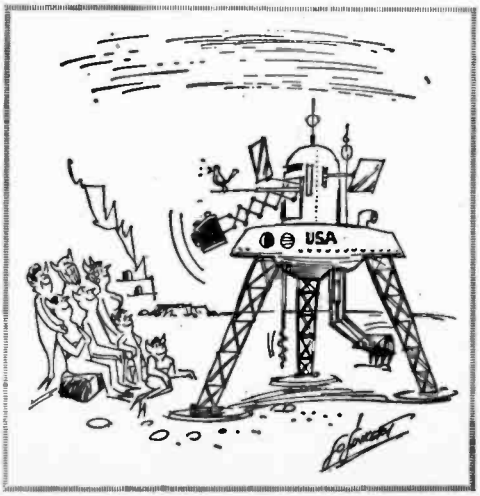
Hy-Gain has introduced a CB phone patch which will interconnect any base CB with the telephone—thus extending a CB call to any telephone in the nation. The company says having the Phone Patch on your base is equivalent to having a telephone in your car. You can talk to any local or long distance phone via your base while traveling. This could be very handy in emergencies for contacting police or other public safety units. The Hy-Gain Phone Patch (part No. 402) can easily be connected to any CB transceiver and comes with complete instructions. It sells for $7.95; for further information write Hy-Gain Electronics Corp., Hwy 6 & Stevens Creek, Lincoln, Neb. 68501.

Hy-Gain CB Phone Patch No. 402

A Scope Within Your Scope

The new Heathkit 10-17 oscilloscope is a really sophisticated instrument for the money. Its dual-primary power supply requires no accessories to operate on 220-V, 50- or 60-Hz systems. There's a 5-MHz bandwidth for TV signal analysis with 30-mV peak-to-peak sensitivity. All controls, except astigmatism, are mounted on the front panel. The vertical gain control has a pull-out x50 attenuator; the 10-17's plastic graticule has four major vertical divisions and six major horizontal divisions. The recurrent-type sweep generator has a frequency response of 20 Hz to 200 kHz in four overlapping ranges and a choice of horizontal sweep source—from

(Continued on page 22)



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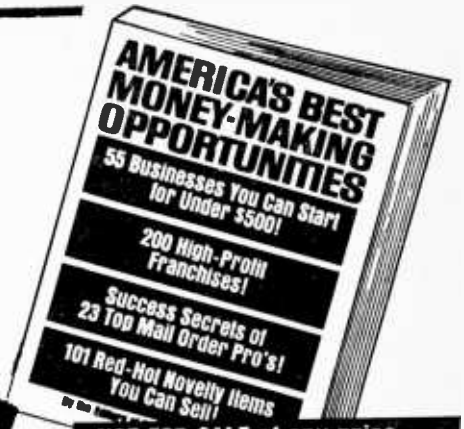

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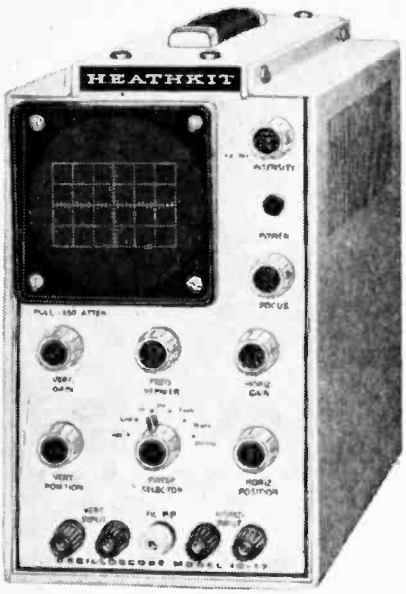


Heathkit 10-17 Oscilloscope

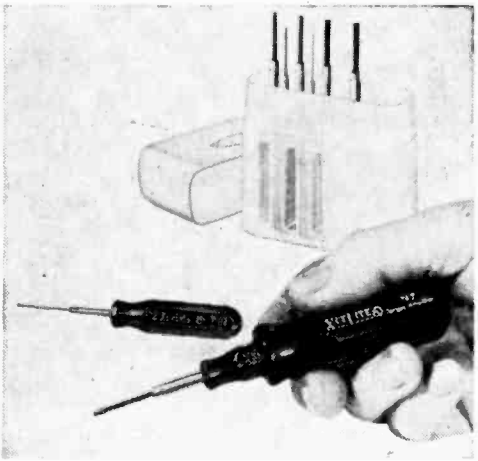
internal generator, 60-Hz line, or external source. Equipped with a nickel-alloy shield to protect the CRT from stray fields, the 10-17 also boasts solid-state high- and low-voltage supplies and Zener diode regulators to minimize trace bounce due to line-voltage variations. You can remove the left and right cabinet halves for servicing without impairing the operation; one circuit board mounts most components. Finished in handsome beige-and-black, this 3-in. scope is only $79.95! Want to know more? Write the Heath Co., Benton Harbor, Mich. 49022.

How Micro They Gonna Get?

Ampex is right in there turning out cassette tape recorders/players. Included in their new line is the Micro 88, which reproduces taped music with 20 watts of power through two slide-on speakers. Two dynamic omnidirectional microphones come with the system. The VU meter permits constant monitoring of record level from mike and line inputs. The Micro 88 operates on 110 V, 60 Hz power. Controls include play/record, record safety lock, fast forward, pause, rewind, stop, and cassette eject. Dimensions, with speakers attached, are 16 x 4 15/16 x 7¾-in.; weight of complete unit is 21 lb. Micro 88 sells for $199.00, with one year warranty. For further specs, Write Ampex Corp., 2201 Lunt Ave., Elk Grove Village, Ill. 60007.

Putting a Hex on Your Screwdriver

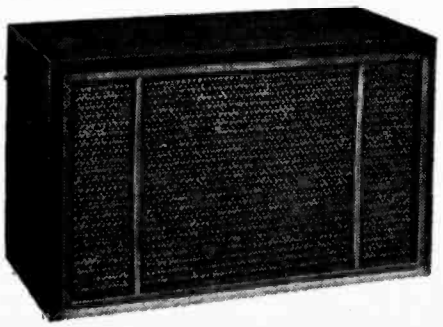
Xcelite has come out with a convertible screwdriver set, No. PS-89, which contains eight midget hex-type socket screwdrivers in sizes from 0.028 to ⅛ in. Recommended for delicate precision work, the set includes a piggyback torque amplifier handle which can be slipped over the top of the midget tool handles to pro-



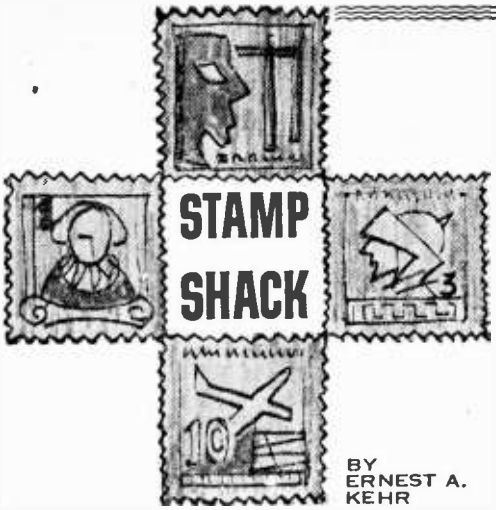
vide larger gripping surface, extended reach, and increased driving power. The compact, see-through plastic case can be carried in a hip pocket or used as a bench stand. Price of the PS-89 is $7.25, and you can get more information by asking for Bulletin N568 from Xcelite, Inc., Orchard Park, N.Y. 14127.

Little Speaker on the Shelf

Here's a tidy new bookshelf speaker system from Heath that uses custom-designed JBL speakers. The new AS-38 will handle up to 40 watts of program material. The system has a 12-in. woofer with a 6-lb. magnet assembly, a heavily-damped long travel cone and a 3-in. edge wound copper ribbon voice coil. The tweeter is a 2-in. piston type direct radiator with a 1¼-lb. magnet assembly. Construction is made easy by building the 2500 Hz LC-type crossover as a separate subassembly prior to mounting in the enclosure. Both crossover and speakers are mounted from the front of the oiled walnut cabinet. Impedance, 8 ohms. Price, $144.95. For ordering and/or specs, write Heath Co., Benton Harbor, Mich. 49022.



Heathkit AS-38 Bookshelf Speaker System



BY
ERNEST A.
KEHR

● ● On Oct. 27, 1959, the Vatican City released a pair of natural color stamps, to commemorate the second anniversary of the dedication of what is the most remarkable and best known of the world's radio transmitting facilities. The design of both features the gigantic cross-like antenna with a statue of Archangel Gabriel and the inscription, *"Centro Radio S. Maria di Galeria."*

Although the last is its formal name, the station is much better known simply as *"Radio Vaticano"* by the millions who listen to its programs on six continents and the islands between.

● Vatican Radio has a specially significant association with the United States, for it was a distinguished American who participated in its very first broadcast 31 years ago.

Almost immediately after the signing of the Lateran Treaty, by which some Vatican properties were returned after having been confiscated by the Italians, in 1870, plans for the establishment of an independent radio station were formulated. Guglielmo Marconi, inventor of this communications medium, undertook the job. The very latest equipment of the early 'thirties was installed in a specially built studio high atop the Vatican Garden's hill and overlooking St. Peter's Basilica.

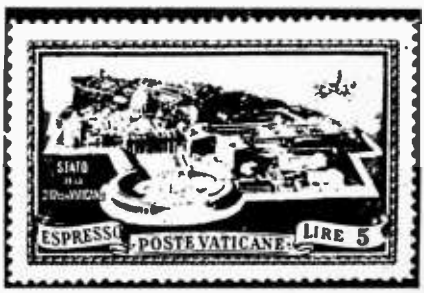
In 1931, with a distinguished number of guests present, the 10-kilowatt shortwave transmitter was formally dedicated with a brief talk by Marchese Marconi and an appropriate talk by Pope Pius XI. The English translation of the program was given by Monsignor Francis J. Spellman, then a member of the Holy See's Secretariate of State, and later to become Cardinal Archbishop of New York. (No stamps marked this occasion, but a special commemorative medal was struck, gold ones being given only to Marconi, His Holiness, and Msgr. Spellman. The latter is part of the Spellman Numismatic Museum and may be seen at 451 Madison Ave., behind St. Patrick's Cathedral, in Manhattan.)

● During the first years, broadcasts were only occasional and featured such events as the Consistory at which Pope Pius XII was elected, Christmas and Easter ceremonies, or notable papal pronouncements.

Later as the station became more widely known and listened to, its programs were updated and put on regular, systematic schedules. They include the cultural, informative and educational and are of interest whether listeners be Catholic or not.

● Technical development enabled Vatican Radio to keep modernizing its equipment, and in 1957, a completely new transmitter was erected atop Santa Maria di Galeria, 12 miles from the original, on land given to the Holy See by Rome, and which enjoys extraterritorial rights. It was provided by RCA, and consists of a 120-kilowatt medium-wave transmitter and five 100-kilowatt shortwave senders, enabling the Vatican to present 350 program each week in 30 languages, 17 of which are spoken behind the Iron Curtain. *(Continued on page 105)*

1959 Vatican Radio Issue
Scott #262-3



LITERATURE

ELECTRONIC PARTS

1. *Allied's* catalog is so widely used as a reference book, that it's regarded as a standard by people in the electronics industry. Don't *you* have the 1969 *Allied Radio* catalog? The surprising thing is that it's free!

★2. Now, get the all-new 512-page, fully illustrated *Lafayette Radio* 1969 catalog. Discover the latest in CB gear, test equipment, ham gear, tools, books, hi-fi components and gifts. Do it now!

★8. Get it now! *John Meshna, Jr.'s* new 46-page catalog is jam packed with surplus buys—surplus radios, new parts, computer parts, etc.

23. No electronics bargain hunter should be caught without the 1969 copy of *Radio Shack's* catalog. Some equipment and kit offers are so low, they look like misprints. Buying is believing.

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

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

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

★135. Get with ICs! *RCA's* new integrated Circuit Experimenter's Kit KD2112 is the first of its kind and should be a part of your next project. Get all the facts direct from *RCA*. Circle 135.

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

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

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

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

6. Bargains galore, that's what's in store! *Poly-Paks Co.* will send you their latest eight-page flyer listing the latest in available merchandise, including a giant $1 special sale.

TOOLS

★78. *Xcelite's* Service Master roll kit puts 23 essential hand tools at your fingertips. Get Catalog 166 for complete description of kit and many optional accessories.

118. Secure coax cables, speaker wires, phone wires, etc., with *Arrow* staple gun tackers. 3 models for wires and cables from 3/16" to 1/2" dia. Get fact-full Arrow literature.

CB—AMATEUR RADIO—SHORTWAVE RADIO

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

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

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

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

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

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

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

129. Boy, oh boy—if you want to read about a flock of CB winners, get your hands on *Lafayette's* new 1969 catalog. *Lafayette* has CB sets for all pocketbooks.

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

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

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

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

45. CBers, Hams, SWLs—get your copy of *World Radio Labs'* 1969 catalog. If you're a wireless nut or experimenter, you'll take to this catalog.

54. A catalog for CBers, hams and experimenters, with outstanding values. Terrific buys on *Grove Electronics'* antennas, mikes and accessories.

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

103. *Squires-Sanders* would like you to know about their CB transceivers, the "23'er" and the new "S5S." Also, CB accessories that add versatility to their 5-watters.

ELECTRONIC PRODUCTS

144. Hear today the organ with the "Sound-of-Tomorrow," the Melo-Sonic by *Whippany Electronics.* It's portable—take it anywhere. Send for pics and descriptive literature.

143. Bring new life to your hobby. Exciting plans for new projects—let Electronics Hobby Shack give you the dope. Circle 143, now.

66. Try instant lettering to mark control panels and component parts. *Datak's* booklets and sample show this easy dry transfer method.

109. *Seco* offers a line of specialized and standard test equipment that's ideal for the home experimenter and pro. Get specs and prices today.

42. Here's colorful 116 page catalog containing a wide assortment of electronic kits. You'll find something for any interest, any budget. And *Heath Co.* will happily send you a copy.

LIBRARY...

★ Starred items indicate advertisers in this issue. Consult their ads for additional information and specifications.

128. If you can hammer a nail and miss your thumb, you can assemble *Schober* organ. To prove the point, *Schober* will send you their catalog and a 7-in. dise recording.

145. *Alco Electronic Products* has 28 circuit ideas using their remote control relay. Get 100-and-one odd jobs done at home without calling an electrician. Get all the facts today!

★44. Kit builder? Like wired products? *EICO's* 1969 catalog takes care of both breeds of buyers. 32 pages full of hi-fi, test, CB, ham, SWL, automotive and hobby kits and products —do you have a copy?

126. *Delta Products* new capacitive discharge ignition system in kit form will pep up your car. Designed to cut gas costs and reduce point and plug wear. Get *Delta's* details in full-color literature.

SCHOOLS AND EDUCATIONAL

142. *Radio-Television Training of America* prepares you for a career—not a job. 16 big kits help you learn as you build. 120 lessons. Get all the facts today!

★74. Get two free books—"How to Get a Commercial FCC License" and "How to Succeed in Electronics"—from *Cleveland Institute of Electronics.* Begin your future today!

★3. Get all the facts on Progressive Edu-Kits Home Radio Course. Build 20 radios and electronic circuits; parts, tools and instructions come with course.

114. Prepare for tomorrow by studying at home with *Technical Training International.* Get the facts today on how you can step up in your present job.

★136. *International Correspondence Schools* has a 384-page manual explaining the function, operation, and objectives of *ICS.* Get the facts on 266 courses of study currently available. Sorry, offer may expire soon.

★137. For success in communications, broadcasting and electronics get your First Class FCC license and *Grantham School of Electronics* will show you how. Interesting booklets are yours for the asking.

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30. *Shure's* business is hi-fi — cartridges, tone arms, and headphone amps. Make it your business to know *Shure!*

134. Discover *PlayTape*—America's newest tape cartridge and tape players. Unit priced at under $17 with cartridges at 45-disc prices. *PlayTape* has one of America's largest recorded libraries.

17. Mikes, speakers, amps, receivers—you name it, *Electro-Voice* makes it and makes it good. Get the straight poop from *E-V* today.

99. Get the inside info on why *Koss/Acoustech's* solid-state amplifiers are the rage of the experts. Colorful brochure answers all your questions.

104. You can't hear FM stereo unless your FM antenna can pull 'em in. Learn more and discover what's available from *Finco's* 6-pages "Third Dimensional Sound."

119. *Kenwood* puts it right on the line. The all-new *Kenwood* FM-stereo receivers are described in a colorful 16-page booklet complete with easy-to-read-and-compare spec data. Get your copy today!

26. The all new, lavishly-illustrated, full-color brochure, "At Home With Stereo" clues you in on *H.H. Scott's* 1969 stereo consoles. Discover how to pick a hi-fi console for your living room.

TAPE RECORDERS AND TAPE

123. Yours for the asking—*Elpa's* new "The Tape Recording Omnibook." 16 jam-packed pages on facts and tips you should know about before you buy a tape recorder.

31. All the facts about *Concord Electronics Corp.* tape recorders are yours for the asking in a free booklet. Portable, battery operated to four-track, fully transistorized stereos cover every recording need.

32. "Everybody's Tape Recording Handbook" is the title of a booklet that *Sarkes-Tarzian* will send you. It's 24-pages jam-packed with info for the home recording enthusiast. Includes a valuable table of recording times for various tapes.

34. "All the Best from *Sony*" is an 8-page booklet describing *Sony-Superscope* products—tape recorders, microphones, tape and accessories. Get a copy today before you buy!

35. If you are a serious tape audiophile, you will be interested in the all new *Viking/Telex* line of quality tape recorders.

TELEVISION

★70. Need a new TV set? Then assemble a *Heath* TV kit. *Heath* has all sizes. B&W and color, portable and fixed. Why not build the next TV you watch?

127. *National Schools* will help you learn all about color TV as you assemble their 25-in. color TV kit. Just one of *National's* many exciting and rewarding courses.

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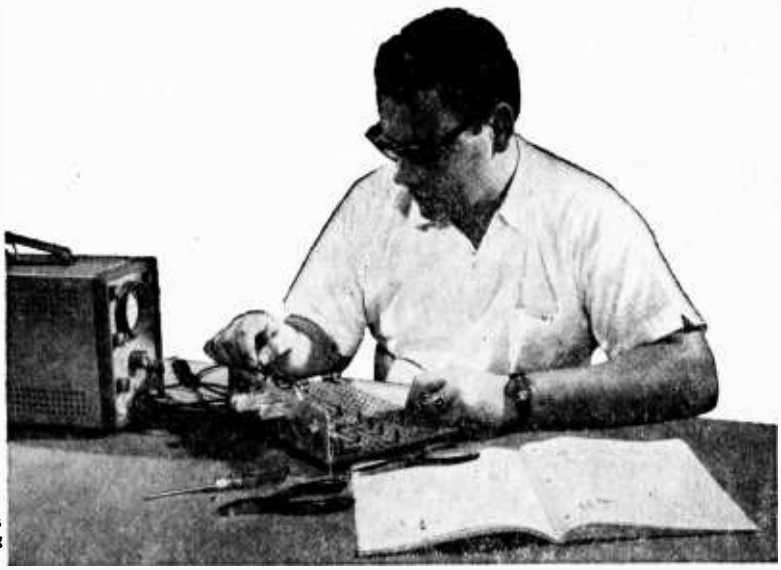

Performing transistor experiments on programmed breadboard — using oscilloscope

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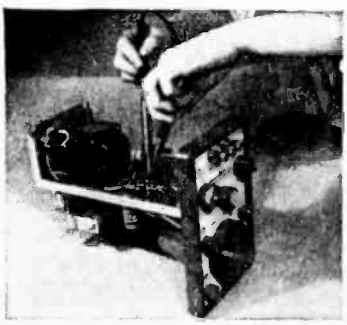
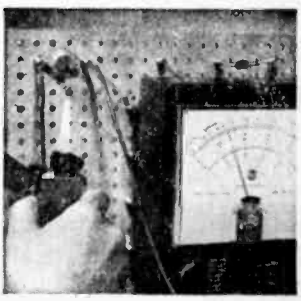
Construction of Multimeter.



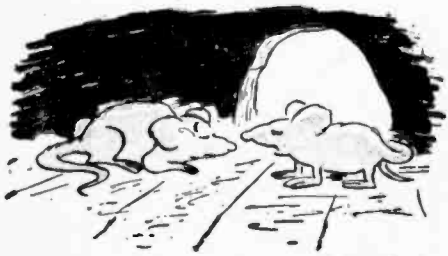
Construction of Oscilloscope.

Temperature experiment with transistors.

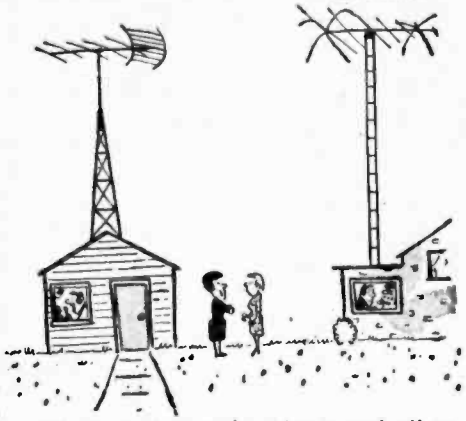


SHORT WAVES

By Jack Schmidt



"If he doesn't turn up the squelch tonight, I'll chew up the speaker cone!"



"That's right, they're talking to each other . . . around the world!"

"How come you can DX, ID, SWBC and QSL, but you can't S-P-E-L-L?"

"Tell your buddies on Venus your Dad wants his radio back—now!"

"My Dad's radio'll go farther'n your Dad's!"

RADIO-TV EXPERIMENTER
and
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ELECTRONICS

In one word, it's . . .

SQUEECH

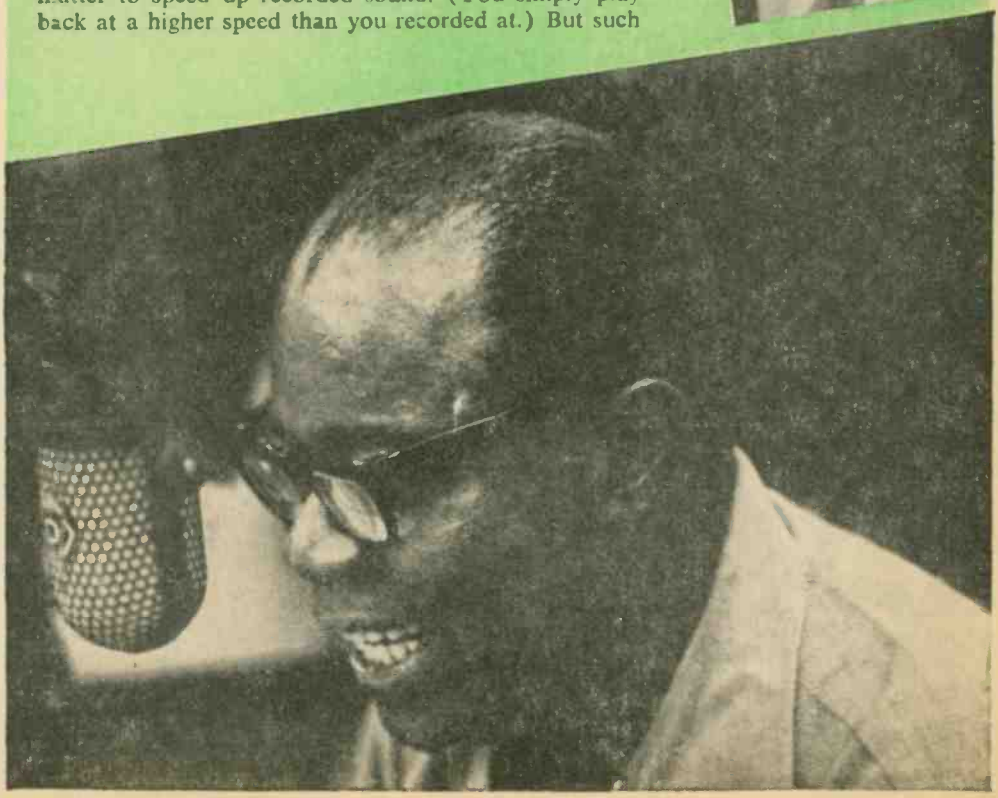
But it can be defined as the technology of s ow or fast talking at the slip of a clutch!

By Jorma Hyypia

How do you get SQUEECH out of SQUEEZED SPEECH? Why, by throwing out a few letters and pushing the remaining word fragments together!

Grab that, and you already have a rough idea about what scientists more formally call *compressed speech*. Their objective: to electronically help people talk faster. Here's how it works, and why you may someday have to learn how to listen faster.

As any tape recorder fan well knows, it is a simple matter to speed up recorded sound. (You simply play back at a higher speed than you recorded at.) But such



speedup is achieved only with a sacrifice of intelligibility. Why? Because with every doubling of playback speed, the pitch of the sound is raised a full octave. Unfortunately, this can make a basso profundo sound like a chattering Disney chipmunk. It's entertaining, but it's also definitely *not* the way to convey information clearly.

The problem, then, is to increase the playback speed *without* changing the pitch. One way to do this by programming a computer to scan prerecorded speech material and compress it in ways to be discussed later. This method is now used only in compressed speech research because of the high cost; the tedious programming that is required costs about $900 per minute.

At present, the more practical means of compressing speech is by utilizing a mechano-electronic device called a Rate Changer. Such equipment is already on the market. And though it costs several thousands of dollars, it's a far cheaper solution because it can quickly compress pre-recorded tapes without the elaborate programming required for computers.

Eltro System. The first rate changer—called an acoustical pitch and tempo regulator—was invented by a German scientist, the late Anton Springer, in the early 1950s. This original TeleNorm equipment was later improved and is now manufactured by Eltro Automation of Heidelberg, West Germany. (U. S. distributor of the Eltro Information Rate Changer is Infotronic Systems, Inc., an affiliate of Gotham Audio Corporation in New York City.)

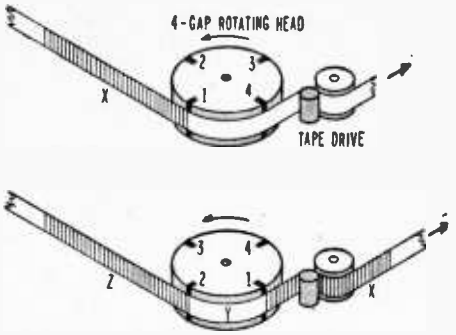


Fig. 2. Just as eye fails to perceive individual frames with movie projector, ear fails to detect operation of four-gap rotating head.

Here's how the Eltro is used. A magnetic tape, normally recorded at a speed of 15 inches per second (ips), is fed into the Eltro unit; the output is channeled into an ordinary tape recorder for re-recording. By simply turning one knob on the rate changer (an exotic clutch-like device), it's possible to increase the playback rate to nearly double the original rate (i.e. to almost 30 ips). Alternatively, it can be slowed down to half the original recorded velocity for an *expansion* of up to 200% of the original time.

A speeding up of the recording leads to information *compression*. A compressed tape has a shortened playback time. Conversely, a slowed-down recording leads to information *expansion*, and in this case the playback time is lengthened. With either procedure, there is no detectable change in pitch. In fact, the speaker sounds quite normal except that he is made to talk faster or slower as the case demands.

The best way to understand just what compressed speech is, and how it sounds, is to actually hear it. Anyone in the country can do this, day or night, by picking up his

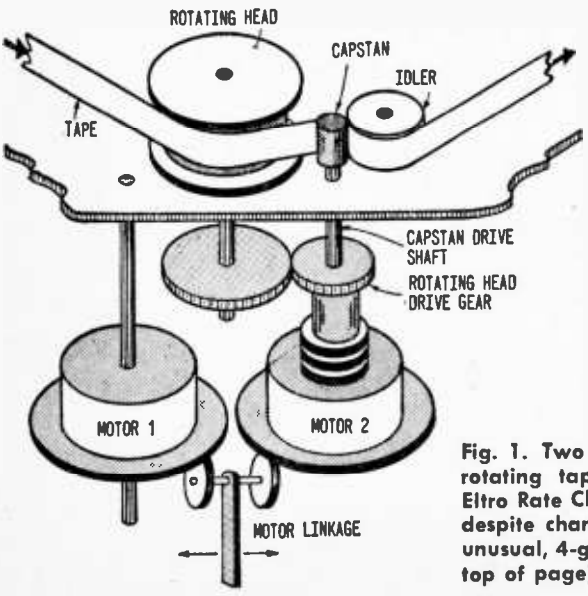
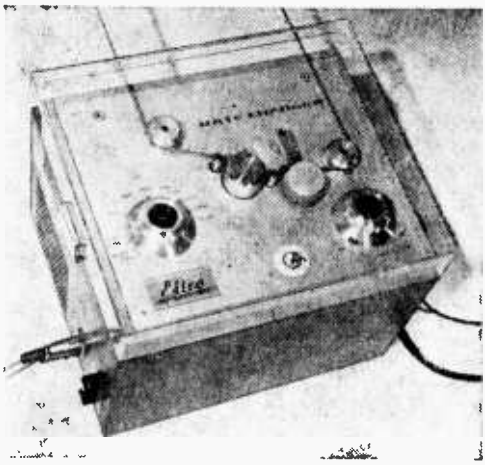


Fig. 1. Two mechanically linked motors and rotating tape head account for ability of Eltro Rate Changer to maintain constant pitch despite changes in tape speed. In operation, unusual, 4-gap head (see detailed drawing at top of page) snips out bits of sound.



Capable of both information compression and information expansion, Eltro Mark II instrument is equipped with but two major controls.

telephone and dialing: 212-265-4144. An automatic answering service will play a demonstration recording lasting less than three minutes. After 8 p.m. you can make the call from any place in the nation (except Alaska and Hawaii) for a maximum cost of one dollar.

Rotating Head. Secret of the Eltro Rate Changer lies in a unique application of a fairly common recording component, a rotating playback head. An ordinary tape recorder has a stationary head with a single sensing gap. If a prerecorded tape moves across this fixed head at varying speeds, pitch changes will occur. But if a multi-gap rotating head is substituted for the fixed head, the tape can be speeded up (or slowed down). *Constant tape-to-head velocity* is maintained by rotating the head in the proper direction at the proper speed. As long as the tape-to-head velocity remains constant, pitch stays unchanged.

Fig. 1 shows the ingenious mechanism used to maintain this constant speed ratio between the tape and head. The velocity of the capstan that drives the tape and that of the rotating head are held in exact synchronization by means of an electric field lock achieved by using two mechanically linked AC motors.

Motor 1 has a fixed speed of 900 rpm angular velocity, which is equivalent to 15 ips linear velocity, the normal tape speed. This motor is coupled to Motor 2 by means of a sliding clutch-like linkage consisting of two rubber-tired wheels engaging discs attached to the *rotors* of the motors.

Motor 2 is of synchronous type having four-pole construction and a speed of 900 rpm. An important design aspect is the freedom of the *field* or stator section of the motor to rotate around the rotor. This field section is coupled to the rotating head by means of two gears.

When the linkage is set at its 100% position, Motor 1 drives the rotor of Motor 2 at a speed of 900 rpm; the rotor shaft in turn drives the capstan at the same speed. Since 900 rpm is the normal synchronous velocity of Motor 2, its field section remains stationary during the 100% setting.

Now, if the control knob is moved to shift the linkage so as to increase the rotor speed of Motor 2, the field section of Motor 2 will move just enough to compensate for the speed-up and maintain a rotor-to-field synchronization of 900 rpm. In so doing, the

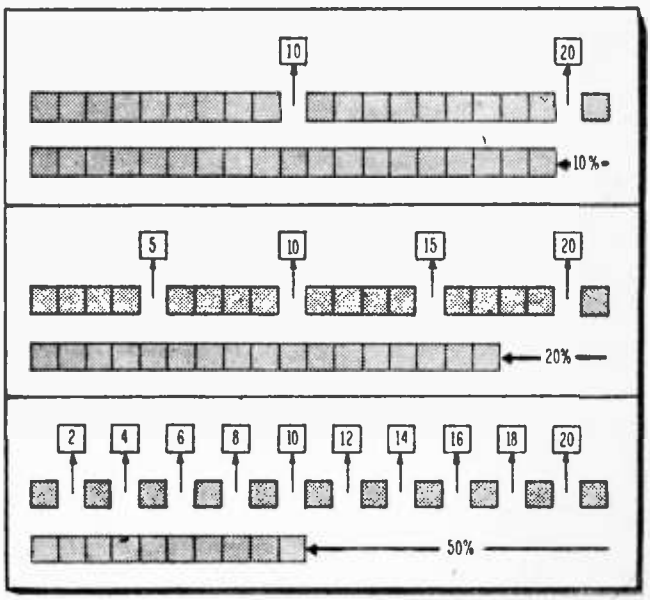


Fig. 3. Dividing length of tape into 21 equal sections aids in understanding Rate Changer's operation. Deleting sections 10 and 20 (top) results in 10% compression; deleting sections 5, 10, 15, and 20 in 20% compression, etc.

SQUEECH

field section moves the gears, thus transmitting the same compensating movement to the rotating playback head.

The speed of Motor 2 can be varied continuously from 450 rpm to a maximum of nearly 1800 rpm; this means that the tape transport speed is variable from about half to double the normal speed of 15 ips. In other words, there's a range extending from 7½ ips to 30 ips tape speed.

No matter what the actual tape speed may be within this range, the electrical field lock maintains a constant 15-ips velocity between the tape and playback head. As a result, the pitch of the recorded sound remains unaffected by tape speed changes.

Compression. The foregoing discussion explains how constant pitch is maintained. But this does not yet explain why *compression* takes place. To understand this, refer to Fig. 2.

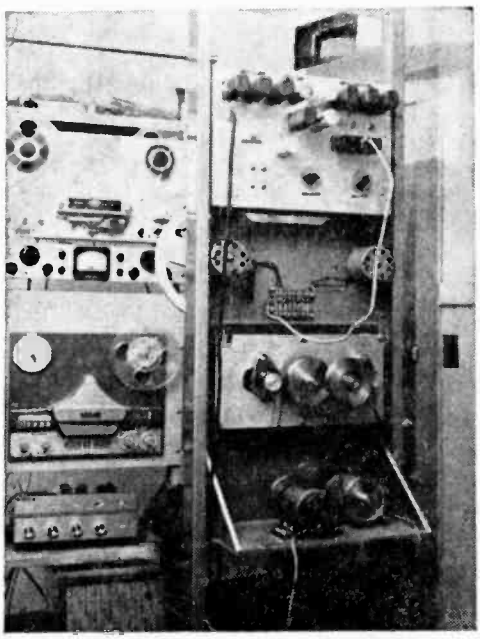
The top diagram shows the starting position as the tape begins to move from left to right, with the head rotating in the same direction (counterclockwise). Gap 1 is just coming into position to sense the shaded section of tape marked X. By the time the head has rotated a quarter turn, section X has been sensed and has moved to the position shown in the lower drawing.

Just as gap 1 moves away from the tape and becomes temporarily ineffective, gap 2 begins to sense the next shaded section marked Z. Note that an intermediate section, Y, *cannot be sensed* by either gap. Gap 1 is moving away from the tape, and gap 2 cannot catch up with section Y. Two important consequences result: 1) the sound information on section Y is eliminated, and 2) the *playing time* represented by section Y is also eliminated (this occurs because the instant that the last sound on section X has been sensed, playback of section Z begins).

What has happened is that a small amount of time compression has been achieved by sacrificing a small amount of recorded information. This process is repeated again and again throughout the length of the tape; the accumulated small time compressions, interspersed throughout the tape, add up to a large overall reduction in the total playback time.

Haas Effect. Does this chopping out of bits of sound information create distortions in the compressed sound? None that you can perceive with the ear. Reason is that each deleted segment is kept shorter than 35 milliseconds, and this is threshold sound duration

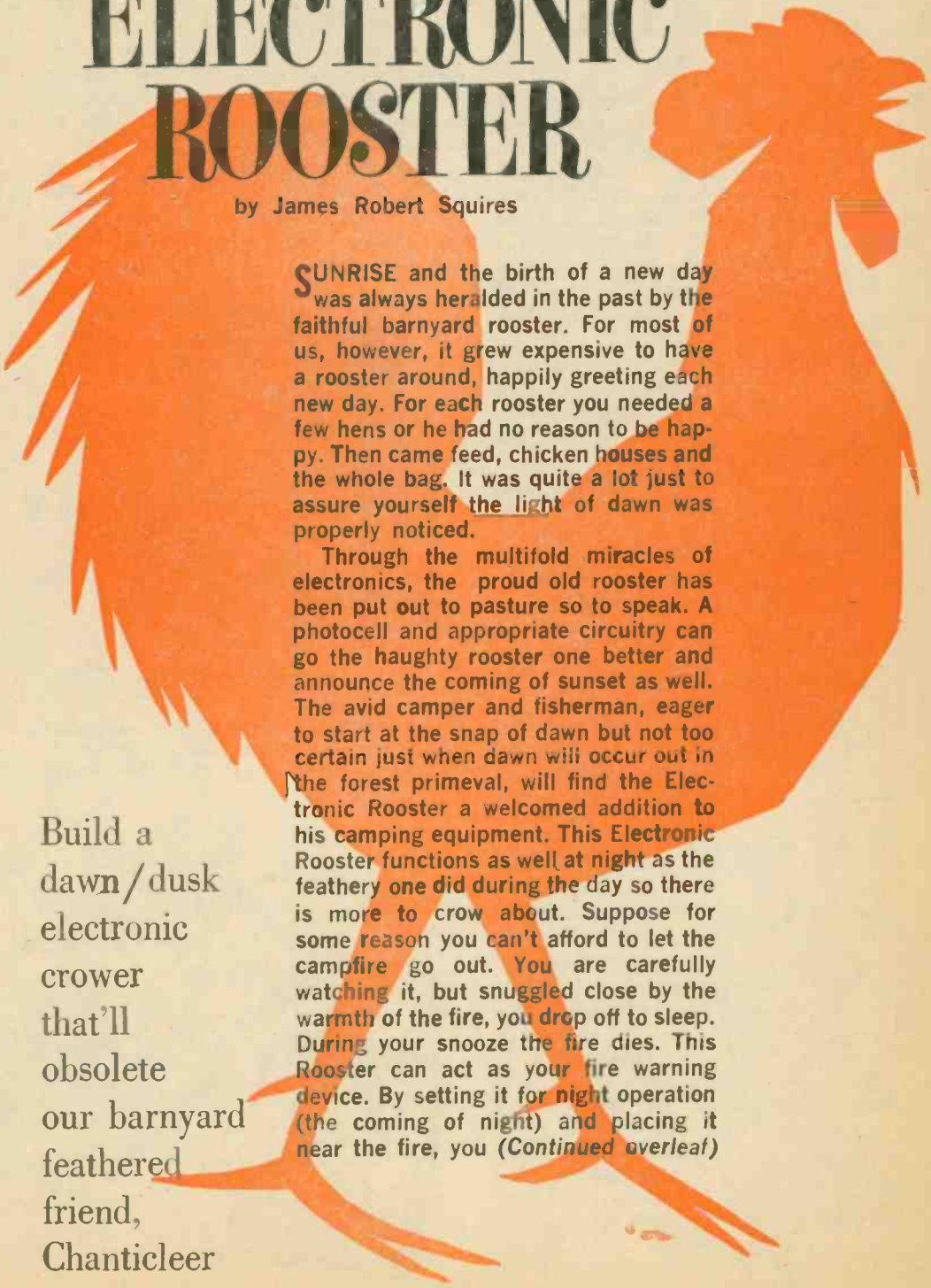
(Continued on page 104)



Two views of speech compression equipment used by Dr. Emerson Foulke at University of Louisville's Center for Rate Controlled Recordings (CRCR). That's Dr. Foulke himself at left.

the ELECTRONIC ROOSTER

by James Robert Squires



Build a dawn/dusk electronic crower that'll obsolete our barnyard feathered friend, Chanticleer

SUNRISE and the birth of a new day was always heralded in the past by the faithful barnyard rooster. For most of us, however, it grew expensive to have a rooster around, happily greeting each new day. For each rooster you needed a few hens or he had no reason to be happy. Then came feed, chicken houses and the whole bag. It was quite a lot just to assure yourself the light of dawn was properly noticed.

Through the multifold miracles of electronics, the proud old rooster has been put out to pasture so to speak. A photocell and appropriate circuitry can go the haughty rooster one better and announce the coming of sunset as well. The avid camper and fisherman, eager to start at the snap of dawn but not too certain just when dawn will occur out in the forest primeval, will find the Electronic Rooster a welcomed addition to his camping equipment. This Electronic Rooster functions as well at night as the feathery one did during the day so there is more to crow about. Suppose for some reason you can't afford to let the campfire go out. You are carefully watching it, but snuggled close by the warmth of the fire, you drop off to sleep. During your snooze the fire dies. This Rooster can act as your fire warning device. By setting it for night operation (the coming of night) and placing it near the fire, you *(Continued overleaf)*

ELECTRONIC ROOSTER

can drift off into peaceful slumber. If the fire light drops below a preset level, a persistent 'crowing' will start that can only be turned off by fixing the fire or switching off the unit. A nine foot cord and a small 1½ inch speaker let you place the Rooster some distance from your bed. The small speaker is placed in a tin can with a plastic lid. When not in use the nine feet of connecting cord are stored coiled inside the can behind the speaker.

In the home it could be placed near valuables in such a way that a light when shined on the valuables also illuminated the Rooster. A crow would sound in your bedroom but the intruder would not hear it.

