FEBRUARY • 35¢

ELECTRONICS ILLUSTRATED

B Publishers of MECHANIX ILLUSTRATED

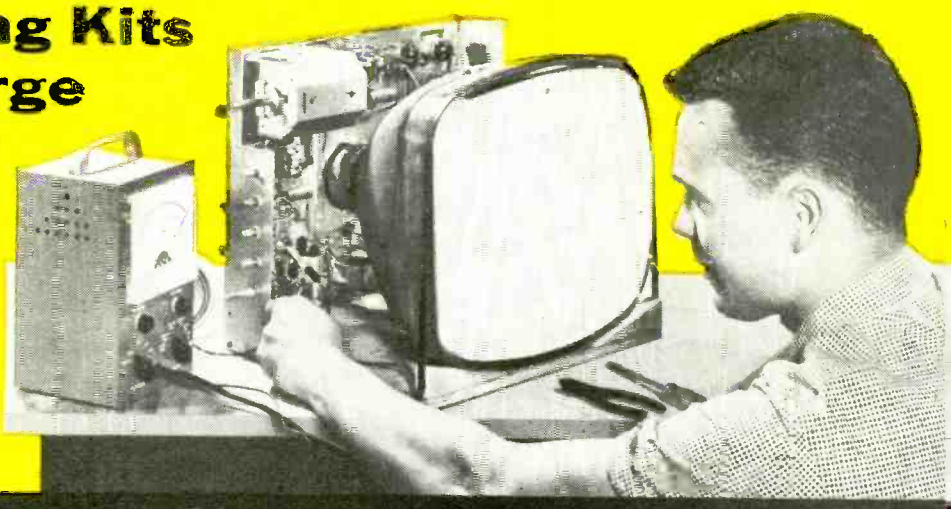
All About America's most sophisticated satellite... COURIER... the communications brain that receives, remembers and rebroadcasts 75,000 words per minute!

Special Bonus Articles

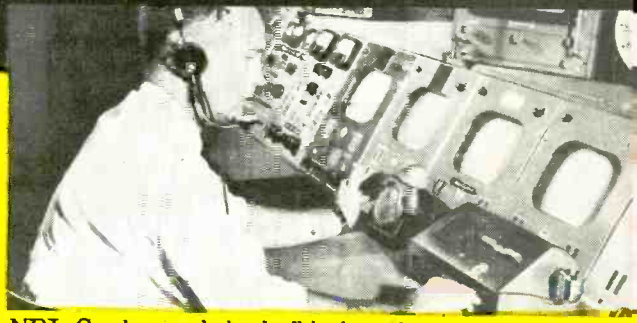
CITIZENS BAND TUNING ADAPTER • HAM ANTENNA TUNER
FM INTERSTATION MUTING • AUTOMATIC TAPE SHUT-OFF
MULTI-PURPOSE STROBE LIGHT • HOW TO FIX RADIOS

al Training Kits
tra Charge

s *practical*—based on OING methods. Be- ated lessons designed for men without pre- ce—you get special give actual practice, the things you study. o keep without extra ole, you get all parts, icture tube, to build d vacuum tube volt- ere. Real course de- 4-PAGE CATALOG. today.



START AND A BRIGHT FUTURE
ONICS Radio Television
SPARE TIME



NRI Graduates help build, install, operate and servic electronic equipment for the "Space Age" we live in- equipment used in offices, factories, the military. Othe are inspectors, laboratory technicians, etc., or work wit the Government and Armed Forces.

Fast Growing Field of Electronics Needs More Trained Technicians

New developments are creating more and more job opportunities for men with Electronics training, and these are better than average jobs. Take NRI training at home in your spare time. Hold your present job while training. Prepare now for a brighter future.

Added Income in Spare Time Starting Soon

Soon after enrolling we show you how to earn extra money in spare time, repairing sets. Many use this extra money to pay for their NRI course, or buy things they normally couldn't afford. Some have found better paying jobs within a year. Others have started their own businesses.

Train With the Leader — Get Started Fast

NRI is the oldest and largest school of its kind. For 45 years, NRI has featured the best training for beginners—for men without previous experience. Mail postage-free card for 64-page Catalog. Read success stories. See equipment you get. Find out about 60-day trial enrollment offer. Convenient monthly terms. ACT NOW.

From Radio-TV Servicing and Broadcasting to missiles NRI graduates share in the gigantic Electronics industry Interesting jobs await you in studios, on ships and planes in your own Radio-TV business. Mail coupon today.

NRI PREPARES YOU FOR JOBS LIKE THES

Electronic Technician • Service Technician • Assistant Enginee Cameraman • Civil Service Specialist • Computer Technicia Computer Programmer • Designer • Field Technician • Field Mainte nance Man • Plant Parts Inspector • Instrument Technician • Laborator Technician • Radio Operator • Transmitter Engineer • Airlines Technicia

MAIL CARD NOW

OLDEST & LARGEST HOME STUDY RADIO-TV SCHOOL

National Radio Institute

WASHINGTON 16, D.C., ESTABLISHED 1914

FREE!

LAFAYETTE'S 1961 CATALOG

324 GIANT SIZED PAGES

The Complete Catalog Featuring "The Best Buys In The Business"

- ☑ Stereophonic Hi-Fi Equipment
- ☑ Public Address Systems
- ☑ Tape Recorders
- ☑ Radio and TV Tubes and Parts
- ☑ Citizen Band Equipment
- ☑ Amateur Equipment
- ☑ Industrial Supplies

Send for Lafayette's FREE Catalog—the most complete, up-to-the-minute electronic supply catalog crammed full of everything in electronics at our customary down-to-earth money-saving prices.

CONTAINS HUNDREDS OF EXCLUSIVE LAFAYETTE ITEMS NOT AVAILABLE IN ANY OTHER CATALOG OR FROM ANY OTHER SOURCE—SEND FOR YOUR COPY NOW!

A "must" for the economy-minded hi-fi enthusiast, experimenter, hobbyist, engineer, technician, student, serviceman and dealer.

Our 40th Year

EASY PAY PLAN—the simplest, and quickest way to get what you want when you want it. As little as $2 down . . . up to 24 months to pay.

Communications Receiver
KT-200, Kit 64.50
HE-10, Wired 79.95

RK-400 2-Speed Portable Tape Recorder 49.50

TE-15 Tube Checker 19.95

RW-60 20,000 Ohms Per Volt Multitester 13.50

TM-14 Radio Field Indicator 7.95

HE-800WX Citizen Band Mobile Antenna 6.95

LAFAYETTE RADIO

Mail the coupon today for your FREE copy of Lafayette Radio's 1961 catalog.

Lafayette Radio Electronics Corp.
Dept. EIB-1, P.O. Box 190
Jamaica 31, N. Y.

Send me the FREE Lafayette 324 page 1961 catalog 610

Name_____

Address_____

City_____ Zone____ State_____

ELECTRONICS ILLUSTRATED

February, 1961 Vol. 4, No. 2

A Fawcett Publication

Contents

FEATURES

Courier Communications Satellite 27
To the Moon! 31
Hot New Prospecting Tool 42
Brain Surgery by Ultrasonics 56
Tape Recorder Doctor 58
TV Interference 62
Dollars from Discs 78
Sun Powered Lifesaver 81
Index 94

BUILD-IT PROJECTS

Grid Dip Meter Kit 34
How to Repair Radios-I 36
The Multi-Strobe 44
CB Tuning Adapter 50
Speaker Leads 53
Code Practice Oscillator-Amplifier 60
Tune Your Antenna 64
New Life for your Record Changer-II 67
Automatic Tape Switch 70
Interstation Muting for your FM Tuner 74
Diode Polarity 80
VOM Battery Conversion 80
Bass-Treble Booster for your Radio 84
Economy Directional Mike 86
Electronic Blinker 92

DEPARTMENTS

Electronics in the News 4
Try These 41
Hi-Fi Doctor and Clinic 54
Tape Tips 57
Electronic Brain 72
Hot Tips 83

ELECTRONICS ILLUSTRATED is published monthly by Fawcett Publications, Inc., Fawcett Place, Greenwich, Conn. W. H. Fawcett, Jr., President; Gordon Fawcett, Secretary and Treasurer; Roger Fawcett, General Manager; Roscoe K. Fawcett, Circulation Director; Donald P. Hanson, Assistant General Manager.

EDITORIAL AND ADVERTISING OFFICES: 67 West 44th Street, New York 36, N. Y.

ADDRESS ALL MAIL: Subscriptions, change of address, Form 3579 to Subscription Dept., Fawcett Bldg., Greenwich, Conn.; and all editorial and advertising to Fawcett Publications, Inc., 67 W. 44th St., New York 36, N. Y.