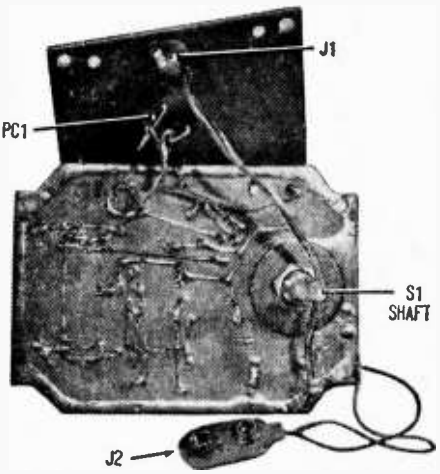
Construction. The entire Rooster with the exception of the speaker is mounted inside a 3 × 4 × 1½-in. plastic meter case with an aluminum panel. All circuitry is mounted on this aluminum panel to simplify construction and assembly. The printed circuit technique was used. For those who do not like this approach there is sufficient room to use pre-punched perf-board and push-in terminals.

The PC Board. The layout for the 3-11/16 × 2⅝-in. single-sided copper-clad board is indicated in a drawing. The hole spacing is for the parts specified in the Parts List. Purchase the parts before attempting to make the printed circuit board. You may have to adjust hole spacing if part substitution is made.

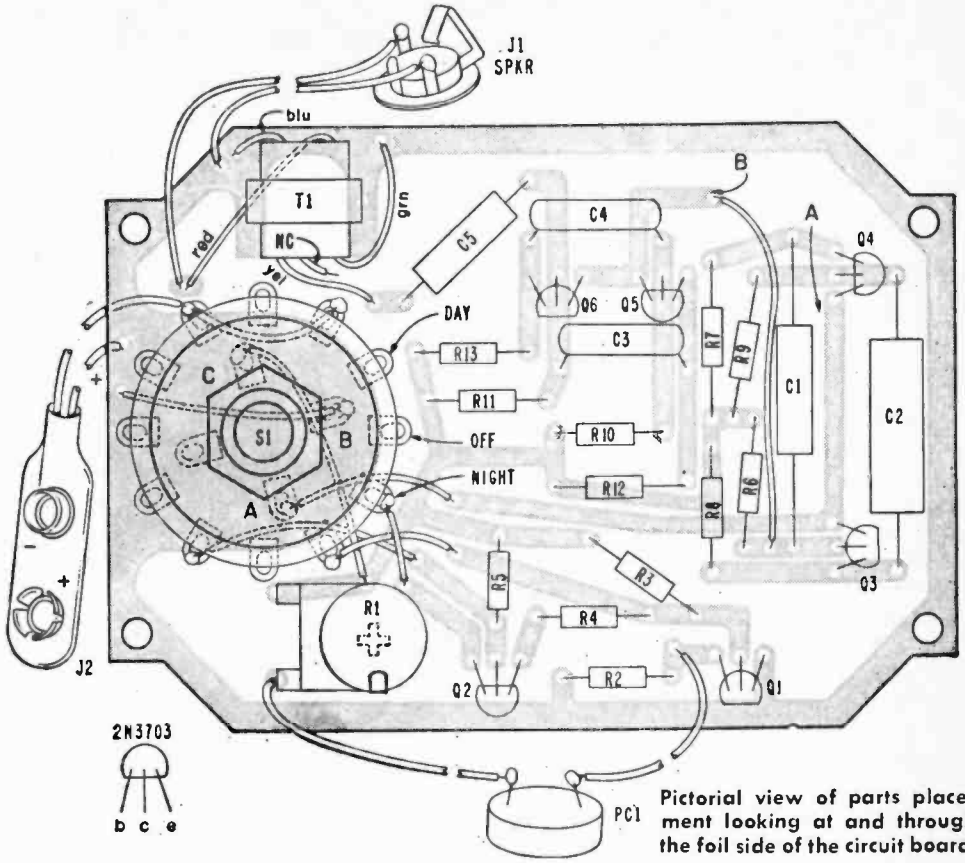
Resist-connecting strips and terminal patches are laid down in the pattern indicated in the PC board same-size diagram. Be certain to use strips that are wide, otherwise the strips may be etched away completely. After the etchant has dissolved away the unwanted copper, be certain to wash the board thoroughly. Be careful when you etch. Follow the instructions that come with the ferric chloride etchant *to the letter*.

Drill holes in the center of each terminal on the strips. Use #56 drill, 0.046 in. Drill from the copper side of the board and use a new drill if available. This is to avoid tearing the thin band of copper loose from the phenolic board. The copper is about three-thousandths of an inch thick. When the holes are finished, carefully go over each hole with a larger drill to remove any burrs that remain. Clean the copper with a good copper cleaner and you are ready to stuff components into their respective holes.

Wiring. Continually check between schematic and PC board layout diagrams as you mount and solder each component. With the exception of R1, S1, and T1, it is best to mount the other components about an eighth of an inch above the board. This facilitates cooling, cleaning and troubleshooting. The components, inserted from the blank side of the board, are soldered, then clipped close to



The printed circuit board mounts on spacers behind the case's panel. All wiring (top) is completed before final assembly. (See below.)

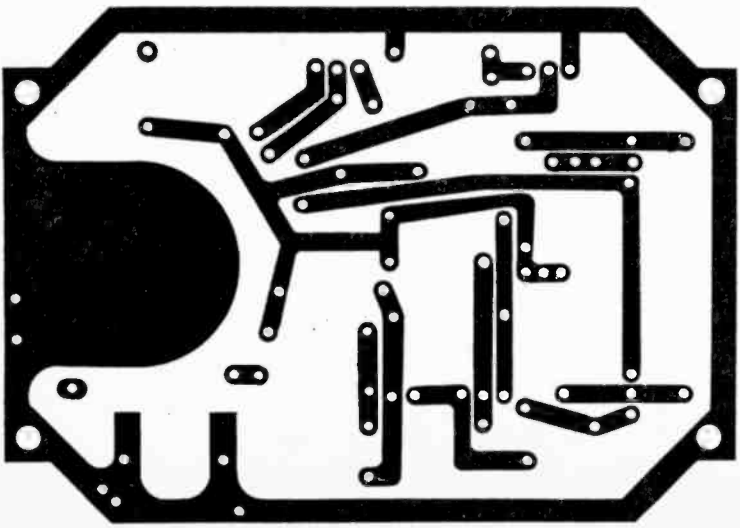


Pictorial view of parts placement looking at and through the foil side of the circuit board.

the board. When all components have been mounted to the board with the exception of S1, tin all remaining exposed copper clad to prevent corrosion.

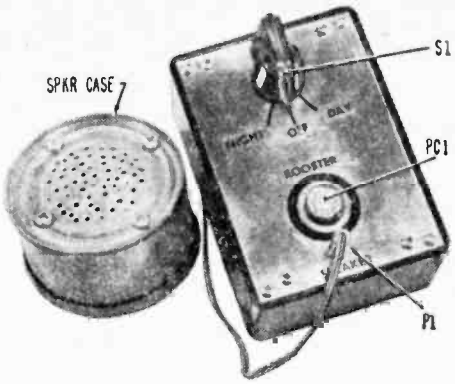
Switch S1 is then mounted to the PC board with its contacts on the component side of the board. Wire the switch, battery plug J2 and speaker jack J1 as indicated by the schematic diagram. The speaker jack double wire should be about five inches long to facilitate exposing the copper side of the PC board for inspection.

Photocell PC1 is next and last. Use about a three inch doubled wire wired as indicated in the PC board layout. Once slipped into its tight fit with the aluminum front panel, use some Epoxy 220 adhesive to fix the cell in place. This should be allowed to dry overnight. While on the subject of time, it should require no more than six hours to go from blank copper clad board to finished wiring. The entire unit may take less than ten hours to build, depending on how much care you put into each step.

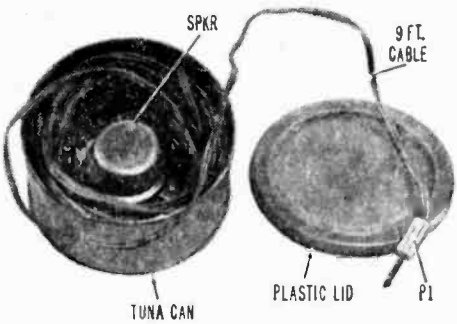


Paste a duplicate of this diagram on cardboard and mount parts on top. If your parts vary from author's, you might have to change layout.

ELECTRONIC ROOSTER



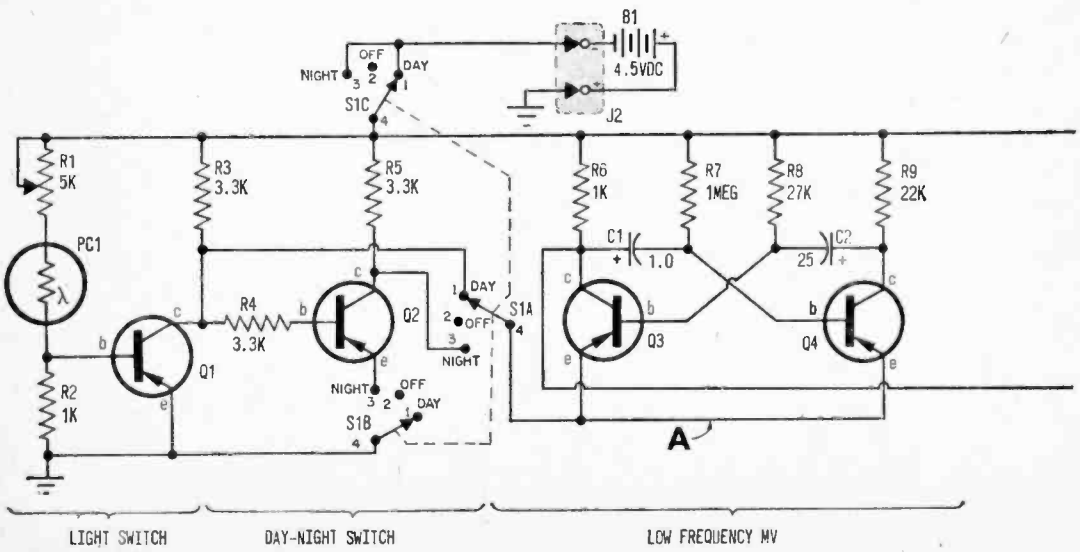
All buttoned up and ready to crow, the Electronic Rooster needs just you to set S1 to Night or Day. Speaker details shown below.



The PC board is mounted to the front panel with ⅜ inch metal spacers. If they are any longer, batteries and Rooster will not fit in the same box.

How It Works. The cadimium sulfide photocell, PC1, is made part of the base circuit of the light switch. Refer to the schematic diagram. Its operation is simple. The collector of the light switch, Q1, goes to ground potential when light falls on the photocell. The Day-Night switch circuit through the action of Q2 reverses the action of the photocell in that its collector is near ground potential when darkness falls on the photocell. This arrangement enables the Electronic Rooster to sense the coming of either *sunset* or *sunrise*. With the switch S1 in the *DAY* position, the Rooster senses the coming of light and with the switch in the *NIGHT* position, the Electronic Rooster will crow at the coming of darkness. The low frequency multivibrator (MV) generates the on-off period while the high frequency MV produces the Rooster tone of about 2.6 kHz. The two MVs operate the same for both *DAY* and *NIGHT* sensing. The output of the high frequency MV is coupled directly to an audio output transformer to drive an eight ohm speaker. If you desire, an earphone may be used at J1 instead of the speaker.

As a troubleshooting aid, the points marked *A* and *B* on the schematic and pictorial diagrams may be grounded copper border around the printed circuit board to check the operation of the low and high fre-



PARTS LIST FOR ELECTRONIC ROOSTER

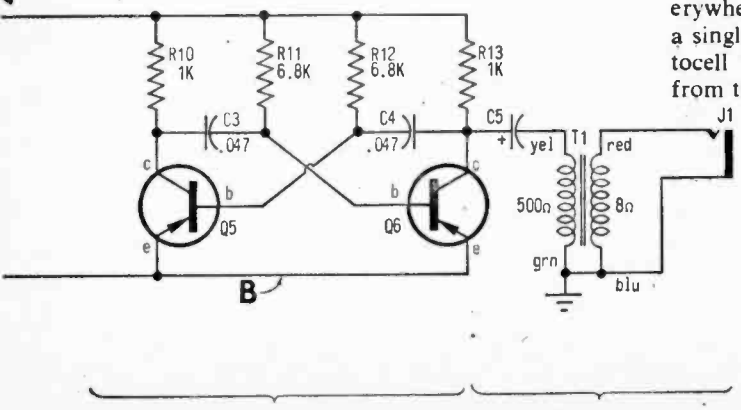
B1—4.5-V battery (3 "AA" cells)
C1—1-uF, 25-VDC electrolytic capacitor (Sprague TL1200 or equiv.)
C2—25-uF, 16-VDC electrolytic capacitor (Sprague TL1157.1 or equiv.)
C3, C4—.047-uF, 100-VDC tubular capacitor (Sprague 225P47391 or equiv.)
C5—5-uF, 12-VDC electrolytic capacitor (Sprague TL1127 or equiv.)
J1, P1—Mating miniature 2-circuit jack and plug, one side connecting to ground (RCA phono type or smaller suitable)
J2—Battery jack similar to unit that clips to 9-VDC transistor battery
PC1—Cadmium sulfide photocell (Burstein-Applebee 20A1113)
Q1-Q6—2N3703 pnp transistor (Texas Instruments)
R1—5000-ohm miniature trim potentiometer (Mallory MTC-4 or equiv.)
R2, R6, R10, R13—1000-ohm, ¼-watt resistor
R3, R4, R5—3300-ohm, ¼-watt resistor
R7—1,000,000-ohm, ¼-watt resistor
R8—27,000-ohm, ¼-watt resistor
R9—22,000-ohm, ¼-watt resistor
R11, R12—6800-ohm, ¼-watt resistor
S1—4-pole, 3-position non-shorting switch (Mallory 3243J)
SPKR—8-ohm, 2-in. dia. PM speaker
T1—Audio transistor-output transformer: 500-ohm pri., 8-ohm sec. (Burstein-Applebee 2A44 or equiv.)
1—Battery holder for 3 "AA" cells (Keystone N565 or equiv.)
1—Plastic case 3 x 4 x 1½-in. with aluminum cover (Davies #220 and #221 or equiv.)
Misc.—Knob, epoxy cement, printed circuit kit of boards and sundries, decals, wire, solder, four ⅜-in. spacers, hardware, etc.

quency multivibrators. This grounding bypasses the action of the two switch circuits consisting of Q1 and Q2.

Use Your Tunex. Battery consumption during Rooster on time is very small. This, connected with the fact that hopefully the Rooster is shut off soon after it sounds, makes it possible to use the three penlight 'AA' cells for an extended period. By way of test, the Rooster was turned on for six hours. The resultant drop in voltage for a fresh set of cells was about two tenths of a volt. Because MV frequency is sensitive to voltage, a very sensitive test of the battery is built into the unit. The period, while different for each unit built by a small amount, is slow and easily measurable with a second hand of a watch. As the battery ages, the frequency of the *crow* will slow down and the beeping or crowing will last for longer times. It is a good idea to measure this time between beeps and jot it on a piece of paper and slip it inside the case for later reference. The light level control, R1, should not be adjusted between time measurements.

Adjustment. The light level control can be adjusted using a light dimmer. Set it to sound a warning at the desired light level and close the box. The same thing can be accomplished by waiting for sunset and adjusting R1 for the light level you want. Don't expect exact *repeatability* from a 50¢ photocell. However, its operation was found to be satisfactory for all but the most exacting requirements. In addition to R1, you can further adjust the trigger level by varying its distance from the light source. That is, the cell is useful in two types of light. The light outdoors can be assumed to come from everywhere. When the light tends to come from a single source such as a campfire, the photocell becomes very sensitive to distance from the light. The tone or frequency of the MVs will to some extent depend on the cell's distance from the light source. This is because they go to ground through a transistor that can have a high or low resistance, depending on how hard it is turned on by the photocell. ■

Parts are available from the following sources: Allied Radio, 100 N. Western Ave., Chicago, Ill. 60680; Burstein-Applebee, 3199 Mercier St., Kansas City, Mo. 64111; Lafayette Radio, 111 Jericho Tpke., Syosset, N.Y. 11791; Newark Electronics, 500 N. Pulaski Rd., Chicago, Ill. 60624.



Inspect one stage at a time to understand schematic diagram. Points A and B may be grounded separately to check working of multi-vibrators.

Big birds now fly the...
PTARMIGAN TRACK

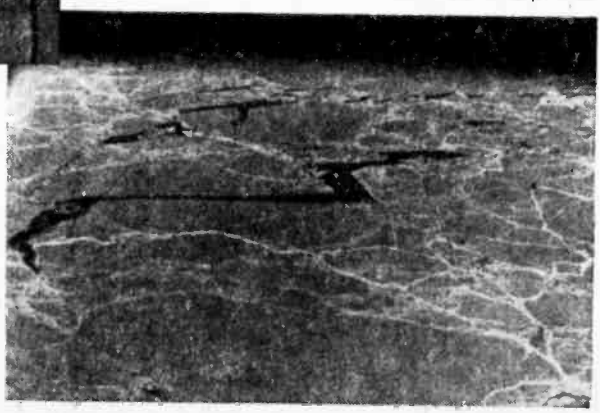
Facts courtesy the Boeing Co.

Computer-equipped jet aircraft now make possible the fresh delivery of a highly perishable harvest. The value of weather information is inversely proportional to its age. So every 24 hours one of a fleet of five Boeing-built WC-135 jet transports flies over the North Pole on a weather mission.

For the past year these giant jets have carried electronic computers to help the crews collect and deliver the raw material on which weather forecasts are based. The computers analyze and transmit weather data in seconds, compared with the hours it took in pre-computer days.

The Milk Run. One of the four-engined jets, which are weatherman versions of the Military Airlift Command's Boeing C-135 transport, departs with a seven-man crew at 1600 hours daily from McClellan Air Force Base, Sacramento, Calif. *(Continued on page 110)*

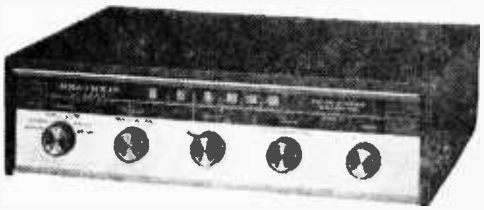
(U.S. Air Force photos)



A big WC-135 (top) is readied on the ramp for trip to England the hard way—over the North Pole by way of Alaska. Packed with electronic devices and computers, the WC-135 plots and charts the world's weather on top of the sphere. Crew member (above) prepares a *dropsonde* probe while in flight over the Arctic ice (right). Probe radios back vital data every 500 feet.

HEATHKIT AR-17

Solid-State, 14-Watt FM/FM-Stereo Receiver



Thanks to the latest in solid-state hardware, the Heath AR-17 FM-stereo receiver offers performance and features heretofore unobtainable at rock-bottom prices.

The AR-17 provides stereo and mono FM, stereo or mono operation of a magnetic phono, and has facilities for an auxiliary input as well. A single source switch selects either of the three inputs for stereo or mono operation. Other controls include a single tone control (high-cut), dual concentric volume controls, tuning, and a phase adjustment which permits optimum stereo separation. (Since the station provides the test signal, no instruments are needed for this phase control.) The front panel also includes a stereo headphone jack and stereo indicator lamp.

The rear apron has antenna and speaker terminals, and the magnetic and auxiliary input jacks. A ground terminal is provided for the turntable motor.

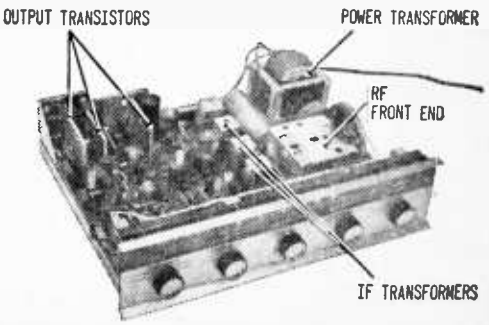
Building the Kit. Except for the front-end tuning unit, which is supplied pre-wired and factory aligned, all construction must be done by the builder. However, the IF and MPX coils are pre-aligned and need only be trimmed upon completion of the kit. Save for the tuner and the heavy components, all circuits are wired on a single printed-circuit board. The IF amplifier has the usual ratio detector and a switching detector is used for multiplex operation. The AF output has no transformer, but uses complimentary symmetry to connect the signal to the speakers via coupling capacitors. This eliminates the possibility of any damage to output transistors should speaker leads become shorted.

Alignment of the receiver is performed using both interstation noise and an FM station as the signal source. This involves making only slight adjustments to the coils and transformers for maximum signal reception. (A final *instrument* check, however, showed that there was little improvement in total performance after alignment. We could measure no improvement in sensitivity, but we did succeed in reducing FM distortion from 1.2% total harmonic to 0.8%.)

Performance. The AR-17 is rated at 5 watts rms per channel (continuous power output) into an 8-ohm load. Its frequency response from 20 to 20,000 Hz is −2 to +0.75 dB. In this range total harmonic distortion did not exceed 0.49% (very good). The tone control, which provides only high-frequency attenuation, sharply reduced severe needle scratch and noise from weak FM stations to tolerable levels.

Mono and stereo FM responses are almost ruler flat from 20 to 15,000 Hz. Total FM harmonic distortion (after alignment with instruments) measured 0.8% mono and 1.1% stereo, comparing favorably with stereo receivers priced considerably higher than the AR-17. The stereo separation at 1 kHz measured 29 dB, also good in comparison with higher-priced receivers.

The IHF sensitivity (microvolt input for 30 dB reduction of noise and distortion) measured 4.0 μV—not a "hot" receiver but certainly adequate for all but fringe-area reception. Full limiting could be obtained



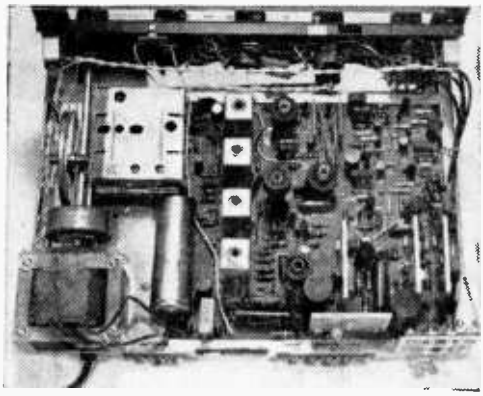
Except for heavy components, circuits are wired on single PC board for easy assembly.

LAB CHECK

with a 10-*u*V input signal (very good).

Though the AR-17's noise level is somewhat higher than that found in more expensive receivers, it is well below the threshold of hearing in normal use, measuring 48 dB down on the magnetic input and better than 58 down on the auxiliary input. The average listener should find this acceptable.

Since solid-state amplifier design is almost "sound perfect" regardless of price, the quality of a budget stereo receiver rests primarily in the FM tuner and the stereo performance.



Output transistors at rear of chassis mount on heat sinks which are bolted to PC board.

Fig. 1. Frequency response of amplifier is ruler flat from 20 to 20,000 Hz at output of 5 W into 8-ohm load. Dotted line shows maximum cut of tone control.

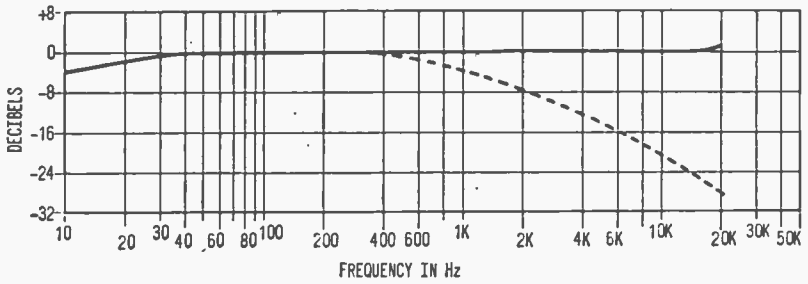
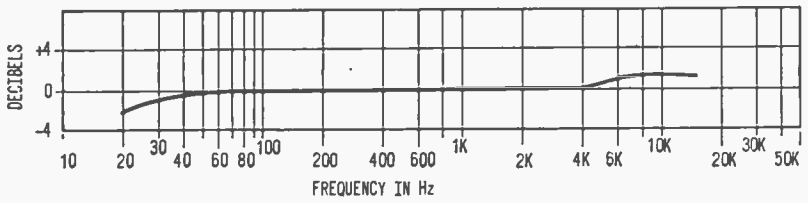


Fig. 2. FM-tuner response is also just about ruler flat from 20 through 15 kHz. Stereo separation at 1 kHz measured 29 dB.

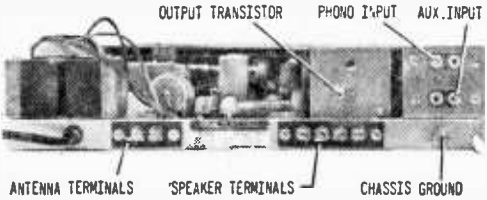


In the AR-17, effects of drift in the receiver are minimized with a phase control which permits adjusting the AR-17 for optimum separation at any time. The phase control works by allowing you to set the point at which the 19-kHz subscriber *locks* the 38-kHz local oscillator. Optimum separation is obtained when the 38-kHz local oscillator locks in phase with the transmitter's 38-kHz oscillator.

Summing Up. Though 5 watts per channel is generally not sufficient for low-efficiency, acoustic-suspension speakers, it's still more than enough to rattle windows when used with standard high-efficiency speakers. Since budget-priced speakers generally have this standard design, the AR-17 will provide more than adequate sound level in a low-cost stereo system. As far as sound quality itself is concerned, this receiver will deliver clean, low-distortion sound fully the equal of receivers priced considerably higher and sometimes having unnecessary frills.

At $79.95, the AR-17 kit is supplied less enclosure. An optional beige metal cabinet is available for $4.50; walnut veneer cabinet for $11.50.

For additional information on the Heath AR-17, write the Heath Co., Dept. D, Benton Harbor, Mich. 49022. ■



Rear apron connections are minimal; there are terminals only for antenna inputs and speakers, plus phono and aux. input jacks.

BLUE EAGLE FLIES AGAIN

by Dick Stripple

Far above the Pacific Ocean a USAF jet transport wings its way to nowhere, orbiting along a fixed circular route. Aboard the craft is enough electronic equipment to set up a good-size telephone company and have enough left over to keep the hams in Palo Alto, Calif., happy for years. As with all Air Force planes, this jet has its distinctive radio call sign. Hers is "Blue Eagle."

No relation to the "Blue Eagle" of four years ago which haunted Baltimore and vicinity (and was probably radio's greatest hoax of 1965), this bird is one of five EC-135P aircraft specially fitted for a vital mission. Operating in turn out of Hickham Air Force Base in Hawaii each "Blue Eagle" is a flying communications center for the US Commander-in-Chief, Pacific. In addition, any one of these flying radio stations could act as an alternate command post in the event its ground headquarters was knocked out during a war.

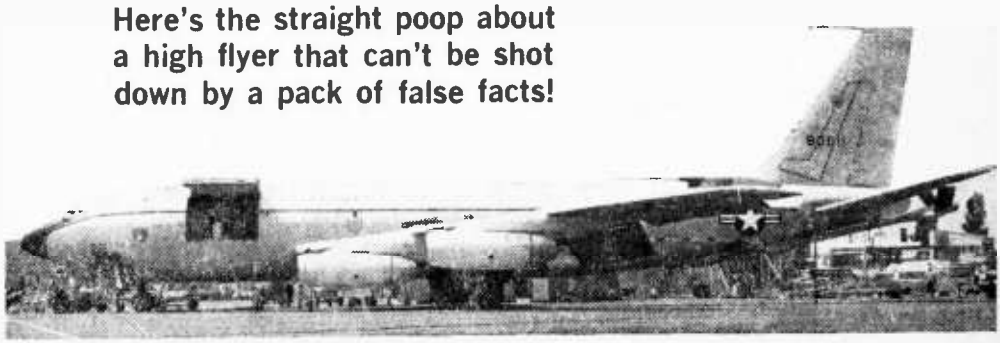
It's What's Up Top That Counts. Almost every major US combat command has its flying command posts. SAC (the USAF's Strategic Air Command) was the first to adopt this high-flying means of communication and insurance that if an enemy wiped out its Offut AFB, Nebr., headquarters a hard-to-take-out alternate would assume command immediately.

Linking these perpetual motion machines with their immediate headquarters and liaison commands are tons of low, high and very-high-frequency equipment. Each flying commander has at his fingertips hundreds of SSB and AM voice, CW and teletypewriter channels.

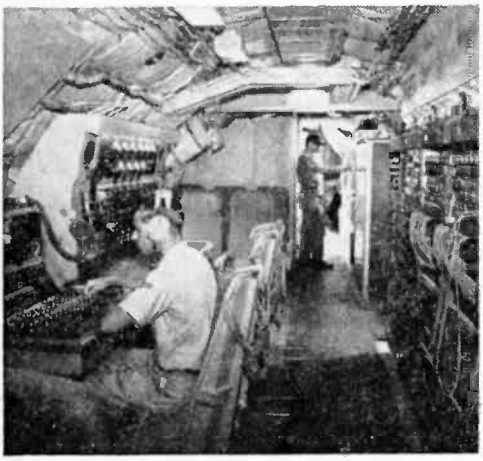
Many flying CPs are equipped with VHF telephone repeater gear, continuously backing up vital land lines protected by immediate cutover facilities should the vulnerable telephone wires be cut. A number of these birds have on-board computers capable of instantly solving tactical and strategic problems to aid the commander in arriving at his necessary decisions. Some have scaled-down replicas of the now-famous electronic situation maps at SAC and North American Air Defense Command headquarters.

A Rose By Any Other Name. Missions flown by these airborne control centers often go by means that would sound great on TV late-late show war films. "Silk Purse" is the project name for the birds used by the US Air Force in Europe in this role. In similar capacities with other commands are "Night Watch," "Looking Glass," "Cover-All," and "Oxeye Daisy." SWLs with general coverage receivers can occasionally hear these aircraft giving routine position or in-flight refueling ("Alfa Romeo") reports on the SSB chan-

Here's the straight poop about a high flyer that can't be shot down by a pack of false facts!



BLUE EAGLE



Inside the Blue Eagle there is enough electronics and communications gear to open a major radio network. This photo was taken in flight high over the Pacific Ocean.

nels clustered around USAF long-distance frequencies of 6738 kHz and 11,228 kHz. They check in on civilian 8 MHz Overseas Airways Control frequencies when they enter the strictly-controlled air corridors.

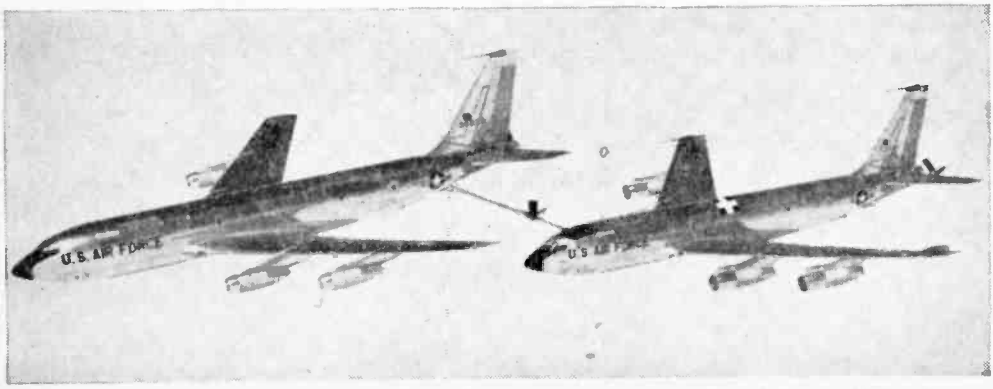
Typical of these high-flying CPs is a ten-year-old lady who began her airborne life as a KC-135A flying tanker built for refueling fighters and bombers at 600 mph. She still carries the "flying boom" which marked her as one of the Gas Pump Gang. Officially, she's known in the Air Force inventory by her tail number—580011, but her crew calls her simply "Zero-Double-One."

In 1961, fully four years before the vaporous "Blue Eagle" of east coast fame, "Zero-Double-One" was taken from aerial refueling and refitted as an airborne 'phone company. Assigned to Hickam AFB, she replaced a prop-driven craft. Now with more than 11,000 flying hours to her credit, only a few of her sisters are ahead of her in time aloft.

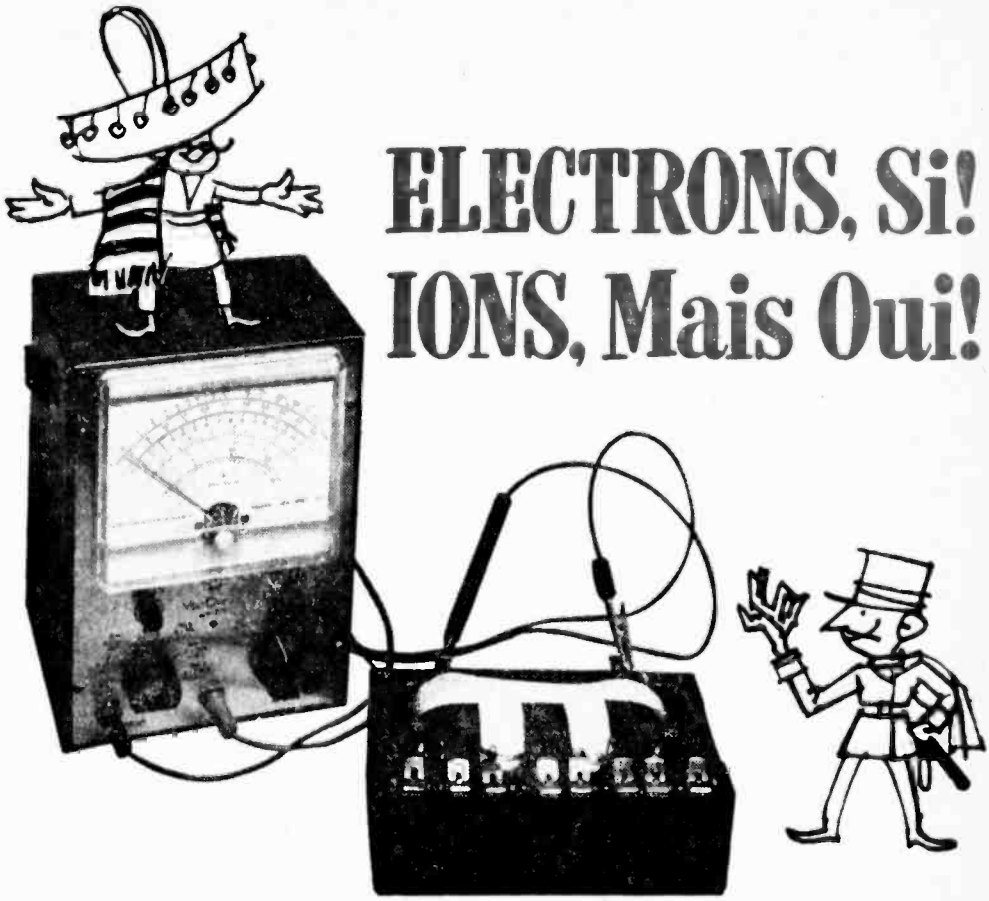
"Zero-Double-One" recently had a complete face-lift and overhaul before being placed back in "Blue Eagle" service. She'll continue in her boring though vital routine until, in Air Force parlance, she's "relieved" by a newer craft. One thing is certain, however: with the world situation, "Blue Eagle" will fly on . . . and on . . . and on . . . ■

The Blue Eagle Blues

☐ In 1965, "the Blue Eagle story" was reported to SWLs in great, yet highly speculative detail. It seems that BCLs and SWLs early in that year were bothered by strange signals coming from the Baltimore, Md., area. Broadcasting recordings and off-the-air signals from local BCB outlets, the station identified itself as "The Voice of the Blue Eagle." It was heard on 535 kHz (with many harmonics) and in the 19 MHz region. In reply to one query, the FCC identified the operation as a civilian bootleg transmitter. In later correspondence, it stated that "Blue Eagle" was a military activity. It now appears that over-eagerness tenuously tied together the two explanations and added information from even a third source. As published, the yarn "exposed" the "Blue Eagle" operation as a government plot in which a Navy C-121 Constellation aircraft had been fitted out with extensive radio and TV broadcast gear. Its test transmissions were supposed to have caused all the din. A C-121 had, in fact, been so equipped and did see service in Southeast Asia, but there is no evidence it was connected with the east coast interference. ■



Blue Eagle, once an Air Force tanker, takes on a load of gas while flying at 600 mph.



ELECTRONS, Si! IONS, Mais Oui!

The electron theory accounts for only half of a battery's chemical action, as these experiments will prove. Give them a try for yourself, and see!

By Charles Green, W6FFQ

Even a rank beginner in electronics is familiar with the operation of what we call a battery. Most would say that a battery (actually a cell) powers a lamp or other electrical load by sending a flow of electrons from its negative electrode through the load and back to its positive electrode. And right they would be. Thing is, most would overlook the fact that any battery also has an *internal* electric circuit—a flow of chemical ions between the battery electrodes themselves.

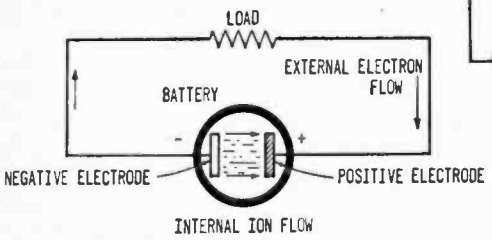
Caused by the change of chemical energy into electrical energy, this internal circuit is made up of ions (electrically-charged particles) that flow through the battery's electrolytic solution (see Fig. 1 on page 46).

The electrolyte (an acid or alkaline solution) causes a chemical breakdown of the more active electrode (usually zinc). As a result, positive ions are released which travel through the electrolyte to the less active electrode (usually carbon). The more active electrode then has an accumulation of electrons, making it the *negative* electrode. Similarly, the less active electrode has an accumulation of ions, making it the *positive* electrode.

By breaking a battery up into two sections, you can conduct experiments that actually reveal the extent of this chemical ion flow. A wet paper bridge soaked in the battery electrolyte will carry the ions between the two sections, as shown in Fig. 2.

Going one step further, *two* batteries can be broken up into separate sections, with a wet paper bridge linking the four electrode cells as shown in Fig. 3. The wet paper circuit will then intermix the ion flows of the two batteries. The ions can be made to either

ELECTRONS, Si!



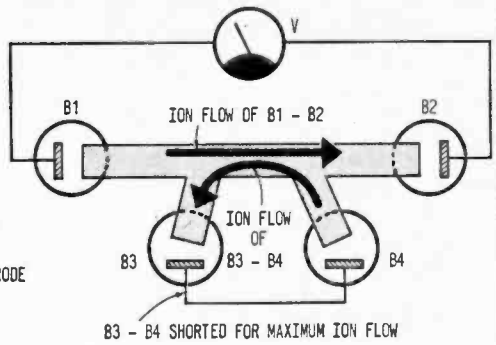


Fig. 1. The diagram at upper left shows a basic battery circuit. Note that ion flow is opposite to the flow of electrons.

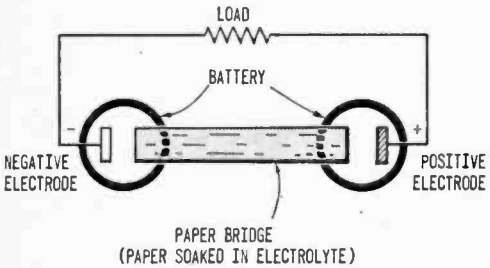


Fig. 2. The wet cell in Fig. 1 can be split in two for experimental purposes. The diagram at left shows how it's done.

Fig. 3. Ion flows from two split cells can be mixed as above to interfere with their mutual flow. Meter indicates drop.

add (flow in the same direction), or oppose (flow in opposite directions). Naturally, the output voltage of the battery assembly will increase or decrease accordingly. And as another experiment, additional electrode cells can be added to the battery assembly and connected with wet paper circuits to intermix the ion flows.

Making the Module. You perform these interesting experiments with our Chemical Ion Flow Module. The module has the equivalent of three batteries in six electrode cells. Additional electrodes are added to each cell for easier control of the ion flows in the wet paper circuits. As shown in our photo, the electrodes are fastened to terminal clips. Aluminum and copper wires serve as the electrodes, with a table-salt solution acting as the electrolyte.

We used a 6 x 3½ x 2-in. plastic box with a perf-board top (Radio Shack 270-097) for our experimental module, with six 7-dram plastic pill containers mounted as shown in the photo and Fig. 4. These containers can be purchased at most drugstores. Alternately, equivalent sized (1-in. dia. x 2⅛-in. high) plastic coin tubes and test tubes can be used, since the size of the containers isn't critical.

Best way to start construction is to lay out and cut the holes in the perf-board top as shown in Fig. 4. Cut and shape the electrodes as shown in the detail drawing of Fig. 5, then mount them with the terminal clips as shown in Fig. 4. Make sure you number the terminals as indicated.

Prepare a salt-water electrolyte by dissolving two tablespoons of table salt in a pint of tap water. Fill each of the module containers to about ¼-in. from the top.

Next, cut a section of paper towel or newsprint as shown in Fig. 6, and wet it thoroughly in the salt water. Carefully place the paper bridge in the module cells as shown in Fig. 8 (note that unused cells in our module are not shown in this drawing).

Experiment No. 1. Connect a vacuum tube voltmeter (VTVM) to the + and − module terminals (a 20,000 ohms-per-volt meter can also be used, but it will be less sensitive to voltage variations than a VTVM). The meter will indicate approximately 0.5 V. Next, connect a lead between terminals 3 and 6 (connection A). The meter reading will increase (our meter indicated approximately 0.6 V). The ion flows have aided each other, increasing the output voltage.

Disconnect the lead, and reconnect it between terminals 4 and 5 (connection B). The meter reading will drop (our meter indicated approximately 0.4 V), thus proving that the ion flows are bucking one another.

Disconnect the lead and reconnect it between terminals 3 and 5 (the two aluminum

Parts List for the Chemical Ion Flow Module

1—6x3½x2-in. plastic box with perf-board top (Radio Shack 270-097)
1—Table salt and water solution (see text)
1—Paper towell or newsprint
6—7-dram plastic pill bottles, approximately 1-in. dia x 2⅛-in. high
10—Fahnestock clip-type terminals or equiv.
Misc.—#16 copper wire, #8 aluminum wire, machine screws and nuts, solder lugs, leads, solder, decal numerals, etc.

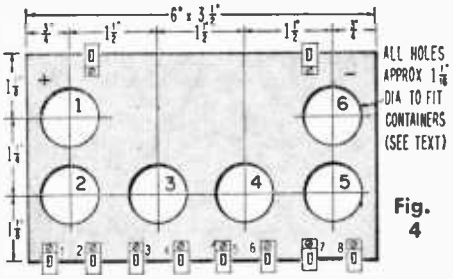
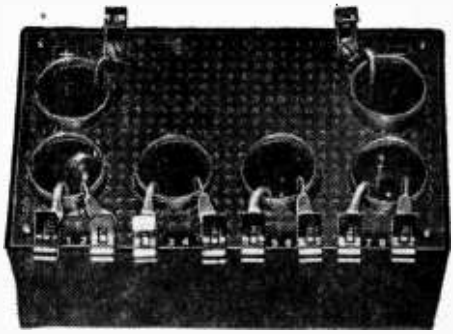


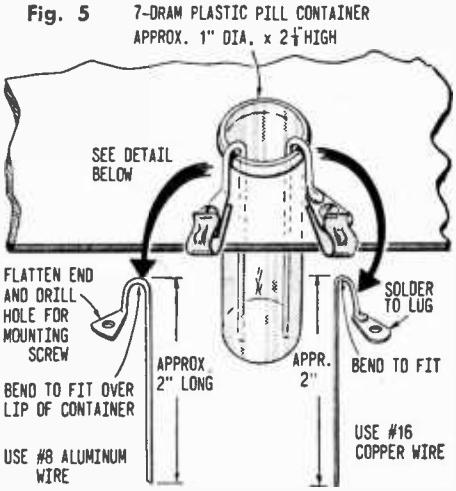
Fig. 4

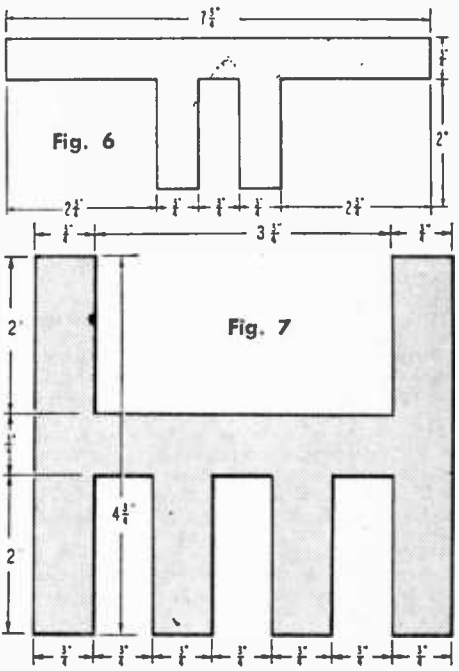


Here's a photo of the finished Chemical Ion Flow Module ready for experiments.

To perform the experiments you must make the Chemical Ion Flow Module. Fig. 4 is a detailed drawing of the module's perfboard lid. Fig. 5 below shows the details of the six cells, and aluminum and copper electrodes. The author used plastic pill boxes, but any plastic or glass container including test tubes can be used. The shapes shown in Figs. 6 and 7 are to be cut from paper towel with care. Be sure to follow the dimensions given. Avoid small tears, cuts or folds, otherwise the paper will tear when wet.

Fig. 5





electrodes), then between terminals 4 and 6 (the two copper electrodes). The meter will reflect no change in voltage since there is no ion flow between electrodes of the same composition. Remove the paper bridge from the module.

Experiment No. 2. Cut out a section of paper towel as shown in Fig. 7 and wet it in salt water. Carefully place it in the module cells as shown in Fig. 9. With the meter connected as shown in the drawing, it should indicate approximately 0.5 V.

Connect leads between terminals 2 and 3, 4 and 5, and 6 and 7 (connection A). The meter will show a large drop (our meter indicated 0.2 V). The meter will then show

IONS, Mais Oui!

a gradual increase in voltage (our meter indicated approximately 0.3 V). This is due to the battery losing its strength under load. The difference in the meter indication as opposed to that of Experiment No. 1 is explained by the greater strength of the ion flow bucking that of the main flow between the Nos. 1 and 2 cells.

Disconnect the leads from the A connections and connect the leads between terminals 1 and 4, 3 an 6, and 5 and 8 (connection B). The meter reading will increase markedly (our meter indicated 0.8 V), since the ion flows are now aiding each other. The reading on the meter will then gradually decrease as the batteries begin to lose their strength.

Experiment No. 3. Still using the setup shown in Fig. 9, remove the leads from the A connections, and connect a lead between terminals 1 and 8. Note that the voltage indicated on the meter rises almost as much as it did when several cells were connected in series in Experiment No. 2 (our meter indicated approximately 0.7 V). This shows that placement of the cells along the wet paper is important (the 2 and 5 cells are now physically close to the 1 and 6 cells at each end of the strip).

The wet paper bridge can be cut into various shapes to connect the cells at different places to further experiment with the chemical ion flow aiding-and-bucking operation. Who says electrons are all that count? ■

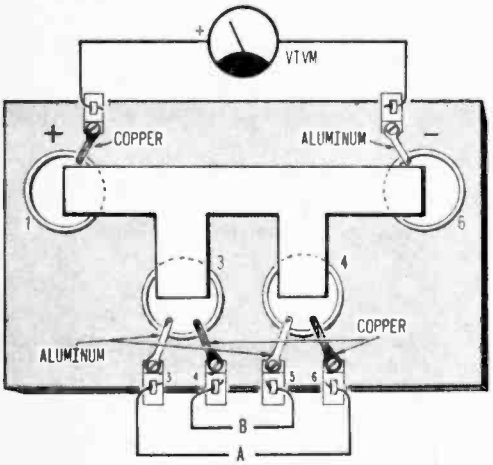


Fig. 8. This set-up for Experiment 1 is identical to that shown in Fig. 3. Shunts "A" and "B" are used one at a time—see text for details.

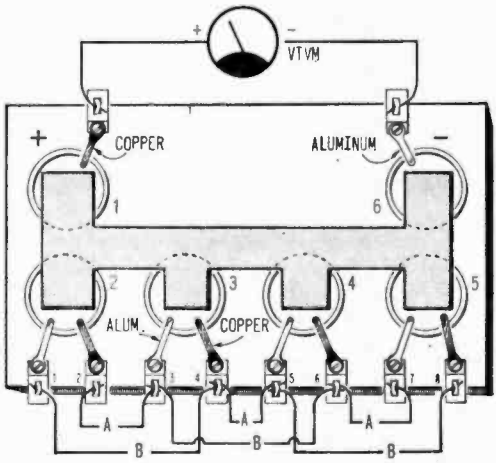


Fig. 9. Here's Experiment 2 all set-up and ready to go. With slight modification, you can use this setup arrangement in Experiment 3.

YOU CAN FILE THIS RADAR PICTURE

The U. S. Weather Bureau is now piping radar weather pics over ordinary voice telephone lines to remote locations for use by commercial weather consultants. At right, a radar display is received at Falls Church, Va. from the Washington National Airport. The system operates using slow-scan TV cameras to view the weather radar scope display and to transmit via phone lines to low cost facsimile recorders at remote points. Instead of viewing a scope at the terminal, an electro-sensitive recording paper which uses "electricity as an ink" provides permanent copies every minute. ■

SPEECH is their SPECIALTY

Electronics helps therapists give kids the gift of speech

☐ Throughout the nation, speech and hearing service centers are facilitating educational and social adjustment of children who desperately need corrective work in speech and audiology.

Take, for example, the clinic at the Queens Center, which is affiliated with and supervised by Queens College in Flushing, N.Y.

Headed by Mrs. Beth Fleischer, the Queens Center's staff of professional and student therapists treats over 200 patients each semester. Thanks in large part to Mrs. Fleischer's talented direction, the Center has developed a comprehensive program of work-and-play exercises which help diagnose and correct a wide range of speech and hearing problems common to children.

Child undergoes test to determine extent of hearing impairment.

The Center's therapists strive their utmost to always present their treatment in the form of games of one sort or another. In doing so, they successfully stimulate the children's speech and language production by means of puppets, mirrors, and a number of group experience and activity programs. Their treatment for children with infantile speech encourages the boys and girls to participate in so-called

SPEECH

spontaneous speech practice sessions. And their program consistently includes exercises which result in greater muscular control of speech-producing organs.

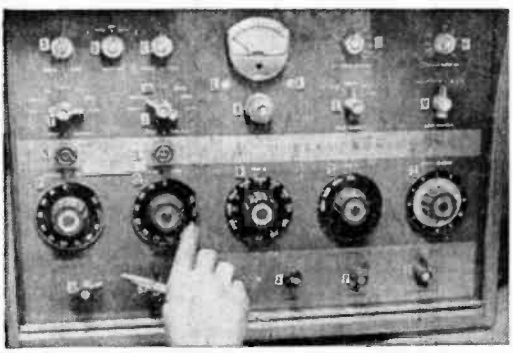
After testing children with hearing problems for auditory discrimination and for awareness of the presence and absence of

Since child is often best judge of optimum listening setup, she is encouraged to adjust earphones in any way she sees fit.

Control consoles enable technicians to preset intensities and frequencies of test tones. In addition, switch selects any one of six audio inputs.

Far left, young boy practices looking, listening, then saying word, while speech therapist reinforces every response he makes. Center, another youngster learns to place peg in hole whenever he hears sound; conducted by two student therapists, experiment tests child's awareness of presence or absence of sound. Below, little girl learns importance of nasal cavity in determining tonal quality of speech she hears.

sound, the Center provides a variety of exercises which demonstrate the relationship between seeing and hearing. By playing games with earphones, mirrors, and toys of various descriptions, the children successfully and painlessly learn to correct their speech and hearing problems. ■



Produced by Maico Electronics, this instrument emits tones at selected frequencies from 125 to 8000 Hz at levels ranging from 0 to 125 dB.

Simple games—in this case, putting so-called doughnuts on a stick—play major part in tests. Instructions are verbal.

Discover the ease and excitement of learning Electronics with programmed equipment

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Propagation Forecast

By C. M. Stanbury II

April/May, 1969

■ Shortwave conditions are constantly changing. They are seldom exactly the same from day to day. Thus, any prediction can only select the band or bands which will more often than not be best during a certain time period. Because conditions do vary, the best SWBC band may be the one above or below the one listed in the table.

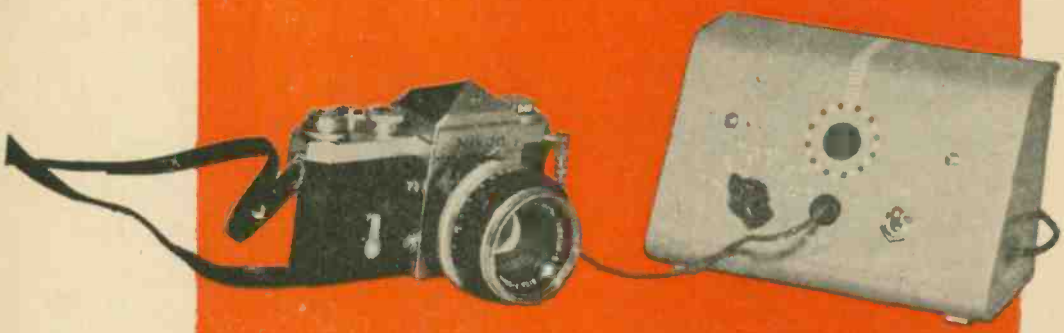
On the other hand, the operating patterns of the SWBC stations themselves modify our table a wee bit. For example, at 0900-1500 listener's time, 16- and 19-meter bands are listed as best for Europe. Technically speaking, on a few days, 13 meters will actually provide stronger signals from Europe than 19 meters. But, as yet, not quite enough Europeans have moved up to the 13-meter band to warrant its listing as an important second choice.

Meanwhile, static has again become an important factor on frequencies below 7-MHz (41 meters), but, these frequencies will still be best for Latin America at night. Why? Well, simply because that's where most of their SWBC stations operate. Most other SW prediction columns around these days don't bother to take this little matter into account. Now is also the time to watch these lower frequencies for stations from the southern part of Africa—Rhodesia, Zambia, S. Africa, etc. See WHITE'S RADIO LOG (pages 96 to 99) for frequencies. ■

April/May 1969 LISTENER'S STANDARD TIME	ASIA (except Near East)	EUROPE, NEAR EAST & AFRICA (N. of the Sahara)	AFRICA (S. of the Sahara)	SOUTH PACIFIC	LATIN AMERICA
0000-0300	19, 25	31, 41	49, 60e	41w, 31 (60w)	49, (60)
0300-0600	(31), 41, 49	31 (poor)	31	49, 60	49, 60
0600-0900	13e, 19, 25, 49w	(13), 16, 19	19	25, 31	(19), 31
0900-1200	16, 19	(13), 16, 19	19, 25	(19), (25)	19
1200-1500	16, 19	(13), 16, 19	19, 25	(19), (25)	19
1500-1800	16, 19, (31)	25, 31	31, (49), (60e)	19 (poor)	(16),(19),25,31
1800-2100	16, 19	25, 31	25, 31, (41w)	16, 19	25, 60, 490
2100-2400	16, 19	25, 31	31, 41, (49), (60)	19, 25	49, 60, 900

To use the table put your finger on the region you want to hear and log, move your finger down until it is alongside the local standard time at which you will be listening and lift your finger. Underneath your pointing digit will be the shortwave band or bands that will give the best DX results. The time in the above propagation table is given in *standard time* at the listener's location, which effectively compensates for differences in propagation characteristics between the East and West Coasts of North America. Abbreviations: w—Western North America and e—Eastern North America. When w or e follow a band listing, it means the band is only good for that part of the continent. The shortwave bands in brackets are suggested as possible second choices. Refer to White's Radio Log for our world-wide Shortwave list.

PHOTOFLASH SYNC TESTER



Check any camera's flash and shutter sync with this simple tester you can build today!

by Ron Michaels

☐ Photographically speaking, one of the most critical mechanisms imaginable is the tiny synchronizing contact system built into your camera's shutter. If the timing function performed by this gadget is out of step by even a few thousandths of a second, the flash pictures you take will be improperly exposed. And therein lies a tale.

Precise synchronization between the opening of the shutter and firing of either a flash bulb or an electronic flash unit is necessary for several reasons. Let's consider flash-bulb first.

A flash bulb doesn't go off instantaneously. Depending on the type of bulb, the time delay between feeding the firing current into the bulb and the production of the maximum light level will be between 7 and 30 ms (1/1000th of a second). The familiar flash bulbs that amateurs use often peak in about 20 ms.

Although 20 ms doesn't sound like a long time, it is when you are talking about cameras! A shutter set for the speed 1/50 of a second is open for only 20 ms (20/1000 = 1/50). And a common diaphragm shutter goes into action very quickly—it begins to open a few milliseconds after the release button is pushed.

(Continued Overleaf)

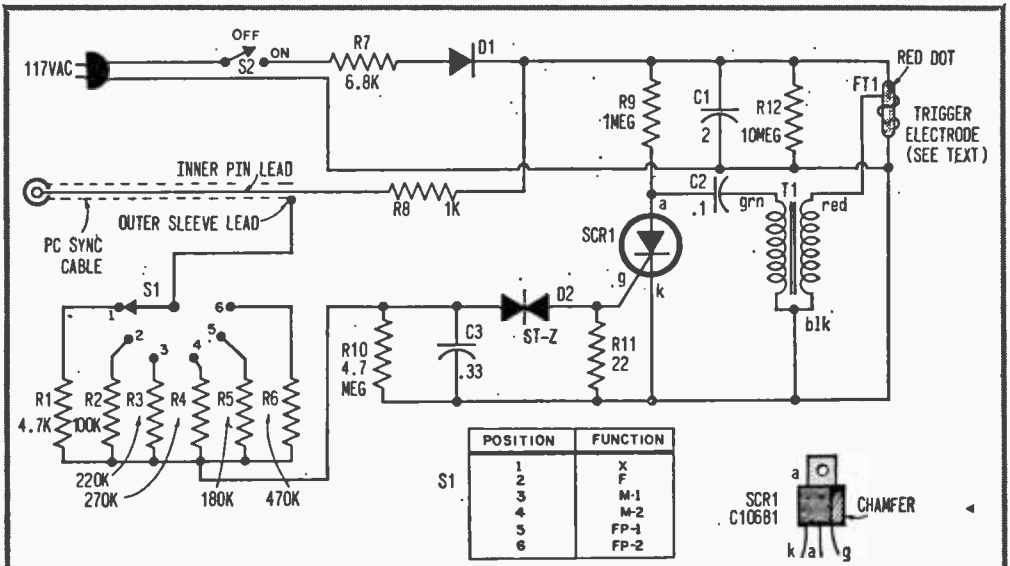
PHOTOFLASH SYNC TESTER

All-Speed Synchro. The point is that for proper exposure the shutter must be synchronized with the firing flash bulb so that the bulb is producing its peak output at the same time that the shutter is fully open. In practical terms, this means that the flash bulb must be fired a short time *before* the shutter starts to open.

An electronic flash introduces another problem. It goes off almost instantaneously and its flash duration (the length of time the tube is glowing brightly) is very short, usually less than a millisecond. This means that the flash must be triggered at the exact instant the camera's shutter is fully opened. A few milliseconds too soon or too late, and a good deal of light will be lost; several milliseconds too soon or too late, and the picture will be totally unexposed.

So far, we've spoken mainly about diaphragm (leaf) shutters. However, focal plane shutters (used in expensive miniature and press cameras) have a different synchronization requirement. Reason is that the shutter consists of an open slit that moves quickly across the film's plane, which means that the entire film area is not exposed simultaneously.

As a result, electronic flash cannot be used with such cameras, nor can ordinary flash bulbs. Instead, a special slow-burning bulb (the *FP*—for focal plane) is called for. The

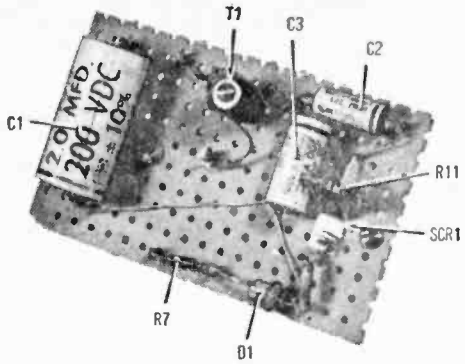


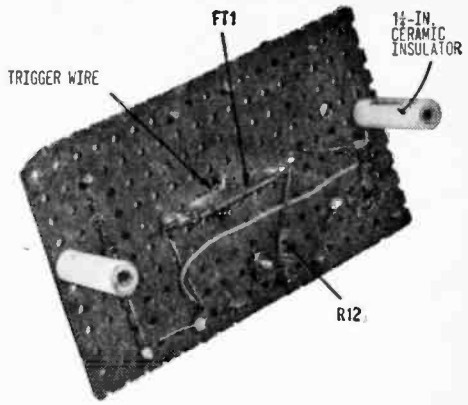
PARTS LIST FOR THE PHOTOFLASH SYNC TESTER

C1—2-uF, 200-VDC paper capacitor
C2—.1-uF, 200-VDC paper capacitor
C3—.33-uF, 200-VDC paper capacitor
D1—200-PIV silicon rectifier
D2—Trigger diode (6E ST-2 Diac)
FT1—Flashtube (GE FT-30; Edmund Scientific 40725)
R1—4700-ohm, ½-watt resistor
R2—100,000-ohm, ½-watt resistor
R3—222,000-ohm, ½-watt resistor
R4—270,000-ohm, ½-watt resistor
R5—180,000-ohm, ½-watt resistor
R6—470,000-ohm, ½-watt resistor
R7—6800-ohm, ½-watt resistor
R8—1000-ohm, ½-watt resistor
R9—1,000,000-ohm, ½-watt resistor
R10—4,700,000-ohm, ½-watt resistor
R11—22-ohm, ½-watt resistor
R12—10,000,000-ohm, ½-watt resistor
S1—1-pole, 6-position rotary switch
S2—Spst toggle switch
SCR1—Silicon controlled rectifier (GE C106B1)
T1—Trigger transformer (Stancor P-6426 or equiv.)

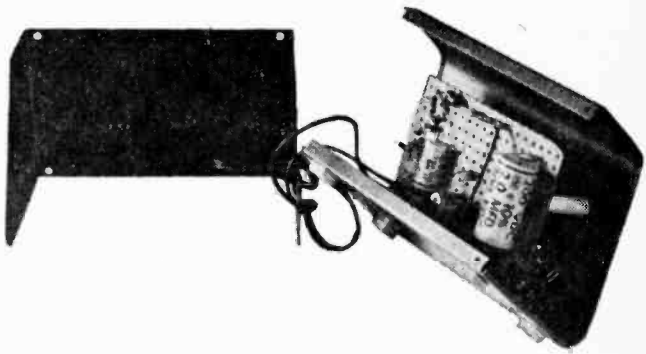
Misc.—Aluminum case with sloping panel, ceramic insulators, PC sync cable, AC line cord, perfboard, push-in terminals, wire, solder, hardware, etc.

Note—The GE FT-30 flashtube is available from Edmund Scientific Co., 600 Edscorp Bldg., Barrington, N.J. 08007, for $7.45 postpaid.





Except for power switch S2 and sync selector switch S1 that mount on the front panel, all parts are mounted on the perfboard (both sides shown above). Be careful when you mount the photoflash tube, FT1, to the perfboard. Handle with care—it breaks easily. The trigger wire must be a soft wire that can be pressed gently against the tube. All is for naught if the tube is not mounted beneath the front panel hole. Photo at right shows perfboard on spacers.



camera's synchronizer triggers this bulb a few milliseconds before the shutter begins to operate. The bulb then produces a fairly uniform output for the relatively long time that is required for the slit to traverse the film's plane (about 25 ms).

Below the critical cut-off speed, ordinary flash bulbs of electronic flash units can be used with a camera having a focal plane shutter. But the same synchronization factors required by diaphragm shutters must be observed.

Time Tables. Clearly, a single synchronization timetable can't be used for both flash bulbs and electronic flash units, regardless of whether you have a diaphragm or focal plane type of shutter. So most cameras are equipped with a choice of synchronizer operation. You can select the appropriate synchronization factor by either flipping a lever or (in some cameras) by plugging the flash unit into different sync connectors on the camera body. The different settings are usually labeled with abbreviations such as *X*, *M*, and *F*. Unfortunately, the use of the different settings is clouded by a good deal of confusion. We'll try to summarize usage here.

The *X* setting fires the flash at the instant that the shutter is fully open. Note that on a focal-plane-shutter camera this setting has meaning only at shutter speeds below the cut-off speed (consult your camera's instruction manual). Traditionally, the *X*-setting is for electronic flash. However, if the shutter speed is set to 1/30 of a second or lower, it can also be used to fire *M*-type (medium speed) flashbulbs and *F*-type (fast speed) flashbulbs. This is because the relatively long exposure time allows the flashbulb to reach its peak brightness before the blades close.

The *M*-setting fires the flash approximately 15 ms before the shutter opens. (On focal-plane shutters set above the cut-off speed, the flash is fired 15 ms before the slit begins to move across the film's plane). This is the correct setting for *M*-type flashbulbs (most common flashbulbs, like the AG-1, AG-3, M-1, M-2, M-3, etc.); and for focal plane cameras, this the setting for *FP* bulbs.

The *F*-setting fires the flash approximately 7 ms before the shutter opens. This setting is rarely used since *F*-type bulbs are no longer common. These are small, fast-firing lamps that have been superseded in most applications by electronic flash units.

PHOTOFLASH SYNC TESTER

As we've said, synchronization is crucial for good flash photography. Surprisingly, it's a factor that the amateur often overlooks—or at least takes for granted. One reason, of course, is that few people own the equipment necessary to check out synchronizer operation. The simple Photoflash Sync Tester about to be described can verify all the sync settings on any type of camera. This gadget is a must for every serious amateur who spends time and effort making flash photographs.

Tricky MO. The Sync Tester is a miniature electronic flash unit equipped with a unique triggering circuit. The trigger has different delay factors built in so that the flash can be used to simulate the action of different photoflash bulbs, as well as duplicate the behavior of an electronic flashgun. The table on the next page details the various instrument and camera settings that will enable you to check synchronization settings.

Making a test is a breeze. Once the camera and Sync Tester are set up, you simply aim the lens at the tester's flash tube, look into the rear lens, and press the shutter release. You will either see the flash or you won't! The *results* column in the table tells you what you should see if the sync setting being tested is functioning properly. But we'll say more about this later.

The circuit is quite simple. A simple half-wave rectifier charges storage capacitor C1 and trigger capacitor C2 to approximately 170 VDC. A miniature xenon flashtube, FT1, is wired across C1.

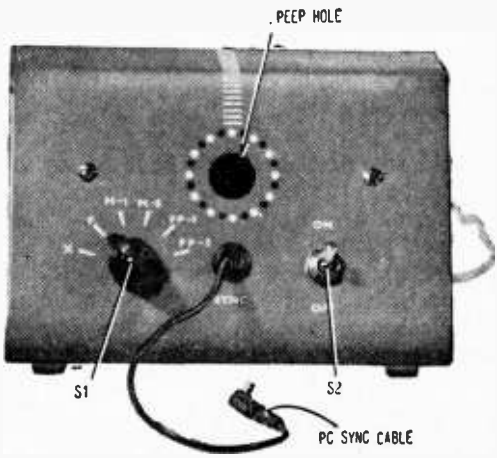
Normally, the tube acts like an electrical insulator. However, if a high-voltage pulse (about 5000 V) is applied to the metal trigger electrode positioned against the tube's glass envelope, things change immediately. The gas inside is ionized slightly and the tube suddenly becomes a good conductor. Almost instantaneously, the electrical energy stored inside C1 is discharged through the flash tube, creating a short burst of blue-white light.

The triggering pulse is produced by a circuit similar to the ignition system inside your car. Silicon controlled rectifier SCR1 acts like an electronic switch. When it is triggered into conduction by a voltage applied to its gate electrode, it permits C2 to discharge through the primary winding of trigger transformer T1. This produces a short high-voltage pulse at the output of T1's secondary. This is the pulse that triggers the flash tube. So whenever a suitable voltage is applied to the gate of the SCR1, the flash tube will fire.

The various sync contacts (operating mechanism) in your camera control the SCR. These are simply electrical switches (or a single switch) that are controlled by the shutter and various mechanical delay trains. The camera is connected to the Sync Tester via a standard sync cable and connector. The sync contacts (when connected to the circuit) are effectively wired in series with an RC time-delay circuit composed of capacitor C3 and one of the six switch-selected timing resistors (R1 through R6).

When you trip the camera's shutter, the contacts close momentarily and permit C3 to charge. The greater the value of the timing resistor, the longer it takes C3 to charge. When the voltage across C3 reaches about 30V, trigger diode D2 breaks down, permitting C3 to discharge through the gate of SCR1. This triggers the SCR and fires the flashtube.

The value of the resistor selected by S1 determines how long after the sync contacts close that the flashtube fires. The six resistance values have been chosen to provide a range of time delays sufficient to allow you to check all common sync settings.



Here's looking at the photoflash Sync Tester from up front. The photoflash tube is positioned directly behind the peep hole.

CAMERA TEST SET UP CHART

Camera Settings			Sync Checker Setting	Results for normal operation
Sync	Shutter Speed	f/stop		
SET UP FOR FOCAL PLANE SHUTTER CAMERAS				
X	1/25 or 1/30	wide open	X	Must see flash clearly.
M	1/25 or 1/30	wide open	M-1 and M-2	Must see flash for both settings.
M	1/100 or 1/125	wide open	FP-1 and FP-2	Must see flash for both settings.
F	1/25 or 1/30	wide open	F	Must see flash clearly.
SET UP FOR DIAPHRAGM CAMERAS				
X	1/50 or 1/60	wide open	X	Must see flash clearly.
M	1/100 or 1/125	wide open	M	Must see flash for both settings.
F	1/50 or 1/60	wide open	F	Must see flash clearly.

Building the Baby. The circuitry is built inside a 7-in. wide, sloping-panel cabinet. Because there is no isolation transformer in the circuit you must be sure that no components other than the switches come in contact with the cabinet.

Most components are mounted on a piece of perfboard, using push-in terminals as wiring points. This board is supported away from the front panel by a pair of ceramic standoff insulators.

Mount the flashtube on the back of the board, and position under a cutout in the case's front panel. Note how the tube is installed; simply press its end electrodes into two push-in terminals mounted in appropriate holes. But be careful when you handle the tube—it's very fragile.

The Sync Tester is so easy to use that our Cover Girl became an expert while posing. Just follow the instructions on this page.

The tube's trigger electrode is a ½-in. long piece of bare hookup wire curled around half of the tube's circumference (at its midpoint). Solder the other end of the wire to an adjacent push-in terminal to hold it in place. Note that the trigger wire doesn't make actual electrical contact with any part of the tube's electrodes; it simply rests against the glass envelope.

Making Your Tests. The six switch positions are labeled according to the tests performed on various sync settings. (See the above table for details.)

- X is a very short delay (well under a millisecond). At any speed of a diaphragm shutter, and below the cut-off speed of a focal plane shutter, you should see the flash clearly through the rear lens of the camera.
- F is a moderate delay (about 7 ms). Same comments as above.
- M is a moderately long delay (about 18 ms). The flash represents the *start* of the light burst from an M-type bulb. At any speed of a diaphragm shutter, and below the cut-off speed of a focal plane shutter, you should see the flash clearly.
- M-2 is a long delay (about 22 ms). The flash represents the *end* of the light burst from an M-type bulb. You should see the flash at all shutter speeds below 1/1000 of a second with any kind of shutter.
- FP-1 (for focal plane shutters only) is a moderate delay (about 15 ms). The flash represents the *start* of the light burst from an FP type bulb. You should see the flash at any shutter speed.
- FP-2 is a very long delay (about 36 ms). The flash represents the *end* of the light burst from an FP bulb. Again, you should see the flash at any shutter speed. ■

THE DAY THE WORLD

Peter Plodner hated the world's guts! His one passion in life was electronics, yet he had been discharged from IBM, RCA, GE, Xerox, and the Houston Space Center. His downfall in every case was one of the variety of women that walked in and out of his life.

At the Space Center, he had worked in Remote Operational Control. After a giant Cyclops rocket was off and on its way to Mars, he had relaxed in his chair and began thinking of Cindy, a vibrant, red-haired hat-check girl he had over tipped only the night before. This caused him to press a red button in place of a green one when it was time to drop off the rear section of the rocket. The red button blew the entire Cyclops to kingdom come, costing the government a cool 30 million dollars. Naturally his association with the Houston Space Center ended immediately.

~@~He sat now in Richard's Bar sipping his Cutty Sark and planning on how to get back at a world that refused to understand his genius.

"What's up, Mack?", asked the boozer beside him. "Your face is longer than a window shade. Your wife come back to you?"

Peter told him of his repeated failures in electronics.

"I've been looking from behind the eight-ball so long my eyes try to roll into my side pockets," he said bitterly. "I hate everybody. I go out of my way to kick stray dogs."

"I knew a guy who was like that," said the man quietly.

"What did he do about it?" asked Peter, downing his Cutty Sark.

"He took the Coney Island Express one night . . . . from in front of it," replied the man in sad tone of voice.

"Well, I think I'll blow up the world," said Peter quietly.

"That would be one sure way of getting even with everyone. But how are you going to step off before you do it?"

"That's right, isn't it?" said Peter. "Well then, I'll only blow up half of it. That'll make me feel better anyway."

"That's the best idea. By the way, when you get ready to do it, let me know which half is going to be left, will you?"

Our world leaders took earth and all because Peter Plodner

"Yeah, I'll do that," said Peter, rising from the bar. "Well, I'm going home to work on the plans. See you later."

~@~When he reached his small apartment in Brooklyn, he took out his college science and physics books and began looking up nuclear actions. For several hours he studied fission and fusion methods of reaction as well as the components of various elements.

"Very heavy elements such as uranium and plutonium are split in the fission method by sub-atomic particles called neutrons," he read aloud as he made notes. "In the fusion method, four hydrogen atoms are fused with one helium atom for helium is the next heavier element. This causes a reaction."

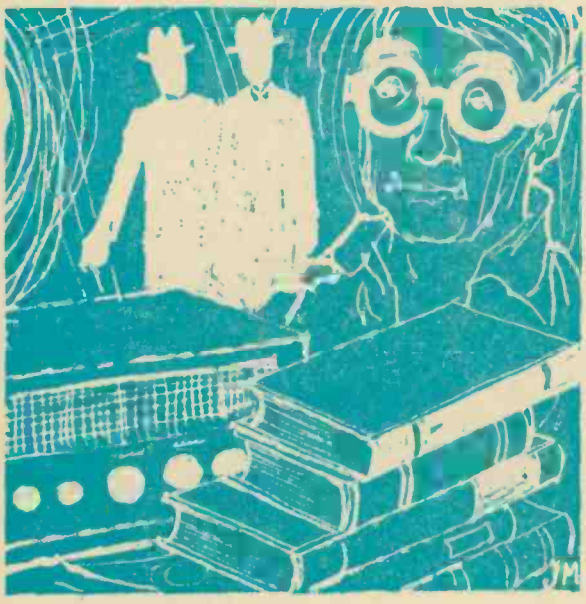
He stopped to light a Kent as he sat back thinking.

"Hydrogen . . . . the sun is made of hydrogen." He found a book on astronomy. "The sun throws off energy because of atomic reactions of hydrogen fusing with helium.

HAD A HOT FLUSH

By Charles Getts

through its first peaceful change, had a mysterious black box!



There is enough hydrogen in the sun to last another seven billion years."

"The sun would give me all the hydrogen I need," he thought aloud, "But how can I get it down to react over the earth?"

It was later, as he was undressing to go to bed and taking off his trousers that he looked down at his belt and the idea struck him. "The Van Allen Belt!", he cried. "It's made up of *charged, sub-atomic* particles. I can use them to trigger the hydrogen atoms from the sun." He dashed to his books, in his baggy shorts, to find information on the Van Allen Belt and began reading aloud.

"The Van Allen Belt is a double layer of charged sub-atomic particles that encircles the earth. Its inner layer is 1500 miles up and does not touch our atmosphere. But the outer layer touches our atmosphere in the vicinity of the poles. The Van Allen Belt catches electrons from the sun and the leakage of these electrons at the poles causes the effect of auroras to spread across the skies."

Peter laid down the book to begin thinking once again.

"Our atmosphere is 78 percent nitrogen and 21 percent oxygen. Oxygen is the next heavier element after nitrogen. Nuclear fusion takes place between four atoms of one element fused with one atom of the next heavier element. Therefore, if I can fuse four atoms of nitrogen with one atom of oxygen, I'll have an explosion. And the Belt will carry it by chain reaction around the world if I can start it going at the North Pole."

A small, happy smile spread over his cherubic face.

"I'll use the hydrogen atoms from the sun that are carried in the electrons hitting the Van Allen Belt. It says it is filled with charged sub-atomic particles. They will do the work of the neutrons in atomic fission. I have just become a . . . genius."

He went to sleep with his mind excited and dreamed that he had set off an explosion that blew up half of the world. He woke up suddenly to find that he had fallen out of his bed.

The next morning he sat down to figure out the final details of his plan. He had to discover some manner in which to send his nitrogen atoms up to the North Pole. His eyes suddenly fell upon his short-wave set in the corner of the room. That was the answer. He would saturate the short-waves with nitrogen and send them to the North Pole. He rushed to get his books to look up nitrogen atoms.

It took him a month before he had his apparatus ready to test. It was all enclosed in a small, black, lead box that fitted over the end of his antenna. *(Author's Note: Due to the nature of this discovery and the possible threat to the safety of the world, I feel it best not to describe the actual manner of transmitting nitrogen atoms by means of shortwave signals.)*

It was eight o'clock one night when Peter decided to make the test. He had made the decision also that he would not destroy the area covered by the Van Allen Belt this

(Continued on page 108)

HAM TRAFFIC DE W2DQS

By MARSHALL LINCOLN

How Much Yak Is Enough?

Have you been listening more and enjoying it less?

This paraphrase on an old cigarette commercial expresses the thoughts many hams are having regarding some of today's operating methods.

With a virtual "conversation explosion" occurring on most ham bands these days, many operators whose experience dates back a number of years are finding they're spending more time flipping through old QSL cards than pushing the transmit button on their rigs. More than one has told me "I sure like working with radio gear, but when I tune across the bands I just don't hear anyone interesting enough to talk to."

When you consider that ham bands today are more crowded than ever, it becomes clear that we apparently have more quantity than quality in much of our operating.

This brings into focus the key question I want to ask: how many hams mistakenly feel that yakity-yak in itself is the object of ham radio?

The way I've always understood it, the purpose of ham radio in the beginning was to learn how to build and operate equipment so you could be heard by another operator some distance away. Naturally once such contact was established, conversation took place. However, the conversation was secondary—the *important* thing was finding out if the bloomin' contraption would work.

As the old timers learned more about this mysterious thing which came to be called radio, it became more and more certain that they could make it work, but the next thing was not just to talk more, but to try to learn how to build equipment that would work even better, or to make it do something that it hadn't been capable of before. From this desire to experiment and improve, came such things as SSB, RTTY, TV, facsimile, microwave and even ham satellites.

And Now—? From a meager beginning, we now have arrived at the present state of affairs wherein making the equipment work requires very little attention, if all you want to do is carry on a conversation. So, many operators have taken advantage of this state of affairs to use their equipment for constructive purposes, such as providing public service communications. Others use it as a technical communications channel to discuss electronic developments and to compare notes on technical subjects. Still others use their radio gear in contests and DX chasing, presumably with the intent of sharpening their operating skills.

Many others, however, have put this marvelous invention to use merely as a nationwide gabby party line. It's all a lot of fun, but does it serve any useful purpose? While mulling over an answer to that one, think about this also: even if you could justify yaking merely for the sake of yaking on the ham bands in moderate amounts, can you defend long-winded barrages of yakity-yak which concern only a very small number of participants? Don't such performances in marathon tongue-wagging fall into the same category as the gossipy housewives who monopolize a party telephone line?

After all, our ham bands are *our* own party lines. That most uncommon thing known as "common sense" should tell us we should use them thoughtfully, with due consideration for others who are forced to listen on our party line?

Can't Check It. No one can set a time limit on tongue wagging, or a quota on QSOs, but we should all remember that ev-

ery time one of us pushes the "go" button on the rig to talk to one other ham, a hundred or a thousand pairs of ears may be listening.

Now let's inject another factor: how many guys and gals really have something to say when they begin transmitting? How often have you heard some fellow break into an existing conversation and say something like: "Hey, Charlie, how you been, ol' boy? Heard you on and just had to give you a shout. Don't have anything to say, just wanted to let you know you were gettin' the ol' signal out of the back yard."

What a tremendous burst of non-intelligence! Is this legal? Sure it is. Is it good manners? Seems doubtful, sometimes. Does it *contribute* anything to ham radio? You supply the answer.

No one can prove inane chatter and long-winded transmissions that say nothing are actually harmful, yet you don't have to look far to find hams who are finding less and less to interest them on some of our bands. And you frequently find fellows who are embarrassed to turn on their receivers for non-ham visitors in the shack for fear of what childish bleatings may pour forth from the speaker upon the astonished ears of folks who thought there was more to ham radio than just idle chatter.

You Can Help. To do your part toward lessening the clutter, try this:

Before you begin transmitting, ask yourself what you have to say that is so all-fired important to someone else. Think how *you* will sound to that vast unseen audience on the band, and you have taken a giant step toward beginning a thoughtful, sensible radio operator.

Don't Cry Wolf. On another, related subject, surely we all realize that no one with an ounce of brains would ever cry "fire!" in a theater, yet now and then someone commits this same sin on the ham bands.

A case in point was an occurrence a while back on 40 meters, where a West Coast group operates a full-time monitoring service for traffic-handling and emergency messages. An operator who shall remain nameless out of mercy for his reputation originated a "test emergency" message, but neglected to specify it was a "test," not the real thing!

Fantastic though it may seem, this fellow reported a major earthquake near a large West Coast city where earthquakes are somewhat common and can be serious disasters.

Following this blunder, well-intentioned hams who were misled by the message swung into action and started notifying official agencies, including the national Civil Defense organization.

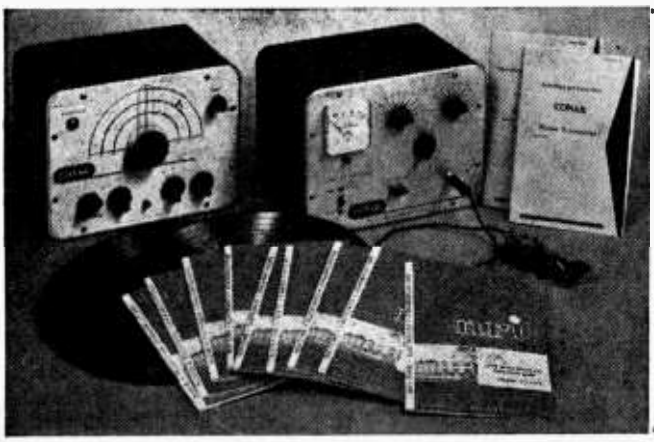
It didn't take long for someone to discover the whole thing was not real, but it took quite a while—and a lot of very embarrassing phone calls—to shut off all the emergency officials who had been alerted. Probably many of these officials will now take a very dim view of anything related to ham radio in the future—thanks to the thoughtlessness of one operator who cried "Wolf!" when he shouldn't have.