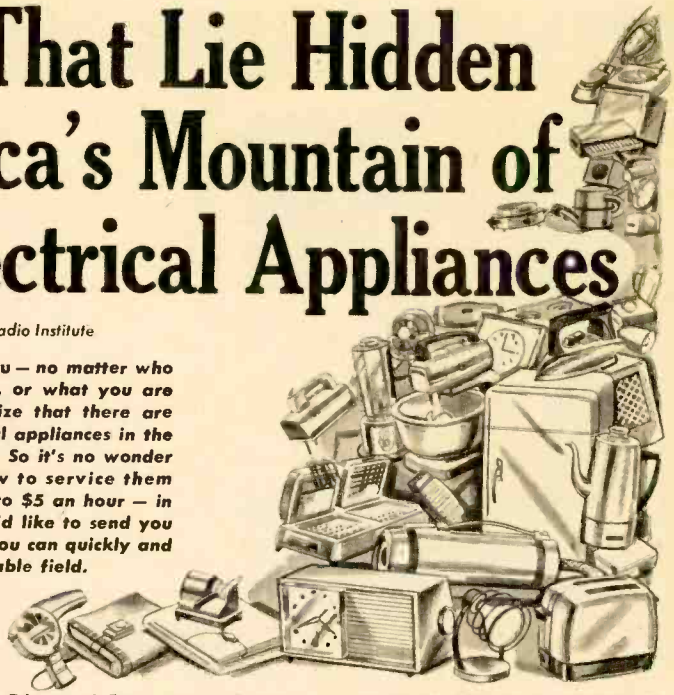
Second-class postage paid at Greenwich, Conn., and at additional mailing offices.

Subscription price $4.00 per year in the U. S. and possessions and Canada. All other countries $6.00 per year. Foreign subscriptions and sales should be remitted by International Money Order in U. S. funds payable at Greenwich, Conn.

Profits That Lie Hidden in America's Mountain of Broken Electrical Appliances

By J. M. Smith *President, National Radio Institute*

And I mean profits for you — no matter who you are, where you live, or what you are doing now. Do you realize that there are over 400 million electrical appliances in the homes of America today? So it's no wonder that men who know how to service them properly are making $3 to $5 an hour — in spare time or full time! I'd like to send you a Free Book telling how you can quickly and easily get into this profitable field.



THE COMING OF THE AUTO created a multi-million dollar service industry, the auto repair business. Now the same thing is happening in the electrical appliance field. But with this important difference: anybody with a few simple tools can get started in appliance repair work. No big investment or expensive equipment is needed.

The appliance repair business is booming — because the *sale* of appliances is booming. One thing naturally follows the other. In addition to the 400,000,000 appliances *already* sold, this year alone will see sales of 76 million *new* appliances. For example, 4,750,000 new coffee makers, almost 2,000,000 new room air conditioners, 1,425,000 new clothes dryers. A nice steady income awaits the man who can service appliances like these. And I want to tell you why that man can be *you* — even if you don't know a volt from an ampere now.

A Few Examples of What I Mean

Now here's a report from Earl Reid, of Thompson, Ohio: "In one month I took in approximately $648 of which $510 was clear. I work only part time." And, to take a big jump out to California, here's one from J. G. Stinson, of Long Beach: "I have opened up a small repair shop. At present I am operating the shop on a spare time basis — but the way business is growing it will be a very short time before I will devote my full time to it."

Don't worry about how little you may now know about repair work. What John D. Pettis, of Bradley, Illinois wrote to me is this: "I had practically no knowledge of any kind of repair work. Now I am busy almost all my spare time and my day off — and have more and more repair work coming in all along. I have my shop in my basement."

We Tell You Everything You Need to Know

If you'd like to get started in this fascinating, profitable, rapidly growing field — let us give you the home training you need. Here's an excellent opportunity to build up "a business of your own" without big investment — open up an appliance repair shop, become independent. Or you may prefer to keep your present job, turn your spare time into extra money.

You can handle this work anywhere — in a corner of your basement or garage, even on your kitchen table. No technical experience, or higher education is necessary. We'll train you at home, in your spare time, using methods proven successful for over 45 years. We start from scratch — *tell* you in plain English, and *show* you in clear pictures — everything you need to know. And, you will be glad to know, your training will cost you less than 20¢ a day.

FREE BOOK *and Sample Lesson*

I think that our 24-page Free Book will open your eyes to a whole world of new opportunities and how you can "cash in" on America's "Electrical Appliance Boom."

I'll also send you a Free Sample Lesson. It shows how simple and clearly illustrated our instruction is — how it can quickly prepare you for a profitable future in this big field. Just mail coupon, letter, or postcard to me: *Mr. J. M. Smith, President, National Radio Institute, Dept. KB1, Washington 16, D.C.* (No obligation, of course — and no salesman will call on you.)

EARN WHILE YOU LEARN
with this APPLIANCE TESTER

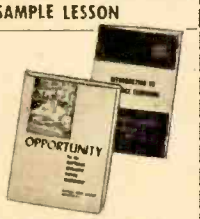
— Yours at No Extra Charge

Your NRI Course comes *complete* with all the parts to assemble a sturdy, portable Appliance Tester that helps you earn while you learn. Easy-to-follow manual tells how to assemble and use the Tester *right away*. Locate faulty cords, short circuits, poor connections, etc. in a jiffy; find defects in house wiring, measure electricity used by appliances; many other uses.

With this Tester you save time and make money by doing jobs quicker, making sure appliances operate correctly after repairs.

MAIL THIS FOR FREE BOOK and SAMPLE LESSON

Mr. J. M. Smith, President
NATIONAL RADIO INSTITUTE
Dept. KB1, Washington 16, D.C.



Tell me how I can "cash in" on the "Electrical Appliance Boom." Send me your illustrated FREE BOOK that outlines the whole NRI Course, tells what opportunities are open to me, answers my questions, describes success of other students, and much more. Also send me the FREE SAMPLE LESSON so I can see how clear and easy your instructions are. I am particularly interested in:

☐ Spare Time Earnings ☐ Business of My Own ☐ Better Job

I understand there is no obligation on my part; and no salesman will call on me.

Name.....

Address.....

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

Accredited Member National Home Study Council

. . . electronics in the news

YOUR *EI* NEWSLETTER . . . .

By now everyone has heard about the successful bouncing of amateur 1926-mc signals off the Moon. Since the triumph last summer it has been done again and again. It isn't as simple as making ordinary contacts via our old friend the ionosphere, but as Columbus said, "It's easy, *if* you know how." Our congratulations to all the original Moonbounce pioneers. Now, about that beard. To open a recent ARRL district convention, signals were sent to the Moon, bounced back down to Ohio, relayed to Long Island and thence to the convention rooms in New York. There they triggered a solenoid which operated shears to trim the beard of Sam Harris, W1FZJ, sparkplug of original attempt. Maybe it wasn't a close shave but it sure was different.

. . . . . .

The Post Office is now evaluating the results of its recently completed 30-day test of **"Speed Mail"** between Washington, D. C., Chicago, and Battle Creek, Mich. Letters were handwritten or typed on special forms (remember "V-Mail" from World War II?) and no Post Office employee read them. They were opened, transmitted via AT&T lines to destination, printed and resealed entirely by automatic machine. . . . The Post Office is now testing an automatic typewritten address reader, too. As the "brain" of a sorting machine, this apparatus could separate letters according to destination and at the end hand each postman the mail for his area.

. . . . . .

An electronic ignition system for cars developed by Tung-Sol Electric, Inc., of N. J., has been under test by car makers. System uses a thyratron tube plus germanium power transistors and silicon diodes and supposedly new circuit ideas that overcome bugs of all previous systems.

. . . . . .

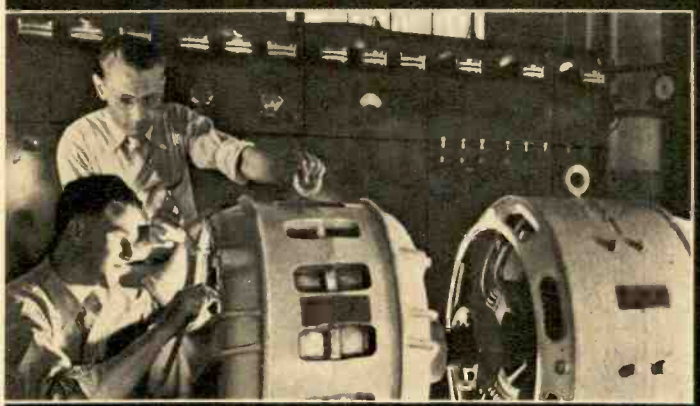
The Soviet Union will be the No. 2 computer "power," just behind us, by 1965, according to a U. S. computer expert just returned from visit to European factories. We now have a lead of "a couple of years" over Europe in computer hardware knowhow, but no monopoly on brains.