As Ed Gribi, WB6IZF, commented in a news letter following the abortive "emergency":

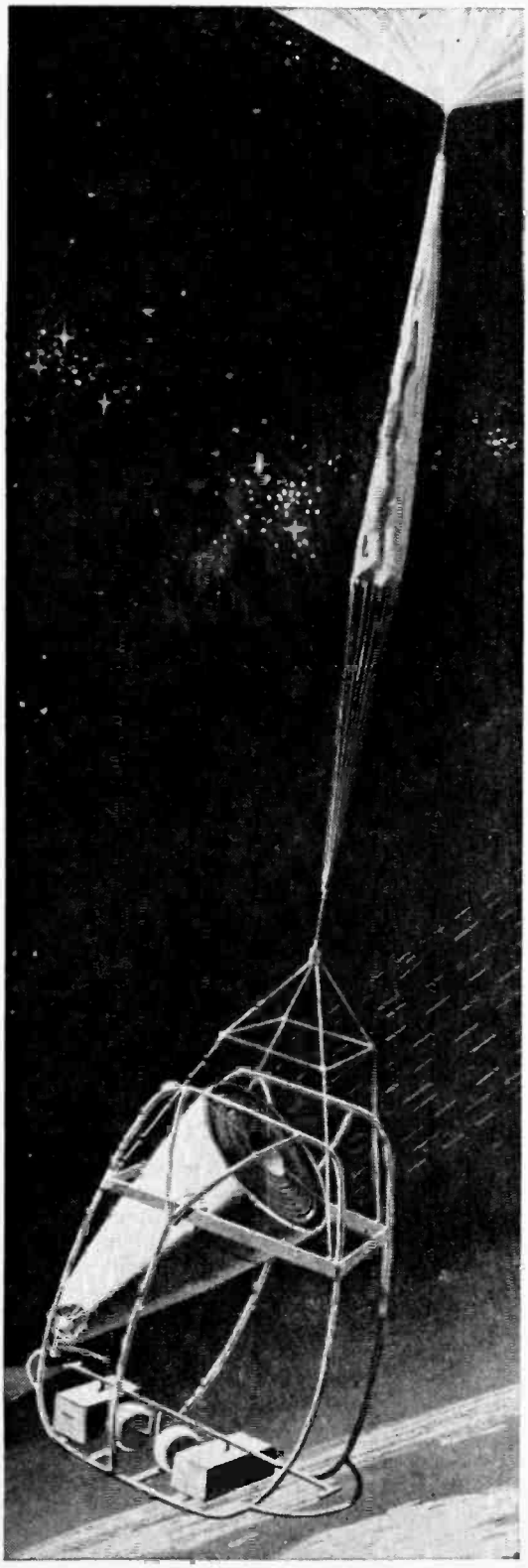
1. *Never* put a test emergency message on the air without liberally sprinkling the message with words like "test", "drill", and "practice".

2. *Always* verify such a message before contacting other authorities.

(Continued on page 105)



A correspondence course leading toward a ham license is now offered by the National Radio Institute. Pictured are the transmitter, receiver, code practice records and some instruction booklets which are included in the course. Information is available from Amateur Radio Division, National Radio Institute, 3939 Wisconsin Ave., Washington, D. C. 20016.



Drawing and photos by Boeing

A new X-ray telescope

Some years ago, during an experiment to learn if the moon was emitting radiation, scientists discovered X rays coming from beyond the moon, from sources which could not be linked with either the sun or her planets.

More than that, some of the X rays seem to begin somewhere beyond our solar system, even outside our galaxy—the Milky Way.

Physicists agree that this happenstance discovery of extra-terrestrial, non-solar X rays opened a new region of the electromagnetic spectrum and offered another possible method of exploring the universe. By measuring the energy spectrum of cosmic X rays, for example, scientists might find clues to the processes and conditions existing in those X-ray-producing areas of space.

EXPLORERS

What Is the Answer. Are X rays produced by protons or electrons mixing with interstellar matter, as some theorize? Or are they the products of gamma rays from radioactive nuclei in stars? No one yet has the answers. The new science has been unable to break the energy spectrum code.

One of the obstacles nature has placed in the way is the incredibly small energies involved. X-ray astronomers deal in terms of a few thousand electron volts. Rough calculations indicate it would take 100 million million million electron volts to equal the energy a 100-watt light bulb puts out in an hour.

Some 25 miles above Earth, "soft" radiation coming from so far away is absorbed by the atmosphere. To counter this atmosphere filter, scientists must send sensors aloft in rockets, balloons or satellites.

promises to send to Earth more knowledge . . .

The X-ray flux, or rate of flow, is small, so scientists use large shielded sensors to collect significant readings. Not surprisingly, weight restrictions imposed on equipment being sent into space limit these experiments.

Even so, their work helped identify some 30 general points in space as sources of X rays. But energy spectra—important keys to understanding X-ray production out there—still are generally unknown.

Gathering X Rays. Some type of device—an improved X-ray telescope perhaps—which collects and focuses the sparse flow of radiation much like an optical telescope concentrates light rays, is needed. Such a device is being fashioned at the Boeing Scientific Research Laboratories in Seattle, Washington. Tests of the Boeing X-ray telescope are planned for later this month.

OF THE UNIVERSE

By William Jury

Preliminary work on the project began last fall by Farrel Lytle and Dr. R. Graham Bingham of Boeing. Prof. William R. Webber of the University of Minnesota is consulting with them. Lytle is a staff member of Boeing Scientific Research Laboratories. Dr. Bingham is a member of the space science group in Boeing's Space Division.

X-ray telescopes are like optical telescopes in some ways. As an optical telescope uses a mirror or lens to bend and focus light rays to improve an image, an X-ray telescope bends or diffracts (a word scientists prefer to "reflect") X rays, concentrating them on a sensor in sufficient numbers to be measured and counted.

Until now, only X rays of certain energies could be measured this way. X rays sometimes passed through the reflective surface or were absorbed.

But Bingham and Lytle are building an X-ray telescope which may succeed in focusing and recording virtually all X rays passing into range while the device is on station above the atmosphere. The Boeing X-ray telescope consists of a nested set of 19 concentric paraboloidal rings or cylinders of cast aluminum. The outside ring is 50 inches in diameter; the smallest inner ring, 10 inches. All are 10 inches high.

The inside surface of each ring is covered with thousands of pieces of lithium fluoride crystal in a meticulously tiled mosaic pattern becoming the "lens" of the telescope.

Old, but New! The fact that lithium fluoride crystals can diffract or bend X rays has been known for many years. What makes the Boeing device something special is that all the pieces of crystal in all of the 19 concentric paraboloidal rings have been precisely arrayed and polished so they will focus X rays of many energies on a single sensor mounted on the axis of the telescope.

Boeing scientists expect to detect X rays and measure them with greater sensitivity than ever before—perhaps *(Turn page)*

Held 25-miles high above Earth's surface by a 10-million cubic-foot balloon, Boeing's X-ray telescope will peek at the Crab Nebula. By measuring the energy spectrum of cosmic X rays scientists might find clues to the origin of our expanding universe.

EXPLORERS

more than 20 times better than before.

The man who machined the 19 rings made 300 cuts for each inch of ring (in all, some 50,000 cuts) to achieve an accuracy to within one thousandth of an inch of the specified shape.

Lithium fluoride crystal of the quality sought for the telescope normally costs about $2 per gram, more expensive than gold. Since the Boeing scientists needed 110 pounds of it, they immediately ran into an economic problem. They solved it by buying odds and ends of the stuff—the scraps left over from filling other orders—at 10 cents per gram. The supplier had a four- or five-year accumulation of scrap crystal and it just happened to total 110 pounds. The next order will be a much more costly one.

That explains, in part, why Boeing wants to recover the telescope after it is launched from Texas or New Mexico in an unmanned balloon probably before the end of the year.

The hand-me-down crystal was delivered to the Boeing laboratories in odd-size pieces, most of them corners and edges from larger orders. From these chunks, tiny rectangular pieces of crystal about half the size of a postage stamp were cleaved. This crystal-cutting took two months and was done by three deaf women hired from Occupation Rehabilitation, Inc., a Seattle organization employing handicapped persons. The tiny pieces — some 150,000 of them — were pressed into epoxy cement smeared on the inside of each aluminum ring.

What's Up. The plan is to attach the telescope and associated telemetry equipment to a high-altitude balloon and send it some 25 miles above the Earth. If all goes well, the huge (10-million-cubic-foot) gas bag will stay aloft for 10 or 12 hours, permitting Boeing scientists to point their X-ray telescope by remote control at the Crab Nebula, or some other known source of X rays, and almost leisurely collect information in energy ranges never before possible.

Earlier X-ray telescopes using simple mirror techniques have been successful for energies up to 2,000 electron volts (or 2 KeV). It is now hoped to extend the range from 18 to 100 KeV. If Boeing succeeds, their work will lead to a deeper understanding of astronomy and cosmology. ■

Photo at left shows Farrel Lytle and Dr. R. Graham Bingham (right) inspecting the crystal-laden rings. Top and bottom photos show the rings in the manufacturing stages.

Want to take an astronaut's pulse long distance?

Try Radio TELEMETRY

■ Over the years we've all become accustomed to the anxious countdowns that precede each rocket launch from Cape Kennedy. The voice from Mission Control ominously sets the pace. "5" . . . "4" . . . "3" . . . "2" . . . "1" . . . "lift off!" But as soon as the rocket disappears into the horizon, we are brought back to reality by the routine reports of conditions in the capsule.

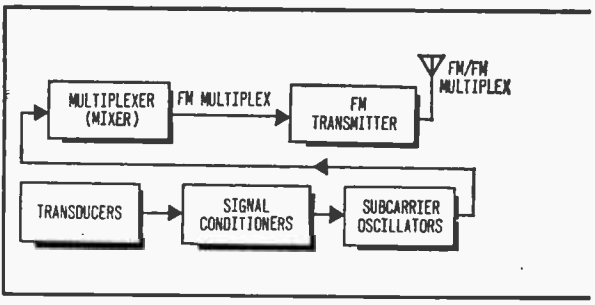
"Pressure, temperature — OK. Pulse — normal." And so it goes. But how can anyone be sure that our astronauts aren't really burning up with fever, or suffering unbearable stomach pains?

The key to this problem is radio telemetry. For telemetry is the science of broadcasting distinct bits of information. It is a system of code that relays back information about such things as pressure, temperature, heart rate, and breathing to a master control center. Called *parameters*, these signals are first picked up by transducers before being processed by the telemetry equipment. How these signals are processed and then sent long distances for recording is the heart of our story.

Any telemetry system is made up of several building blocks. It makes no difference whether the information *(Turn page)*

By John D. Lenk

TELEMETRY



several building blocks. It makes no difference whether the information is gathered aboard a guided missile and transmitted to ground control or a tracking station, or if the information is obtained at various locations in a vast industrial complex and transmitted (often by cable) to a central control location.

There are different telemetry systems and each system requires special building blocks. However, when you boil it down, there are only four that are basic: FM/FM (frequency modulation), PAM (pulse-amplitude modulation), PDM (pulse-duration modulation), and PCM (pulse-code modulation). We'll look at each of these systems to see how measurements are taken in one place and then transmitted to a remote location where they are displayed and recorded. If you understand these four techniques, you'll have no difficulty in understanding other telemetry systems such as FM/FM/FM (triple FM), PACM (combined PAM and PCM), SS/FM (single-sideband FM), and PPM (pulse-position modulation).

FM Doubled. FM/FM (frequency-modulated FM) is one of the original techniques used in telemetry and is still in use today. It consists of frequency modulating a transmitter with the output of one or more *subcarrier oscillators*. These subcarrier oscillators are in turn frequency modulated by information obtained from transducers.

Shown in Fig. 1 is the block diagram of a typical FM/FM transmission system that might be used aboard a guided missile. Three transducers sense information and convert it into electrical signals. In this case, the information includes pressure, vibration, and radiation. The transducer outputs are applied through signal conditioners to their respective subcarrier oscillators. The frequency-modulated outputs of the three subcarrier oscillators are mixed, or *multiplexed*, and then amplified. (Multiplex operation is the simultaneous transmission of several messages on a single RF carrier. Information is modulated so that time-sharing of single channels is possible.) This output is used to frequency-modulate the transmitter and the

TELEMETRY, it monitors the pulse of our space program . . .

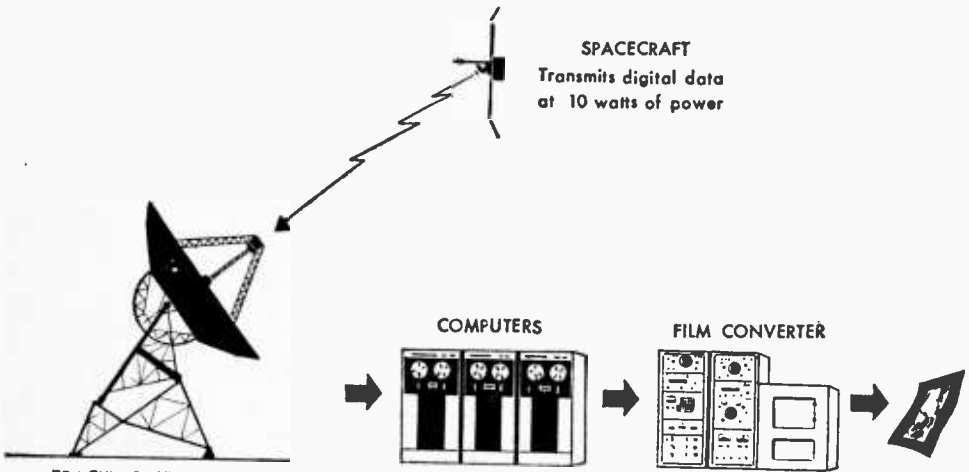
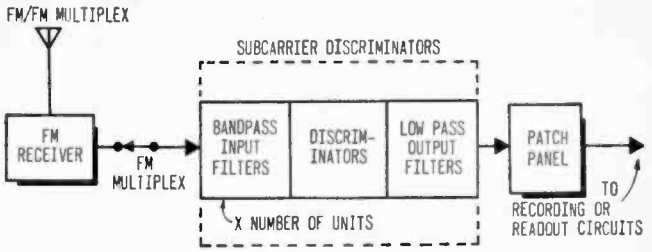


Fig. 1. Here's a block diagram of a typical FM/FM telemetry transmission system used in missiles.

Fig. 2. FM/FM receiving system showing just one of what may be many subcarrier discriminators.



double-modulation process results in an FM/FM output which is transmitted to the receiving station.

A block diagram of a typical FM/FM receiving system that might be used at a missile ground station is seen in Fig. 2. Here, the function is to receive, separate, and display signals which are proportional to the transducer outputs. The RF carrier is demodulated by the receiver to produce a multiplexed signal. This signal is the same as that appearing at the output of the mixer-amplifier system.

The multiplexed signal is then routed to several subcarrier discriminators where the subcarrier signals are separated and the information signals are recovered. In their simplest form, the subcarrier discriminators consist of a bandpass input filter, a discriminator (or detector), and a low-pass output filter. The bandpass filter of each channel separates the three subcarrier signals. The output from each bandpass filter is the same as that appearing at the output of each corresponding subcarrier oscillator.

After the three signals are detected by their corresponding discriminators, they are fed through low-pass filters. This signal is the same as that appearing at the input to the subcarrier oscillators (i.e., the transducer output).

The output from the subcarrier discriminators is often routed to a patch panel or switching network. This permits the outputs of individual channels, or groups of channels, to be monitored or recorded. When the information is monitored directly at the same the term *real-time monitoring* is used.
time it is being sensed by the transducers.

In addition to recording individual signals from the discriminators, most telemetry systems have a provision for recording the

. . . acceleration, vibration, drift it converts to beeps!

Telemetry lets you do more things in a given time because important data is relayed back immediately. On this story's lead page is a photo of three sounding rockets blasted off at the same time—a first for our Air Force. The launching of three Javelin III rockets cast 120-lb. payloads 150,000 feet straight up. Devices in the rockets and payloads measured many parameters even prior to lift off and radioed these data bits back to ground control central (pic at right). A giant antenna for each shot kept track of the flight, picking weak signals and amplifying them. A complex of computers recorded the events for study.

composite signal from the receiver on magnetic tape. These tapes can then be played back through the subcarrier discriminator circuits at any future time.

Transducer Circuits. A transducer is any device that changes energy from one form into another. In our case, we want to change parameters like pressure, vibration, and radiation into electrical signals that can frequency-modulate the subcarrier oscillators of the FM/FM transmitting system.

A variable-resistance transducer is often used to measure pressure. A typical transducer using the voltage-divider principle is shown in Fig. 3A. Here, a full 5 V is placed across the resistance element. (Five volts is chosen since it's common practice in aerospace telemetry to standardize transducers of all types so they'll operate in the range from 0 to 5 V.)

The contact arm of the resistance element is moved by mechanical force, such as the force produced by a bellows which has been sealed at a given air pressure. If the air pressure surrounding the bellows changes, the bellows will expand or contract and move the contact arm across the resistance element. The output voltage, therefore, is proportional to the change in pressure.

A magnetic-induction transducer is the logical choice for measurement of vibration. Its operating principle is similar to that of sound-powered telephones or a magnetic phonograph pickup. A permanent magnet is suspended within a coil (see Fig. 3B) and joined directly to a probe that takes up the vibrations. As the magnet vibrates, it moves back and forth within the coil.

Each time the magnetic lines of force around the magnet move in one direction, the coil develops an output current in one direction. Since the magnetic lines of force change direction, the output current also changes direction. Therefore, the output is an alternating current. Its strength is proportional to the amplitude of vibration, while its frequency is proportional to the vibration's frequency.

Though several types of transducers are used to measure radiation, a scintillation counter is the most common. In its simplest form (Fig. 3C), it consists of a solar cell placed in a sealed chamber with a mineral that emits light in the presence of nuclear radiation. If there is enough radiation to cause the mineral to emit a measurable amount of light, the solar cell develops an output voltage. Again, the amplitude of this voltage is proportional to the amount of light.

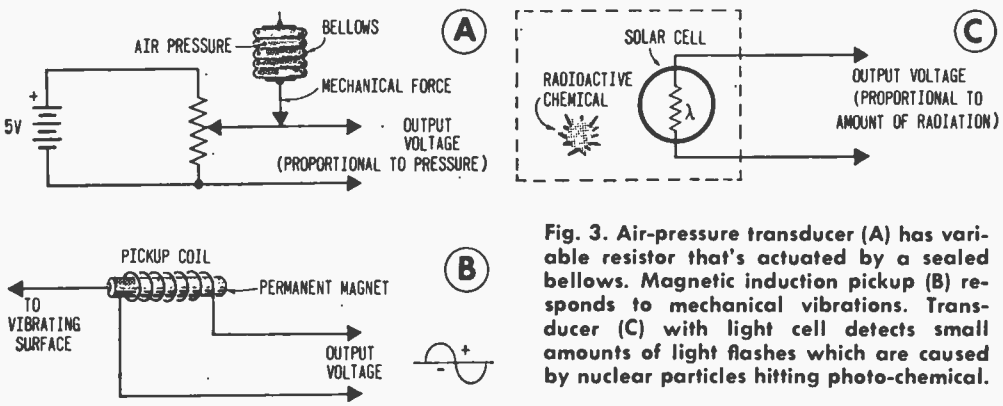


Fig. 3. Air-pressure transducer (A) has variable resistor that's actuated by a sealed bellows. Magnetic induction pickup (B) responds to mechanical vibrations. Transducer (C) with light cell detects small amounts of light flashes which are caused by nuclear particles hitting photo-chemical.

Signal Conditioners. Signal conditioners convert transducer outputs into a form suitable to modulate a subcarrier oscillator (or the transmitter itself). If you take another look at the three transducers you'll see why these conditioners are needed.

Assume that the ideal signal going into the subcarrier oscillators is 0- to 5-DC volts and proportional to the quantity being measured. In the case of the pressure transducer, no signal conditioning would be needed since the transducer output is a varying DC voltage that doesn't exceed 5 V.

The solar cell's output is also DC, but probably only a few millivolts at most. Thus, a DC amplifier is needed to raise its output

up to the 5-V level. In the vibration transducer, however, we have a different conditioning problem. This transducer's output is AC, while we need DC for the subcarrier oscillator.

If we want to measure vibration amplitude only, it's a simple matter to rectify the AC output into a DC signal and then amplify the DC up to the required level. If we wish to measure the vibration's frequency, however, we have to convert frequency into a proportional DC signal.

This requires a *frequency-to-analog* conversion signal conditioner. There are several circuits used for this type of operation. Most of the circuits use a Schmitt trigger output and a rectifier as the basic elements. Fig. 4 shows such a circuit in simplified block form: the Schmitt trigger produces a pulse output for each cycle of the AC input while the width of these output pulses remains constant. So as frequency increases, the *on* time of the trigger output increases. This also increases the DC output from the rectifier.

Subcarrier Oscillators. Remember that the subcarrier oscillator is frequency-modulated by the information signal coming from the transducer, and in turn generates a subcarrier frequency. In FM/FM telemetry, one subcarrier oscillator is used for each information channel. Though there are many types of subcarrier oscillators, the voltage-controlled oscillator (VCO) is the most common.

Fig. 5 reveals the circuit of a typical solid-state VCO. Transistor Q1 functions as a DC amplifier and raises the modulating voltage from the signal conditioning circuit to a level suitable to deviate the multivibrator's frequency. Transistors Q2 and Q3 make up a typical free-running multivibrator whose frequency is determined by the modulating voltage.

In most VCO circuits, the multivibrator runs free at a given center frequency when no information signal is applied. When a signal is applied, the multivibrator's output is deviated above and below the center frequency as the amplitude of the information varies above and below its zero-signal reference. Should the transducer's voltage in-

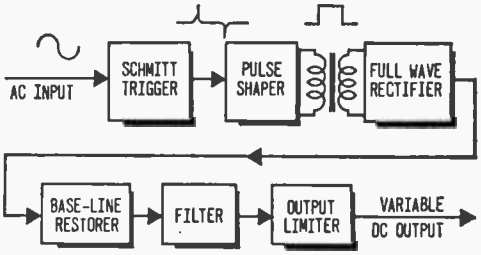


Fig. 4. This frequency-to-analog system converts AC signals to DC signals—as the frequency increases, the DC output increases.

crease, the multivibrator's frequency also increases. Finally, the output is applied through a low-pass filter which reduces the amplitude of harmonics (multivibrators produce numerous harmonics) so they will not interfere with or distort other channels.

Multiplex or Bust. The outputs from all of a system's subcarrier oscillators are mixed prior to the final frequency modulation of the transmitter. This mixing is usually accomplished across a resistive network as shown in Fig. 6. The network consists of potentiometers located at the output of each subcarrier oscillator.

In some telemetry equipment, a mixer-

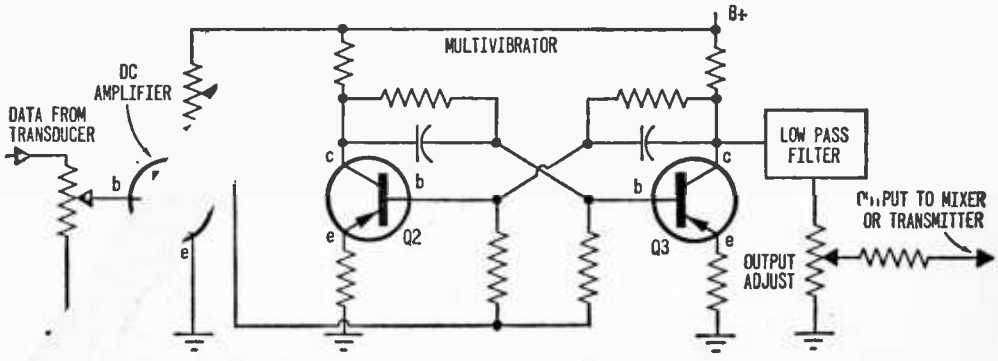


Fig. 5. This voltage-controlled oscillator (VCO) includes a free-running multivibrator and DC amplifier. The amplifier determines the frequency of the multivibrator.

TELEMETRY

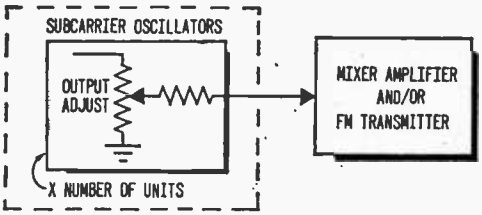


Fig. 6. Here's a typical resistor-mixer circuit usually used in FM/FM telemetry systems.

amplifier must be available to amplify the FM multiplex signal so that it can drive the transmitter. These amplifier circuits are straightforward, and often a wide-band audio amplifier is used. Amplification must be linear within the multiplex signal's frequency range.

The telemetry transmitter must provide an FM/FM signal which accurately reflects the information contained in the FM multiplex signal. The function of the FM receiver is to amplify the desired FM/FM signal, convert the RF carrier to a lower intermediate frequency, and remove the FM multiplex from the FM/FM signal with a minimum of distortion.

The transmitters and receivers used in FM telemetry are almost identical to corresponding FM communications equipment. In fact,

Fig. 7. Block diagram of a typical subcarrier discriminator. First block, bandpass input filter, selects a very narrow range of frequencies that's related to a specific telemetry channel.

FM telemetry systems can be used as communications systems. With this in mind, we won't discuss the radio link here. Instead, let's concentrate on the subcarrier discriminator in the receiver—this is the counterpart of the subcarrier oscillator (VCO) in the transmitter.

Being Selective. The subcarrier discriminator selects a specific FM channel frequency from the incoming FM multiplex, separates the intelligence signal from the FM carrier with a minimum of distortion, and then supplies the intelligence with sufficient amplitude to drive a monitoring device. Sometimes the discriminator is also used to compensate for varying tape speeds, but we'll talk about that later. As shown in Fig. 7, the subcarrier discriminator contains a bandpass input filter, a detector, and an output filter.

The bandpass filters used in FM/FM telemetry consist of a low-pass filter and high-pass filter, shown in Fig. 8. The bandpass filters are designed to separate the desired FM signal from random noise and other FM multiplex signals.

After being filtered by the bandpass input the FM signal data is applied to the input of a limiter-amplifier. As with any FM receiver, the limiter-amplifier eliminates amplitude modulation (AM) imposed on the FM signal by noise and interference. The circuitry, however, can be quite different!

Fig. 9 is a diagram of a limiter used in a subcarrier discriminator that has a pulse-averaging detector. As will be explained, this kind of detector reveals the positive *zero crossing* of the FM signal. Zero crossings must be well defined at the detector's input.

To bring this about, the limiter contains a high-gain amplifier, limiting diodes, and a monostable multivibrator. The FM signal coming out of the bandpass filter is first amplified by the high-gain amplifier to provide a large-excursion (wide ranging) signal. The diodes limit the positive and negative swing of this signal to fixed values above and below zero reference.

Catch the Pulse Train. The signal appearing at the output of the limiting diodes approximates a square-wave pulse train; this is used to define the positive and negative zero crossings of the FM signal. Since the

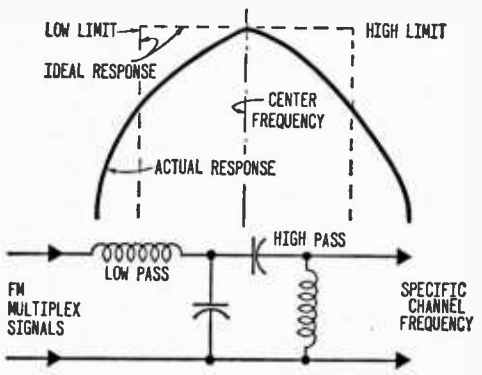


Fig. 8. The bandpass filter is nothing more than two filters—a low-pass and high-pass—coupled together passing only a narrow band.

subcarrier discriminator detects only positive zero crossings, the diode output is applied to a monostable multivibrator to get a square-wave output which defines the positive zero crossings with the sharp leading edge of each pulse.

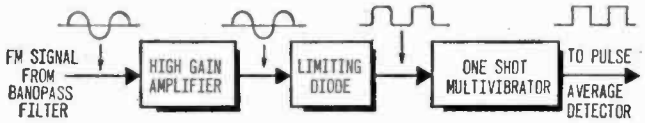


Fig. 9. Block diagram of a typical limiter with a pulse-averaging detector effect.

The pulse-averaging FM detector (Fig. 10) operates on the principle that the frequency of an input signal can be determined by measuring the time between zero crossings. The basic operation of pulse averaging can be seen in Fig. 10. The waveforms that appear at the input to the trigger generator and at the output of the monostable multivibrator are shown in Fig. 11.

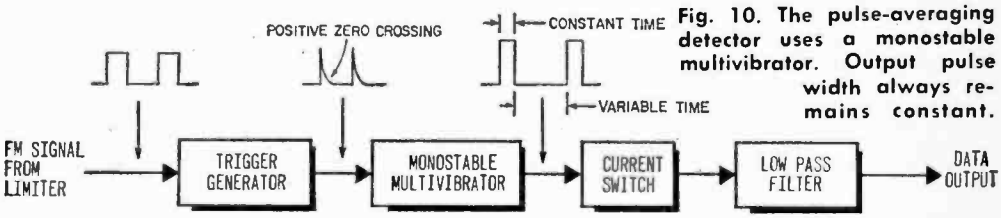


Fig. 10. The pulse-averaging detector uses a monostable multivibrator. Output pulse width always remains constant.

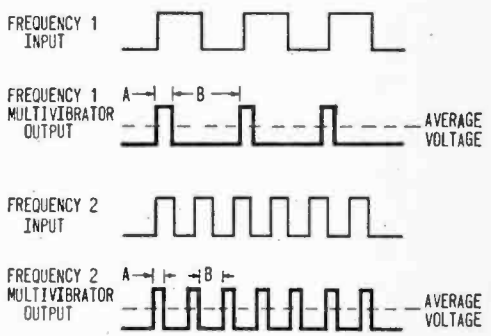
The positive-going edge of each monostable output pulse is initiated by a pulse from the trigger circuit, which in turn is initiated by the positive-going (zero-crossing) edge of the FM signal. The duration of the positive portion of the multivibrator's waveform is determined by the RC time constant of the multivibrator, and this remains constant regardless of the input frequency.

The duration of the negative portion of the waveform is determined by the frequency of the input signal. Once the multivibrator's output falls to a negative level, another positive zero-crossing trigger pulse must occur before the multivibrator output can be driven positive. This output is applied to a current generator which averages the pulses. The output from this current switch is filtered by the low-pass filter to provide a DC level which represents the frequency originally applied to the trigger's input.

Tape Speed Compensation. Since most of the data is recorded on tape, telemetry systems usually include some type of tape speed compensation. Variations of tape speed (better known as wow and flutter) during recording or playback cause frequency modulation of all channels using FM multiplex. Unless the effects of tape speed variations are corrected in a system used to record FM telemetry signals, the discriminator will never be able to tell the difference between these random variations and the actual data.

A basic frequency-lock servo circuit is detailed in Fig. 12. It is used to correct variations in tape speed due to such factors as varying line voltage, improper regulation of the drive motor, mechanical slippage, tape stretching, etc. The information to be recorded is applied to the RECORD head through an amplifier and mixer. A bias signal is also applied to the head as in an ordinary tape recorder, but this bias signal is applied through a modulator circuit.

The modulator also receives a 60-Hz signal from a frequency standard. The result is that the bias signal is modulated by this 60-Hz reference.



A - DURATION CONSTANT FOR ALL INPUT SIGNAL FREQUENCIES

B - DURATION IS A FUNCTION OF INPUT SIGNAL FREQUENCY. ARROWS ON INPUT SIGNAL WAVEFORMS INDICATE POSITIVE ZERO CROSSINGS.

Fig. 11. These waveforms are the inputs and MV outputs shown in Fig. 10 above.

TELEMETRY

During playback, the data is amplified to a level suitable for the readout devices. At the same time, the modulated bias signal is separated into another channel by a bandpass filter, and the 60-Hz reference is recovered by a detector. The detector output is then compared with the 60-Hz standard used during RECORD. If there is any difference, an error voltage is produced. This error voltage is used to control an oscillator similar to the VCO previously discussed. The VCO signal is amplified so it will control the tape-drive motor, and the motor tracks any variations that may have occurred during recording.

PAM Telemetry. Pulse-amplitude modulation is a technique that makes for better use of the data-handling capacity of a telemetry system. One of the drawbacks to FM/FM is the bandwidth limitation of the FM transmitter (i.e., the allowable carrier-frequency deviation).

For example, assume that the input to the subcarrier oscillators can be no more than 2000 Hz. Also assume that two of our data channels require a 1500-Hz response, while a third channel requires only a 1-Hz response. If FM/FM telemetry were used, two transmitters would be required; one transmitter for the 1-Hz and 1500-Hz channels, and a second transmitter for the other 1500-Hz channel. With PAM telemetry, only one transmitter and one subcarrier oscillator are required for the three channels.

The heart of any PAM system is a *commutator* in the transmitter and a *decommutator* in the receiver. These commutators and decommutators can be either mechanically or electronically operated. As shown in Fig. 13, mechanical commutators and decommutators are essentially a series of contacts that can be selected by a motor-driven arm. Both units must be driven at a constant speed, and they must be synchronized.

The outputs from the transducers (and signal conditioning circuits) are fed to contacts on the commutator—30 or more channels operating from one commutator is not uncommon. The commutator arm is connected to the input of a single subcarrier oscillator. This may feed directly into the transmitter, or it may be mixed with other oscillator outputs.

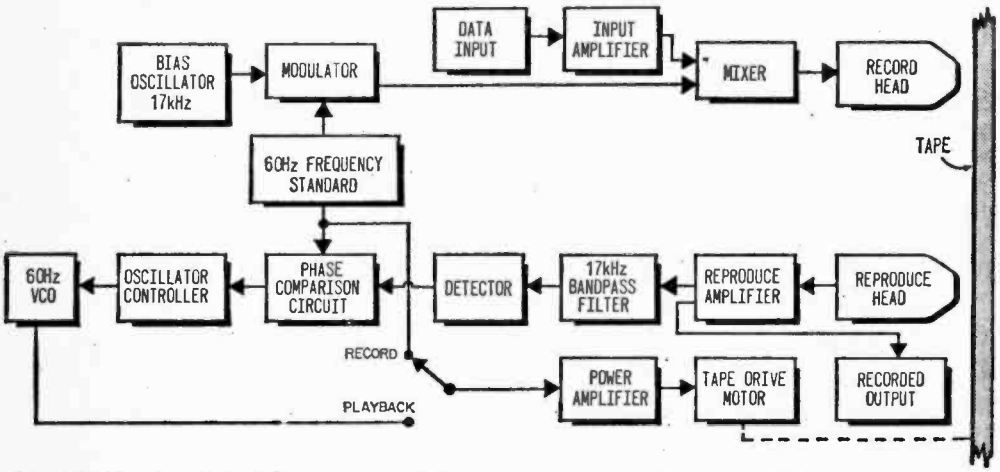


Fig. 12. Varying line voltage can play havoc with tape recorders. Diagram above shows basic frequency-lock servo used for speed compensation.

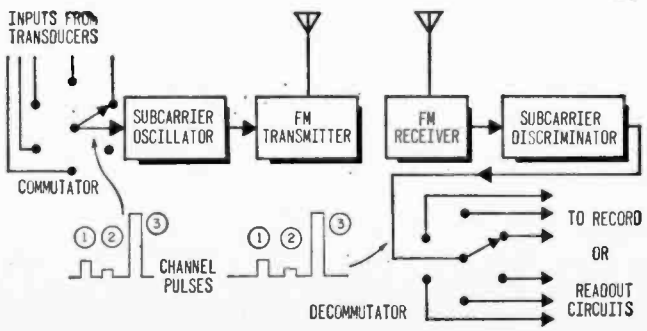


Fig. 13. A commutator in the transmitter and a decommutator in the receiver are always in step with one another to pick the desired signal on time.

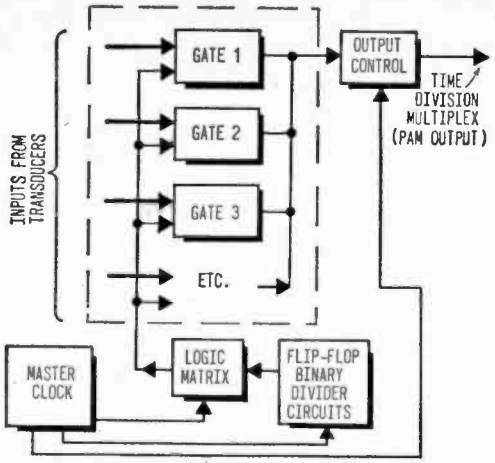


Fig. 14. The important thing to do in telemetry is to keep in step. This basic commutator and gate circuit helps to do this particular task.

As the commutator arm turns, only one particular transducer output is applied to the subcarrier oscillator. Simultaneously, the decommutator arm at the receiver makes contact with the corresponding subcarrier discriminator output.

Actually, the input to the subcarrier oscillator is a series of pulses, whose amplitudes correspond to the transducer input. These pulses cause the subcarrier oscillator to deviate from the subcarrier center frequency by a corresponding amount. Each train of pulses generated in one full revolution of the commutator also includes a synchronizing signal which is transmitted along with the remaining pulses. This serves to synchronize the decommutator and commutator.

Fig. 14 shows a typical multi-channel, electronic PAM commutator. With this system, the inputs from transducers and signal conditioners are applied to individual *gates*. The gates are closed in sequence under the control of a logic matrix and binary divider chain faster than the eye can blink.

This chain is driven by a master clock oscillator at a given frequency. The gate outputs are combined and then further processed under synchronous control of the clock oscillator. This results in a time-division multiplex operation (each transducer input being given equal time).

Get the Gate. A typical gate circuit is shown in Fig. 15. Gating is a process whereby a tube (or transistor) will only conduct at certain instants. The tube is held in a *cutoff* state (extreme negative bias) so that conduction only occurs upon application of a positive gating pulse.

When a pulse train contains both wanted and unwanted information at regular intervals, synchronized gating pulses may be applied so that only the desired signal is passed (and amplified) by the tube. Obviously, this is a form of synchronized switching.

Since decommutation is the complement of commutation, the same basic circuits can be used for both operations, except in inverted form. In a commutator, inputs from various channels are applied to individual gates, mixed, and then fed to the transmitter. The same gates and control circuits can be

Fig. 15. A commutator can be an electronic device as this circuit shows. Only those signals that occur at the same instant will be amplified by the tube. All other signals do not pass through the circuit. The gate pulses unlock the vacuum tube for conduction whenever input is a positive-going pulse.

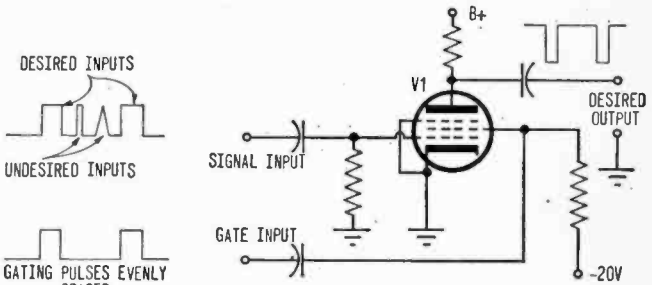
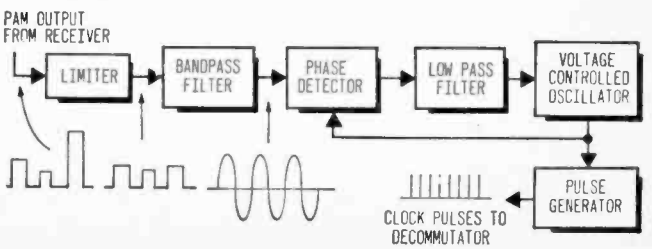


Fig. 16. It's important to keep step in telemetrying. One way the job's done is with this closed-loop PAM telemetry channel synchronization circuit.



used at the receiving end, except that the gate inputs are now connected in parallel to the input from the receiver, while the gate outputs remain separate.

Synchronization between commutator and decommutator is a major problem in any telemetry system. There are many synchronization systems used in PAM telemetry. Fig. 16 shows a typical *closed-loop* circuit where incoming signals from the receiver are applied to a limiter and bandpass filter.

The limiter removes AM variations and the filter generates a sine wave at the fundamental repetition frequency of the data. If there is any variation in the PAM signals (for instance, as a result of variation in the transmitter's commutator circuit) this is sensed immediately, and the filter produces the correct frequency.

The output from the filter is applied to a phase detector which is also excited by a local oscillator whose frequency can be varied with a control voltage. The detector's output is a voltage which is proportional to the difference in phase between the two sine waves applied to it.

After low-pass filtering, this error voltage is used to control the frequency of the local VCO. When the circuit is in balance, the VCO frequency is identical to that of the incoming pulse repetition frequency and is locked in a definite phase relationship (usually 90 deg.) to the incoming signals. This phase shift ensures that the clock pulses will arrive in sufficient time to trigger the decommutator just ahead of the incoming PAM signals.

PDM Goes Wide. Pulse-duration modulation is a technique that eliminates some of the basic problems of any PAM system using mechanical commutation. Another problem associated with PAM systems is that noise can be introduced due to intermodulation between subcarrier oscillators.

Like a PAM system, PDM telemetry involves the use of a commutator which receives signal inputs from a group of transducers. However, PDM commutators have an extra set of contacts. These contacts are used to trigger a *keyer* circuit that is placed between the signal contacts and the subcarrier oscillator or transmitter (see Fig. 17).

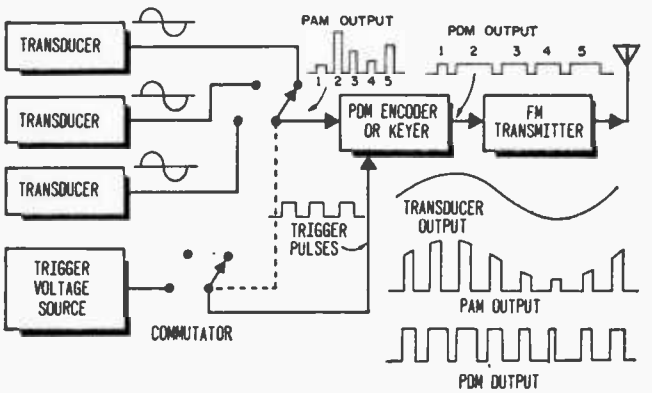


Fig. 17. Pulse-duration modulation can be best described by looking at the output signals—note size of each pulse width.

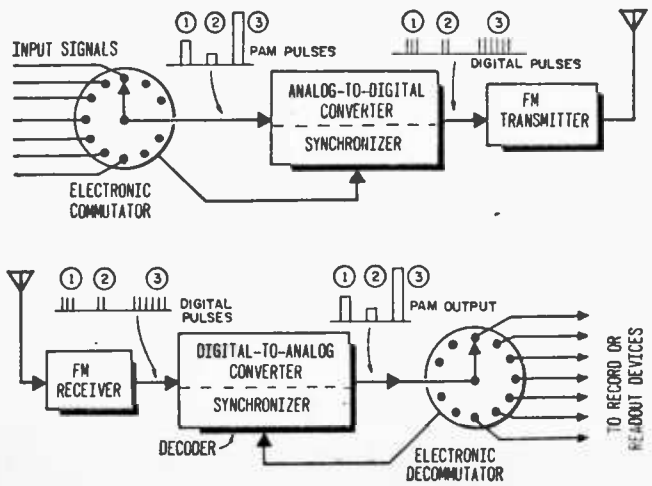


Fig. 18. This simple pulse-code modulation telemetry system is very much like that used to relay moon and Mars TV pictures to our earth from outer space.

The keyer or encoder converts constant-width, variable-amplitude pulses into constant-amplitude, variable-width pulses. This conversion results in a train of pulses whose amplitude can tolerate

(Continued on page 107)

Radio-TV EXPERIMENTER LAB CHECK

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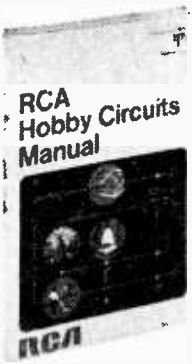
■ Just about everyone in the electronics business old enough to vote cut his teeth, as a hobbyist, on the circuits in the back of the RCA tube manual. It wasn't so much that the RCA circuits were different than those in other circuit handbooks, the big thing was the RCA circuits worked—and worked well!

RCA's new entry in the circuits handbook field, the RCA Hobby Circuits Manual priced at $1.75, carries on the old tradition

Here's a winner—an all solid-state metal locator made from the plans in the RCA Hobby Circuits Manual—the Miss is a winner too!



of *useful circuits*, but this time using all solid-state equipment—there is not a tube in sight.

The Hobby Circuits Manual contains 35 projects; that right, *projects*. Unlike many circuit handbooks which just present a circuit and a parts list, each RCA project is more like those found in RADIO-TV EXPERIMENTER, complete with schematic, pictorial, photographs, wiring instructions, operating notes, and a very basic theory of operation.

Almost Printed Circuit. To insure that even a rank beginner at electronic construction will have little difficulty in assembly, the back of the manual has full scale drilling templates for solid circuit boards. The templates indicate where to drill the holes for the component's leads, the location of the board's mounting holes and the positions for the solid-state devices. A pictorial in the construction section for each project shows where to plug-in the components. Those projects which do not utilize a circuit board are illustrated with very clear photographs having "callouts" (arrows) indicating the location of all components.

Projects with Purposes. Unlike most circuit handbooks which have super-simple circuits that wink, beep, pop or flicker—but are functionally useless, the RCA projects can be put to practical use almost instantly, you don't have to dream up ways to use the RCA projects. A few examples will give you the general idea. Among the 35 projects are: a clamped auto tachometer (the accurate type), a full-wave light dimmer the equal of commercial photo-studio dimmers priced from $35 and up, a complete hi-fi preamplifier, automatic keyer (for Hams), dip/wavemeter, audio compressor, audio Q-multiplier, and that old favorite, a metal detector (treasure finder) about which we'll go into more detail later.

And if you're the type that likes to experiment with really odd-ball devices, you'll find an electronic slot machine and electronic

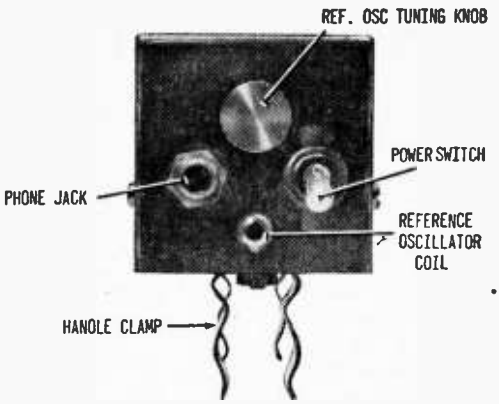
LAB CHECK

dice, among other unusual projects.

How the projects perform. We tested the projects two ways. First, by trying some original working models built by RCA for the hobby manual. Second, by building a few projects using mostly junk-box components (as would the average experimenter) but always using the suggested solid-state devices. In all instances, both RCA and RADIO-TV EXPERIMENTER projects worked exactly as described. As example, the organ produced a real organ sound, not the usual sine-waveform tone delivered by simple experimenter circuits. And the lamp dimmer controlled a lamp from full off to full brilliance, not reduced brilliance as is common in many SCR circuits (the RCA uses a Triac rather than an SCR).

But our favorite performer was the metal detector, which worked every bit as well as some of the higher priced commercial treasure finders.

Large or small. The three-transistor metal detector works on the beat-frequency principle. A single transistor oscillator of semi-fixed frequency provides a reference for a second transistor oscillator which uses a loop of wire for the oscillator coil. The reference oscillator is adjusted so it differs in frequency from the loop oscillator by only several hundred cycles. The resulting beat note (difference frequency) between the two oscillators is amplified by a third transistor and monitored with headphones. Any metal near the loop causes the loop's inductance to change, and hence the oscillator frequency



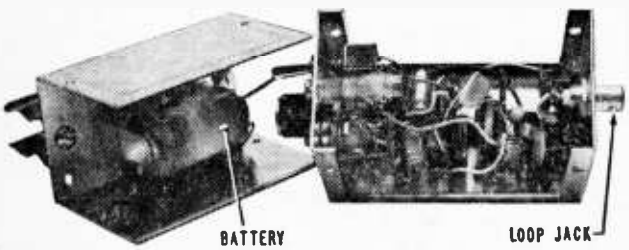
All controls and headphone jack face the user when the cabinet is mounted on the search coil handle. Handle clamps are ordinary broom jobs available at hardware stores.

changes. The new beat note, heard in the phones, indicates the presence of metal. Because the loop is enclosed in a Faraday shield—a section of copper tubing forming an open loop and grounded at one end, copper, iron and aluminum causes the loop's inductance to always change in the same direction, thereby causing the tone heard in the phones to decrease in frequency. Because of the oscillator coupling design, the oscillators tend to "lock together," so just a slight presence of metal is enough to cause a large change in the headphone tone.

The metal detector was able to clearly spot a quarter at two inches, a 3 x 4 inch piece of copper-clad perf-board at 2 feet, and a small electric heater at four feet. This sensitivity compares favorably with, if not better than, many budget priced metal detectors. Because of the loop's design, metal indications are obtained from under the edge of the loop rather than in the center.

The metal detector's stability was very good, and temperature changes did not usually require resetting of the reference oscillator's frequency. The loose loop wires in the copper tubing, however, caused the oscillator frequency to change as the metal detector was moved, producing a warble-tone in the phones. This can be stabilized by simply packing the loop with RTV Silicon Rubber

(Continued on page 105)



Except for the loop coil the entire metal detector is built in a small aluminum cabinet that clips to the search coil's (loop) handle. This project is point to point wired—does not use a circuit board. Since circuit is neither complex nor critical user supplies his own layout. Circuit manual concentrates on the search coil which is the most critical part of the detector.

"But grandmama, what a Big Nose you have!"

Sniffing people at close quarters can be very risky. Fortunately, truly hazardous people sniffing can now be done from a distance with the aid of electronic sniffers. And while you personally may never feel the need to carry an electronic nose for security reasons, it's just possible you may someday pack a mini-sniffer with your vacation gear—just for fun.

People sniffing may sound straight from weirdsville, but it's really a very common practice. Sniffing the nose, face, and hand of another individual is an extremely common form of greeting throughout the world; it's especially prevalent in much of the Pacific area, among Eskmos and Papuans, the hill tribes of India, in Africa, and even in Europe. After all, the European gallant who pecks at the back of a lady's hand is symbolically sniffing her to make certain she's of good quality, and to compliment her on the fact that she's eminently sniffable. It may well be that the common kiss was discovered long ago by some myopic, would-be sniffer who missed his mark and accidentally stumbled on something more interesting.

(Continued overleaf)

"All the better to sniff you with, my dearie."

By Erik Horneman

"But grandmama, what a Big Nose you have!"

Science Takes Over. Sooner or later all all of the human sensory organs need to be supplemented with electronic counterparts. The microphone became a third ear; the photocell an extra eye. It was inevitable that the nose, too, would eventually acquire its unique electronic counterpart.

One of the first practical electronic sniffers was built 20 years ago for the Navy; it was designed to sniff out enemy submarines by detecting diesel engine effluents. People sniffers came much later. And they did so only because those who proposed the idea didn't mind being laughed at by others who thought the notion was patently absurd. Not that anyone doubted the potential usefulness of people sniffers; it just seemed unlikely that anyone could actually invent such a device for sniffing out humans.

But mockery turned to awe when defense scientists came up with a portable package that unquestionably could detect human beings at ranges up to 300 yards. For the better part of two years, these electronic sniffers have been used in Vietnam to ferret the enemy hidden in jungle recesses. One sniffer model is backpacked by land troops; another version is used in planes to make in-flight sniffs of enemy concentrations.

The Defense Department has partly declassified the E-63 manpack personnel detector developed by General Electric and put to practical use in Vietnam over a year ago. To be sure, the basic scientific principles utilized in this sniffer are pretty much common knowledge. Even so, many of the technical tricks used to make these principles work in practice remain classified.

Sweat Stream. In use, the manpack sniffer is pointed upwind so that it can sample air swept in from enemy positions. If a

They can sniff the enemy up and down! Top photo shows an officer racing from a helicopter to G-2 with information on enemy troop concentrations detected by the airborne sniffer he is carrying. Looking like Heimie of Get Smart, the TV program, (bottom photo) special forces sergeant reveals the complicated electronic and mechanical parts that comprise the E-63 manpack sniffer. Photos on next page show trooper and special forces noncom using the sniffer to rout out enemy troops from thickets. Wide World Photos

fairly large number of human beings are within the 300-yard range, the sniffer will detect their body odors. The sniffer operator is alerted by a microammeter and by a tone signal that changes in frequency when people are sensed by the instrument. It is then a simple matter for the operator to call in bombers or artillery fire to saturate the incated positions.

The sniffer is designed to detect and measure ammonia, a waste product given off by the respiratory system and sweat glands. The amount of ammonia given off by any one individual is small, hence the sniffer must be able to detect the gas in concentrations of only one part in 200 million parts of air. This is akin to finding, instantly, one Indianhead penny from among 200 million Lincoln pennies!

As any chemistry student knows, ammonia gas will form a white smoke of ammonium chloride when it comes into contact with hydrochloric acid vapors. Such smoke formation is believed to be involved in the detection process.

However, the amount of smoke produced by such low concentrations of ammonia as would be given off by people would be too slight to permit direct detection. It is obvious that the smoke formation is only the first step in the detection system.

Cloud Chamber Principle? Air sampled by the sniffer must be humidified before the presence of ammonia can be detected. This fact implies that the ammonium chloride smoke is probably used as condensation nuclei to induce the formation of a heavier, measurable fog consisting of water vapor.

Cloud chambers are familiar laboratory devices used to observe the tracks of ionizing particles which act as condensation nuclei. Fog formation (as tracks) occurs only if the air in the chamber is supersaturated with water or alcohol vapor. This supersaturation can be achieved in either of two ways: 1) by vapor diffusion from a liquid reservoir to a region strongly cooled with dry ice or other coolant, or 2) by cooling a mixture of air and water vapor by sudden expansion of the gaseous system.

It seems likely that the second (sudden expansion) method is used in the sniffer because of the impracticality of carrying dry ice or other coolants into the field.

Simple Experiment. Our photos show a simple experimental setup that can be used to demonstrate the principles that are probably utilized in the people sniffer. One 2-

"All the better to sniff you with, my dearie."

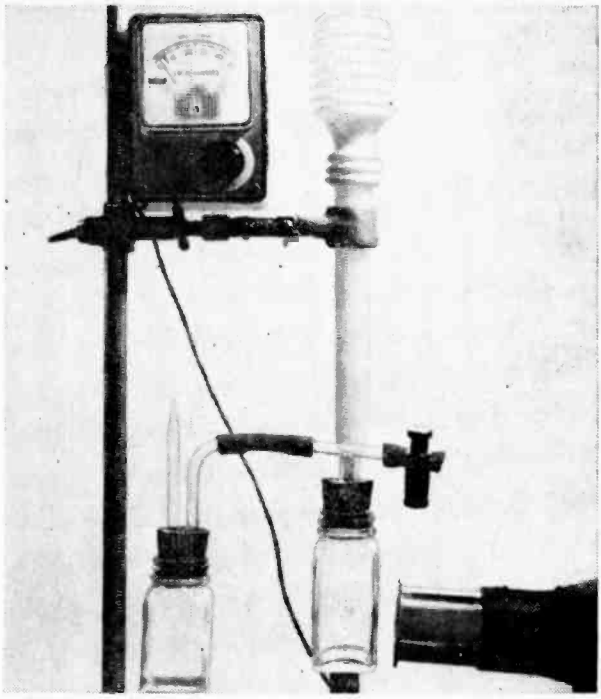
ounce, wide-mouth bottle serves as a reservoir to hold a small amount of concentrated hydrochloric acid; another bottle of the same size serves as a cloud chamber. The cloud chamber bottle is fitted with a rubber stopper with two holes; an inlet tube is inserted into one hole, and an air pump consisting of a bellows-operated meat baster is inserted into the second hole. A rubber bulb will serve in lieu of the baster.

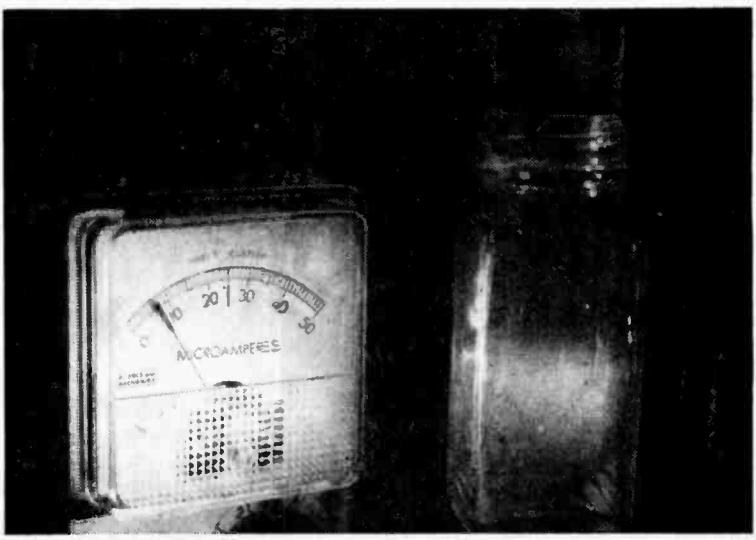
The bellows action is used to draw air in and out of the acid bottle and cloud chamber. If a bit of cotton is wet with ammonia and held near the intake tube of the acid bottle, the ammonia entering the system will form a smoke with the acid vapors. If the bellows is pumped several times, the cloud chamber will be filled with the ammonium chloride smoke. Simultaneously, the photocell will indicate the presence of the smoke by giving a higher reading on the microammeter. Repeated pumping will not increase the reading over a more or less limited rise.

Now remove the cloud chamber and add a little water or alcohol to the previously dry bottle. Repeat the experiment. This time the maximum attainable meter reading should be significantly higher than when the water was absent. Pinching the tube between the acid and cloud bottle while continuing the pumping action may further increase the reading by a small amount. This is a direct result of the cooling action caused by alternate compression and expansion of the confined air in the cloud chamber.

The effects are easily seen by eye if a strong light, as from a slide projector, is beamed through the cloud chamber. Naturally, a strong light beam is needed if a photocell is used.

Photocell Detector. In the military people sniffer, a photoelectric cell is used to measure the fog created by ammonia in the sampled air. Theoretically, the cell could be used in either of two ways: 1) if it is pointed





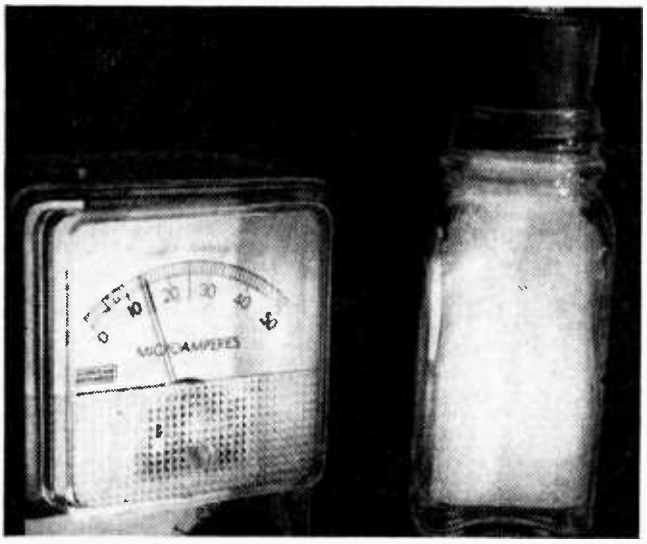
Chemical and photoelectric principles used in the people sniffer can be demonstrated with this simple set-up (top photo) made from bottles, a plastic meat baster, light source and photographic exposure meter. For details, refer to text. Photos below show how photo sensing is accomplished. At left, ammonium chloride smoke in a dry bottle produces a relatively low meter reading of 7 microamps. At right, increased smoke content steps up meter reading to 16 microamps. Uncle Sam's unit works the same way.

through the chamber, directly at the light source, a condensation fog will cause a *drop* in the meter reading by cutting off some of the light reaching the cell; 2) if the cell is oriented perpendicular to the light beam (as in the above experiment), the fog will cause an *increase* in the meter reading because more light will reach the cell due to the light-scattering effect of the fog. The second method appears to be the more efficient.

Though the above experiment can demonstrate the basic principles that are probably used in the people sniffer, the crude experimental setup is hardly practical. It simply isn't sensitive enough to detect the very small concentrations of ammonia that an actual people sniffer must measure. Just how defense scientists have been able to increase the sensitivity to such remarkable degree remains a military secret.

More To Come. The science of olfactronics (odor detection) is becoming increasingly important, and all sorts of odor-detecting devices are being investigated. Special sniffers are said to be incorporated into spacecraft for the protection of astronauts. In the future, olfactronics may be used to measure air pollution, serve as fire and burglar alarms, and detect respiratory diseases. Since the people sniffer can provide a rough measure of the number of people within its range, it seems that the sniffer might well be used to estimate the sizes of crowds at large public gatherings.

No one type of sniffer could even begin to do all the jobs that electronic noses of the future may be required to do. Each instrument must be specially tailored to detect specific odorous chemicals. The special techniques of gas chromatography will probably provide solutions to many difficult sniffer design problems.



Skunk Sniffers. We don't seriously think that there will ever be much of a demand for electronic skunk sniffers—except, perhaps, among farmers whose hen houses are raided by polecats. But the general approach to sniffer design can be illustrated by considering how one might go about building a skunk sniffer.

Whether or not a skunk perspires is immaterial; it would be pointless to try to detect ammonia when the animal offers a more distinctive and pungent scent for detection. The two chemical compounds responsible for the unmistakable skunk odor are butyl mercaptan and dicrotyl sulfide.

The chemical characteristics of these two compounds would have to be studied intensively in the hope of finding one reaction that would produce a detectable product. Detection of the product might involve optical, chemical, or electronic methods—or combinations of these methods.

A word of advice: if you should plan to do any practical experimentation on a skunk sniffer, set up your lab back in the woods!

Fish Finder. The olfactronic investigator who is sharp enough to invent a reliable underwater fish sniffer could undoubtedly retire for life on the royalties such a device would bring. Fish have a rather characteristic odor. If these odor-causing chemicals could be picked up by means of an underwater probe, and analyzed with an electronic minipack, every fisherman in the country would want a fish sniffer.

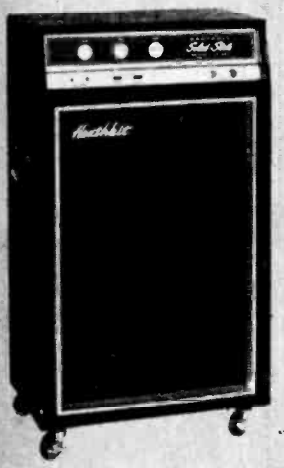
The angler could simply thrust the sniffer probe into the water, and by reading a meter, obtain immediate information about the presence —or absence—of fish in that part of the stream or lake. Commercial fishermen would be even more interested in a fish sniffer that really works out in deep water.

Can it be made? We just don't know. But don't sniff at the idea off-hand. Remember that those who first suggested people sniffers were considered impractical oddballs—until they showed how practical the idea was. ■

"Performance-Plus" Kits For Home And

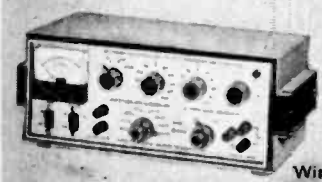
NEW
kit AD-27
$169.95

NEW
kit AD-17
$109.95



NEW
kit TA-38
$225.00

NEW
kit GR-58
$47.95



NEW
kit IG-18
$67.50

Wired IGW-18
$99.50

HEATHKIT AD-27 FM Stereo Compact

The new Heathkit "27" Component Compact was designed to change your mind about stereo compact performance. How? By sounding as if it were made of top quality stereo components . . . which in fact it is. Heath engineers took their highly rated AR-14 solid-state Stereo Receiver, modified it physically to fit the cabinet, and matched it with the precision BSR McDonald 500A Automatic Turntable. Performance? Here's the AD-27 in detail. The amplifier delivers 30 watts music power . . . 15 honest watts per channel — enough to drive any reasonably efficient speaker system. Response is virtually flat from 12 Hz to 60 kHz, and Harmonic & IM distortion are both less than 1% at full output. Tandem Volume, Balance, Bass & Treble controls give you full range command of all the sound. Select the FM stereo mode with a flick of the rocker-type switch and tune smoothly across the dial, thanks to inertia flywheel tuning. You'll hear stations you didn't know existed in your area, and the clarity and separation of the sound will amaze you. The adjustable phasing control insures best stereo separation at all times. And the automatic stereo indicator light tells you if the program is in stereo. AFC puts an end to drift too. The BSR Automatic Turntable has features normally found only in very expensive units, like cueing and pause control, variable anti-skating device, stylus pressure adjustment and automatic system power too. Comes complete with a famous Shure diamond stylus magnetic cartridge. The handsome walnut cabinet with sliding tambour door will look sharp in any surroundings, and the AD-27 performs as well as it looks. For the finest stereo compact you can buy, order your "27" Component Compact now. 41 lbs.

HEATHKIT AD-17 Stereo Compact

Using the component approach of the AD-27, Heath engineers took the solid-state stereo amplifier section of the AD-27, matched it with the high quality BSR-400 Automatic Turntable and put both of these fine components in a handsomely styled walnut finish cabinet. The result is the "17" — featuring 30 watts music power, 12 Hz to 60 kHz response, auxiliary & tuner inputs, less than 1% Harmonic & IM distortion, adjustable stylus pressure & anti-skate control and much more. Order your "17" now. 27 lbs.

HEATHKIT TA-38 Solid-State Bass Amplifier

The new Heathkit TA-38 is the hottest performing bass amp on the market, for quite a few reasons. First, there's all solid-state circuitry for reliability. Then there's the tremendous power — the TA-38 puts out 120 watts of EIA music power, 240 watts peak, or 100 watts continuous. Extremely low harmonic & IM distortion too. Many amps suffer from "blow-out" problems, but not the new TA-38 — *YOU CAN'T BLOW IT* . . . it boasts two 12" heavy duty special design speakers with giant 3 pound 6 ounce magnet assemblies mounted in a completely sealed, heavily damped ¾" pressed wood cabinet — those speakers will take every watt the amp will put out, and still not blow. Sound? The TA-38 is tailored to reproduce the full range of bass frequencies delivered by bass guitars and its sound with combo organs and other instruments is remarkable. Easy 15 hour assembly to the wildest bass amp on the market. Order one now and surprise the guys with the high-priced gear. 130 lbs.

HEATHKIT GR-58 Solid-State AM/FM Clock Radio

The easy way to get up in the morning. Choose the morning news & weather on AM or the bright sound of FM music. AFC makes FM tuning easy. The "Auto" position on the Telechron® clock turns only the radio on, or use the "Alarm" setting for both the radio and the alarm. You can even enjoy fresh coffee when you awake in the morning, thanks to the clock-controlled accessory AC socket on the back of the new GR-58. The handy "snooze" alarm feature lets you wake up gradually for ten minutes to the sound of the radio, then the alarm goes on . . . push the "snooze" button to silence the alarm for ten minutes more of music or news — the alarm sounds automatically every ten minutes and the "snooze" button turns it off, cycling continuously until the selector switch is moved to another position. Fast, easy circuit board construction, smart blue hi-impact plastic cabinet and top reliability make this GR-58 the clock radio for you. 8 lbs.

HEATHKIT IG-18 Solid-State Sine-Square Wave Generator

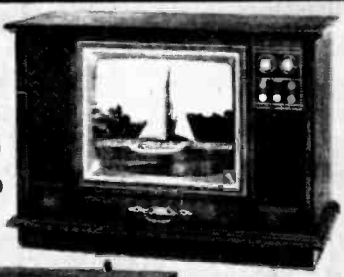
A precision source of sine or square waves at a low kit price . . . that's the new solid-state IG-18 from Heath. Delivers 5% accuracy thru the wide range of 1 Hz to 100 kHz. The sine wave section features less than 0.1% distortion thru the audio range, 8 output voltage ranges from 0.003 to 10V, switch-selected internal 600 ohm load or external load and metered output of both voltage & dB. The square wave section has a 50 nS rise time and three output voltage ranges from 0.1 to 10 V P-P. Both sine & square waves are available simultaneously and the frequency is switch-selected for constant repeatability and fast operation. Circuit board construction makes the new IG-18 easy to build . . . new Heathkit styling and engineering excellence make it easy to use. Put the new IG-18 on your bench now. 10 lbs.

Hobby...From The Leader

HEATHKIT

Now There are 4 Heathkit Color TV's... All With 2-Year Picture Tube Warranty

NEW Deluxe "681" Color TV With Automatic Fine Tuning



kit GR-681
$499.95
(less cabinet)

The new Heathkit GR-681 is the most advanced color TV on the market. A strong claim, but easy to prove. Compare the "681" against every other TV — there isn't one available for any price that has all these features. Automatic Fine Tuning on all 83 channels . . . just push a button and the factory assembled solid-state circuit takes over to automatically tune the best color picture in the industry. Push another front-panel button and the VHF channel selector rotates until you reach the desired station, automatically. Built-in cable-type remote control that allows you to turn the "681" on and off and change VHF channels without moving from your chair. Or add the optional GRA-681-6 Wireless Remote Control described below. A bridge-type low voltage power supply for superior regulation; high & low AC taps are provided to insure that the picture transmitted exactly fits the "681" screen. Automatic degaussing, 2-speed transistor UHF tuner, hi-fi sound output, two VHF antenna inputs . . . plus the built-in self-servicing aids that are standard on all Heathkit color TV's but can't be bought on any other set for any price . . . plus all the features of the famous "295" below. Compare the "681" against the others . . . and be convinced.

GRA-295-4, Mediterranean cabinet shown..... **$119.50**
Other cabinets from $62.95

Deluxe "295" Color TV...Model GR-295

kit GR-295
now only
$449.95
(less cabinet)

Big, Bold, Beautiful . . . and packed with features. Top quality American brand color tube with 295 sq. in. viewing area . . . new improved phosphors and low voltage supply with boosted B + for brighter, livelier color . . . automatic degaussing . . . exclusive Heath Magna-Shield . . . Automatic Color Control & Automatic Gain Control for color purity, and flutter-free pictures under all conditions . . . preassembled IF strip with 3 stages instead of the usual two . . . deluxe VHF tuner with "memory" fine tuning . . . three-way installation — wall, custom or any of the beautiful Heath factory assembled cabinets. Add to that the unique Heathkit self-servicing features like the built-in dot generator and full color photos in the comprehensive manual that let you set-up, converge and maintain the best color picture at all times, and can save you up to $200 over the life of your set in service calls. For the best color picture around, order your "295" now.

GRA-295-1, Walnut cabinet shown..... **$62.95**
Other cabinets from $99.95

Deluxe "227" Color TV...Model GR-227

kit GR-227
now only
$399.95
(less cabinet)

Has same high performance features and built-in servicing facilities as the GR-295, except for 227 sq. inch viewing area. The vertical swing-out chassis makes for fast, easy servicing and installation. The dynamic convergence control board can be placed so that it is easily accessible anytime you wish to "touch-up" the picture.

GRA-227-1, Walnut cabinet shown..... **$59.95**
Mediterranean style also available at $99.50

Deluxe "180" Color TV...Model GR-180

kit GR-180
now only
$349.95
(less cabinet)

Same high performance features and exclusive self-servicing facilities as the GR-295 except for 180 sq. inch viewing area. Feature for feature the Heathkit "180" is your best buy in deluxe color TV viewing . . . tubes alone list for over $245. For extra savings, extra beauty and convenience, add the table model cabinet and mobile cart.

GRS-180-5, table model cabinet and cart..... **$39.95**
Other cabinets from $24.95

Now, Wireless Remote Control For Heathkit Color TV's

New Wireless
TV Remote Control
For GR-295, GR-227 & GR-180
$69.95

New Wireless
TV Remote Control
For GR-681
$59.95

Control your Heathkit Color TV from your easy chair, turn it on and off, change VHF channels, volume, color and tint, all by sonic remote control. No cables cluttering the room . . . the handheld transmitter is all electronic, powered by a small 9 v. battery, housed in a small, smartly styled beige plastic case. The receiver contains an integrated circuit and a meter for adjustment ease. Installation is easy even in older Heathkit color TV's thanks to circuit board wiring harness construction. For greater TV enjoyment, order yours now.

kit GRA-681-6, 7 lbs., for Heathkit GR-681 Color TV's..... **$59.95**
kit GRA-295-6, 9 lbs., for Heathkit GR-295 & GR-25 TV's..... **$69.95**
kit GRA-227-6, 9 lbs., for Heathkit GR-227 & GR-180 TV's..... **$69.95**

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People Pleasers

● Take a peek at the new Schober Tunesmith—a 32-note electronic musical instrument which provides melody along with accompaniment from any keyboard instrument, guitar, or combo. In kit form it sells for $149.50; wired, $189.50. The keys are standard organ size, and the unit draws only 3 watts of power for its solid-state circuitry. It can be plugged into any guitar, P.A., or hi-fi stereo amplifier.

● Your winter's heating bill will be tickled soot with this mini-furnace cuddled by Joyce Byam at left. Invented by Raytheon Company engineers, the experimental gas-fired device is compact—the size of a two-pound coffee can—and extremely efficient. Heat transfer from burning fuel to water or air using severe turbulence was designed after heat exchangers used to cool radar magnetrons. The Raytheon people are working for a consumer product.

● Here's what you need on the road—Norelco's new stereo cassette tape player for your listening pleasure. Model 2602 shown above sells for less than $120. Designed to operate on the car's 12-volt electrical system, the unit automatically shuts off at the end of a tape and lifts the cassette into position for easy removal.

WHITE'S RADIO LOG

An up-to-date Directory of North American AM, FM, and TV Stations, including special sections on World-Wide Shortwave Stations and Emergency Stations for Selected Areas

WHITE'S RADIO LOG CONTENTS FOR 1969*

* If you save six consecutive issues of Radio-TV Experimenter and Science and Electronics, you will have a complete White's Radio Log. If you have missed an issue, you may be able to get a copy by writing directly to the publisher stating which issue you wish and enclosing $1.00 for each issue.

U. S. Television Stations by States

U. S. stations listed alphabetically by cities within state groups. Territories and possessions follow states. Chan., channel; C.L., call letters. †, educational stations. Listing indicates stations on the air up to December 16, 1968.

WHITE'S RADIO LOG

Location	C.L.	Chan.
ALABAMA		
Birmingham	WBRC-TV	6
	WAPI-TV	13
	WBMG	42
	†WBIQ	10
Decatur	WMSL-TV	23
Dothan	WTVY	4
Dozier	†WDIQ	2
Florence	†WFIQ-TV	36
	WOWL-TV	15
Huntsville	WHNT-TV	19
	†WHIQ	25
	WAAY-TV	31
Louisville	†WGIQ	43
Mobile	WKRG-TV	5
	WALA-TV	10
	†WEIQ	42
Montgomery	WSFA-TV	12
	WCOV-TV	20
	WKAB-TV	32
	†WAIQ	26
Mount Cheaha State Park	†WCIQ	7
Tuscaloosa	WCFT-TV	33
ALASKA		
Anchorage	KENI-TV	2
	KTVA	11
	KHAR-TV	13
Fairbanks	KFAR-TV	2
	KTVF	11
Juneau	KINY-TV	8
Sitka	KIFW-TV	13
ARIZONA		
Nogales	XHFA-TV	2
	KZAZ	11
Phoenix	KTVK	3
	KPAZ-TV	21
	KPHO-TV	5
	KOOL-TV	10
	KTAR-TV	12
	†KAET	8
	*KPAZ-TV	21
	KLUZ	15
Tucson	KVOA-TV	4
	KGUN-TV	9
	KOLD-TV	13
	†KUAT-TV	6
Yuma	KIVA	11
	KBLU-TV	13
ARKANSAS		
El Dorado	KTVE	10
Fayetteville	KGTO-TV	36
Ft. Smith	KFSA-TV	5
Jonesboro	KAIT-TV	8
Little Rock	KARK-TV	4
	KATV	7
	KTHV	11
	†KETS	2
CALIFORNIA		
Bakersfield	KLYD-TV	17
	KERO-TV	23
	KBAK-TV	29
Chico	KHSL-TV	12
El Centro	KECC-TV	9
Corona	KBSC-TV	52
El Centro-Mexicali	XHBC-TV	3
Eureka	KIEM-TV	3
	KVIQ-TV	6
	†KRWE-TV	13
Fontana	KXLA-TV	40
Fresno	KMJ-TV	24
	KFRE-TV	30
	KJEO	47
	KAIL	53
Hanford	KSJV-TV	21
Los Angeles	KNXT	2
	KNBC	4
	KTLA	5
	KABC-TV	7
	KHJ-TV	9
	KTTV	11
	KCOP	13
	KWHY-TV	22
	KMEX-TV	34
	†KCET	28
Modesto	KLOC-TV	19
Monterey	KMBY-TV	46
Oakland-San Francisco	KTVU	2
Palm Springs	KRIV	36
	KPLM	42
Redding	KRCR-TV	7
	†KIXE-TV	9
Sacramento	KCRA-TV	3
	KRAK-TV	15
	KXTV	10
	†KVIE	6
Salinas-Monterey	KSBW-TV	8
San Bernardino	†KVCR-TV	24
	KHOF-TV	30
San Diego	†KEBS-TV	15
	KFMB-TV	8
	KOGO-TV	10
	KCST	39
San Diego-Tijuana	XETV	6
	XEWT-TV	12
San Francisco	KRON-TV	4
	KPIX	5
	KGO-TV	7
	KEMO-TV	20
	†KQED	9
	KNEW-TV	32
	KUDO	38
	KBHK-TV	44
San Jose	KNTV	11
	KGSC-TV	36
San Luis Obispo	†KTEH	54
	KSBY-TV	6
San Mateo	†KCSM-TV	14
Santa Barbara	KEYT	3
Santa Maria	KCOY-TV	12
Stockton-Sacramento	KOVR	13
Ventura	KKOG-TV	16
Visalia	KICU-TV	43
COLORADO		
Colo. Springs	KKTV	11
	KRDO-TV	13
Denver	KWGN-TV	2
	KOA-TV	4
	KLZ-TV	7
	KBTV	9
	†KRMA-TV	6
Durango	KREZ-TV	6
Grand Junction	KREX-TV	5
Montrose	KREY-TV	10
Pueblo	KOAA-TV	5
Sterling	KTVS	3
CONNECTICUT		
Bridgeport	*WFTT	43
	†WEDW	49
Hartford	WTIC-TV	3
	WHCT	18
	†WEDH	24
New Britain-Hartford	WHNB-TV	30
New Haven	WNHC-TV	8
Norwich	†WEDN	53
Waterbury	WATR-TV	20
DELAWARE		
Wilmington	†WHYY-TV	12
DISTRICT OF COLUMBIA		
Washington	WRC-TV	4
	WTTG	5
	WMAL-TV	7
	WTOP-TV	9
	WFAN-TV	14
	†WETA-TV	26
	WOCA-TV	20
	WGSP-TV	50
FLORIDA		
Clearwater	WJNR-TV	22
Daytona Beach-Orlando	WESH-TV	2
Ft. Lauderdale	WSMS-TV	51
Ft. Myers	WINK-TV	11
	WBBH-TV	20
Ft. Pierce	WTVX	34
Gainesville	†WUFT	5
Jacksonville	WJXT	4
	WDUV-TV	30
	WFGA-TV	12
	WJKS-TV	17
	†WJCT	7
	WUMJ-TV	47
Miami	WTVJ	4
	WCIX-TV	6
	WCKT	7
	WLBW-TV	10
	†WTHS-TV	2
	†WSEC-TV	17
	WAJA-TV	23
Orlando	WOBO-TV	6
	WFTV	9
	†WMFE-TV	24
Palm Beach	WPTV	5
Panama City	WJHG-TV	7
Pensacola	WEAR-TV	3
	†WSRE	23
St. Petersburg-Tampa	WSUN-TV	38
	†WEOU	3
	WTOG	44
Tallahassee-Thomasville	WCTV	6
Tallahassee	†WFSU-TV	11
Tampa-St. Petersburg	WFLA-TV	8
	WLCY-TV	10
	WTVT	13
	†WUSF-TV	16
W. Palm Beach	WEAT-TV	12
	WJUD	25
GEORGIA		
Albany	WALB-TV	10
Ashburn	†WJIA-TV	23
Athens	†WGTV	8
Atlanta	WSB-TV	2
	WAGA-TV	5
	WQXI-TV	11
	†WETV	30
	*WBMO-TV	36
	WJRJ-TV	17
Augusta	WJBF	6
	WRDW-TV	12
	WATU-TV	26
Chatsworth	†WCLP-TV	18
Cochran	†WDCO-TV	15
Columbus	WRBL-TV	3
	WTVM	9
	†WJSP-TV	28
	WYEA-TV	38
Dawson	†WACS-TV	25
Macon	WMAZ-TV	13
	WCWB-TV	41
	WMCN-TV	24
Pelham	†WABW-TV	14
Savannah	WSAV-TV	3
	WTOC-TV	11
	†WVAN-TV	9
Warm Springs	†WJSP-TV	28
Waycross	†WXGA-TV	8
Wrens	†WCES-TV	20
HAWAII		
Hilo	KPUA-TV	9
	KHAW-TV	11
	KHVO	13
Honolulu	KHON-TV	2
	KHVH-TV	4
	KGMB-TV	9
	KTRG-TV	13
	†KHET	11
Wailuku	KMAU-TV	3
	KAII-TV	7
	KMVI-TV	12
	†KMEB	10
IDAHO		
Boise	KBOI-TV	2
	KTVB	7
Idaho Falls-Pocatello	KID-TV	3
	KIFI-TV	8
Lewiston	KLEW-TV	3
Moscow	†KUID-TV	12
Twin Falls	KMVT	11
ILLINOIS		
Aurora	WLXT	60
Carbondale	†WSIU	8
Champaign	WCIA	3
	WICD	15
	†WILL-TV	12
Chicago	WBBM-TV	2
	WMAQ-TV	5
	WLS-TV	7
	WGN-TV	9
	WCIU-TV	26
	WCFL-TV	38
	WFLD	32
	†WTTW	11
	†WXXW	20
Decatur	WAND	17
Elgin	WFNT	66
Freeport	WCEE-TV	23
Harrisburg	WSIL-TV	3
La Salle	WEEQ-TV	35
Moline	WQAD-TV	8
Olney	†WUSI	16
Peoria	WIRL-TV	19
	WEEK-TV	25
	WMBD-TV	31
Quincy-Hannibal	WGEM-TV	10
Rockford	WREX-TV	13
	WTVO	17
Rock Island	WHBF-TV	4
Springfield	WICS	20
	WPNG	55
INDIANA		
Anderson	WAIV-TV	67
Bloomington-Indianapolis	WTTV	4
Evansville	WTVW	7
	WFIE-TV	14
	WEHT	50
Ft. Wayne	WANE-TV	15
	WPTA	21
	WKJG-TV	33
Indianapolis	WFBM-TV	6
	WISH-TV	8
	WLWI	13
Lafayette	WLFI-TV	18
Marion	WTAF-TV	31
Muncie	WLBC-TV	49
Richmond	WACH-TV	43
St. John	†WCAE	50
South Bend	WNDU-TV	16
	WSBT-TV	22
South Bend-Elkhart	WSJV	28
Terre Haute	WTWO	2
	WTHI-TV	10
Vincennes	*†WVUT	22
IOWA		
Ames-Des Moines	WOI-TV	5
Cedar Rapids	KCRG-TV	9
Cedar Rapids-Waterloo	WMT-TV	2
Davenport	WOC-TV	6
Des Moines	KRNT-TV	8
	WHO-TV	13
	†KDPS-TV	11
	KWIG-TV	63
Ft. Dodge	KVFO-TV	21
Sioux City	KCAU-TV	9
	KMEG	14
	KTIV	4
Waterloo-Cedar Rapids	KWWL-TV	7
KANSAS		
Ensign	KTVC	6
Garden City	KGLD	11
	KUPK-TV	13
Goodland	KLOE-TV	10
Great Bend	KCKT	2
Hays	KAYS-TV	7
Hutchinson-Wichita	KTVH	12
Pittsburg-Joplin, Mo.	KOAM-TV	7
Salina	*KSLN-TV	34
Topeka	WIBW-TV	13
	KTSB	27
Wichita	KARO-TV	3
	KAKE-TV	10
KENTUCKY		
Ashland	†WKAS	25
Bowling Green	WLTV	13
	†WKGB	53
Elizabethtown	†WKZT	23
Lexington	WLEX-TV	18
	†WKLE	46
	WKYT-TV	27
	WBLG-TV	62
Louisville	WAVE-TV	3
	WHAS-TV	11
	WLKY-TV	32
	†WFPK-TV	15
Madisonville	†WJNA	35
Morehead	†WKMR	38
Murray	†WKMU	21
Owenton	†WKON	52
Paducah	WPSD-TV	6
Somerset	†WKSO	29
LOUISIANA		
Alexandria	KALB-TV	5
Baton Rouge	WBRZ	2
	WAFB-TV	9
	WRBT	33
Lafayette	KATC	3
	KLFY-TV	10
	KLNI-TV	15
Lake Charles	KPLC-TV	7
Monroe	KNOE-TV	8
New Orleans	WWL-TV	4
	WDSU-TV	6
	WVUE	12
	†WYES-TV	8
	*WWOM-TV	26
Shreveport	KTBS-TV	3
	KTAL-TV	6
	KSLA-TV	12
W. Monroe	KUZN-TV	39
MAINE		
Augusta	†WCBB	10
Bangor	WLBZ-TV	2
	WABI-TV	5
	WEMT	7
Calais	†WMEO-TV	13
Orono	†WMEB-TV	12
Poland Spring	WMTW-TV	8
Portland	WCSH-TV	6
	WGAN-TV	13
Presque Isle	WAGM-TV	8
	†WMEM-TV	10