. . . . . .

Atop the New Jersey palisades, across the Hudson River from skyscrapered Manhattan, a steel ribbed, scarecrow-shaped radio mast towers in lonely majesty. It is FM pioneer Major Edwin H. Armstrong's monument. Long unused after Armstrong's death, it may now serve as the support for a high UHF channel TV antenna during the FCC-suggested tests of the feasibility of UHF in large cities. The Empire State building now houses the broadcast antenna for the lower UHF channels . . . . Bell Telephone Labs recently demonstrated an acoustic *antifeedback* circuit to lick ringing and squawking in public address systems. The circuit introduces a five-cycle frequency shift between microphone and loudspeaker and then back to microphone again. This frequency shift was not discernible by listeners and eliminated in-phase feedback, major cause of howling. . . .

These men are getting practical training in . . .

ELECTRICITY ELECTRONICS



On Real:

A.C. and D.C. Motors
Generators
Switchboards
Controllers
Modern Appliances
Automatic Electronic Control Units

(Shown at left—Instructor explaining operation and testing of a large Motor Generator in our A.C. Department.)

TELEVISION RADIO ELECTRONICS

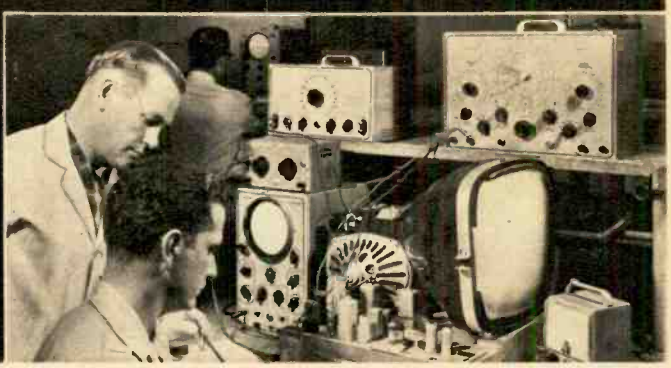
On Real:

Television Receivers Black & White and Color

AM-FM and Auto Radios Transistors—Printed

Circuits—Test Equipment

(Right — Instructor helping students check the wiring and trace circuits of television receivers.)



Train in the NEW SHOP-LABS of COYNE

Largest, Oldest, Best Equipped School of its Kind in the U.S.

Prepare for your future now in today's top opportunity field. Don't be satisfied with a "No Future" job. Train the Coyne way for a better job in a field that offers a world of opportunities in the years ahead.

You train in Chicago—the Electrical and Electronic Center of the World—on real equipment. Professional and experienced instructors show you how, then you do practical jobs yourself. No previous experience or advanced education is needed.

FINANCE PLAN: Enroll now, pay most of tuition after graduation. Part-time employment help for students.

Mail coupon or write to address below for free book—"Guide to Careers". Whether you prefer Electricity, Television-Radio or Combined Electronics Training, which includes both fields, this book describes all training and gives facts to Vets and Non-Vets.

B. W. Cook, Jr., Pres. **COYNE ELECTRICAL SCHOOL** **Founded 1899**

CHARTERED AS AN EDUCATIONAL INSTITUTION NOT FOR PROFIT
1501 W. CONGRESS PARKWAY, CHICAGO 7 Dept. 21-8C
ELECTRICITY ★ RADIO ★ TELEVISION ★ REFRIGERATION ★ ELECTRONICS

Mail Coupon or Write for FREE Book

Book comes by mail. No obligation and no salesman will call.

Mail coupon below in an Envelope or paste on a Postal Card or write Address given and Free book, "Guide to Careers", with information will be sent to you by return mail.

COYNE ELECTRICAL SCHOOL
Dept. 21-8C New Coyne Building
1501 W. Congress Pkwy., Chicago 7, Illinois

Send BIG FREE book and details of all the training you offer. However, I am especially interested in:

☐ Electricity ☐ Television ☐ Both Fields

Name_____

Address_____

City_____ State_____

(I understand no Salesman will call)

. . . News

The National Aeronautics and Space Administration (NASA) has selected Hughes Aircraft Co. to build an experimental *ion propulsion* engine for space craft. (Various types of ion engines under consideration were described over two years ago in *EI*.) In the Hughes engine a stream of cesium-derived ions is neutralized by the addition of electrons and then shot out from the rear of the engine, developing an ejection speed of more than 100,000 miles per hour. The entire engine measures about 8 inches long and 4 inches in diameter.

—o—

Another new computer, this one by G-E, automatically translates English words and symbols into "machine language." This unit does not require services of a highly trained programmer, or even of a skilled technician, for everyday applications. Although a complicated piece of equipment, its operation can be learned in about the same time that a fairly complex office machine requires.

A new tube tester, which checks for shorts, leakages, opens and intermittents in octal, loctal and 9-prong and miniature tubes has been announced by Electronic Measurement Corp. This unit checks each section of multipurpose tubes separately. Quality is indicated directly on the front dial. $22.90 for the wired unit, $14.90 for the kit. 625 Broadway, New York 12, N. Y.

. . . News

New Gadgets, Instruments, Etc.

The "Infraphone," a self-powered voice transmitter and receiver that uses a beam of infrared light as its transmission medium was demonstrated recently by Infrared Industries, Inc., of Waltham, Mass. This is a commercial product to be on the market at a cost of $40 per two-unit set (assuming you don't want to talk invisibly to yourself). This all-transistor unit uses a photosensitive

semiconductor sensitive to infrared. The sending and receiving circuits are separate so that 2-way conversations may be carried on simultaneously. The working range is several hundred feet, but it saves shouting and acts as a "wireless intercom." Of course Infraphones can be used only when both units are aimed at each other within line of sight.

—o—

A new stripping gadget which slips onto the barrel of an Ungar soldering tip or heating unit and is used for stripping wire insulation while soldering has just been made available by Ungar Electric Tools, 4101 Redwood Avenue, Los Angeles 66, Calif. Three different types of strippers are available: v-shaped, notched or circular. The price is $.75 per unit.

—o—

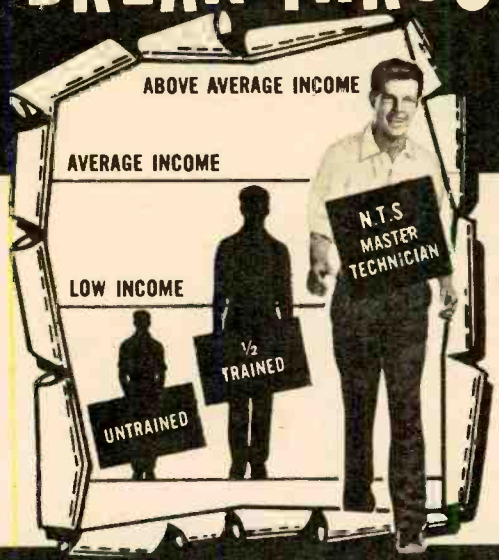
Healthier, happier babies through electronics, that's the promise of the "Securitone" heartbeat simulator developed by Dr. Lee Salk and manufactured by Sonotone Corp., Elmsford, N.Y. When this instrument, the size of a small table radio, is placed next to a baby's crib or bassinet the baby hears from it

the sound of a normal heartbeat. Tests in hospital nurseries have demonstrated that this sound helps infants to sleep better and they cry less. Evidently it gives them the secure feeling they had in the womb when they heard this same sound. The "Securitone" will be sold in retail stores for under $30.

—o—

Only the hardiest boatmen go out on the water this time of year but now is the time to build things which will increase your boating fun come Spring. One item of proven usefulness is a depth finder. A new completely transistorized kit has just been announced by PACO Electronics Co., 70-31 84th St., Glendale 27, L. I., N. Y. It is the model DF-90 with a range of 120 feet calibrated in one foot intervals on its circular dial. The transducer (the gizmo you put on the bottom outside of the boat) is of the barium titanite type and can be mounted on the transom but will work better on the hull. The kit is $84.50; factory wired the DF-90 costs $135.50.