Location	C.L.	Chan.
MARYLAND		
Baltimore	WMAR-TV	2
	WBAL-TV	11
	WBFF	45
	WJZ-TV	13
	WMET-TV	24
	†WMPB	67
Cumberland	WTBO-TV	52
Salisbury	WBOC-TV	16
MASSACHUSETTS		
Adams	WCDC	19
Boston	WBZ-TV	4
	WHDH-TV	5
	WNAC-TV	7
	WSBK-TV	38
	†WGBH-TV	2
	†WGBX-TV	44
Cambridge-Boston	WKBG-TV	56
Greenfield	WRLP	32
Springfield	WWLP	22
	WHYN-TV	40
Worcester	WJZB-TV	14
MICHIGAN		
Battle Creek	WWWU-TV	41
Bay City-Saginaw	WNEM-TV	5
Cadillac-Traverse City	WWTV	9
Cheboygan	WTOM-TV	4
Detroit	WJBK-TV	2
	WWJ-TV	4
	WXYZ-TV	7
	WKBD-TV	50
	†WTVS	56
	WXON	62
Detroit-Windsor	CKLW-TV	9
Flint	WJRT-TV	12
Grand Rapids	WZZM-TV	13
Grand Rapids-Kalamazoo	WOOD-TV	8
Kalamazoo	WKZO-TV	3
Lansing	WJIM-TV	6
Lansing (Onondaga)	WILX-TV	10
Marquette	WLUC-TV	6
Mt. Pleasant	*†WCMU-TV	14
Muskegon	WMKG	54
Onondaga-East Lansing	†WMSB	10
Saginaw-Bay City	WKNX-TV	25
Sault Ste. Marie	WWUP-TV	10
Traverse City	WPBN-TV	7
University Center (Bay City)	†WUCM-TV	19
MINNESOTA		
Appleton	†KWCM-TV	10
Alexandria	KCMT	7
Austin	KAUS-TV	6
Duluth	†WDSE-TV	8
	WDIO-TV	10
Duluth-Superior	KDAL-TV	3
	WDSM-TV	6
	†WDSE-TV	8
Hibbing	WIRT	13
Mankato	KEYC-TV	12
Minneapolis-St. Paul	WCCO-TV	4
	KMSP-TV	9
	WTCN-TV	11
Rochester	KROC-TV	10
St. Paul	†KTCI-TV	17
St. Paul-Minneapolis	KSTP-TV	5
	†KTCA-TV	2
Walker	KNMT	12
MISSISSIPPI		
Biloxi-Gulfport-Pascagoula	WLOX-TV	13
Columbus	WCBI-TV	4
Greenwood	WABG-TV	6
Gulfport	WROA-TV	25
Hattiesburg-Laurel	WDAM-TV	7
Jackson	WLBT	3
	WJTV	12
Meridian	WTOK-TV	11
Tupelo	WTWV	9
MISSOURI		
Cape Girardeau	KFVS-TV	12
Columbia	KDMU-TV	8
Hannibal-Quincy	KHQA-TV	7
Jefferson City	KRCG	13
Joplin	KODE-TV	12
	KUHI-TV	16
Kansas City	WDAF-TV	4
	KCMO-TV	5
	KMBC-TV	9
	†KCSD-TV	19
Kirksville-Ottumwa, Ia.	KTVD	3
*Poplar Bluff	*KPOB-TV	15
St. Joseph	KFEQ-TV	2
St. Louis	KTVI	2
	KMOX-TV	4
	KNDL-TV	30
	KSD-TV	5
	KPLR-TV	11
	†KETC	9
Sedalia	KMOS-TV	6
Springfield	KYTV	3
	KTTS-TV	10
	KMTC	27
MONTANA		
Billings	KOOK-TV	2
	KULR-TV	8
Butte	KXLF-TV	4
Glendive	KXGN-TV	5
Great Falls	KRTV	3
	KFBB-TV	5
Helena	KBLL-TV	12
Kalispell	WCFW-TV	9
Missoula	KGVD-TV	13
NEBRASKA		
Albion	KHQL-TV	8
Alliance	†KTNE-TV	13
Bassett	†KMNE-TV	7
Grand Island	KGIN-TV	11
Hastings	KHAS-TV	5
	†KHNE-TV	29
Hayes Center	KHPL-TV	6
Hay Springs	KDUH-TV	4
Henderson	KHBV	5
Kearney-Holdrege	KHOL-TV	13
Lexington	†KLNE-TV	3
Lincoln	KOLN-TV	10
	†KUON-TV	12
McCook	KOMC	8
Merriman	†KRNE-TV	12
Norfolk	†KXNE-TV	19
No. Platte	KNOP-TV	2
	†KPNE-TV	9
Omaha	KMTV	3
	WOW-TV	6
	KETV	7
	†KYNE-TV	26
	KAKS	42
Scottshluff-Gering	KSTF	10
Superior	KHTL-TV	4
NEVADA		
Henderson	KHBV	5
Las Vegas	KORK-TV	2
	KLAS-TV	8
	†KLVX	10
	KSHO-TV	13
Reno	KCRL	4
	KOLO-TV	8
	KTVN	2
NEW HAMPSHIRE		
Durham	†WENH	11
Hanover	†WHED-TV	15
Keene	†KEKW	52
Lehanon	WRLH	49
Littleton	†WLED-TV	49
Manchester	WMUR-TV	9
NEW JERSEY		
Atlantic City	WOND-TV	53
Burlington	WKBS-TV	48
Linden (Newark)	WNJU-TV	47
Paterson	WXTV	41
Vineland	WVNE	65
Wildwood	WCMC-TV	40
NEW MEXICO		
Albuquerque	KOB-TV	4
	KOAT-TV	7
	KGGM-TV	13
	†KNME-TV	5
Carlsbad	KAVE-TV	6
Clovis	KFDW-TV	12
Roswell	KSWS-TV	8
	KBIM-TV	10
NEW YORK		
Albany	WTEN	10
	WAST	13
	WEEE-TV	67
Binghamton	WNBF-TV	12
	WBJA-TV	34
	WINR-TV	40
	†WSKG	46
Buffalo	WGR-TV	2
	WBEN-TV	4
	WKBW-TV	7
	†WNED-TV	17
Carthage-Watertown	WWNY-TV	7
Elmira	WSYE-TV	18
Garden City	†WLIW	21
Jamestown	WNYP	26
New York	WCBS-TV	2
	WNBC-TV	4
	WNEW-TV	5
	WABC-TV	7
	†WNYE-TV	25
	WOR-TV	9
	WPIX	11
	†WNDT	13
	#WNYC-TV	31
Plattsburgh	WPTZ	5
Rochester	WROC-TV	8
	WHEC-TV	10
	WAAE-TV	13
	WPYH	31
	†WXXI	21
Schenectady	WRGB	6
	†WMHT	17
Syracuse	WSYR-TV	3
	WHEN-TV	5
	WNYS-TV	9
	†WCNY-TV	24
Utica	WKTV	2
NORTH CAROLINA		
Asheville	WLOS-TV	13
	WISE-TV	62
	†WUNF-TV	33
Chapel Hill	†WUNC-TV	4
Charlotte	WBTV	3
	WCTU-TV	36
	WSOC-TV	9
	†WTVI	42
	*WCTU-TV	36
Columbia	†WUND-TV	2
Concord	†WUNG-TV	58
Durham	WRDU	28
Durham-Raleigh	WTVD	11
Greensboro	WFMY-TV	2
	WUBC	48
Greenville	WNCT-TV	9
Hickory	WHKY-TV	14
High Point	WGHP-TV	8
New Bern	WNBE-TV	12
Linville	†WUNE-TV	17
Raleigh-Durham	WRAL-TV	5
Washington	WITN-TV	7
Wilmington	WWAY	3
	WECT	6
Winston-Salem	WSJS-TV	12
NORTH DAKOTA		
Bismarck	KFYR-TV	5
	KXMB-TV	12
Devils Lake—Grand Forks	WDAZ-TV	57
Dickinson	KDIX-TV	2
Fargo	WDAY-TV	6
	KTHI-TV	11
	†KFME	13
Minot	KMOT	10
	KXMC-TV	13
Pembina	KCND-TV	12
Valley City	KXJB-TV	4
Williston	KUMV-TV	8
OHIO		
Akron	WAKR-TV	23
	WCOT-TV	55
Athens	†WOUB-TV	20
Bowling Green	†WBGU-TV	70
Canton	WJAN	17
Cincinnati	WLWT	5
	WCPO-TV	9
	WKRC-TV	12
	†WCET	48
Cincinnati-Newport	WXIX-TV	19
Cleveland	WKYC-TV	3
	WCTF	19
	WEWS	5
	WJW-TV	8
	†WVIZ-TV	25
	WKBF-TV	61
Columbus	WLWC	4
	WTVN-TV	6
	WBNS-TV	10
	†WOSU-TV	34
Dayton	WLWD	2
	WHIO-TV	7
	WKEF	22
Kettering (Dayton)	WKTR-TV	16
Lima	WIMA-TV	35
Lorain	WUAB	43
Newark	†WGSF	28
Oxford	†WMUB-TV	14
Portsmouth	WRLO	30
Springfield	WSWO-TV	26
Steubenville-Wheeling, W. Va.	WSTV-TV	9
Toledo	WTOL-TV	11
	WSPD-TV	13
	WDHD-TV	24
	†WGTE-TV	30
	WDKS-TV	54
Youngstown	WFMJ-TV	21
	WKBN-TV	27
	WYTV	33
Zanesville	WHIZ-TV	18
OKLAHOMA		
Ada	KTEN	10
Ardmore Sherman-Denison, Tex.	KXII	12
Lawton	KSWO-TV	7
Oklahoma City	WKY-TV	4
	KOCO-TV	5
	KWTV	9
	†KETA	13
	†KOKH-TV	25
Sayre	KFDD-TV	8
Tulsa	KVOO-TV	2
	KDTV	6
	KTUL-TV	8
	†KOED-TV	11
	KVMP	41
OREGON		
Coos Bay	KCBY-TV	11
Corvallis	†KDAC-TV	7
Eugene	KEZI-TV	9
	KVAL-TV	13
Klamath Falls	KDTI	2
La Grande	KTVR	13
Medford	KOBI	5
	KMED-TV	10
Portland	KATU	2
	KOIN-TV	6
	KGW-TV	8
	KPTV	12
	†KOAP-TV	10
Roseburg	KPIC	4
PENNSYLVANIA		
Allentown	†WLVT-TV	39
Altoona	WFBG-TV	10
Clearfield	†WPSX-TV	3
Erie	WICU-TV	12
	WJET-TV	24
	WSEE	35
	†WQLN	54
Harrisburg	WHP-TV	21
	WTPA	27
Hershey	†WITF-TV	33
Johnstown	WJAC-TV	6
	WARD-TV	56
Lancaster	WGAL-TV	8
Lebanon	WLYH-TV	15
Philadelphia	KYW-TV	3
	WFIL-TV	6
	WCAU-TV	10
	WPHL-TV	17
	WIBF-TV	29
	WKBS-TV	48
	†WUHY-TV	35
Pittsburgh	KDKA-TV	2
	WTAE-TV	4
	WIIC-TV	11
	†WQED	13
	†WQEX	16
	WPGH-TV	53
Scranton	WDAU-TV	22
	†WVIA-TV	44
Scranton-Wilkes-Barre	WNEP-TV	16
	WBRE-TV	28
York	WSBA-TV	43
RHODE ISLAND		
Providence	WJAR-TV	10
	WPRI-TV	12
	†WSBE	36
Providence-New Bedford	WTEV	6
SOUTH CAROLINA		
Allendale	†WEBA-TV	14
Anderson	WAIM-TV	40
Charleston	WUSN-TV	2
	WCIV	4
	WCSC-TV	5
	†WITV	7
Columbia	WIS-TV	10
	WNOK-TV	19
	WOLO-TV	25
	†WRLK-TV	35
Florence	WBTW	13
	†WJPM-TV	33
Greenville	WFBC-TV	4
	†WNTV	29
Spartanburg	WSPA-TV	7
SOUTH DAKOTA		
Aberdeen	KXAB-TV	9
Brookings	†KESD-TV	8
Deadwood-Lead	KDSJ-TV	5
Florence (Watertown)	KDLO-TV	3
Lead	KHSD-TV	11
Mitchell	KDRN-TV	5
Rapid City	†KBHE-TV	9
	KOTA-TV	3
	KRSD-TV	7
Reliance	KPLD-TV	6
Sioux Falls	KELO-TV	11
	KSDD-TV	13
Vermillion	†KUSD-TV	2
TENNESSEE		
Chattanooga	WRCB-TV	3
	WTVC	9
	WDEF-TV	12
Jackson	WBBJ-TV	7
Johnson City-Bristol-Kingsport	WJHL-TV	11
Knoxville	WATE-TV	6
	WBIR-TV	10
	WTVK	26
Lexington	†WLJT-TV	11

WHITE'S

RADIO LOG

Location	C.L.	Chan.
TEXAS		
Memphis	WREC-TV	3
	WMCT	5
	WHBQ-TV	13
	†WKNO-TV	10
Nashville	WSM-TV	4
	WLAC-TV	5
	WMCV	33
	WSIX-TV	8
	†WDCN-TV	2
Sneedville	†WSJK	2
Abilene	KRBC-TV	9
Amarillo	KGNC-TV	4
	KVII-TV	7
	KFDA-TV	10
Austin	KTBC-TV	7
	KHFI-TV	42
Beaumont	KFDM-TV	6
	KBMT	12
Big Spring	KWAB-TV	4
Bryan	KBTX-TV	3
Corpus Christi	KIII	3
	KRIS-TV	6
	KZTV	10
Dallas-Fort Worth	KRLD-TV	4
	WFAA-TV	8
	†KERA-TV	13
	KLIF-TV	27
	KMEC-TV	23
	KDTV	39
El Paso	KROD-TV	4
	KTSM-TV	9
	KELP-TV	13
El Paso-Juarez	XEPM-TV	2
	XEJ-TV	5
Ft. Worth-Dallas	WBAP-TV	5
	KFWT	21
	KTVT	11
Galveston	KVVV-TV	16
Harlingen	KGBT-TV	4
Houston	KPRC-TV	2
	KHOU-TV	11
	KTRK-TV	13
	KHTV	39
	KVRL	26
Longview	†KUHT	8
Laredo	KHER	16
	KGNS-TV	8
Lubbock	KVTV	12
	KCBD-TV	11
	KLBK-TV	13
	KSEL-TV	28
	†KTXT-TV	5
Lufkin	KKBC-TV	34
Midland-Odessa	KTRE-TV	9
Monahans	KMID-TV	2
Odessa	KVKM-TV	9
Port Arthur-Beaumont	KOSA-TV	7
Richardson	KJAC-TV	4
San Angelo	†KRET-TV	23
San Antonio	KACB-TV	3
	KCTV	8
	WOAI-TV	4
	KENS-TV	5
	KSAT-TV	12
	KWEX-TV	41
San Antonio-Austin	†KLRN-TV	9
Sweetwater-Abilene	KTXS-TV	12
Temple-Waco	KCEN-TV	6
Tyler-Longview	KLTV	7
Waco	KWTX-TV	10
Weslaco	KRGV-TV	5
Wichita Falls	KFDX-TV	3
	KAUZ-TV	6
UTAH		
Logan	†KUSU-TV	12
Ogden	†KOET	9
	†KWCS-TV	18
Provo	†KBYU-TV	11
Salt Lake City	KUTV	2
	KCPX-TV	4
	KSL-TV	5
	†KUED	7
VERMONT		
Burlington	WCAX-TV	3
	†WETK	33
	WVNY-TV	22
	†WVER	28
Rutland	WVTB	20
St. Johnsbury	†WVTA	41
Windsor		
VIRGINIA		
Bristol	WCYB-TV	5
Hampton-Norfolk	WVEC-TV	13
	†WHRO-TV	15
Harrisonburg	WSVA-TV	3
Lynchburg-Roanoke	WLVA-TV	13
Norfolk	WTAR-TV	3
Petersburg-Richmond	WXEX-TV	8
Portsmouth	#WYAH-TV	27
Portsmouth-Norfolk	WAVY-TV	10
Richmond	WTVR-TV	6
	WWBT	12
	†WCVE-TV	23
	†WCVW	57
Roanoke	†WBRA-TV	15
	WDBJ-TV	7
	WSLS-TV	10
	WRFT-TV	27
Staunton	†WVPT	51
WASHINGTON		
Bellingham	KVOS-TV	12
Pasco	KEPR-TV	19
Pullman	†KWSC-TV	10
Richland	KNDU	25
Seattle	KOMO-TV	4
	KING-TV	5
	KIRO-TV	7
	†KCTS-TV	9
	KTLF	22
Spokane	KREM-TV	2
	KXLY-TV	4
	KHQ-TV	6
	†KSPS-TV	7
Tacoma-Seattle	KTNT-TV	11
Tacoma	KTVW	13
	KLAY-TV	20
	†KPEC-TV	56
	†KTPS	62
Yakima	KNDO	23
	KIMA-TV	29
	†KYVE-TV	47
WEST VIRGINIA		
Bluefield	WHIS-TV	6
Charleston	WCHS-TV	8
	WTIP-TV	23
Clarksburg	WBOY-TV	12
Huntington	†WMUL-TV	67
Huntington-Charleston	WSAZ-TV	3
	WHTN-TV	13
Oak Hill	WOAY-TV	4
Parkersburg-Marietta, O.	WTAP-TV	15
Weston	WOTV	5
Wheeling Steubenville, O	WTRF-TV	7
WISCONSIN		
Eau Claire	WEAU-TV	13
Fond du Lac	KFIZ-TV	34
Green Bay	WBAY-TV	2
	WFRV-TV	5
	WLUK-TV	11
LaCrosse	WKBT	8
	WXOW-TV	25
Madison	WISC-TV	3
	WMTV	15
	WKOW-TV	27
	†WHA-TV	21
Milwaukee	WTMJ-TV	4
	WITI-TV	6
	WISN-TV	12
	WVTV	18
	†WMVS	10
	†WMVT	36
Rhinelander	WAEO-TV	12
Wausau	WSAU-TV	7
	WAOW-TV	9
WYOMING		
Casper	KTWO-TV	2
Cheyenne	KFBC-TV	5
Riverton	KWRB-TV	10
GUAM		
Agana	KUAM-TV	8
PUERTO RICO		
Aquadilla	WOLE-TV	12
Caguas	WKBM-TV	11
Mayaguez	WORA-TV	5
	†WIPM-TV	3
Ponce	WRIK-TV	7
	WSUR-TV	9
	*WPSJ	14
San Juan	WKAQ-TV	2
	WAPA-TV	4
	†WIPR-TV	6
	WTSJ	18
	WITA-TV	30
VIRGIN ISLANDS		
Charlotte Amalie	WBNB-TV	10
Christiansted	WSVI	8

Canadian Television Stations by Cities

Canadian stations listed alphabetically by cities. Abbreviations: Chan., channel; C.L., call letters.

Location	C.L.	Chan.
Adams Hill, B.C.	CFCR-TV-8	11
Alticane, Sask.	CKBI-TV-1	10
Amherst, N.S.	CJCH-TV-3	8
Antigonish, N.S.	CJCB-TV-2	9
Argentia, Nfld.	CJOX-TV	3
Asheroft, B.C.	CFCR-TV-2	10
Ashmont, Alta.	CFRN-TV-4	12
Athabasca, Alta.	CBXT-1	8
Atikokan, Ont.	CBWCT-1	7
Avola, B.C.	CFCR-TV-13	3
Baldy Mountain, Man.	CKSS-TV	8
Baie St. Paul, Que.	CKRT-TV-1	2
Bancroft, Ont.	CHEX-TV-1	2
Banff, Alta.	CKRD-TV-2	10
	CFCN-TV-2	8
	CHCT-TV-2	13
Barrie, Ont.	CKVR-TV	3
Bayview, N.S.	CJCH-TV-2	6
Big River, Sask.	CKBI-TV-5	9
Bon Accord, N.B.	CHSJ-TV-1	6
Bonavista, Nfld.	CJON-TV-2	10
Bonnyville, Alta.	CKSA-TV-2	9
Boss Mountain, B.C.	CFCR-TV-16	7
Boston Bar, B.C.	CFCR-TV-9	5
Bowen Island, B.C.	CBUT-4	13
Bowen Island, B.C.	CHAN-TV-2	8
Bralorne, B.C.	CFCR-TV-15	3
Brandon, Man.	CKX-TV	5
Brooks, Alta.	CFCN-TV-3	9
Bullhead Mt., B.C.	CJDC-TV-2	8
Burmis, Alta.	CJLH-TV-3	3
Burnaby, B.C.	CHAN-TV	8
Burns Lake, B.C.	CFTK-TV-3	4
Cahane, P.Q.	CKRT-TV-4	5
Calgary, Alta.	CFCN-TV	4
Calgary, Alta.	CHCT-TV	2
Callander, Ont.	CFCH-TV	10
Campbellton, N.B.	CKCD-TV	7
Camp Woss, B.C.	CFNV-TV-1	3
Canning, N.S.	CJCH-TV-1	10
Canoe, B.C.	CHBC-TV-8	3
Canoe Mountain, Near Valemont, B.C.	CFCR-TV-14	8
Carleton, Que.	CHAU-TV	5
Carlyle Lake, Sask.	CFSS-TV	7
Castlegar, B.C.	CBUAT-2	3
Causapscal, Que.	CKBL-TV-5	6
Cawston, B.C.	CHKC-TV-3	3
Celista, B.C.	CHBC-TV-6	6
Chandler, Que.	CHAU-TV-4	7
Chapleau, Ont.	CFCL-TV-8	7
Charlottetown, P.E.I.	CFCY-TV	13
Cherryville, B.C.	CJWR-TV-1	10
Chicoutimi, P.Q.	CJPM-TV	6
Chilliwack, B.C.	CHAN-TV-1	11
Cheticamp, N.S.	CBFCT	10
Chicoutimi, Que.	CKRS-TV-2	2
Churchill, Man.	CHGH-TV	4
Clearwater, B.C.	CFCR-TV-10	2
Clinton, B.C.	CFCR-TV-4	9
Cleridorme, Que.	CHAU-TV-8	6
Coleman, Alta.	CJLH-TV-1	12
Corner Brook, Nfld.	CBYT	5
Corner Brook, Nfld.	CJON-TV-1	10
Cornwall, Ont.	CJSS-TV	8
Coronation, Alta.	CKRD-TV-1	10
Colgate, Saskatchewan	CKCK-TV-1	12
Courtenay, B.C.	CBUT-1	9
Cranbrook, B.C.	CBUBT	10
Crawford Bay, B.C.	CBUAT-3	5
Crescent Valley, B.C.	CHMS-TV-1	5
Creston, B.C.	CBUAT-4	3
Dawson Creek, B.C.	CJDC-TV	5
Deer Lake, Nfld.	CBYAT	12
Drumheller, Alta.	CFCN-TV-1	12
Drumheller, Alta.	CHCT-TV-1	6
Dryden, Ont.	CBWDT	9
Eastend, Sask.	CJFB-TV-1	2
Edmonton, Alta.	CBXT	5
Edmonton, Alta.	CFRN-TV	3
Edmundston, N.B.	CJBR-TV-1	13
Elliott Lake, Ont.	CBFST-3	12
Elliot Lake, Ont.	CKSO-TV-1	3
Enderby, B.C.	CFEN-TV-1	5
Enderby, B.C.	CHBC-TV-5	72
Falkland, B.C.	CFWS-TV-1	5
Fisher Branch, Man.	CBWT-1	10
Flin Flen, Man.	CBWBT	10
Fort Francie, Ont.	CBWCT	5
Fort Fraser, B.C.	CKPG-TV-3	6
Foxwarren, Man.	CKX-TV-1	11
Gaspe, Que.	CHAU-TV-6	10
Gaspe West, Que. (Bechervaise Mountain)	CFGW-TV-1	6
Geraldton, Ont.	CBLAT	13
Goose Bay, Nfld.	CFLA-TV	8
Grand Bank, Nfld.	CJOX-TV-1	10
Grand Falls, Nfld.	CBNAT	11
Grand Falls, Nfld.	CJCN-TV	4
Grand Forks, B.C.	CBUAT-5	5
Grande Prairie, Alta.	CBXAT	10
Grande Vallee	CKBL-TV-3	11
Greenwater Lake, Sask.	CKBI-TV-3	4
Haliburton, Ont.	CKVR-TV-3	5
Halifax, N.S.	CBHT	3
Halifax, N.S.	CJCH-TV	5
Hamilton, Ont.	CHCH-TV	11
Hearst, Ont.	CBFOT-2	7
High Prairie, Alta.	CFCL-TV-4	4
Hinton, Alta.	CBXAT-2	2
Hixon, B.C.	CBXT-3	8
Houston, B.C.	CKPG-TV-1	10
Hudson Hope, B.C.	CFTK-TV-10	2
Huntsville, Ont.	CJDC-TV-1	11
Invermere, B.C.	CKVR-TV-2	8
Inverness, N.S.	CFWL-TV-1	9
Jasper, Alta.	CJCB-TV-1	6
Jonquiere, Que.	CBXT-4	5
Jubilee Mountain, B.C.	CKRS-TV 12	
Juskatla, B.C.	CFWL-TV-2	8
Kamloops, B.C.	CFTK-TV-7	2
Kapuskasing, Ont.	CFCR-TV	4
Kapuskasing, Ont.	CBFOT-1	12
Kearns, Ont.	CFCL-TV-3	3
Kemano, B.C.	CFCL-TV-2	2
Kelowna, B.C.	CFTK-TV-5	2
Kenora, Ont.	CHBC-TV	2
	CBWAT	8
Keremeos, B.C.	CHKC-TV-1	5
Kildala, B.C.	CFTK-TV-4	5
Kingston, Ont.	CKWS-TV	11
Kitchener, Ont.	CKCO-TV	13
Kokish, B.C.	CFKB-TV-2	9
Labrador City, Nfld.	CJCL-TV	13
Lac du Bonnet, Man.	CBWT-2	4
Lac la Biche, Alta.	CBXT-5	10
	CFRN-TV-5	8
Lake Louise, Alta.	CFLL-TV-1	8
L'Anse a Valleau, Que.	CHAU-TV-9	7
Lawn, Nfld.	CJOX-TV-2	10
Lethbridge, Alta.	CJLH-TV	7
Lillooet, B.C.	CFCR-TV-1	11
Liverpool, N.S.	CBHT-1	12
Lloydminster, Alta.	CKSA-TV	2
London, Ont.	CFPL-TV	10
Lookout Ridge, Near Chilliwack, B.C.	CBUT-2	3
Lumby, B.C.	CHID-TV-1	5
Lynn Lake, Man.	CBTA-TV	8
Mabel Lake, B.C.	CHPP-TV-1	8
Magdalen Islands, Que.	CBFCT-1	12
Malakwa, B.C.	CFFI-TV-1	5
Malartic, Que.	CFCL-TV-5	5
Manicouagan, Que.	CKHQ-TV-1	10
Manitouwadge, Ont.	CBLAT-1	8
Marquis, Sask.	CKMJ-TV	7
Marystown, Nfld.	CBNT-3	5
Matagami, Que.	CKRN-TV-4	7
Matane, Que.	CKBL-TV	9
	CKBL-TV-6	6
Meadow Lake, Sask.	CKSA-TV-1	12
Medicine Hat, Alta.	CHAT-TV	6
Melita, Man.	CKX-TV-2	9
Merritt, B.C.	CFCR-TV-3	10
Mica Creek Village, B.C.	CFZQ-TV-2	5
Micoua, Que.	CKHQ-TV-3	6
Midway, B.C.	CKMY-TV-1	7
Minden, Ont.	CHEX-TV-2	10
Moncton, N.B.	CBAFT	11
Moncton, N.B.	CKCW-TV	2

Location	C.L.	Chan.
Mont Blanc Perce, Que.	CFGW-TV-2	8
Mont Climont, Que.	CKBL-TV-1	11
Mont Georges, Que.	CKHQ-TV-5	13
Mont-Laurier, Que.	CBFT-2	3
Mont-Louis, Que.	CKBL-TV-4	2
Mont Tremblant, Que.	CBFT-1	11
Montreal, Que.	CBFT	2
Montreal, Que.	CBMT	6
Montreal, Que.	CFCF-TV	12
Montreal, Que.	CFTM-TV	10
Moose Jaw, Sask.	CHAB-TV	4
Mount Timothy, B.C.	CFCR-TV-6	5
Moyie, B.C.	CKVS-TV-1	5
Mt. Parizeau, B.C.	CFTK-TV-8	5
Mt. Poole (near Queen Charlotte) B.C.	CHQC-TV-1	4
Murdochville, Que.	CKBL-TV-2	6
	CKMU-TV-1	3
Nakusp, B.C.	CJNP-TV-1	2
	CJNP-TV-2	4
Nass Camp (Near Lava Lake) B.C.	CFTK-TV-6	5
Nelson, B.C.	CBUAT-1	9
Newcastle, N.B.	CKAM-TV-1	7
Newcastle Ridge, B.C.	CFKB-TV-1	7
New Denver, B. C.	CHSL-TV-1	6
New Glasgow, N.S.	CFCY-TV-1	7
Ninkish, B.C.	CFNV-TV-2	6
Nipawin, Sask.	CKBI-TV-4	2
North Battleford, Sask.	CKBI-TV-2	7
Ocean Falls, B.C.	CFTK-TV-9	2
Olalla	CHKC-TV-2	11
Oliver, B.C.	CHBC-TV-3	8
Ottawa, Ont.	CBOFT	9
	CBOT	4
	CJOH-TV	13
Outardes, Que.	CKHQ-TV-2	12
Parry Sound, Ont.	CKVR-TV-1	11
Passmore, B.C.	CHMB-TV-2	2
Peace River, Alta.	CBXAT-1	7
Peachland, B.C.	CHPT-TV-1	5
Pembroke, Ont.	CHOV-TV	5
Penticton, B.C.	CHBC-TV-1	13
Perce, Que.	CHAU-TV-5	2
Perrys, B.C.	CHMB-TV-3	5
Peterborough, Ont.	CHEX-TV	12
Pivot, Alta.	CHAT-TV-1	4
Placentia, Nfld.	CBNT-2	12
Port Albernie, B.C.	CBUT-3	4
Port Alfred, Que.	CKRS-TV-1	9
Port Alice, B.C.	CKPA-TV-1	2
Port Arthur, Ont.	CKPR-TV	2
Port Aux Basques, Nfld.	CBYBT	3
Port Daniel, Que.	CHAU-TV-3	10
Port Hardy, B.C.	CFKB-TV-3	3
Port Renfrew, B.C.	CJTV-TV-1	11
Port Rexton, Nfld.	CBNT-1	13
Prince Albert, Sask.	CKBI-TV	5
Prince George, B.C.	CKPG-TV	2
Princeton, B.C.	CHGP-TV-1	5
Prince Rupert	CFTK-TV-1	6
Promontory Mountain, B.C.	CFCR-TV-12	5
Quebec, Que.	CBVT	11
	CFCM-TV	4
	CKMI-TV	5
Quesnel, B.C.	CFCR-TV-11	7
Quesnel, B.C.	CKCQ-TV-1	13
Red Deer, Alta.	CKRD-TV	6
Red Lake, Ont.	CBWET	10
Regina, Sask.	CHRE-TV	9
Regina, Sask.	CKCK-TV	2
Revelstoke, B.C.	CFZQ-TV-1	9
Rimouski, Que.	CJBR-TV	3
Riverhurst, Sask.	CJFB-TV-3	10
Rivière-au-Renard	CHAU-TV-7	7
Rivière du Loup, Que.	CKRT-TV	7
Riviere du Loup, Que.	CKRT-TV-3	13
Roberval, Que.	CKRS-TV-3	8
Rouyn, Que.	CKRN-TV	4
Saint John, N.B.	CHSJ-TV	4
Salmon Arm, B.C.	CHBC-TV-4	9
Saskatoon, Sask.	CFQC-TV	8
Sault Ste. Marie, Ont.	CJIC-TV	2
Savona, B.C.	CFCR-TV-7	8
Schefferville, Que.	CFKL-TV	11
Senneterre, Que.	CKRN-TV-1	7
Sheet Harbour, N.S.	CBHT-4	11
Shelburne, N.S.	CBHT-2	8
Sherbrooke, Que.	CHLT-TV	7
Sioux Lookout, Ont.	CBWOT-1	12
Skaha Lake (near Penticton), B.C.	CHBC-TV-7	10
Smithers, B.C.	CFTK-TV-2	5
Sointula, B.C.	CFKB-TV-4	5
Spences Bridge, B.C.	CJNA-TV-1	3
Squamish, B. C.	CHAN-TV-3	7
St. Albans, Nfld.	CBNT-4	9
St. Andrews, Nfld.	CBYBT-1	6
St. Georges de Beauce, P. Q.	CBVT-1	2
St. John's, Nfld.	CBNT	8
	CJON-TV	6
Ste. Marguerite-Marie, Que.	CHAU-TV-1	2
St. Quentin, N.B.	CHAU-TV-2	10
Ste. Rose du Dégelé, Que.	CKRT-TV-2	2
Stephenville, Nfld.	CBYT-1	8
Stranraer, Sask.	CFQC-TV-1	3
Sturgeon Falls, Ont.	CBFST	7
Sudbury, Ont.	CHFST-1	13
	CKSO-TV	5
Swift Current, Sask.	CJFB-TV	5
Sydney, N.S.	CJCB-TV	4
Temiscaming, Que.	CBFST-2	12
	CFCH-TV-1	3
Terrace, B.C.	CFTK-TV	3
The Pas, Man.	CBWBT-1	7
Timmins, Ont.	CFCL-TV	6
	CBFOT	9
Toronto, Ont.	CBLT	6
	CFTO-TV	9
Trail, B.C.	CBUAT	11
Trois-Rivières, Que.	CKTM-TV	13
Uclulet, B. C.	CKUP-TV-1	6
Upsalquitch Lake, N.B.	CKAM-TV	12
Val D'Or, Que.	CKRN-TV-2	8
Val Marie, Sask.	CJFB-TV-2	2
Vancouver, B.C.	CBUT	2
Vernon, B.C.	CHBC-TV-2	7
Victoria, B.C.	CHEK-TV	6
Ville Marie, Que.	CKRN-TV-3	6
Waterton Park, Alta.	CJWP-TV-1	12
Wawa, Ont.	CRLAT-3	9
Westwold, B.C.	CFWS-TV-2	12
Whitecourt, Alta.	CBXT-2	9
	CFRN-TV-3	12
White River, Ont.	CBLAT-2	12
Williams Lake, B.C.	CFCR-TV-5	8
Willow Bunch, Sask.	CKCK-TV-2	6
Windsor, Ont.	CKLW-TV	9
Wingham, Ont.	CKNX-TV	8
Winnipeg, Man.	CBWFT	3
	CBWT	6
	CJAY-TV	7
	CHSS-TV	6
Wynyard, Sask.		
Yellowknife, N.W.T.	CFYK-TV	8
Yorkton, Sask.	CKOS-TV	3
Yarmouth, N.S.	CBHT-3	11

Canadian AM Stations by Frequency

Canadian stations listed alphabetically by call letters within groups. Abbreviations: kHz, frequency in kilocycles; W.P., power in watts; d, operates daytime only; n, operates nighttime only. Wave length is given in meters.
Listing indicates stations on the air up to April 1, 1968.

kHz	Wave Length	W.P.
540—555.5		
CBK Regina, Sask.		50,000
CBT Grand Falls, Nfld.		10,000
550—545.1		
CFBR Sudbury, Ont.		1,000d
CFNB Fredericton, N.B.		50,000
CHLN Trois-Rivières, Que.		10,000d
		5,000n
CKPG Prince George, B.C.		10,000
560—525.4		
CFOS Owen Sound, Ont.		1,000
CHCM Marystown, Nfld.		1,000d
		500n
CHTK Prince Rupert, B.C.		1,000d
		250n
CJKL Kirkland Lake, Ont.		5,000
CKCN Sept-Iles, Que.		10,000d
		5,000n
CKNL Fort St. John, B.C.		1,000
570—526.0		
CFCB Corner Brook, Nfld.		1,000
CJEM Edmundston, N.B.		5,000d
		1,000n
CKCQ Quesnel, B.C.		1,000
CKEK Cranbrook, B.C.		1,000
CFWH Whitehorse, Y.T.		1,000
580—516.9		
CFRA Ottawa, Ont.		50,000d
		10,000n
CHLC Hauterive, Que.		5,000d
		2,500n
CJFX Antigonish, N. S.		10,000
CKAP Kapuskasing, Ont.		1,000
CKPR Port Arthur, Ont.		5,000d
		1,000n
CKUA Edmonton, Alta.		10,000
CKWW Windsor, Ont.		500
CKXR Salmon Arm, B.C.		1,000
CKY Winnipeg, Man.		50,000
590—508.2		
CFAR Flin Flon, Man.		10,000d
		1,000n
CFNL Fort Nelson, B. C.		250
CKEY Toronto, Ont.		10,000
CKRS Jonquiere, Que.		1,000
CFTK Terrace, B.C.		1,000
VOCM St. John's, Nfld.		10,000
600—499.7		
CFCF Montreal, Que.		5,000
CFCH Callander, Ont.		10,000d
		5,000n
CFQC Saskatoon, Sask.		5,000
CJOR Vancouver, B.C.		10,000
CKCL Truro, N.S.		1,000
610—491.7		
CHNC New Carlisle, Que.		10,000d
		5,000n
CHTM Thompson, Man.		1,000
CJAT Trail, B.C.		1,000
CKML Mont Laurier, P.Q.		1,000
CKTB St. Catharines, Ont.		10,000d
		5,000n
CKYL Peace River, Alta.		10,000d
		1,000n
620—483.6		
CFCL Timmins, Ont.		10,000d
		5,000n
CKCK Regina, Sask.		5,000
CKCM Grand Falls, Nfld.		10,000
630—475.9		
CFCO Chatham, Ont.		10,000d
		1,000n
CFCY Charlottetown, P. E. I.		10,000
CHED Edmonton, Alta.		10,000
CHLT Sherbrooke, Que.		10,000d
		5,000n
CJET Smiths Falls, Ont.		10,000
CKAR Huntsville, Ont.		1,000
CKOV Kelowna, B.C.		1,000
CKRC Winnipeg, Man.		10,000
640—468.5		
CBN St. John's, Nfld.		10,000
680—440.9		
CHFA Edmonton, Alta.		5,000
CHFI Toronto, Ont.		1,000d
		10,000n
CHLO St. Thomas, Ont.		1,000
CJCN Grand Falls, Nfld.		10,000
CJOB Winnipeg, Man.		10,000d
		2,500n
CKGB Timmins, Ont.		10,000
690—434.5		
CBF Montreal, Que.		50,000
CBU Vancouver, B.C.		10,000
710—422.3		
CFRG Gravelbourg, Sask.		5,000d
CHYR Leamington, Ont.		10,000
CKVM Ville-Marie, Que.		10,000d
		1,000n
CJOX Grand Bank, Nfld.		1,000
730—410.7		
CHIR Leamington, Ont.		250
CJNR Blind River, Ont.		1,000
CKAC Montreal, Que.		50,000
CKDM Dauphin, Man.		10,000d
		5,000n
CKLG North Vancouver, B.C.		10,000
740—405.2		
CBL Toronto, Ont.		50,000
CBX Edmonton, Alta.		50,000
790—379.5		
CFDR Dartmouth, N.S.		5,000
CFCW Camrose, Alta.		10,000
CKMR Newcastle, N.B.		1,000
CKSO Sudbury, Ont.		10,000d
		5,000n
CHIC Brampton, Ont.		1,000d
		500n
800—374.8		
CFOB Fort Frances, Ont.		1,000d
		500n
CHAB Moose Jaw, Sask.		10,000d
		5,000n
CHRC Quebec, Que.		50,000
CJAD Montreal, Que.		50,000d
		10,000n
CJBQ Belleville, Ont.		1,000
CJLX Fort William, Ont.		10,000d
		5,000n
CKOK Penticton, B.C.		10,000d
		500n
CKLW Windsor, Ont.		50,000
VOWR St. John's, Nfld.		1,000
810—370.2		
CHQR Calgary, Alta.		10,000
850—352.7		
CJJC Langley, B.C.		1,000
CKRD Red Deer, Alta.		10,000d
		1,000n
CKVL Verdun, Que.		50,000d
		10,000n
860—348.6		
CBH Halifax, N.S.		10,000
CFPR Prince Rupert, B.C.		10,000
CHAK Inuvik, N.W.T.		1,000
CJBC Toronto, Ont.		50,000
900—333.1		
CHML Hamilton, Ont.		5,000
CHNO Sudbury, Ont.		10,000d
		1,000n
CJBR Rimouski, Que.		10,000
CJVI Victoria, B.C.		10,000
CKBI Prince Albert, Sask.		10,000
CKDR Dryden, Ont.		1,000d
		250n
CKDH Amherst, N.S.		1,000
CKJL St. Jérôme, Que.		1,000
CKTS Sherbrooke, Que.		1,000
CKVD Val D'Or, Que.		10,000d
		2,500n
910—329.5		
CBO Ottawa, Ont.		5,000
CFJC Kamloops, B.C.		10,000d
		1,000n
CFSX Stephenville, Nfld.		500
CHRL Roberval, Que.		1,000
CJOV Drumheller, Alta.		5,000
CKLY Lindsay, Ont.		1,000
920—329.9		
CFRY Portage La Prairie, Man.		1,000
CJCH Halifax, N.S.		10,000d
		5,000
CJCJ Woodstock, N.B.		1,000
CKCY Sault Ste. Marie, Ont.		10,000d
		5,000n
CKNX Wingham, Ont.		2,500d
		1,000n
930—322.4		
CFBC Saint John, N.B.		10,000d
		5,000n
CJCA Edmonton, Alberta		10,000d
		5,000n
CJON St. John's, Nfld.		10,000
940—319.0		
CBM Montreal, Que.		50,000
CJGX Yorkton, Sask.		10,000
CJIB Vernon, B.C.		10,000d

WHITE'S RADIO LOG

kHz	Wave Length	W.P.
950—315.6		
CHER	Sydney, N.S.	10,000
CKBB	Barrie, Ont.	10,000d 2,500n
CKNB	Campbellton, N.B.	10,000d 1,000n
960—312.3		
CFAC	Calgary, Alta.	10,000
CHNS	Halifax, N.S.	10,000
CKWS	Kingston, Ont.	10,000d 5,000n
970—309.1		
CKCH	Hull, Que.	5,000
CBZ	Fredericton, N.B.	10,000
980—305.9		
CBV	Quebec, Que.	5,000
CFPL	London, Ontario	10,000d 5,000n
CHEX	Peterborough, Ont.	10,000d 5,000n
CKGM	Montreal, Que.	10,000
CKNW	New Westminster, B.C.	50,000
CKRM	Regina, Sask.	10,000d 5,000n
990—302.8		
CBW	Winnipeg, Man.	50,000
CBY	Corner Brook, Nfld.	10,000
1000—299.8		
CKBW	Bridgewater, N.S.	10,000
1010—296.9		
CBR	Calgary, Alta.	50,000
CFRB	Toronto, Ont.	50,000
1050—285.5		
CFGP	Grande Prairie, Alta.	10,000
CHUM	Toronto, Ont.	50,000
CJIC	Sault Ste. Marie, Ont.	10,000d 2,500n
CJNB	North Battleford, Sask.	10,000
CKSB	St. Boniface, Man.	10,000
1060—282.8		
CFCN	Calgary, Alta.	50,000
CJLR	Quebec, Que.	10,000
1070—280.2		
CBA	Sackville, N.B.	50,000
CFAX	Victoria, B.C.	1,000
CHOK	Sarnia, Ont.	5,000d 1,000n
1080—277.6		
CKSA	Lloydminster, Alta.	10,000
1090—275.1		
CHEC	Lethbridge, Alta.	5,000
CHRS	St. Jean, Que.	10,000d
1110—272.6		
CBO	Saint John, N.B.	10,000
CFML	Cornwall, Ont.	1,000
CFTJ	Galt, Ont.	250d
CHQT	Edmonton, Alta.	10,000
1130—265.3		
CKWX	Vancouver, B.C.	50,000
1140—263.0		
CBI	Sydney, N.S.	10,000
CKXL	Calgary, Alta.	10,000
1150—260.7		
CHSJ	Saint John, N.B.	10,000d 5,000n
CKOC	Hamilton, Ont.	10,000
CKTR	Trois-Rivières, Que.	10,000d 1,000n
CKX	Brandon, Man.	10,000d 1,000n
1170—256.3		
CFNS	Saskatoon, Sask.	1,000
1220—245.8		
CHSC	St. Catherines, Ont.	1,000d 500n
CJOC	Lethbridge, Alta	10,000d 5,000n
CJRL	Kenora, Ont.	1,000
CJSS	Cornwall, Ontario	1,000
CKOA	Victoria, B.C.	10,000
CKCW	Moncton, N.B.	10,000
CKSM	Shawinigan, Que.	1,000
1230—243.8		
CBOR	Scheffervilie, Que.	250
CFBV	Smithers, B.C.	1,000d 250n
CFGR	Gravelbourg, Sask.	250n
CFLK	Kapuskasing, Ont.	100
CFPA	Port Arthur, Ont.	1,000d 250n
CHFC	Churchill, Man.	250
CHVO	Oolbeau, P.Q.	1,000d 250n
CJSA	Ste. Agathes des Monts, Que.	1,000d 250n
CJTT	New Liskeard, Ont.	1,000d 250n
CKLO	Thetford Mines, Que.	1,000d 250n
CKMP	Midland, Ont.	1,000d 250n
CKTK	Kitimat, B.C.	1,000d 250n
VOAR	St. John's, Nfld.	100
1240—241.8		
CFLM	La Tuque, Que.	1,000d 250n
CFLS	Levis, P.Q.	250
CFVR	Abbotsford, B.C.	1,000d 250n
CJAF	Cabano, Que.	250
CJAV	Port Alberni, B.C.	1,000d 250n
CJCS	Stratford	500d 250n
CJRW	Summerside, P.E.I.	250
CJWA	Wawa, Ont.	1,000d 250n
CKWL	Williams Lake, B.C.	250
CKBS	St. Hyacinthe, Que.	250
CKLS	La Sarre, Que.	250
CKOO	Osoyoos, B.C.	1,000d 250n
1250—239.9		
CBOF	Ottawa, Ont.	10,000
CHWO	Oakville, Ont.	1,000d
CHSM	Steinbach, Man.	10,000
CKBL	Matane, Que.	10,000d 5,000n
CKOM	Saskatoon, Sask.	10,000
1260—238.0		
CFRN	Edmonton, Alta.	50,000
1270—263.1		
CFGT	Alma, Que.	1,000
CHAT	Medicine Hat, Alta.	10,000
CHWK	Chilliwack, B.C.	10,000
CJCB	Sydney, N.S.	10,000
1280—234.2		
CHIQ	Hamilton, Ont.	10,000d 5,000n
CHQB	Powell River, B.C.	1,000
CJMS	Montreal, Que.	50,000
CJSL	Estevan, Sask.	1,000
CKCV	Quebec, Que.	10,000d 5,000n
1290—232.4		
CFAM	Altona, Man.	10,000d 5,000n
CJOE	London, Ont.	10,000
1300—230.6		
CBAF	Moncton, N.B.	5,000
CJME	Regina, Sask.	1,000
1310—228.9		
CFGM	Richmond Hill, Ont.	10,000d 2,500n
CHGB	Ste-Anne-de-la-Pocatière, Que.	5,000
CKOY	Ottawa, Ont.	50,000
1320—227.1		
CHQM	Vancouver, B.C.	50,000
CJSO	Sorel, Que.	10,000d 5,000n
CKEC	New Glasgow, N.S.	5,000
CKKW	Kitchener, Ont.	1,000
1330—225.4		
CKKR	Rosetown, Sask.	10,000
1340—223.7		
CFGB	Goose Bay, Nfld.	1,000
CFLH	Hearst, Ont.	100
CFSL	Weyburn, Sask.	1,000d 250n
CFYK	Yellowknife, N.W.T.	1,000
CHAO	Amos, Que.	250
CJLS	Yarmouth, N.S.	250
CFOM	Ville Vanier, Que.	250
CKAR-1	Parry Sound, Ont.	250
CKCR	Revelstoke, B.C.	250
CKFL	Lac Megantic, Que.	250
CKNR	Elliott Lake, Ont.	250
CKOX	Woodstock, Ont.	1,000d 250n
1350—222.1		
CHOV	Pembroke, Ont.	1,000
CJDC	Dawson Creek, B.C.	1,000
CJLM	Joliette, Que.	1,000
CKEN	Kentville, N.S.	1,000
CKLB	Oshawa, Ont.	10,000d 5,000n
1360—220.4		
CKBC	Bathurst, N.B.	10,000
1370—218.8		
CFLV	Valleyfield, Que.	1,000
1380—217.3		
CFOA	Victoriaville, Que.	1,000
CKLC	Kingston, Ont.	10,000d 5,000n
CKPC	Brantford, Ont.	10,000
1390—215.7		
CHOO	Ajax, Ont.	10,000
CKKC	Nelson, B.C.	1,000
1400—214.2		
CFLO	Burns Lake, B. C.	250
CJFP	Rivière du Loup, Que.	10,000d 250n
CKCB	Collingwood, Ont.	250
CKRN	Rouyn, Que.	250
CKSW	Swift Current, Sask.	1,000d 250n
1410—212.6		
CFMB	Montreal, Que.	10,000
CFUN	Vancouver, B.C.	10,000
CKSL	London, Ont.	10,000
1420—211.1		
CJMT	Chicoutimi, Que.	1,000
CJVR	Melfort, Sask.	10,000
CKPT	Peterborough, Ont.	5,000
1430—209.7		
CKFH	Toronto, Ont.	10,000
1440—208.2		
CFCP	Courtenay, B.C.	1,000
CKPM	Ottawa, Ont.	10,000
1450—206.8		
CBG	Gander, Nfld.	250
CFAB	Windsor, N.S.	250
CFJR	Brockville, Ont.	1,000d 250n
CHEF	Granby, Que.	1,000d 250n
CHRT	Riviere du Loup, P.Q.	250
CHUC	Cobourg, Ont.	1,000
CJBM	Causapscal, Que.	1,000d 250n
1460—205.4		
CJOY	Guelph, Ont.	10,000d 5,000n
CKRB	Ville St. Georges, Que.	10,000d 5,000n

A THANK YOU NOTE FROM THE EDITORS

Thank you! The Editors of RADIO-TV EXPERIMENTER would like to thank all readers who offered information on station changes, additions and deletions during the past few months. Though many of the letters overlapped, each aided us considerably in making the task of keeping White's Radio Log as current as possible at press time. If we left your name out, please forgive us!

Jean Pierre Bedard, Charlesbourg, Quebec
William Boerner, Massillon, Ohio
Egan Brian
James E. Carter III, Augusta, Ga.
Don Chalupiak, Regina, Sask.
Jason Farlam, Capetown, Ont.
Willis Geo. Frahm, Boise, Ida.
W. Ganderath, Albany, N.Y.
W. R. Garrett, Augusta, Ga.
Bill Johnson, N. Canton, Ohio
Ken Knecht, Oneonta, N.Y.
Tom Kneitel, New York, N.Y.
Frank LaBelle, Montreal, Que.
Robert Locke, Winnipeg, Manitoba
Grant MacDonald, Islington, Ont.
Robert D. McAllister, Rossland, B.C.
O. E. Millet, Toronto, Ont.
Bruce Parker, Swissvale, Pa.
Marke Parse, N. Surrey, B.C.
Richard Ringenback, Fair Lawn, N.J.
John Robertson, Port Huron, Mich.
G. Sienkiewicz, Brooklyn, N.Y.
Ken Skene, Port Arthur, Ont.

kHz	Wave Length	W.P.
1470—204.0		
CFOX	Pointe Claire, Que.	10,000d 5,000n
CFRW	Winnipeg, Man.	5,000
CHOW	Welland, Ont.	1,000d 500n
1480—202.6		
CHRD	Drummondville, Que.	10,000
1490—201.2		
CFMR	Fort Simpson, N.W.T.	25
CFRC	Kingston, Ont.	100
CHYM	Kitchener, Ont.	10,000d 5,000n
CJSN	Shaunavon, Sask.	1,000d 250n
CKAD	Middleton, N.S.	1,000d 250n
CKBM	Montmagny, Que.	1,000d 250n
CFWB	Campbell River, B.C.	250
1500—199.9		
CKAY	Ducan, B.C.	1,000
1510—199.1		
CJRS	Sherbrooke, P.Q.	10,000
CKOT	Tillsonburg, Ont.	1,000
1540—195.0		
CHIN	Toronto, Ont.	50,000
1550—193.5		
CBE	Windsor, Ont.	10,000
1560—192.3		
CFRS	Simcoe, Ont.	250d
1570—191.1		
CFOR	Orillia, Ont.	10,000d 1,000n
CHUB	Nanaimo, B.C.	10,000
CKLM	Montreal, Que.	50,000
1580—189.2		
CBJ	Chicoutimi, Que.	10,000
1600—187.5		
CJRN	Niagara Falls, Ont.	10,000

World-Wide Shortwave Stations

■ It's quizeroo time again gang! Just rip off the top of your favorite receiver and rush right down to your local grocer for a case of Ovaltine to give you the strength to try for all of these stations in our contest-without-prizes. Scoring details later, in the mean time, see what you can do with these:

1. A *new* station! It's *Radio Atenea*, San Jose, C.R. Although they have been broadcasting for 33 years on the broadcast band, they are now firing up a shortwave rig. Watch for them testing and broadcasting on 6150 kHz at about 0600 GMT.

2. Red Cross to the rescue. Yes, the International Red Cross is again starting their annual transmitter tests from Switzerland on 7210 kHz. Dates for the tests are July 21, 23, 25 and Sept. 22, 24, 26. Schedule is 0600, 1130, 1700, and 2300 GMT. Hear any 6 transmissions, report them, and receive a special certificate. Send those reports to: International Committee of the Red Cross, 7 Ave. de la Paix, 1211 Geneva 1, Switzerland.

3. Shades of Taras Bulba, the Mongols ride again! This time they're doing it electronically via Radio Ulan Bator on shortwave. Watch for their English programs daily at 1220 to 1250 GMT on 7345 and 9540 kHz, also 2200 to 2230 GMT on 11810 and 11850 kHz.

4. Up 'n down the ol' Mississippi is the theme here today. Many listeners didn't know that many of the vessels plying the Mississippi can be heard on a special channel, namely 2782 kHz. Listen in this evening after dark. How many ship and shore stations can you log in 30 minutes?

5. Dive into the Maldives, a group of small islands which surely you haven't yet heard. Listen for the *Maldive Islands Broadcasting System*, in Male, on 7150 kHz at 0100 and 0900, 6150 kHz at 0300 and 1100, 9538 kHz at 0700, 3331 kHz at 1300, and 4740 kHz at 1515 GMT.

6. Have you heard the brand new 300 kw station calling itself *Bonaire Noord?* It's *Radio Nederlands* own relay station in the Caribbean and has been testing on 6085, 9590, 11730, 15320, and 17810 kHz. It's located on the island of Bonaire in the Netherlands Antilles.

7. Bootleg antics are on the rise again, with the newest addition to the shortwave ranks being *Radio Euro Weekend* which runs from about 1530 GMT on 6040 kHz. It's located in Holland or Germany.

8. Here's a wierdie, station OE3XNB of the *Niederosterreichischer Landesfunk*, Vienna, Austria. They have a DX program for hams every Sunday at 1000 GMT on 7040 GMT. Can you hear this one? *Can you spell it?*

9. That Caribbean aero channel of 6567 kHz has been quite active of late and you might wish to see how many land stations and aircraft you can log in a 30 minute period some evening. The planes include some really exotic callsigns from the smaller banana countries.

10. Leaving the Caribbean area, we fly to Greenland to see about hearing *Greenland Radio*. They are being reported from 2030 to 0230 GMT on 3990, 5960, and 5980 kHz, daily.

Scoring 10 points is all you get for each

This Issue's Shortwave Contributors

Max Reynolds, Urbana, Ill., **Robert L. Winslow**, Sanford, Me., **Howard Moskowitz**, S. Charleston, W. Va., **Billy Jarmel**, N. Canton, Ohio, **Peter Kelley**, Chehalis, Wash., **Gladys Sienkiewicz**, Brooklyn, N. Y., **Tom Kneitel**, New York, N. Y., **Al. Eugston**, Vallejo, Calif., **Jose Melendez**, Bogota, Colombia, **Fred L. Martin III**, APO San Francisco, **Gary Ferguson**, Versailles, Ky., **Michael H. Melton**, Homestead, Fla., **Rudy Questel**, Beaumont, Tex., **Albert Vitale, Jr.**, Sanford N. C., **Bob Lebourget**, Montreal, Que., **Warren Matthews**, Nashville, Tenn., **Willard Hopkins**, Lacoochee, Fla., **Flo Stokes**, Chicago, Ill., **Mike McReynolds**, Vancouver, B.C., **Troy Norwood**, Ashtabula, Ohio

WHITE'S RADIO LOG

question, except 4 and 9, which pile up 1 point per station logged. Less than 40 total, not so hot; 40 to 49, you're getting warm; 50 to 59, you show promise; 60 to 75, very good; 75 to 85, excellent; above 85, you get the gold medal!

90-Meter Band—3200 to 3400 kHz

kHz	Call	Station Name	Location	GMT
3265	ZFY	R. Demerara	Georgetown, Guyana	0205
3280	—	W. Indies BC	St. Georges, Grenada	2315
3365	HIRL	—	Santo Domingo, D.R.	0300
3986	—	Nigerian R.	Lagos, Nigeria	2230
3990	—	V. America	Monrovia, Liberia	2300

60-Meter Band—4750 to 5060 kHz

kHz	Call	Station Name	Location	GMT
4770	ELWA	R. Village	Monrovia, Liberia	2230
4820	HRVC	—	Tegucigalpa, Honduras	0400
4890	—	R. Senegal	Dakar, Senegal	0610
4915	—	R. Ghana	Accra, Ghana	0600
4960	YVQA	R. Sucre	Cumana, Venez.	0145
4990	OAZ4C	R. Atlanta	Lima, Peru	0320
5000	WWV	N. Bureau Stds.	Ft. Collins, Colo.	2245
5015	—	W. Indies BC	St. Georges, Grenada	2240
5040	XZK	Burmese BC	Ragoon, Burma	1130
5045	—	R. Imperial	Petropolis, Brazil	0840
5047	—	R. Lome	Lome, Togo	0600
	—	V. Indonesia	Jogjakarta, Indonesia	1130
5050	—	Nigerian R.	Lagos, Nigeria	2215

49-Meter Band—5950 to 6200 kHz

kHz	Call	Station Name	Location	GMT
5970	—	R. Canada	Montreal, Que.	0845
6005	CFCX	CFCX	Toronto, Ont.	1530
6070	CFRX	CFRX	Toronto, Canada	1715
6095	—	R. South Africa	Johannesburg, S. Afr.	0530
6120	4VE	V. West Indies	Cap Haitien, Haiti	0230
6130	CHNX	Halifax BC	Halifax, N.C.	0930
6160	HJKJ	—	Bogota, Colombia	0430
6210	ZAA	R. Tirana	Tirana, Albania	0345

41-Meter Band—7100 to 7300 kHz

kHz	Call	Station Name	Location	GMT
7125	—	R. Warsaw	Warsaw, Poland	0315
7190	VLK	R. Australia	Melbourne, Austral.	1130
7195	—	NHK	Tokyo, Japan	0930
7245	OEI	Austrian BC	Vienna, Austria	0535
7270	—	R. RSA	Johannesburg, S. Africa	0530
7290	—	V. Ethiopia	Addis Ababa, Eth.	0340
9009	4XB3I	Kol Israel	Tel Aviv, Israel	2100
9360	—	R. Nacional	Madrid, Spain	0210
9410	—	BBC	London, England	2210

31-Meter Band—9500 to 9775 kHz

kHz	Call	Station Name	Location	GMT
9505	ZAA	R. Tirana	Tirana, Albania	0140
9535	HER	Swiss BC	Berne, Switz.	0140
9545	DMQ9	Deutsche Welle	Cologne, W. Germ.	2230
	—	R. Ghana	Accra, Ghana	2100
9560	CE956	R. Portales	Santiago, Chile	0520
	VLK	R. Australia	Melbourne, Austral.	1110
9575	—	RAI	Rome, Italy	2245
9578	CE956	R. Portales	Santiago, Chile	0710
9580	—	BBC	London, Engl.	2310
	VLK	R. Australia	Melbourne, Austr.	0900
9585	—	V. West	Lisbon, Port.	2210
9590	—	R. Bucharest	Bucharest, Rumania	0200
	—	R. Pres. Balmaceda	Santiago, Chile	1000
9600	XEYU	R. Universidad	Mexico DF, Mex.	1515
9615	ORU	V. Friendship	Brussels, Belg.	2245
9625	OAX8K	R. Atlantidos	Iquitos, Peru	0400
	—	Canadian BC	Montreal, Que.	0845
9635	—	R. Aparecida	Aparecida, Braz.	0945
9640	DMQ9	Deutsche Welle	Cologne, W. Germ.	0145
9655	OAX9G	R. Norte Peruana	Chachapoyas, Peru	0440
9665	—	R. Nacional Brasilia	Brasilia, Brazil	0910
9700	PRL7	R. Nacional	Rio de Janiero, Braz.	0900
9705	—	R. RSA	Johannesburg, S. Afr.	0200
9760	—	R. Accra	Accra, Ghana	2100
	—	R. Nacional	Madrid, Spain	2100
9770	—	R. Sofia	Sofia, Bulgaria	0015
	4VEH	V. Evangelique	Cap Haitien, Haiti	1400
	OEI	Viennese R.	Vienna, Austria	0200
10000	WWV	N. Bureau Stds.	Ft. Collins, Colo.	2105

25-Meter Band—11700 to 11975 kHz

kHz	Call	Station Name	Location	GMT
11705	—	R. Sweden	Stockholm, Sweden	2250
11710	VLK	R. Australia	Melbourne, Australia	1110
11740	—	R. Rodina	Rodina, USSR	0800
11760	—	R. Habana	Habana, Cuba	1630
11770	—	R. Monagas	Caracas, Venez.	1530
11775	—	Swiss BC	Berne, Switz.	0345
11790	—	AFRTS	Delano, Calif.	2345
11795	DMQ11	Deutsche Welle	Cologne, W. Germ.	0615
11800	—	V. Ceylon	Colombo, Ceylon	1200
	—	R. Nacional	Madrid, Spain	2000
11805	—	R. Sweden	Stockholm, Sweden	2345
	—	R. Globo	Rio de Janiero, Brazil	0900
11810	VUD	All India R.	Delhi, India	1400
11825	ZYK32	R. Jornal do Comercio	Recife, Brazil	0040
11860	—	R. Moscow	Moscow, USSR	0450
11870	—	R. Moscow	Moscow, USSR	2315
11875	—	R. RSA	Johannesburg, S. Afr.	2200
11880	VLK	R. Australia	Melbourne, Austral.	1140
11890	—	V. America	Greenville, N.C.	2400
11895	HVJ	Vatican R.	Vatican City	0045
11900	—	R. Moscow	Moscow, USSR	2345
11915	HCJB	V. Andes	Quito, Ecuador	0210
11945	DMQ11	Deutsche Welle	Cologne, W. Germ.	0345
11990	—	R. Prague	Prague, Czech.	1800
15000	WWVH	N. Bur. Standards	Maui, Hawaii	1755
15050	—	R. Peking	Peking, China	2315

19-Meter Band—15100 to 15450 kHz

kHz	Call	Station Name	Location	GMT
15100	—	West Indies BC	St. Georges, Grenada	2330
15115	HCJB	V. Andes	Quito, Ecuador	0600
15130	WNYW	R. N.Y. Worldwide	New York, N.Y.	2325
15140	—	BBC	London, England	2330
	—	R. Berlin Int'l.	Berlin, E. Germ.	0330
15150	—	R. Moscow	Moscow, USSR	0440
	CE1515	R. Corporacion	Santiago, Chile	0210
15160	—	Turkish R.	Ankara, Turkey	2215
15165	—	R. Damascus	Damascus, Syria	2020
15185	—	Vatican R.	Vatican City	1930
15220	—	R. RSA	Johannesburg, S. Afr.	2330
15235	VUD	All India R.	Delhi, India	2300
15255	—	Nigerian BC	Lagos, Nigeria	2130
15260	—	BBC	Ascension I.	2115
15275	4VEH	V. Evangelique	Cap Haitien, Haiti	2330
15300	DZH9	Call of Orient	Manila, P.I.	2400
15305	HER	Swiss BC	Berne, Switz.	0015
15315	—	R. Pakistan	Pakistan	1100
	DMQ15	Deutsche Welle	Cologne, W. Germ.	1100
15325	HCJB	V. Andes	Quito, Ecuador	2335
15350	—	R. Moscow	Moscow, USSR	1915
	—	BBC	London, England	2300
15380	—	R. Bucharest	Bucharest, Rumania	0215
15400	—	RAI	Rome, Italy	1845
15410	ETLF	R. V. Gospel	Addis Ababa, Ethiopia	1330
15430	—	V. Free Korea	Seoul, Korea	0330
15445	—	R. Nacional	Rio de Janiero, Brazil	2330

kHz	Call	Station Name	Location	GMT
15520	—	R. Pakistan	Karachi, Pakistan	0200

16-Meter Band—17700 to 17900 kHz

17720	BED39	V. Free China	Taipei, Formosa	0300
17785	—	R. Japan	Tokyo, Japan	0215
17805	—	R. RSA	Johannesburg, S. Afr.	2130
17820	VLK	R. Australia	Melbourne, Australia	0350
17825	—	R. Japan	Tokyo, Japan	0200
17830	HEU	Swiss BC	Bèrne, Switz.	2330
17840	VLK	R. Australia	Melbourne, Austral.	0340
17845	—	R. Pakistan	Karachi, Pakistan	1345

kHz	Call	Station Name	Location	GMT

13-Meter Band—21450 to 21750 kHz

21450	—	R. Prague	Prague, Czech.	1720
	—	V. Nigeria	Lagos, Nigeria	1515
21500	—	R. Brazzaville	Brazzaville, Congo	1530
21535	—	R. RSA	Johannesburg, S. Afr.	1545
21540	HER	Swiss BC	Berne, Switz.	1500
25610	—	R. Nederland	Hilversum, Neth.	1430
25650	—	BBC	London, England	1450
25730	LLL	R. Norway	Oslo, Norway	1630
25790	—	R. RSA	Johannesburg, S. Afr.	1800
25900	LLA	R. Norway	Oslo, Norway	1800

Emergency Radio Station Listings for New York City and Surrounding Areas in N. Y., N. J. and Conn.

☐ RADIO-TV EXPERIMENTER and SCIENCE AND ELECTRONICS furnishes this exclusive listing of emergency radio stations as an aid to our many readers now engaged in the fascinating and rapidly growing hobby of monitoring emergency radio communications. We will be publishing similar lists devoted to different metropolitan areas in forthcoming issues so in the months ahead you'll be able to accumulate a sizable array of this difficult-to-obtain data.

NEW YORK CITY POLICE DEPT.

Boro Div.	Pcts.	Call	mHz
Manh 1	1 4 5 6 7	KEA837	154.74
Manh 2	9 10 13 14	KEA370	155.655
		KEG730	155.655
Manh 3	16 17 18	KEA837	154.74
Manh 4	19 20 22 23	KEA370	155.52
Manh 5	24 26 30 34	KEB281	155.97
Manh 6	25 28 32	KEB281	155.58
Bx 7	40 42 44 48	KEA744	156.03
		KEA841	156.03
Bx 8	41 43 45	KEA841	155.67
Bx 9	46 47 50 52	KEA745	155.64
Bkln 10	60 61 62 64 66 70	KJK601	151.205
Bkln 11	68 72 76 78 84	KJK599	151.46
Bkln 12	63 67 69 71 74 75	KJK600	151.37
Bkln 13	73 77 79 80 88	KJK604	151.16
		KJK606	151.16
Bkln 14	81 83 87 90 92 94	KJK598	151.34
		KJK605	151.34
Qns 15	100 101 102 104 106	KJK605	151.34
Qns 16	103 105 107 109 111	KJK603	151.19
Qns 17	108 110 112 114	KJK607	151.145
Rich 18	120 121 122	KJK597	151.355
		KJK601	151.355
		KJK602	151.355
OTHER NYPD STATIONS:			
Tactical Patrol Force		KEA394	155.535
Safety & Emergency Svce.		KEA394	155.85
		KEC530	155.85
Special Events		KEA394	154.77
Misc. Units		KLK551	39.36
		KEC531	39 82
		KLE915	39.90
		KIZ361	453.50
		KJS779	155.685
Walkie Talkies		Manh.	154.785
		Bx.	154.755
		Bkln.	154.725
		Qns.	155.565
		Rich.	155.655
"City Wide" Manh. & Bx.		KEA394	155.70
"City Wide" Bkln. Qns. & Rich.		KJK597	151.25
Harbor & Helicopters: 156.30 156.80 156.95			
Police Commissioner: 161.22			
Transit Authority Police		KEP672	154.875
	L.I. City	KLE770	154.875
	Flushing	KLE771	154.875
	Bronx	KLE772	154.875
	Bkln	KLE773	154.875

NEW YORK CITY POLICE DEPT.

Station	Call	Transmit	Receive
City Wide	KEB523	154.43	153.89
Manhattan	KEB524	154.25	154.01
Brooklyn	KEB525	154.37	153.95
Queens	KEB526	154.40	153.83
Richmond	KEB527	154.19	154.07
Bronx	KED962	154.25	154.01
UHF channels		460.525	465.525
		460 575	465.575
		460.625	465.625

NEW JERSEY AGENCIES

Station	Police		Fire	
Allendale	KEJ811	37.08	KJE944	33.86
Allentown			KDA357	154.43
			KEH880	154.43
Alpine	KBS936	155.13	KJR228	154.43
Asbury Pk.				
Atlantic Hglnds.	KEJ395	39.46	KDK766	33.82
Avenel				
Avon/Sea	KEB227	39.10		
	KEB227	39.46		
Basking Rdge.			KEE232	154.31
Bayonne	KEB206	155.49	KEJ693	166.25
Bedminster			KCJ825	33.94
Belleville	KEA388	155.61	KAY729-KAY731	154.22
Belmar	KEB229	39.46	KCO378	37.10
	KCO378	45.44		
Bergenfield	KEB447			
Berkeley Hts.	KEF868	39.10	KDG888	46.06
Bernards Twp.			KJN790	154.31
Bloomfield	KEB361	37.22	KEI864	46.44
	KEB361	37.36		
Bloomingdale			KDK760	46.42
			KJN827	46.42
Bogota	KEB308	45.90		
Boonton	KEB239	45.34	KEJ338	46.42
Boonton Twp.	KJG932	45.34	KJF898	46.42
Bound Brook	KEB685	155.31	KCL783	154.31
Bradley Beach	KEB229	39.10		
	KEB229	39 46		
Bridgewater Twp.			KDO202	33.94
			KEH859	33.94
			KGP741	33.94
Brielle	KEF596	39.46		
Butler	KEH651	37.30	KBE465	46.42
Caldwell	KEA587	159.15		
Carlstadt	KEA555	155.73	KCN856	154.16
Carteret	KEB504	39.18	KFI478	33.82
Cedar Grove	KDR771	45.18		
	KEB242	45.18		
	KLI928	45.18		
Charlotteburg	KEX320	37.30		
Chatham			KGW784	154.31
Chatham Twp.	KBC882	156.15	KEH308	154.31
			KFN570	154.31
Chester			KEE929	46.42
			KJW777	46.42

EMERGENCY RADIO STATIONS

Clark Twp.	KEC358	159.09
Cliffside Pk.	KEB387	155.61
	KGK596	155.61
Clifton	KE8328	155.91
Closter	KEB330	155.13
Colonia		
Colts Neck		
Cranbury		
Cranford Twp.	KEB451	155.25
Cresskill	KEB646	45.58
Deal		
Demarest	KBS937	155.13
Denville Twp.	KEG962	45.46
Dover	KEB291	46.02
Dumont	KEB366	45.58
	KJD582	45.08
Dunellen	KEC570	155.13
E. Brunswick Twp.	KEF477	155.415
E. Hanover Twp.	KEG887	159.15
E. Newark	KFN674	155.79
E. Orange	KEB385	39.50
E. Paterson	KEA391	158.73
E. Rutherford	KEB613	155.73
Eatontown	KFZ867	39.46
	KFZ867	154.80
Edison Twp.		
Elizabeth	KEA626	154.86
Emerson	KEF730	155.13
Englewood	KEA422	159.21
Englewood Cliffs	KAT544	37.38
Englishtown		
Essex Fells	KDK768	158.94
	KEB207	159.15
Fairfield Twp.	KE8446	45.18
Fair Haven	KOA780	39.46
Fair Lawn	KEB383	158.73
Fair View	KEA416	155.61
Fanwood	KEC757	158.73
Far Hills		
Florham Pk.		
Fords		
Ft. Lee	KEB364	155.595
	KEB364	155.51
Franklin Lakes	KEG853	158.73
Freehold	KEA317	39.46
	KEA317	154.875
Garfield	KE8347	45.46
Garwood	KEC592	155.25
Glen Ridge	KEC853	45.18
Glen Rock	KEB351	158.73
Green Brook	KEC288	155.13
Guttenberg	KEB350	159.09
Hackensack	KE8406	156.09
Haledon	KEI204	39.86
Hanover Twp.	KEG446	45.38
Harrington Pk.	KBY355	155.13
Harrison	KCP551	155.19
Hasbrouck Hts.		
Haworth	KEE528	45.58
Helmetta		
Highland Pk.		
Highlands	KGR276	39.46
	KGR276	154.815
Hillsboro Twp.	KEE841	155.31
Hillsdale	KEF720	155.13
Hillside Twp.	KEB404	154.845
Hoboken	KEB413	159.09
Hohokus	KEC846	158.73
Holmdel	KFS994	39.46
Howell Twp.		
Irvington	KEA783	45.10
	KEC578	45.10
	KJE932	45.10
Iselin		
Jamesburg	KDV718	155.61
Jefferson Twp.	KEI426	46.02
Jersey City	KEB353	158.97
	KJR239	158.85
	KJR239	158.97
Kearny	KEA245	46.02
Kenilworth	KEC773	159.21
KDJ547	46.06
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KED411	33.86
KED411	154.16
KEE968	154.415
K8T809	154.16
KDO248	33.82
KFD632	154.43
KEC822	33.82
KEC996	46.06
KJV337	154.43
KFN500	154.16
KCS485	46.42
KCQ272	46.42
KDG223	33.82
KEA489	154.31
KED944	33.86
KLI370	154.16
KEG776	33.82
KDR477-8	453.15
KDX387	154.16
KGP614	154.43
KED736	33.86
KJI511	46.06
KJJ464	33.94
KDQ304	46.32
KDQ304	46.42
KEG253	33.82
KCP610	33.86
KCP610	154.445
KAR779	154.43
KAZ202	154.43
KJZ859	154.43
KDR384	33.86
KEP989	46.06
KDR415	154.31
KDZ365	170.15
KFB902	46.38
KLG628	46.38
KGW760	154.16
KCW343	46.18
KDS612	154.16
KGJ643	33.82
KDK783	33.82
KEC956	46.06
KEC795	170.15
KED377	
KED342	170.15
KED472	170.15
KET228	154.43
KEM664	154.43
KFD597	154.43
KJI472	154.43
KAS411	46.24
KAZ584-7	46.24
KCI664	46.24
KEG883	33.82
KDS687	33.82
KCO314	33.82
KEI340	46.42
KBI857	166.25
KBM655	154.205
KEB984	154.205
KEC917	154.205
KEI665	154.205
KJP555	154.235
KCQ319	46.18
KDJ741	46.06

Keyport	KEG345	39.46
	KEG345	155.37
Kinnelon	KGT554	37.30
Leonia	KEB397	37.26
Liberty Corner		
Lincoln Park	KEG822	45.34
Linden	KEA781	155.73
Little Falls	KEA377	45.70
	KGW672	45.70
Little Ferry	KEB562	155.73
Little Silver	KD8448	39.46
Livingston Twp.	KEA318	159.15
Lodi	KEC626	37.10
Long Branch	KEB225	39.46
Long Valley		
Lyndhurst Twp.	KEB371	155.73
Madison		
Madison Twp.	KEF819	39.46
	KEF819	45.54
Mahwah Twp.	KED397	37.10
	KFD603	37.08
	KFD603	37.10
Manville	KEB559	155.31
Maplewood Twp.	KEA849	45.50
Marlboro Twp.		
Martinsville		
Matawan	KJI375	39.46
Matawan Twp.	KBK290	39.46
	KBK290	155.37
Maywood	KEB489	155.01
Metuchen	KEA403	155.01
Middletown Twp.	KEB912	39.46
	KEB912	45.94
Midland Park	KEC921	158.73
Millburn Twp.	KE8211	37.10
Millington		
Milltown	KEC372	155.61
Mine Hill	KEJ368	46.02
Montclair	KEB238	158.79
Montgomery Twp.		
Montville	KCY596	45.34
Moonachie		
Morganville		
Morris Twp.	KEB326	45.30
	KJR442	45.30
Morristown	KEB262	39.08
Mountain Lakes		
Mountainside	KEC800	39.10
Mt. Freedom	KEB282	46.02
Neptune	KJS843	154.65
Neptune Twp.	KBY250	45.24
	KDX500	39.46
	KEA276	37.26
	KEA276	39.46
Neshanic		
Neshanic Sta.		
Newark	KEA953	154.80
	KEA953	156.21
	KEC882	156.21
New Brunswick	KEA379	155.61
New Milford	KEE355	45.58
New Shrewsbury	KGP653	155.625
N. Arlington	KE8615	155.25
N. Bergen	KEB367	159.09
N. Brunswick		
N. Caldwell	KE8430	45.18
N. Plainfield	KEB456	155.13
Northvale	KAU754	155.13
Norwood	KBS938	155.13
Nutley	KEA216	155.37
Oakland	KEC799	37.30
	KCW418	46.56
	KDG727-8	46.56
	KFM478	46.56
Oaklyn	KEG942	156.21
Ocean Twp.	KEB842	39.46
	KEB842	155.37
Ocean Grove Twp.	KEC427	39.46
	KEC427	155.25
Oceanport	KDZ388	39.46
Old Tappan	KAY951	155.13
KED268	46.42
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KEJ339	154.31
KBC889	46.42
KEF952	46.42
KDP360	46.06
KAU335	46.38
KEF200-2	46.38
KEF652	46.38
KFR698	154.43
KJF782	33.86
KFM326	154.145
KFF324	46.42
KJS690	46.42
KDN950	154.16
KEC840	46.32
KEC840	46.42
KDD911	33.82
KDD911	46.42
KEF954	33.86
KJB888	33.86
KJB888	154.16
KJB888	154.28
KJE929	33.86
KDP349	154.31
KCR926-8	154.43
KCS570-1	154.43
KDP293	33.94
KEF826	33.94
KEG663	33.82
KCR963	46.50
KEE720	33.78
KAU316	46.42
KBD656	46.16
KFR711	154.31
KJK804	154.31
KEP364	46.42
KFZ860	154.16
KCR926	154.43
KCI738	46.42
KEH547	46.42
KDL830	46.06
KJB851	46.42
KEH986	154.31
KCN860	154.31
KEC989	154.13
KJI456	154.13
KJE874	33.82
KDD904	154.16
KGW664-5	154.16
KDD977	154.325
KEC425	33.82
KEG514	33.82
KDO249	33.82
KJU862	33.82
KEE227	33.94
KLI985	155.28

Oradell	KEB409	45.58	KDF533	154.16
Orange	KEB348	39.62	KDA401	46.12
Palisades Park	KEB299	45.90	KEE846	33.86
Paramus	KEC209	39.94		
Park Ridge	KEB223	155.37		
Parsippany	KEE480	39.02	KBG778	46.48
	KEF480	39.14	KCK990-5	46.48
			KEX279	46.48
Passaic	KEB435	45.78	KEH997-8	46.40
	KDN419	45.78		
Paterson	KLK522	39.68	KAQ236	46.20
	KCT257	39.68	KAQ236	46.38
	KCT257	39.86		
	KEB412	39.86		
Perth Amboy	KEA741	155.37	KEG514	33.82
Piscataway Twp.	KEA571	158.73	KEE208	33.82
Plainfield	KEB468	158.73	KBA463	46.06
			KBA466	46.06
			KEC581	46.06
Pompton Lakes	KEA291	37.30		
	KED237	37.30		
Port Reading			KDY438	33.82
Pottersville			KJJ465	33.94
Prospect Park	KGP690	39.86	KGL591	46.38
Rahway	KEB464	155.73	KEC249	46.06
Ramsey	KED765	37.08	KEG722	33.86
			KFG721	33.86
			KED765	37.10
Randolph Twp.	KEB291	46.02	KCQ272	46.42
Raritan	KEF210	155.31	KDJ434	154.31
Raritan Twp.	KEJ245	39.46		
	KEJ245	155.37		
Red Bank	KEB230	39.10		
Ridgefield	KBW853	155.61	KBI777	33.88
Ridgefield Park	KEB376	45.90		
Ridgewood	KEB415	158.73		
Ringwood	KEG720	37.30		
Riverdale	KEC751	37.30		
River Edge	KEB340	156.09	KDJ612	154.16
			KJJ448	154.16
River Vale Twp.	KEF304	155.13		
Rochelle Park			KEB990	37.10
Rockaway	KFF345	46.02	KEY973	46.42
Rockaway Twp.	KEI621	45.78	KEJ452	46.42
Roseland	KEE344	159.15		
Roselle	KEA477	155.61	KEF442	46.06
			KDR445	154.98
Roselle Park	KEA779	159.21	KDG367	46.06
Roxbury Twp.			KDL833-5	46.42
Rumson	KEA698	39.46		
	KEA698	155.25		
Rutherford	KEA311	155.73	KCR939	154.16
Saddle Brook			KJR450	33.87
			KEC240	37.17
Saddle River	KEJ810	37.38	KEH513	33.87
Sayreville	KEB653	155.61	KDQ338	33.87
Schooleys Mtn.			KGR203	46.42
Scotch Plns. Twp.	KEB454	39.10	KDG887	46.07
Sea Girt	KEG968	39.46		
	KEG968	155.25		
Secaucus	KEB212	155.07	KDJ536	170.17
Shrewbury	KGW756	39.46		
Smithburg			KLE733	154.47
Somerville	KEB547	155.31	KDG354	154.37
			KGJ779	154.37
S. Amboy	KEB417	155.01		
S. Belmar	KDB425	37.10		
	KDB425	39.46		
S. Bound Brook	KED832	155.31	KDD996	154.37
S. Brunswick Twp.	KEH518	39.98		
S. Hackensack	KBB860	37.10		
	KBB860	37.38		
S. Orange	KEB488	155.595		
S. Plainfield	KEB427	158.73	KED814	33.87
S. River	KEB224	155.61	KDN530	33.87
			KDN530	154.37
Spotswood	KED697	155.61	KDN517	33.87
Springfield	KEB341	39.30	KEG795	46.07
Spring Lake	KEB231	39.46	KFY427	154.47
	KEB231	155.25		
Spring Lk. Hts.	KEJ337	39.46		
	KEJ337	155.25		
Stirling	KJH299	39.04	KJF884	46.47
Summit	KEB300	155.91	KCZ906	154.17
	KEB300	156.15		
Teaneck	KEA916	158.73		
Tenafly	KE3349	45.58		
Tennent			KEO287	154.43
Totowa	KEG724	45.70	KEG597	46.38
Union Twp.	KEA348	155.37	KCX433	46.06
	KGR339	155.57	KE8674	46.06
			KEJ307	46.06
Union Beach	KEE389	39.46	KDG376	154.43
	KEE389	45.54		
Union City	KEB357	159.09	KAQ911	170.15
Upper Saddle R.			KEE869	33.86
			KEJ878	37.10

EMERGENCY RADIO STATIONS

Vernon Twp.	KJF701	45.46		
Verona	KEA963	45.18		
Waldwick	KEE458	37.38		
Wall Twp.	KEG287	37.06		
	KEG287	37.10		
	KEG287	39.46		
Wallington	KEA737	155.73	KFI482	154.16
Wanaque	KED505	37.30		
Warren Twp.			KCO382	33.94
			KEJ336	33.94
Washington Twp.	KJH250	46.02		
	KED704	155.13		
Watchung	KEH654	155.13	KEE216	33.94
Wayne Twp.	KEP604	45.26	KBM805	46.36
			KGY256	46.36
Weehawken	KE8386	159.09	KAY967	170.15
Westfield	KE8333	39.10	KEJ495	46.06
	KE8333	39.12	KCS504	46.06
W. Milford Twp.	KEJ812	37.30	KEY916	46.38
W. New York		27.275	KAQ490	170.15
	KEB426	45.98		
W. Orange	KED285	45.62	KCZ455	46.08
W. Paterson	KEH729	45.70	KFT494	46.38
	KGK666	45.70	KGK658	46.38
Westwood	KE8354	155.13		
Winfield	KEE880	45.50	KFB840	46.06
Woodbridge	KEA926	45.18		
Woodbridge Twp.			KED485	33.82
Woodcliff Lake	KIZ358	155.37		
Wood Ridge	KEA349	155.73		
Wyckoff	KEB440	158.73		

N. J. COUNTY POLICE & FIRE AGENCIES

Station	Police		Fire	
BERGEN COUNTY, N.J.				
Hackensack	KEA334	37.38		
Mahwah	KFO785	37.38	KJB254	39.98
Paramus	KFM359	37.38		
	KFN507	37.38		
Rockleigh	KEJ294	37.38		
ESSEX COUNTY, N.J.				
Newark	KED494	45.22	(Police)	
W. Orange	KEE872	45.94	(Park Comm. PD)	
mobile units	—	45.30	(Prosecutor's Off.)	
HUDSON COUNTY, N.J.				
Jersey City	KEB420	155.73		
MIDDLESEX COUNTY, N.J.				
New Brunswick	KCO383	154.43	KEF386	33.82
	KET309	159.03		
Plainsboro Twp.	KGK560	154.43		
MONMOUTH COUNTY, N.J.				
Freehold Twp.	KEA317	39.46	KAZ202	154.43
MORRIS COUNTY, N.J.				
Bedminster Twp.	KJP467	39.02		
Bernards Twp.	KJP471	39.02		
Bernardsville	KJP474	39.02		
Chester Twp.	KJP473	39.02		
Harding Twp.	KJP466	39.02		
Hopatcong	KJP472	39.02		
Ledgewood	KEC223	39.02		
Lyons	KLG652	39.02		
Mendham Boro	KJP468	39.02		
Mendham Twp.	KJP465	39.02		
Morris Plains	KEC223	39.02		
Mt. Olive Twp.	KJP470	39.02		
Mountain Lakes	KJP469	39.02		
Peapack	KJP464	39.02		
Randolph Twp.	KEG702	45.90		
Succasunna	KED462	39.02		
PASSAIC COUNTY, N.J.				
Paterson	KED839	45.42	(Park Comm.)	
portable	KBR646	45.42	(Park Comm.)	
SOMERSET COUNTY, N.J.				
Bridgewater	KCQ249	39.18	(Park Comm.)	
UNION COUNTY, N.J.				
Elizabeth	KEC361	45.98	(Park Comm.)	