BREAK THROUGH TO HIGHER PAY in ELECTRONICS TV-RADIO



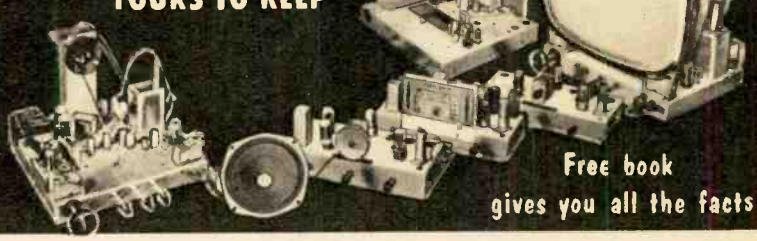
START NOW! Break through the Earning Barrier that stops half-trained men. N.T.S. "All-Phase" training prepares you — at home in spare time — for a high-paying CAREER in Electronics — TV — Radio as a MASTER TECHNICIAN. One Master Course at One Low Tuition trains you for unlimited opportunities in All Phases: *Servicing, Communications, Preparation F.C.C. License, Broadcasting, Manufacturing, Automation, Radar* and *Micro-Waves, Missile* and *Rocket Projects.*

A more rewarding job . . . a secure future . . . a richer, fuller life can be yours! As an **N. T. S. MASTER TECHNICIAN** you can go straight to the top in industry . . . or in your own profitable business.

SUCCEED IN MANY HIGH-PAYING JOBS LIKE THESE...

- TV-Radio Sales, Service and Repair
- Profitable Business of Your Own
- Communications Technician — F.C.C. License
- Hi-Fi, Stereo & Sound Recording Specialist
- TV-Radio Broadcasting Operator
- Technician in Computers & Missiles
- Electronics Field Engineer
- Specialist in Microwaves & Servomechanisms
- Expert Trouble Shooter
- All-Phase Master Technician

19 BIG KITS YOURS TO KEEP



Free book gives you all the facts

NATIONAL TECHNICAL SCHOOLS
WORLD-WIDE TRAINING SINCE 1905
4000 SO. FIGUEROA ST., LOS ANGELES 37, CALIF., U. S. A.
Write Dept. R4Y-11

RESIDENT TRAINING AT LOS ANGELES
If you wish to take your training in our Resident School at Los Angeles, start NOW in our big, modern Shops and Labs. Work with the latest Auto and Diesel engines — all types fuel injection, automatic transmissions, all power equipment — most complete facilities offered by any school. Expert, friendly instructors. Graduate Employment Service. Help in finding home near school — and part time job while you learn.
WRITE FOR SPECIAL RESIDENT SCHOOL CATALOG AND INFORMATION

ACCREDITED MEMBER
... the only nationally recognized accrediting agency for private home study schools.

N.T.S. Shop-Tested HOME TRAINING is **Better, More Complete, Lower Cost** . . . and it is your key to the most fascinating, opportunity-filled industry today!

YOU LEARN QUICKLY AND EASILY THE N.T.S. SHOP-TESTED WAY

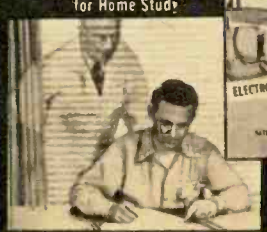
You get lessons, manuals, job projects, unlimited consultation, graduate advisory service.
You build a Short Wave-Long Wave Superhet Receiver, plus a large-screen TV set from the ground up, with parts we send you at no additional cost. You also get a Professional Multitester for your practical job projects.

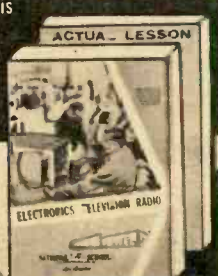
EARN AS YOU LEARN... WE SHOW YOU HOW!

Many students pay for entire tuition — and earn much more — with spare time work they perform while training. You can do the same . . . we show you how.

SEND FOR INFORMATION NOW... TODAY! IT COSTS YOU NOTHING TO INVESTIGATE.

N.T.S HOME TRAINING is
- Classroom Developed
- Lab Studio Planned
- Shop-Tested
- Industry-Approved
- Specifically Designed for Home Study





MAIL COUPON NOW for FREE BOOK and ACTUAL LESSON

NO OBLIGATION! NO SALESMAN WILL CALL

NATIONAL TECHNICAL SCHOOLS
WORLD-WIDE TRAINING SINCE 1905

Mail Now To
National Technical Schools, Dept. R4Y-11
4000 S. Figueroa St., Los Angeles 37, Calif.

Please rush FREE Electronics-TV-Radio "Opportunity" Book and Actual Lesson. No Salesman will call.

Name _____ Age _____
Address _____
City _____ Zone _____ State _____
☐ Check here if interested ONLY in Resident Training at Los Angeles.
VETERANS: Give date of discharge _____

83 YX 929. Stereo Tape Record-Play Preamp Kit. $79.95 (less case)

One of the many great Knight-Kit stereo component kits. Professional quality; superb performance with virtually any tape transport; separate dual-channel recording and playback preamps; permits tape monitoring, sound-on-sound and echo effects. Packed with quality features for every possible stereo and monophonic function...

Simply

these and 59

knight

A PRODUCT

a pleasure to build...

83 YX 928. FM-AM Hi-Fi Tuner Kit. $49.95

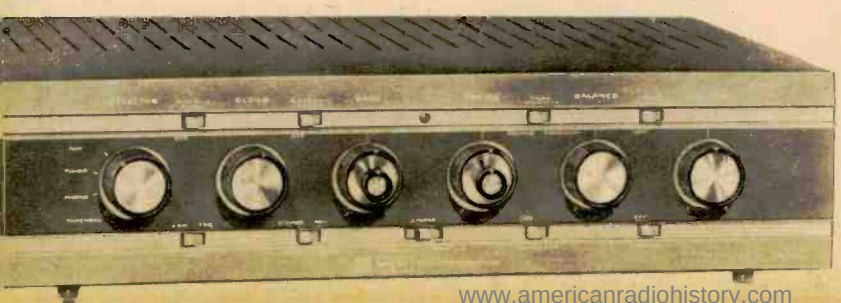
Typical Knight-Kit hi-fi value—incomparable at the price. With AFC, tuned RF stage on FM, multiplex jack. Straight FM tuner kit also available at $38.95. For deluxe Stereo FM-AM and FM tuner kits, see the Allied catalog...

The most satisfying do-it-yourself experience awaits you when you build a Knight-Kit! You'll marvel at the sheer ease of assembly, absolutely assured by exclusive "show-how" manuals, wall-sized picture diagrams, step-by-step do-and-check instructions, pre-cut wire, "visi-packed" parts and an engineering perfection that eliminates guesswork. You'll get perfect results. You'll enjoy with pride a true custom-built electronic product, professionally engineered and styled—the best you can own. And to top off your pleasure, you'll save substantially at the unbeatable Knight-Kit price...

83 YX 927. 20-Watt Stereo Hi-Fi Amplifier Kit. $39.95

Biggest bargain in quality Stereo hi-fi. Has special clutch-type dual-concentric level control; simplified control facilities; DC preamp filaments. Similarly styled 32-Watt Stereo Amplifier Kit with full frequency center channel available at a low, low $59.95...

83 YU 934. Deluxe 70-Watt Stereo Hi-Fi Amplifier Kit. $119.95



Super-power to drive any of today's speakers, a do-it-yourself stereo masterpiece, featuring: special "blend" control; full-range center channel; tape-source monitor; dual phasing switches; Stereo paralleling switch. For deluxe 40-watt Stereo amplifier at only $76.95, and 60-watt Stereo amplifier, see the Allied catalog...

83 YX 712-2. Superhet Citizen's Band Transceiver Kit. $79.95

Dual-conversion for highest sensitivity and selectivity; crystal-controlled operation on any 2 channels, plus manual tuning. Another Knight-Kit Citizen's Band Transceiver is available at an amazing low $39.95—see the Allied catalog for full details...

Great!

other money-saving -kits®

OF ALLIED RADIO

and you own the best

83 YX 258. 4-Band "Span Master"® Receiver Kit. $25.95

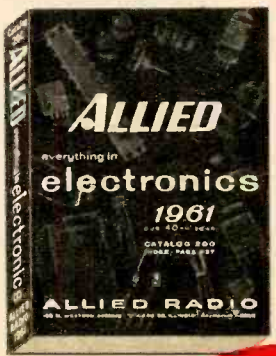
Fabulous performer for world-wide reception; thrilling shortwave adventures, plus fine Broadcast; band-switching, 540 KC to 30 MC; with cabinet. For additional receiver kits, radio-intercom, clock-radio, transistor radios, intercom systems, electronic labs and other great hobbyist Knight-Kits, see the Allied catalog...

money back guarantee

Every Knight-Kit is unconditionally guaranteed to meet our published specifications for performance or your purchase price is refunded in full.

only $2 down

It's easy to buy any Knight-Kit: only $2 down on orders up to $50; $5 down up to $200; $10 down over $200—up to 24 months to pay.



83 Y 125. Electronic VTVM Kit. $25.75

High sensitivity general-purpose VTVM; 11 meg input resistance; balanced-bridge circuit; 4½" meter. One of many fine instrument kits including 5" scopes, AC VTVM, tube checkers, signal tracer, audio generator, sweep generator, and others, described in detail in the Allied catalog...