N.J. STATE POLICE		
Berkeley Hts.	KEA827	44.62 44.66 44.94 154.68 155.46
Colts Neck	KED752	44.62 44.66 44.94 154.68 155.445
Edison Twp.	KEA822	44.62 44.66 44.94 154.68 155.445
Frankfort Twp.	KBE497	44.62 44.66 44.86 154.68 155.46
Fredon Twp.	KEA823	44.62 44.66 44.94 154.68 155.46
Glen Gardner	KEC766	44.62 44.66 44.94 154.68 155.46
Greystone Pk.	KE8635	39.02 (State Hospital)
Hightstown	KEA814	44.62 44.66 44.94 154.68 155.445
Hopewell	KFX347	44.62 44.66 44.94 154.68 155.445
Howell Twp.	KEA815	44.62 44.66 44.94 154.68 155.445
Morristown	KEA820	44.62 44.66 44.94 154.68 155.46
Mt. Horab	KEA828	44.62 44.66 44.94 154.68 155.46
Newfoundland	KEE615	44.62 44.66 44.94 154.68 155.46
Oakland	KEE431	44.62 44.66 44.94 154.68 155.46
Paramus	KEA845	44.62 44.66 44.94 154.68 155.46
Plainsboro	KEC848	44.62 44.66 44.94 154.68 155.445
Raritan Twp.	KEA812	44.62 44.66 44.94 154.68 155.46
	KEA816	44.62 44.66 44.94 154.68 155.445
Roxbury Twp.	KEA821	44.62 44.66 44.94 154.68 155.46
Sussex	KEC371	44.62 44.66 44.94 154.68 155.46
Tennent	KEF824	44.62 44.66 44.94 154.68 155.445
Washington	KEA831	44.62 44.66 44.94 154.68 155.46
N.J. TURNPIKE		
Jersey City	KEE970-1	154.83
	KEE973	154.83
New Brunswick	KEC469	155.19
radar units	—	45.82
N.J. HIGHWAY AUTHORITY		
Bloomfield	KEE284	154.905
Holmdel Twp.	KEE283	154.905
mobile units	—	154.95 158.91
PALISADES INTERSTATE PARK COMMISSION		
Alpine, N.J.	KEA400	154.89

N. Y. STATE COMMUNITIES (EXCEPT L. I.)

Station	Police		Fire	
Ardsley	KED651	155.73	KBN504	46.26
			KJB973	46.26
Armonk	KEA234	45.14	KEE879	46.26
Banksville			KFB933	46.14
			KFB933	46.26
Bedford Hills	KEB457	155.25	K8G923	46.26
			KEF249	46.26
Briarcliff Mnr.	KEC363	37.10	KEF612	46.14
			KEF612	46.26
Bronxville	KEB458	155.49		
Buchanan			KDY272	46.14
			KDY272	46.26
Chappaqua	KLK582	39.10	KEJ739	46.14
			KEJ739	46.26
Congers			KEE626	46.18
Croton/Hudson	KED434	37.10	KDP348	46.14
			KDP348	46.26
Eastchester	KEA950	155.49	KBR359	46.14
Elmsford	KEA307	155.73		
Fairview			KEE326	46.14
Glenwood Landg			KEB533	46.10
Greenburgh	KEA959	45.14	KED478	46.14
	KGV209	45.26	KED478	46.26
Greenville			KEC624	46.14
			KEC624	46.26
Greenwood Lake	KEE594	39.10		
Harrison	KEB417	155.13		
Hartsdale			KEB478	46.14
			KEB478	46.14
Hastings/Hudson	KEB583	155.73		
Haverstraw	KEA399	37.18		

Hawthorne			KEE279	46.14	
			KEE279	46.26	
Irvington	KEB583	155.73	KDR456	46.14	
			KDR456	46.26	
Katonah			KEF498	46.14	
			KEF498	46.26	
Larchmont	KEA333	155.25	KBR622	46.14	
	KEA404	155.25	KBR622	46.26	
			KEJ584	46.14	
			KEJ584	46.26	
Letchworth Vlg.			KEG907	46.18	
Mamaroneck	KEB449	155.25	KEF940	46.14	
			KEF490	46.26	
Millwood			KEJ244	46.14	
			KEJ244	46.26	
Moleston			KIZ310	46.18	
			KED435	46.18	
Monsey			KEJ956	46.18	
			KDV409	46.18	
Montrose			KED763	46.14	
			KED763	46.26	
Mt. Kisco	KEA805	155.25	KEI615	46.14	
			KEI615	46.26	
Mt. Plesant	KEC315	37.06			
	KEC315	37.10			
Mt. Vernon	KEA501	155.37	KEE404	46.14	
			KEE404	154.145	
Nanjet			KED946	46.18	
New Castle			KEJ739	46.14	
			KEJ739	46.26	
New City	KEB591	37.18	KEE598	46.18	
New Rochelle	KEA351	155.13	KCQ267	46.14	
			KEF934	46.26	
			KJV334	46.14	
			KJV334	46.26	
No. Castle			KCS576	46.26	
			KEE879	46.26	
No. Pelham	KEB375	155.25			
No. Tarrytown	KEA434	37.10	KBS999	46.14	
			KBS999	46.26	
Nyack	KEA332	37.18	KEX339	46.18	
Orangeburg	KEA378	37.18	KFN569	46.18	
Ossining	KEB208	37.10	KBE467	46.14	
			KBE467	46.14	
			KLD812	46.26	
Pearl River			KEF204	46.18	
Peekskill	KEB564	45.14	KCP575	46.14	
			KCP575	46.26	
Pelham	KEB372	155.25	KBR623	46.14	
			KBR623	46.26	
Pelham Manor	KEB209	155.25	KBP638	46.14	
			KBP638	46.26	
Piermont	KEA490	37.18			
Pleasantville	KEC547	155.25	KED433	46.26	
Pocantico Hills			KEY897	46.14	
			KEY897	46.26	
Pomona			KIZ310	46.18	
Pt. Chester	KEB908	155.01	KEF213	46.14	
			KEF213	46.26	
Pound Ridge			KED693	46.14	
			KED693	46.26	
Purchase			KBT813	46.14	
			KBT813	46.26	
Rye	KEB266	155.01	KEJ252	46.14	
			KEJ252	46.26	
Scarsdale	KEA443	155.49	KDS681	46.14	
			KDS681	46.26	
			KEC624	46.14	
			KEC624	46.26	
Sloatsburg			KGJ715	46.18	
S. Spring Vall.			KEC810	46.18	
Sparkill			KJD215	46.18	
Spring Valley	KEC222	37.18	KEC810	46.18	
Stony Pt.	KLI225	37.18	KEF476	46.18	
Suffern	KEA511	37.18	KEE558	46.18	
	KEA683	37.18			
Tallman	KEA511	37.18	KED748	46.18	
Tappan			KEE526	46.18	
Tarrytown	KEB268	•155.73	KEE248	46.14	
			KBR624	46.26	
Thielle	KGT615	37.18	KBW404	46.18	
Thornwood			KEE248	46.14	
			KEE248	46.26	
Tuckahoe	KEB448	155.49			
Tuxedo Park	KDF574	37.18			
	KEA357	37.18			
Valhalla			KEJ768	46.14	
			KEJ768	46.26	
Valley Cottage			KGW678	46.18	
Verplanck			KFI518	46.14	
			KFI518	46.14	
Vista			KDD912	46.14	
			KDD912	46.26	
Warwick	KDT394	39.98			
W. Haverstraw			KFX354	46.18	
W. Nyack			KEF538	46.18	
White Plains	KEB301	37.06	KEE326	46.14	
	KEB301	37.10	KEE326	46.26	
			KED497	46.14	
			KED497	46.14	
Yonkers	KEB442	45.50	KCI560	46.50	
	KJR433-4	453.925			

LONG ISLAND (NASSAU COUNTY)

COMMUNITIES

Station	Police		Fire	
Baldwin			KEB486	46.10
Bayville			KEI437	46.10
Bellmore			KEB868	46.10
Bethpage			KED745	46.10
Carle Place			KEH987	46.10
Cedarhurst			KEG312	46.10
E. Meadow			KEC697	46.10
E. Norwich			KEB866	46.10
E. Rockaway			KED622	46.10
Elmont			KEB861	46.10
Farmingdale			KAV466	46.10
			KEC211	46.10
Floral Park	KEA312	39.18	KEE323	46.10
Franklin Sq.			KEC563	46.10
Freeport	KEB461	154.815	KCK525	154.815
Garden City	KEA474	155.43		
Garden City Pk.			KGJ777	158.925
Glen Cove			KED283	46.10
Great Neck			KEC289	46.10
			KEE204	46.10
Great Neck Ests.	KEB581	155.61		
Hewlett			KEC960	46.10
Hempstead	KEA678	154.71	KBW814	154.71
	KEC899	154.71		
Hempstead Twp.	KFR703	155.01		
Hicksville			KED347	46.10
Inwood			KEF283	46.10
Island Pk.			KBL515	46.10
Jericho			KEG503	46.10
Kensington	KFG511	155.61		
Kings Pt.	KEB373	155.61		
Lake Success	KEE522	155.61		
Lakeview			KEE877	46.10
Laurel Hollow	KFT554	39.72		
Lawrence			KDA694	46.10
			KEG312	46.10
Levittown			KEB914	46.10
Lido Beach			KEJ695	46.10
Locust Valley			KED865	46.10
Long Beach	KEB324	155.37	KBJ970	46.10
Lynbrook	KBG782	39.54	KEE209	46.10
Malverne	KEB455	155.13	KED266	46.10
Massapequa			KEB965	46.10
Mineola			KED820	46.10
N. Bellmore			KED747	46.10
			KFF238	46.10
N. Massapequa			KEH415	46.06
			KEH415	46.10
N. Merrick			KEC961	46.10
Oceanside			KED554	46.10
Old Brookville	KEI438	39.54		
Old Westbury	KAW382	39.54		
Oyster Bay			KEE844	46.10
Plainview			KEE716	46.10
Plandome	KEC683	155.61		
Point Lookout			KEJ695	46.10
Port Washington	KEB429	155.61	KDB416	46.10
Rockville Cent.	KFZ837	39.86	KBH354	33.90
	KEA398	39.98		
	KED870	39.98		
Roosevelt			KED847	46.10
Roslyn Hts.			KEC910	46.10
			KEG292	46.10
Sands Point	KEB437	155.61		
Sea Cliff			KEE610	46.10
Seaford			KEE666	46.10
S. Hempstead			KEU924	46.10
Syosset	KFG553	37.30	KED586	46.10
Uniondale			KED396	46.10
Wantagh			KEC859	46.10
W. Hempstead			KED761	46.10
			KEE877	46.10
Westbury			KDP449	46.10
Williston Pk.			KGN521	46.10
			KGN521	46.22
Woodmere			KEE625	46.10

U. S. WEATHER BUREAU FORECASTS

KWO35 162.55

Squeech

Continued from page 34

that the human ear is just able to perceive. This perception phenomenon is known as the *Haas Effect*.

This fortunate deficiency of the ear is similar to the perceptual limitation of the human eye that makes motion pictures possible. As you may already know, a motion picture film actually consists of a series of still pictures strung together along the length of the film. As the projector moves each successive picture or *frame* into position for showing, there is a momentary period of darkness. But the dark periods are so short that the eye does not perceive them, and the overall effect is that of a continuous moving image. In the same way, the ear fails to perceive rapid sound deletions.

Degree of Compression. Fig. 3 diagrams 10%, 20%, and 50% degrees of compression. The middle line in each section of the diagram represents a length of tape divided into 21 blocks; each block represents a tape segment that is 13.35 millimeters in length. Why this length? Because at a 15 ips tape speed, this length of tape represents 34.68 milliseconds of playing time, a period slightly shorter than threshold perceptual time of 35 milliseconds. This length is automatically measured out by the playback equipment because it is equal to the gap-to-gap distance of the rotating head.

If the Eltro Changer's control knob is adjusted so that there is a 10% increase of the tape velocity (about 16.5 ips), every *tenth* bit of sound information on the tape is eliminated. This results in a *time compression* of 10%. If the tape speed is increased by 20% (to about 18 ips), every *fifth* bit is removed to achieve a 20% time compression. Finally, if the tape speed is doubled to 30 ips, every *second* bit is removed, and the total playing time is chopped in half.

Time Expansion. Speech compression now appears to be of primary interest in terms of potential applications. However, speech expansion also has uses. In this case the playing time is lengthened without introducing pitch changes.

The Eltro does this with equal ease when the control knob is properly adjusted. Basically, expansion is created in much the same way as is compression except that the tape velocity is made slower than the relative playback velocity, hence the head gaps tend to catch up with tape segments already scanned once. Instead of eliminating information bits, the head now *replays* bits periodically.

Frequency of these replays depends on the way the instrument is adjusted. The highest, limiting expansion of 200% is achieved when each bit (13.35 mm segment) is reproduced *twice* before the head goes on to the next bit. This condition yields a tape that requires twice as much playback time as the original recording. To obtain lesser degrees of expansion, the system is adjusted so that fewer information bits are reproduced twice.

The "Make-a-Buck" Boy! Business and industry may find uses for squeech—for management training purposes, for indoctrination of salesmen, for review of board meetings or sales meetings, for scanning client conferences. And consider the harassed secretary or steno who must cope with the dictation of a fast-talking bossman. If the employer's dictation is slowed down, the typist is likely to make far fewer mistakes when transcribing the material. On the other hand, speeded up recordings might be just the thing for testing the proficiencies of secretarial applicants.

There are many other potential applications for squeech. One more might be mentioned, if only because it is so unusual. Squeech may solve a particularly vexing problem in deep sea exploration. The addition of helium to the breathing atmosphere of divers hampers telephone communications because the gas causes a pitch increase in the voices of the divers. This pitch increase greatly reduces intelligibility. However, a rate changer could be used to restore such off-pitch speech to normalcy without in any way deteriorating the sound quality.

If compressed speech eventually becomes as diversely useful as these examples suggest, all sorts of people will have to acquire new listening habits. The adjustment may be a little easier for some than for others. For example, one man who had just listened to a speeded-up recording for the first time simply shrugged his shoulders and said: "What's so unusual about that? My teenage daughter talks like that all the time?"

If you don't happen to be the parent of a fast-talking teenager, there is another way you can test your ability to cope with compressed speech. Just dial 212-265-4144 and listen to some Squeech. ■

Hobby Circuits Manual

Continued from page 80

Adhesive, thereby preventing the loop wires from moving when the metal detector is moved.

Summing up. The RCA Hobby Circuits Manual shapes up as the best buy in circuit handbooks for the experimenter. Even forgetting the extra-detailed construction notes, the full scale circuit board templates and excellent photographs, there are an unusually large number of *really useful* projects for only $1.75—it's a great buy.

The RCA Hobby Circuits Manual is available from RCA parts distributors and from the major mail order houses such as Allied Radio and Lafayette Electronics. ■

Stamp Shack

Continued from page 23

Prepared by both lay and clerical experts, they cover news, current events and commentaries on subjects of particular interest to peoples who face social problems. Except for commercial or government networks, VOA or Radio Free Europe, there is no radio facility in the world today that can even closely touch Vatican Radio in the number of places to which its waves are beamed and received.

● Though the stamps' design suggests that Gabriel is just in front of the antenna, this really is a montage effect, since the immense statue of the patron of communications stands atop Castel San Angelo, within a few blocks of the Vatican, in Rome itself. ■

"Then, you say, he took out an electronic gun and shoved it in your face?"

Ham Traffic

Continued from page 65

3. Net Control must become a very hard-nosed control in such a situation and *enforce* net discipline completely. Net Control should be the only one to designate who shall make calls for what type of assistance.

4. Monitoring stations *must* remain silent unless called on for help.

This last point of Ed's is a cardinal rule of the real pros—the commercial radio operators. In emergency situations, *do not transmit* unless you have something really important to say. Monitor the frequency with a keen ear and *stay off the air.*

For a perfect example of this vital self-discipline in action, we should all remember the radio operator on board the ship which rescued some of the survivors of the infamous Titanic ship-sinking disaster of many years ago. Upon hearing the Titanic's SOS and learning its position, this sharp operator gave his own position, said his ship was heading for the Titanic at full speed . . . and never touched his key again. He had said all that was necessary, so he cleared the frequency for others who might need it.

This op's actions, dating from the days when Things Radio were still in their infancy, form the basis of some extremely valuable advice for all of us—especially when our ability as radio operators can be absolutely vital to the safety or comfort of someone else. Clearly, when disaster strikes, the word is *clear all decks, clear all channels,* and pronto!

Pipeline to Our GIs. More routine in nature, but definitely a contribution to our "public" is the service being provided by many stations who arrange phone patches for servicemen overseas to visit with their families at home. This is grueling, tedious work, requiring a real devotion to public service to be effective. Fortunately, we have quite a few fellers and gals in our ranks who like to perform service, rather than look for cheap thrills and excitement.

Some of these phone patch operations are temporary, set up for a short time—such as over a weekend—but most are continuous, week in and week out. An individual station may be involved, or a club station operated by a group of members working in relays. One such station is owned by Barry Goldwater, K7UGA. Barry doesn't have much time for hamming these

Continued from preceding page

days, but he does have a fine station at his hilltop home at Phoenix, Arizona, and he has made it available to a group of trusted operators for handling of phone patches and traffic to and from overseas GIs.

Regardless of how widely-known or how unknown a ham may be, this type of service is a mighty fine example of how hams can make this battered old world a little nicer to live in.

Some of this overseas work consists of "traffic messages," handled through various traffic nets in this country which link up with the various MARS (Military Affiliate Radio Service) nets. Unfortunately, some of the traffic incoming from overseas MARS nets seems to lie around in the MARS system quite a while before being fed into the ham nets in this country.

Consequently, many a ham has been embarrassed to deliver a message by telephone from an overseas GI telling his wife he's coming home soon . . . only to be told that the guy got home a week before!

You'll hear this complaint anytime you stick your head in the door of a meeting of traffic net operators. This has been going on literally for years, with no indication of improvement. It's really a shame, and this lack of a better MARS system has caused some hams to shy away from MARS activities. It's strange, but true, that the individual hams working in their voluntary traffic nets have a much better speed record than their military counterparts, who should be better organized.

New W1AW Frequencies. Some of the hams who listen to W1AW, operated by the *American Radio Relay League* in Newington, Conn., for code practice or news bulletins may be wondering what has happened to the station.

W1AW is still there, plunking away every night, but on different frequencies than before. All W1AW bulletin and practice transmissions are now made at 20 kHz *above* the bottom of each band. This includes phone transmissions, which are 20 kHz *above* the bottom of the American amateur phone bands.

This change was made because of the bottom portions of each band now being restricted to Extra Class operators under the new incentive licensing rules. The folks at ARRL headquarters figured the bottom portions of the bands would be less crowded, so they've moved there for bulletins and code practice.

However, you can still work W1AW, even if you don't have an Extra Class license, if you know how. General contacts with the station will be made on the Extra Class frequencies following bulletin transmissions, but at other times the station operators will listen for calls on the previously-used W1AW frequencies, in the General Class portions of the bands. These are printed in the schedule which appears each month in QST magazine.

Caution for Club Stations. While on the subject of incentive licensing operating rules, here's one to watch out for: If you're planning to operate a club station, like a lot of folks do during the annual Field Day, remember that regardless of what license *you* have, you must limit your operation to those frequencies *permitted for your club trustee, as well as yourself.*

For example, if the club station trustee has a General Class license, then you may use only General Class frequencies when using the club station, even if you may have an Advanced or Extra Class license.

And, conversely, if you have a General and the trustee has an Advanced or Extra, you yourself can operate only on General Class frequencies. ■

"Too bad, Mr. Gredznickski, I'm afraid we'll have to take it down to the shop!"

Telemetry

Continued from page 78

substantial noise without affecting data accuracy. This is because information is now represented by pulse width! The PAM (amplitude) measurements have become PDM (time) measurements. Thus, a large-amplitude PAM pulse will now produce a wide PDM pulse.

A typical PDM keying circuit is a sawtooth (or linear-ramp) generator that is triggered by pulses from the extra contacts of the commutator. A separate voltage is developed for each triggering pulse. This occurs simultaneously upon application of the variable-amplitude data pulse which has also been applied to the keyer circuit. The two signals are compared in the keyer circuit, and when the two values are equal, the pulse-width output is stopped.

PCM, No Less! Pulse-code modulation is one of the latest techniques developed for telemetry. A form of PCM telemetry has been used to transmit photographs of the moon (see photo of Mariner IV telemetry link).

As with other pulse systems, the PCM technique also uses a commutator and decommutator arrangement. However, these are always electronic devices (usually solid-state), and the commutated data is usually sampled at rates of 50,000 samples per second, or more. Because of this high speed it's possible to feed the output of a slow PAM system into a PCM channel and get a PACM (pulse-amplitude/code modulation) system.

Fig. 18 shows how the high-speed commutator's pulse train is fed to a high-speed analog-to-digital converter. (In PCM, the high-speed commutator is usually referred to as a multiplexer.) In the analog-to-digital convertor, each channel pulse is converted into a series of binary digits representing the amplitude of the signal data.

The encoding or conversion process in the convertor is accomplished by comparing the magnitude of the input pulse with a number of precise reference voltages within the convertor, and transmitting a *coded* group of pulses representing the magnitude of each input pulse. Each group of pulses has a code representing the binary numbering system, where the presence or absence of a pulse can indicate a "one" or "zero."

In some PCM systems a number of slower-speed commutators are built in to increase data-handling capacity. Actually, these are sub-commutators that feed their output into the main high-speed commutators. Because of this system of subassemblies it is possible for PCM systems to handle thousands of channels—which is necessary to convert the output from a television camera (i.e., scanning the moon) to 35-mm film exposures.

In most cases, the encoder's output goes directly to the transmitter, resulting in a single modulation system (PCM/FM). In addition to the large number of channels that can be handled, PCM also has the advantage of being able to operate in the presence of considerable noise and interference. This is because the information is transmitted in binary form. The receiver doesn't have to recognize pulse amplitudes (PAM) or pulse widths (PDM), but only the presence or absence of pulses that define the data.

Because of high-speed commutation, PCM information is recorded on magnetic tape at the receiving station and then played back at lower speeds on digital counters or computer tape. Engineers, technicians, and scientists can analyze this data at will and learn more about the conditions prevailing in a capsule, the trajectory of a rocket, or the nature of the lunar surface. ■

"I could stay up here forever!"

...World Had a Hot Flush

Continued from page 63

first time but simply show the world the tremendous power he now held.

He sat down at his set and put his hand on the switch then paused. It could be his last minute on earth. Perhaps he'd better have a cup of coffee and a final cigarette before making the test. He went out to go to the cafe on a nearby corner.

"Too bad in a way," he said to himself as he looked up at the towering skyline. "All of this work for nothing."

He entered the coffee shop and sat down at the counter. He saw there was a new girl working there and she was very pretty.

"What would you do if the world blew up in the next ten minutes?" he asked her as she brought him his coffee.

"Oh no, don't say anything like that!" she cried in dismay. "I just got this job and I owe three weeks rent."

When he returned to his apartment, he found it difficult to erase a red mouth and two blue eyes from his memory. However, he took a firm grip on his emotions, sat down at his set to take a deep breath and then flick the switch on and off, quickly.

Immediately the apartment was filled with both the sunlight and the heat of a July hot spell. Then it was dark again. He was vaguely conscious of the accompanying sound of thunder.

He sat back in his chair, took out his handkerchief and mopped the perspiration from his forehead as he trembled. He'd done it. He had sent a nuclear reaction around the world. Or had it gone around? He'd have to wait until the morning papers came out to discover this information. He went to bed.

"Mysterious Blast Circles World!" was the headline that met his eyes when he bought the Times. The paper went on to say that the cause of the phenomenon was believed to originate in Russia. No deaths or injuries had been reported but all people under the slice of the Van Allen Belt and outside a building had received an instantaneous sunburn as good as a month's vacation in Miami Beach. Pravda claimed it was a Crimean sun tan.

Peter Plodner went to stand at his kitchen window and look out over the big town. He had the power to destroy a large section of the globe. Then suddenly he thought of the pretty waitress that owed three weeks back rent. In place of destroying this section, he would simply rule the world. He would be a modern Genghis Khan. Genghis Plodner, everyone would call him.

He sat down and wrote an ad to insert in The New York Times.

"To the Governments of the World. I, Peter Plodner, am responsible for lighting up the sky last night. This was only a demonstration of my invention. As I am at present short of cash, I am asking the governments of each country to bring me a first payment of one million dollars, these payments to be continued monthly during the rest of my life. In exchange, I promise not to release this tremendous power I control. Please bring this money to Apartment 4, 1874 Green Street, Brooklyn. Do not think that I am a nut of some kind as I am not."

Peter put the letter in an envelope and walked down to give it to the girl at the Classified desk in the offices of the Times. Then he left and went back to the cafe for a cup of coffee.

"Did you see that strange light in the sky last night?", he asked the girl. "Like a short nuclear bomb, wasn't it?"

"Did I? I'm still shaking," she said quickly. "And only a little while before you were talking about the world blowing up," she added as she looked at him with wide, blue eyes.

"You know, I could let you have some money, say ten thousand dollars, to pay your back rent and buy a few things," he said calmly, "just as one friend to another, of course."

"Honey," she said with a wink, "if you give me ten thousand dollars I'll show you how really friendly I can be."

"It's a deal then," said Peter happily. "I won't have the money until day after tomorrow, Friday. I'll see you then."

The following morning, two neatly dressed gentlemen came to call on Peter. He welcomed them into his rooms with a smile.

"I presume you've seen my ad," he said. "Where's the money?"

"You are Mr. Plodner, the man who left this letter at The New York Times classified desk yesterday?" asked one of them, taking the letter from his pocket and opening it to show to Peter.

"Yes, of course," said Peter. "How did you get it?"

"We would like you to come along with us," replied the man. "The money is in our office, or should be by now, I think. You see it takes a little time to get that much cash together."

"Well, all right. Wait until I get my hat and coat."

~@~ A half-hour later, Peter was sitting in a white-walled office in Bellevue Hospital and talking to a bald-headed analyst.

"I've told you five times already, I'm not having delusions," shouted Peter. "You saw the explosion, didn't you? I made it!"

"Right there from your room, with your shortwave radio set?" said the Doctor. "But, you refuse to say how you did it?"

"Of course. Do you think I'm crazy?" asked Peter.

"Well, let's just say you've probably been working too hard lately and need a little rest with us. As to the strange blast, Washington has already been in contact with Russia who was in contact with Red China and things are working out very favorably for all concerned. I'll talk with you again later."

Peter was led from the office and locked up in a funny room.

~@~ The papers that night carried the story that, while Russia did not admit setting off any nuclear device, she proposed a top security meeting to discuss better relations with the United States and even hinted she might withdraw from East Germany and Czechoslovakia.

Poland said it would take the blame if Russian troops withdrew.

Red China asked the United States for a high level security meeting to establish better world relations between all countries.

France suddenly decided to become everyone's friend and offered to send this country the Eiffel Tower as a small gift.

It seemed that each country feared the other country had a world-destroying bomb, yet no one could learn which country it was. That brilliant flash around the globe was having quick results and creating a wave of brotherly love in the world.

~@~ Two days passed and Peter became worried about his set.

"Listen, Doctor," he pleaded. "Just do one thing for me. Send a man to my apartment and tell him to go to the room and take the little black box off the top of my antenna. Tell him to be sure and not touch the shortwave set before doing this."

"Very well, Mr. Plodner. I'll send a man over this afternoon," said the doctor. "Now go back to your room and play with your blocks."

Three hours later he had Peter returned to his office.

"There is no black box on your antenna, Mr. Plodner. In fact, there is no antenna. Mr. Lombardi, your landlord, had it taken down as it was causing the roof to leak. He said that his boy threw the box into the garbage can. Now, do you still persist in believing you can blow up the world anytime you feel like it?"

"Of course," said Peter quickly. "Whenever you let me out."

As the attendants led him away, he turned to ask, "Could I have my shortwave set in my room . . . to help pass time away?"

The doctor looked at him for quite a while as he seemed to be thinking of several strange things. Finally he replied. "No, I think not, Mr. Plodner."

When the door closed he took his pen and wrote across the top of Peter's file, "Schizophrenic case, possibly dangerous and appears incurable . . . *Hold.*"

~@~ Here it was Friday. The waitress in the coffee shop started chatting to a slick-haired customer, "You know, this nut came in here the other day and offered me ten gees. Man, what a nut. I wonder where he is. . . ." ■

Ptarmigan Track

Continued from page 40

Five-and-a-half hours and 2196 miles later, the weather plane stops at Eielson AFB, Alaska, for refueling. Take-off is at 0230. Destination: The Royal Air Force Base at Mildenhall, England, 11 hours and 4039 miles away.

In the long arctic night, shimmering curtains of red, green and yellow northern lights form a stupendous backdrop for the lonely transit on the frosty skyway across the top of the world. Below stretches the immense fractured desolation of the arctic icepack. Inside the warm airplane cabin, airmen shiver at the thought of how cold it is outside—50 below zero!

The Why of It. On these trans-polar missions the Air Force garners data to help chart the immense drifts of storm fronts born and bred in the arctic's frigid air masses. When mature, these storms drive down to warmer latitudes, influencing much of the world's weather.

"Horizontal" data are collected from the plane's exterior sensors, from the navigator's records and from the weather officer's observations. This information includes such items as wind speed and direction, temperature, latitude, longitude, time and date. In addition the weather officer keeps a record of air turbulence, icing and cloud cover, which are usually horizontal sheets of stratiform but sometimes cotton-bale cumulus.

"Vertical" data are collected by dropsondes—small expendable cylinders of weather-sensing instruments akin to the radiosondes on weather balloons. Two weather observers eject dropsondes at set intervals. As they float down on parachutes, the dropsondes radio back temperature, pressure and humidity readings every 500 feet.

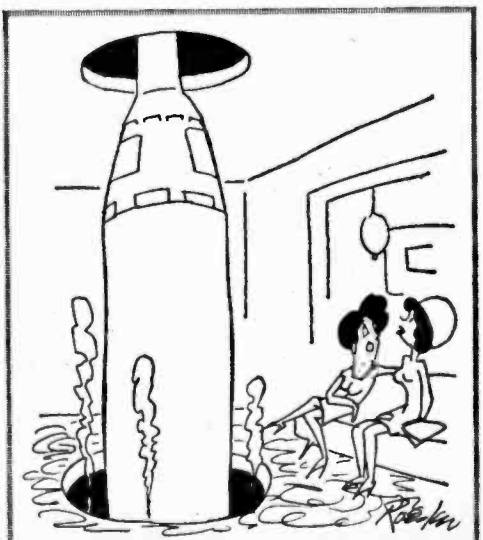
The computer combines the dropsonde data with the other information and punches a coded weather message on a paper tape. The coded message is broadcast via radioteletype to ground stations.

In Their Spare Time. In addition to their weather missions, the crews also measure the level of radiation and nuclear debris in the atmosphere. Customers for this commodity include the Atomic Energy Commission, Department of Defense, and the U. S. Public Health Service.

Some of the flight of five WC-135s are at times deployed to distant points for special weather missions associated with missile, satellite and man-in-space launches.

Whatta You Call It? Until the advent of the computer-equipped WC-135, the Air Force's flying weathermen called the Eielson-Mildenhall leg of the flight the Ptarmigan Track. First flown in 1947, it is the world's oldest weather track and was named after the game bird of the grouse family whose dominions are the frozen wastes ringing the Pole—northern regions of Siberia, Alaska, Canada, Greenland, and Scandinavia. Unfortunately, as versatile as the computer is, it is still strictly a four-letter-word machine. It could not handle *Ptarmigan* in its limited vocabulary so a new code name had to be given the track. The new name is *Lark*—a word that doesn't evoke the same aura of mystery as Ptarmigan but *does* help get the job done quickly.

Information from the polar region is integrated by the U.S. Air Weather Service (AWS) with data from other weather reconnaissance flights and from some 400 world-spanning AWS stations. Pieced together the parts make up the daily weather picture transmitted to other weather stations, the armed forces, airlines, and to cooperating governments such as Russia, France, Germany, England and Switzerland. Weather work contributes to international harmony—and for good reason—weather knows no international boundaries. ■



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More than 5 million two-way transmitters have skyrocketed the demand for service men and field, system, and R&D engineers. Topnotch licensed experts can earn $12,000 a year or more. You can be your own boss, build your own company. And you don't need a college education to break in.

HOW WOULD YOU LIKE to start collecting your share of the big money being made in electronics today? To start earning $5 to $7 an hour... $200 to $300 a week... $10,000 to $15,000 a year?

Your best bet today, especially if you don't have a college education, is probably in the field of two-way radio.

Two-way radio is booming. Today there are more than *five million* two-way transmitters for police cars, fire department vehicles, taxis, trucks, boats, planes, etc. and Citizen's Band uses—and the number is still growing at the rate of 80,000 new transmitters per month.

This wildfire boom presents a solid gold opportunity for trained two-way radio service experts. Many of them are earning $5,000 to $10,000 a year *more* than the average radio-TV repair man.

Why You'll Earn Top Pay

One reason is that the United States Government doesn't permit anyone to service two-way radio systems unless he is *licensed* by the Federal Communications Commission. And there simply aren't enough licensed electronics experts to go around.

Another reason two-way radio men earn so much more than radio-TV service men is that they are needed more often and more desperately. A home radio or television set may need repair only once every year or two, and there's no real emergency when it does. But a two-way radio user must keep those transmitters operating at all times, and *must* have their frequency modulation and plate power input checked at regular intervals by licensed personnel to meet FCC requirements.

This means that the available licensed experts can "write their own ticket" when it comes to earnings. Some work by the hour and usually charge at least $5.00 per hour, $7.50 on evenings and Sundays, plus travel expenses. A more common arrangement is to be paid a monthly retainer fee by each customer. Although rates vary widely, this fixed charge might be $20 a month for the base station and $7.50 for each mobile station. A survey showed that one man can easily maintain at least 100 stations, averaging 15 base stations and 85 mobiles. This would add up to at least $12,000 a year.

Be Your Own Boss

There are other advantages too. You can become your own boss—work entirely by yourself or gradually build your own fully staffed service company. Instead of being chained to a workbench, machine, or desk all day, you'll move around, see lots of action, rub shoulders with important police and fire officials and business executives who depend on two-way radio for their daily operations. You may even be tapped for a big job working for one of the two-way radio manufacturers in field service, factory quality control, or laboratory research and development.

How To Get Started

How do you break into the ranks of the big-money earners in two-way radio? This is probably the best way:

1. Without quitting your present job, learn enough about electronics fundamentals to pass the Government FCC Exam and get your Commercial FCC License.
2. Then get a job in a two-way radio service shop and "learn the ropes" of the business.
3. As soon as you've earned a reputation as an expert, there are several ways you can go. You can move *out* and start signing up and servicing your own customers. You might become a franchised service representative of a big manufacturer and then start getting into two-way radio sales, where one sales contract might net you $5,000. Or you may even be invited to move *up* into a high-prestige salaried job with one of the major manufacturers either in the plant or out in the field.

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Ed Dulaney is an outstanding example of the success possible through CIE training. Before he studied with CIE, Dulaney was a crop duster. Today he owns the Dulaney Communications Service, with seven people working for him repairing and manufacturing two-way equipment. Says Dulaney: "I found the CIE training thorough and the lessons easy to understand. No question about it—the CIE course was the best investment I ever made."

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- PRINTED CIRCUITRY

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

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

PRINTED CIRCUITRY

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

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

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

UNCONDITIONAL MONEY-BACK GUARANTEE

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

☐ Regular model $26.95.
☐ Deluxe model $31.95 (same as regular model except with superior parts and tools plus valuable Radio & TV Tube Checker).

Check one box to indicate manner of payment

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

Name .....

Address .....

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

PROGRESSIVE "EDU-KITS" INC.
1186 Broadway, Dept. 553NN, Hewlett, N. Y. 11557