Featured

IN THIS VALUE-PACKED 1961

444-PAGE ALLIED CATALOG

Send coupon today for the 1961 Allied electronics catalog (the world's biggest), featuring the complete Knight-Kit line. See the best in electronic kits—save on *everything* in Electronics. Send for your FREE copy now!

sold exclusively by

ALLIED RADIO

pioneer in electronic kit development

our 40th year

also available in Canada

free *send coupon today!*

ALLIED RADIO, Dept. 203-B1
100 N. Western Ave., Chicago 80, Ill.

☐ Send Free 1961 Allied Catalog No. 200

Name_____
PLEASE PRINT

Address_____

City_____ Zone____ State_____

. . . News

Going the techniques of mass production one step better, the Librascope Division of General Precision, Inc., of Glendale, Calif., has just developed a "universal" circuit card which can be adapted to many different circuit requirements, primarily for computers.

Basically, this is an etched circuit board with a universal pattern of lines—the interconnections formed when parts are soldered to the board form the particular circuit needed. What an idea for a kit maker!

—o—

An interesting new idea for enlarging the printed research departments of schools, laboratories and libraries has just been unveiled by the Nord Photocopy & Electronics Corp., 300 Denton Ave., New Hyde Park, L. I., N. Y. A central library's microfilm slides can be read by a viewer sitting before a television-type console miles from the library itself. In addition, the viewer can enlarge up to 60 times, electronically, any portion of the microfilm slide he wishes to view in greater detail. This slide can contain diagrams, written material, or photographs. The transmission system uses 945 lines per frame.

. . .News

Your next bankbook may have your signature in it but don't worry, this is not an invitation to forgers to imitate your signature on a withdrawal slip if you lose your book or it is stolen. Your signature will be scrambled by a new electronic device called "Signaguard," just developed by RCA, and will be an unrecognizable mass of broken lines. When the passbook is presented at the

teller's window the device returns your signature to its original appearance for comparison with the withdrawal slip. The secret is light-transmitting glass tubes which scatter the information they see before it is imprinted on sensitized paper. Similar tubes in the teller's viewer re-assemble the writing. Your only fear now is a crook who likes to build electronic gadgets.

—o—

Sylvania Electric, whose "Panelescent" nite light has sold over 1 million, has just introduced an electric switch plate with the same principle. This switch plate may replace any now in use in the home and provides a green glowing light in a darkened room. When the switch is flicked on, the normal room lights come on and the panelescent glow goes off. The new switch plate is $2.49. One plate adds about a nickel to your electric bill . . . in a year.

—o—

For tapping new threads or renewing old ones in metal or plastic, CBS Electronics offers a new "Tri-Tap" tool combining the three most popular sizes, 6-32, 8-32, and 10-32 in one small tool. At your tube distributors.

Accredited by the National Home Study Council

good training doesn't cost . . . it pays!

How To Get an FCC License (Commercial)

Get All Three Booklets Free...

An FCC License Or Your Money Back!

Completion of the Master Course (both Sections) will prepare you for a First Class Commercial Radio Telephone License with a Radar Endorsement. Should you fail to pass the FCC examination for this license after successfully completing the Master Course, you will receive a full refund of all tuition payments. This guarantee is valid for the entire period of your enrollment agreement.

Get This Handy Pocket Electronics Data Guide Free...

Puts all the commonly used conversion factors, formulas, tables, and color codes at your fingertips. Yours absolutely free if you mail the coupon today. No further obligation.

Cleveland Institute of Electronics
1762 E. 17 Street Desk EI 29 Cleveland 14, Ohio

Increase Your Technical Knowledge

Get a government license plus an understanding of such electronic applications as computers . . . industrial electronics . . . radar . . . communications . . . and many more.

Cleveland Institute of Electronics
1762 E. 17 Street Desk EI 29, Cleveland 14, Ohio

Please send Free Career Information Material prepared to help me get ahead in Electronics and a free copy of your "Pocket Electronics Data Guide." I have had training or experience in Electronics as indicated below:

- ☐ Military
- ☐ Radio-TV Servicing
- ☐ Manufacturing
- ☐ Amateur Radio
- ☐ Broadcasting
- ☐ Home Experimenting
- ☐ Telephone Company
- ☐ Other .....

In what kind of work are you now engaged? .....

In What branch of Electronics are you interested? .....

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

Address .....

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

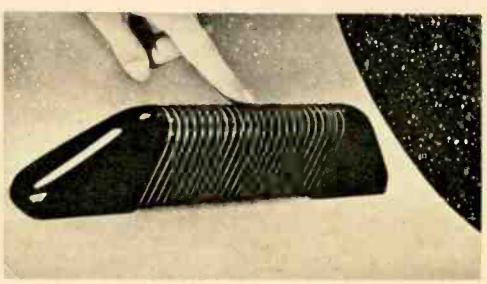
EI 29

. . . News

Long needed has been a public address system tailored for school buses to enable the driver to talk to his passengers without taking his eyes off the road while driving. The DuKane Corp.

of St. Charles, Ill., is now marketing a complete system to do just that. It includes a fully transistorized four-watt amplifier, a close talking microphone and horn loudspeakers for inside and outside the bus.

—o—



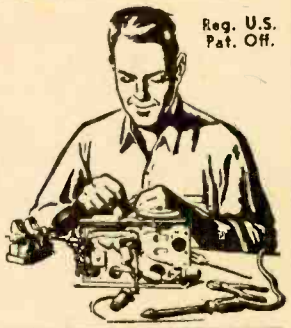
Is your wife, sweetheart or mother overdrying? What she needs are electronic sensors on her baffles. Or so the Maytag Co., manufacturers of automatic clothes dryers, tell us. They have recently placed on the market a new clothes dryer that incorporates an electronic control that measures the moisture in the clothes themselves and stops the drying cycle before the clothes are overdried. Thus it automatically compensates for washday's weather—high or low humidity. Why is this desirable? Overdried fabric wears out soon.

BUILD 20 RADIO CIRCUITS AT HOME

with the New PROGRESSIVE RADIO "EDU-KIT" ®

Reg. U.S. Pat. Off.

only $26.95



A Practical Home Radio Course

Now Includes
- ★ 12 RECEIVERS
- ★ 3 TRANSMITTERS
- ★ SQ. WAVE GENERATOR
- ★ SIGNAL TRACER
- ★ AMPLIFIER
- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ EXCELLENT BACKGROUND FOR TV
- ★ School Inquiries Invited
- ★ Sold in 79 Countries

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

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

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

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

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

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

THE KIT FOR EVERYONE

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

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

PROGRESSIVE TEACHING METHOD

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

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

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

THE "EDU-KIT" IS COMPLETE

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

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

FREE EXTRAS

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

SERVICING LESSONS

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

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."

FROM OUR MAIL BAG

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

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

It is understood and agreed that should the Progressive Radio "Edu-Kit" be returned to Progressive "Edu-Kits" Inc. for any reason whatever, the purchase price will be refunded in full, without quibble or question, and without delay.

The high recognition which Progressive "Edu-Kits" Inc. has earned through its many years of service to the public is due to its unconditional insistence upon the maintenance of perfect engineering, the highest instructional standards, and 100% adherence to its Unconditional Money-Back Guarantee. As a result, we do not have a single dissatisfied customer throughout the entire world.

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

Name .....

Address .....

.....

PROGRESSIVE "EDU-KITS" INC.

1186 Broadway, Dept. 533AE, Hewlett, N. Y.

EXAMINE ANY OF THESE TESTERS *BEFORE* YOU BUY!!

Yes, we offer to ship *at our risk* one or more of the testers described on these pages.

Superior's New Model 70 UTILITY TESTER®

FOR REPAIRING ALL ELECTRICAL APPLIANCES and AUTOMOBILE CIRCUITS

Model 70—UTILITY TESTER
Total Price...$15.85—
Terms: $3.85 after 10 day trial, then $4.00 monthly for 3 months, if satisfactory. Otherwise return, no explanation necessary.

As an electrical trouble shooter the Model 70:

- Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Switches, Thermostats, etc.
- Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakages, etc.
- Will measure current consumption while the appliance under test is in operation.
- Incorporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, motors, etc.
- Leakage detecting circuit will indicate continuity from zero ohms to 5 megohms (5,000,000 ohms).

As an Automotive Tester the Model 70 will test:

• Both 6 Volt and 12 Volt Storage Batteries • Generators • Starters • Distributors • Ignition Coils • Regulators • Relays • Circuit Breakers • Cigarette Lighters • Stop Lights • Condensers • Directional Signal Systems • All Lamps and Bulbs • Fuses • Heating Systems • Horns • Also will locate poor grounds, breaks in wiring, poor connections, etc.

INCLUDED FREE *This 64-page book—practically a condensed course in electricity. Learn by doing.*

Just read the following partial list of contents: What is electricity? • Simplified version of Ohms Law • What is wattage? • Simplified wattage charts • How to measure voltage, current, resistance and leakage • How to test all electrical appliances and motors using a simplified trouble-shooting technique. • How to trace trouble in the electrical circuits and parts in automobiles and trucks.

Model 70 comes complete with 64 page book and test leads

Only **$15.85**

Superior's New Model 82A A truly do-it-yourself type

TUBE TESTER

TEST ANY TUBE IN 10 SECONDS FLAT!

Model 82A—Tube Tester
Total Price $36.50
Terms: $6.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

1. Turn the filament selector switch to position specified.
2. Insert it into a numbered socket as designated on our chart (over 600 types included).
3. Press down the quality button—

THAT'S ALL! *Read emission quality direct on bad-good meter scale.*

FEATURES:

• Tests over 600 tube types. • Tests 0Z4 and other gas-filled tubes. • Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings. • Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence. • Dual Scale meter permits testing of low current tubes. • 7 and 9 pin straighteners mounted on panel. • All sections of multi-element tubes tested simultaneously. • Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms.

Production of this Model was delayed a full year pending careful study by Superior's engineering staff of this new method of testing tubes. Don't let the low price mislead you! We claim Model 82A will outperform similar looking units which sell for much more—and as proof, we offer to ship it on our examine before you buy policy.

Model 82A comes housed in handsome, portable Saddle-Stitched Texon case

(Picture Tube Adapter available for $5.50 additional)

Only **$36.50**

DID YOU EVER?

Order merchandise by mail, including deposit or payment in full, then wait and write . . . wait and write?

Purchase anything on time and sign a lengthy complex contract written in small difficult-to-read type?

Purchase an item by mail or in a retail store then experience frustrating delay and red tape when you applied for a refund?

Obviously prompt shipment and attention to orders is an essential requirement in our business . . . We ship at *our* risk!

NO CONTRACT TO SIGN
CO-MAKERS
EMPLOYER NOTIFICATION

The simple order authorization included in this offer is *all* you sign. We ask only that you promise to pay for or return the goods we ship in good faith.

EXAMINE ANY ITEM YOU SELECT IN THE PRIVACY OF YOUR OWN HOME

Then if completely satisfied pay on the interest-free terms plainly specified. When we say interest-free we mean not one penny added for "interest" for "finance" for "credit-checking" or for "carrying charges." The net price of each tester is plainly marked in our ads—that is all you pay except for parcel post or other transportation charges we may prepay.

Model 79—Super Meter
Total Price $38.50
Terms: $8.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

SUPERIOR'S NEW MODEL 79 **SUPER-METER** WITH NEW 6" FULL-VIEW METER

A Combination VOLT-OHM MILLIAMMETER
Plus CAPACITY, REACTANCE, INDUCTANCE & DECIBEL MEASUREMENTS
Also Tests SELENIUM & SILICON RECTIFIERS, SILICON & GERMANIUM DIODES

The model 79 represents 20 years of continuous experience in the design and production of SUPER-METERS, an exclusive SICO development. It includes not only every circuit improvement perfected in 20 years of specialization but, in addition includes those services which are "musts" for properly servicing the ever-increasing number of new components used in all phases of today's electronic production. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes — components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily required extra meter scale, SICO used its new full-view 6-inch meter.

SPECIFICATIONS:

• **D.C. VOLTS:** 0 to 7.5/15/75/150/750/1,500. • **A.C. VOLTS:** 0 to 15/30/150/300, 1,500/3,000 • **D.C. CURRENT:** 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes • **RESISTANCE:** 0 to 1,000/100,000 Ohms, 0 to 10 Megohms. • **CAPACITY:** .001 to 1 Mfd., 1 to 50 Mfd. • **REACTANCE:** 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms. • **INDUCTANCE:** 15 to 7 Henries, 7 to 7,000 Henries. • **DECIBELS:** —6 to +18, +14 to +38, +34 to +58. The following components are all tested for QUALITY at appropriate test potentials. Two separate BAD-GOOD scales on the meter are used for direct readings. All Electrolytic Condensers from 1 MFD to 1000 MFD. All Germanium Diodes. All Selenium Rectifiers. All Silicon Diodes. All Silicon Rectifiers.

Model 79 comes complete with operating instructions, test leads, and streamlined carrying case. Use it on the bench—use it on calls. Only **$38.50**

Model 77—VACUUM TUBE VOLTMETER.. Total Price.... $42.50
Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

Superior's New Model 77 **VACUUM TUBE VOLTMETER**

WITH NEW 6" FULL-VIEW METER

Compare it to any peak-to-peak V. T. V. M. made by any other manufacturer at any price!

• Extra large meter scale enables us to print all calibrations in large easy-to-read type.

• Employs a 12AU7 as D. C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability. • Meter is virtually burn-out proof. The sensitive 400 micro-ampere meter is isolated from the measuring circuit by a balanced push-pull amplifier. • Uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

AS A DC VOLTMETER: The Model 77 is indispensable in HI-FI Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

AS AN ELECTRONIC OHMMETER: Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, Intermittents are easily found, isolated and repaired.

AS AN AC VOLTMETER: Measures RMS values if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

SPECIFICATIONS

• **DC VOLTS**—0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance. • **AC VOLTS (RMS)**—0 to 3/15/75/150/300/750/1,500 volts. • **AC VOLTS (Peak to Peak)**—0 to 8/40/200/400/800/2,000 volts. • **ELECTRONIC OHMMETER**—0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms. • **DECIBELS:** -10 db to + 18 db, + 10 db to + 38 db, + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v); • **ZERO CENTER METER**—For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Comes complete with operating instructions, probe leads, and streamlined carrying case. Operates on 110-120 volt 60 cycle. Only..... **$42.50 NET**

Try any of the instruments on this or the facing page for 10 days before you buy. If completely satisfied **then** send down payment and pay balance as indicated on coupon. **No Interest or Finance Charges Added!** If not completely satisfied return unit to us, no explanation necessary.

MOSS ELECTRONIC, INC.
Dept. D-850 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligation.

Name .....
Address .....
City ..... Zone..... State.....

All prices net, F.O.B., N. Y. C.

- ☐ **Model 77**.....**Total Price $42.50 $12.50 within 10 days. Balance $6.00 monthly for 5 months.**
- ☐ **Model 79**.....**Total Price $38.50 $8.50 within 10 days. Balance $6.00 monthly for 5 months.**
- ☐ **Model 70**.....**Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.**
- ☐ **Model 82A**.....**Total Price $36.50 $6.50 within 10 days. Balance $6.00 monthly for 5 months.**
- ☐ **Include Model 82A Picture Tube Adapter at $5.50**

Export Division: Rocke International Corp., 13 East 40th St., New York 16, N. Y.

. . . News

It's so easy to become a Novice class radio amateur and the satisfactions derived from "hamming" are so great that it's surprising that more people don't become hams. One reason they don't is the fear of the code test but it only takes a couple of weeks' practice. Allied Radio Corp. in Chicago is doing its part

to help more people realize this. For the past six years they have given three 14-week classes a year on code and theory. This year they are inaugurating a new Thursday evening class which, like the veteran Monday class, will be given in the Allied cafeteria in their 100 N. Western Ave. building.

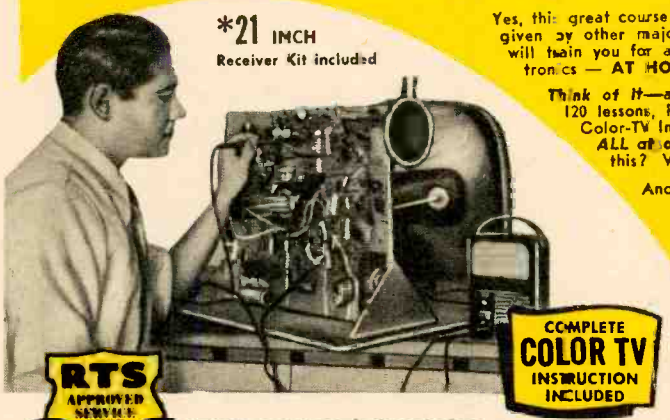
—o—

EICO has just brought out a new compact low-power standby rig for the 80 to 10 meter bands. The 723 is available as a kit for $49.50 or factory wired for $79.95 and features 60 watts to the final on CW. All other "musts" are included: TV suppression, modulator input socket, antenna relay, and panel meter. EICO, 32-00 Northern Boulevard, L. I. C., N. Y.

AT LAST!

RADIO-TV and ELECTRONICS TRAINING

.... AT A PRICE YOU CAN AFFORD!



Yes, this great course costs *far less* than *any* training of its kind given by other major schools! Radio-Television Training School will train you for a good job in Television or Industrial Electronics — **AT HOME IN YOUR SPARE TIME.**

Think of it—a complete training program including over 120 lessons, Fourteen Big Radio-Television Kits, Complete Color-TV Instruction, Unlimited Consultation Service . . . *ALL at a really big saving to you.* How can we do this? Write to us today . . . and find out!

And what's more — you can (if you wish)

OPEN YOUR OWN RTS-APPROVED AND FINANCED RADIO-TV SERVICE SHOP

We Want Many More Shops This Year

This 39 year old training organization — called RTS, that's Radio-Television Training School — wants to establish a string of Radio-TV Repair Shops in principal cities throughout the U. S. So far, a great many such shops are NOW IN BUSINESS AND PROSPERING. We are helping and training ambitious men to become future owners and operators of these shops in all areas.

FOR UNSKILLED INEXPERIENCED MEN ONLY — WE TRAIN YOU OUR WAY!

We must insist that the men we sign up be trained in Radio-TV Repair, Merchandising and Sales by our training methods—because WE KNOW the requirements of the industry. Therefore, we will TRAIN YOU . . . we will show you how to earn EXTRA CASH, during the first month or two of your training period. YOU KEEP YOUR PRESENT JOB. TRAINING TAKES PLACE IN YOUR OWN HOME, IN YOUR SPARE TIME!

RTS APPROVED SERVICE SHOP

Get your free book on the

FAMOUS RTS BUSINESS PLAN

find out how you can open

A REPAIR SHOP OF YOUR OWN

We supply and finance your equipment

When you are ready and qualified to operate one of our RTS-Approved TV Repair Shops ***WE WILL SUPPLY AND FINANCE EVERY BIT OF EQUIPMENT YOU NEED TO GET STARTED*** plus an inventory of parts and supplies. In other words *we will stake you* . . . **AN OFFER NEVER MADE BEFORE BY ANY TRAINING ORGANIZATION.** Under the RTS Business Plan you receive:

1. An electric sign for the shop front.
2. Complete laboratory of test equipment.
3. Letterheads, calling cards, repair tickets, etc.
4. Basic inventory of tubes, parts, supplies.
5. Complete advertising and promotional material.
6. Plans for shop arrangement.
7. Instructions on how to go into business.
8. Continuous consultation and help.
9. The right to use RTS Seal of Approval, and the RTS Credo.
10. The right to use the Famous Trade Mark.

you build these and other units

*tubes excluded

RADIO-TELEVISION TRAINING SCHOOL

815 EAST ROSECRANS AVENUE

LOS ANGELES 59, CALIFORNIA

Est. 1922

ACT NOW!

CUT OUT AND MAIL — *TODAY!*

RADIO-TELEVISION TRAINING SCHOOL
815 EAST ROSECRANS AVE Dept. EI-21
LOS ANGELES 59 CALIFORNIA

SEND ME FREE — all of these big opportunity books — "Good Jobs in TV-Electronics," "A Repair Shop of Your Own" and "Sample Lesson." I am interested in:

☐ Radio-Television ☐ Industrial Electronics (Automation)

Name _____ Age _____

Address _____

City & State _____

301

Mail This Coupon Now—No Salesman Will Call

ASSOCIATION OF HOME STUDY SCHOOLS

RTS' Membership in The Association of Home Study Schools is your assurance of Reliability, Integrity, and Quality of Training.

ALL THESE FREE!

. . . News

New Literature. . . .

A commendably honest (if you will forgive the title's presumptuousness) and well-written 32-page book called "All About Stereo" is now available from Bell Sound, 555 Marion Road, Columbus 7, Ohio, for 25¢. Written by John Conly, it has some interesting things to say about how to plan and choose a stereo system, components of course, for your home. . . . A useful little catalog for the transistor experimenter is the new Semiconductor Catalog of the Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N. Y. It contains basic specs on a new line of VHF transistors suitable for converter, mixer and oscillator applications. . . . "How to Decorate With Music" is the name of an 8-page brochure available free from the Rek-O-Kut Co., 38-19 108th St., Corona 68, N. Y. Five room layouts are included to suit all decorating tastes (well, almost all anyway) and even if you don't agree with their suggestion to hang the loudspeakers above a planter in a neat little alcove (oh, the sound is important?) the other four recommendations do make sense. . . . Like to window shop through test equipment catalogs? Well, you can get another one free from Precision Apparatus Co., 70-31 84th St., Glendale 27, L. I., N. Y. They request that you write for it on company stationery, ask for catalog 28. . . . Shopping for a microphone? Thirty models plus accessories, tape recorder heads, and hi-fi components are described in a new 28-page catalog issued by Shure Bros., 222 Hartrey Ave., Evanston, Ill. This is catalog 60A, and while you're at it, you might request their 8-page brochure listing all specs on Shure's Stereo Dynetic series phone cartridges and tone arms. . . . Mullard tubes have long been popular with advanced hi-fi designers and constructors in this country. A newly revised technical bulletin giving complete specifications for all Mullard tubes including the popular frame grid types should therefore be of wide interest. It is available free from International Electronics Corp., 81 Spring St., NYC.

BEST BUYS IN STEREO AND MONO HI-FI

New Stereo/Mono 4-Track Tape Deck RP100
Semikit (electronics in kit form) $289.95 Wired $395.00

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

New 70-Watt Integrated Stereo Amplifier ST70
Kit $94.95 Wired $144.95

New 40-Watt Integrated Stereo Amplifier ST40
Kit $79.95 Wired $124.95

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

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

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

Stereo Preamplifier HF85
Kit $39.95 Wired $64.95

Stereo Power Amplifiers

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

Stereo/Mono Changer/Player 1007 with stereo cartridge and dual sapphire styli $49.75

Bookshelf Speaker System HFS1 Kit $39.95 Wired $47.95

BEST BUYS IN CITIZENS TRANSCEIVERS, HAM GEAR, RADIOS

Citizens Band Transceivers from
Kit $59.95
Wired $89.95

New 60W CW Transmitter =723
Kit $49.95 Wired $79.95

Transistor Portable Radio RA6
Kit $29.95 Wired $49.95
Incl. FET

BEST BUYS IN TEST EQUIPMENT

New Metered Variable AC Bench Supplies Model 1073 (3 amps)
Kit $35.95 Wired $47.95
Model 1078 (7½ amps)
Kit $42.95 Wired $54.95

Peak-To-Peak VTVM =232 & Uni-Probe® Pat. =2,790,051
Kit $29.95
Wired $49.95

VTVM =221
Kit $25.95 Wired $39.95

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

5" Push-Pull Scope =425
Kit $44.95 Wired $79.95

Tube Tester =625
Kit $34.95 Wired $49.95

RF Signal Generator =324
Kit $26.95
Wired $39.95

1000 Ohms/Volt V-O-M =536
Kit $12.90
Wired $14.90

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

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

R-C Bridge & R-C-L Comparator #950B
Kit $19.95 Wired $29.95

Multi-Signal Tracer =145A
Kit $19.95
Wired $28.95

EICO

EXCELLENCE IN CREATIVE ELECTRONICS

Over 2 MILLION EICO instruments in use throughout the world. Compare, take them home — right "off the shelf" — from 1500 neighborhood dealers, most of whom offer budget terms.

EICO, 3300 N. Blvd., L.I.C. 1, N.Y. EI-2
☐ Send free Catalog describing over 80 top-quality products, free Stereo Hi-Fi Guide, free Short Course for Novice License, name of nearest EICO dealer. ☐ Send new 36-page GUIDEBOOK TO HI-FI for which I enclose 25¢ for postage & handling.

Name .....
Address .....
City ..... Zone .... State ....
Add 5% in the West

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

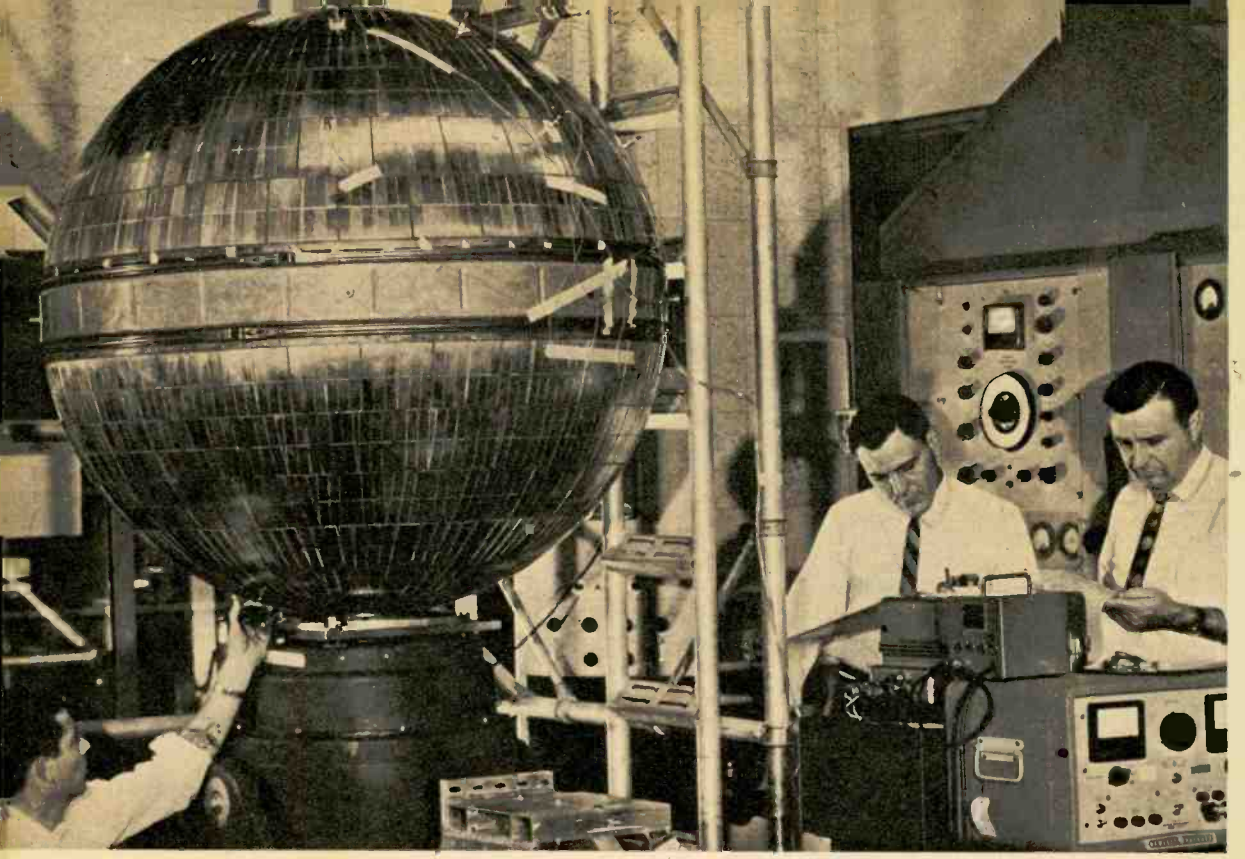
the future opens:

Courier Communications Satellite

The public has missed the significance of this achievement as a new communications link.

By Lloyd Mallan

ON October 4, 1960—precisely three years to the day after Russia launched the world's first man-made satellite—a breakthrough in space-age electronics was achieved by the United States. Appropriately, the project name was "Courier." It carries messages across the world, traveling through the sky with a speed of almost 15,000 miles an hour. It is mankind's first *active* telephonic-telegraphic-facsimile repeating station to be



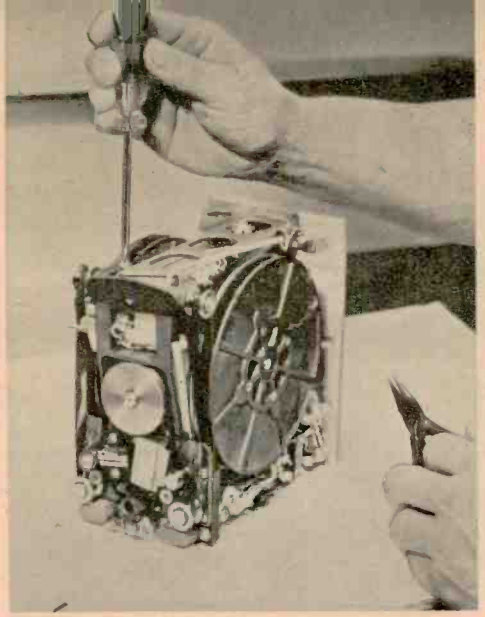
Engineers run vibration checks on Courier's sphere in pre-launch inspection. "Skin" is covered with over 19,000 solar cells to power radio equipment.

placed in orbit around the Earth. (The famous aluminized sphere, or "balloon," of Project Echo is merely a *reflector* of ground signals—a "passive" communications satellite.)

In the years since the Space Age began with the successful launching of Sputnik I, there have been a dazzling number of spectacular achievements. Because of this, the real significance of the Courier satellite has been missed by a jaded press and public. Certainly it had its moment of front-page publicity, but what it represents to the future of electronics and spaceflight was understandably glossed over, perhaps not even realized. The average member of the daily press lacks the background for a full appreciation of an event like this one.

Considering the highly reliable performance of the Douglas Thor-Able-Star rocket which launched Courier, the "hardware" is available *today* to establish a worldwide microwave communications network. Such a network would be independent of weather conditions, of distortions of the Earth's magnetic field caused by solar disturbances, of the time of day or night and of the seasons of the year. At present, global communications by radio are subject to them all, with their blackouts and fadeouts, and the shifting polarizations of the *Faraday Effect*.

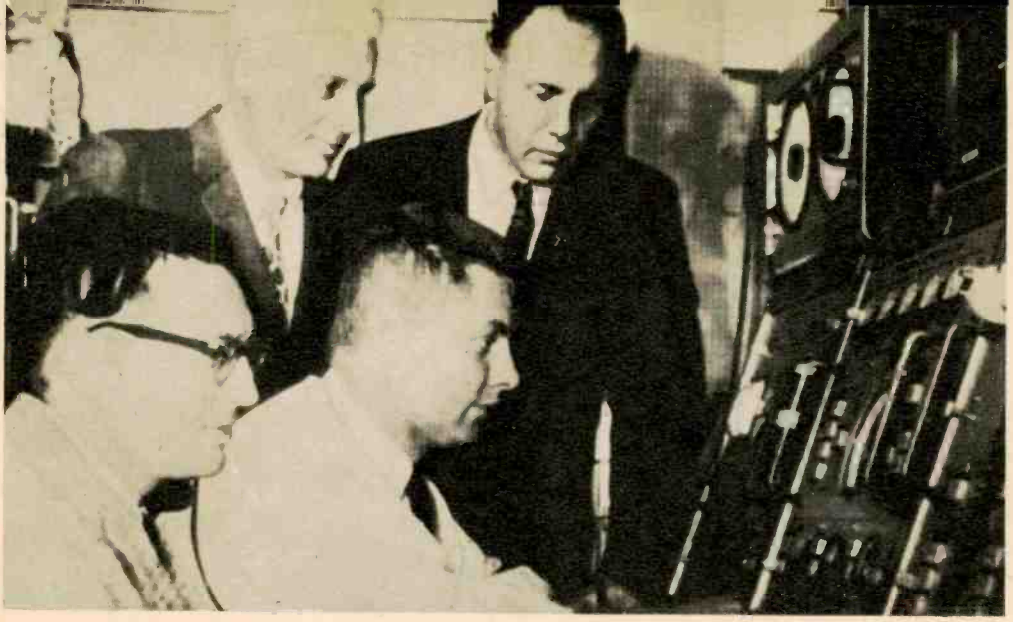
This latter effect, discovered by Michael Faraday, is caused when an electromagnetic wave passes, under certain conditions, through a magnetic field. More simply, this means that when radio waves pass through the atmosphere in the presence of the Earth's magnetic field, their *plane of polarization* is continually shifted. The degree and direction of the shift depends upon the strength and direction of the geomagnetic field. The electrically charged particles of the atmospheric gases are affected by changes in the Earth's field-strength. These changes in turn affect



One of Courier's five tape recorders, each of which can record or play back 15,000 words a minute, or equivalent in other signal types.

Courier's ground control centers are specially designed mobile vans. Small control panel is used to give satellite data or "commands."

This view down the length of a control van shows engineers making early experiments with voices and pictures over 1500-mile New Jersey-Florida path.



A photo from Courier: showing the four men directly responsible for its success, it was sent to satellite, relayed back by facsimile, all in 5 minutes.

COURIER SPECIFICATIONS
(approximate)

Weight:	500 pounds
Size	51" diameter
Spin rate	40 rpm
Orbit Altitude	600 nautical miles
Speed in Orbit	14,400 mph
Battery Power Supply	28 volt, 12 ampere-hour, nickel-cadmium
Charging Supply	19,152 solar cells 1.8 amp. charging rate
Total Power Consumption:	Standby: 10 watts Active: 225 watts
Data Storage	Five Tape Recorders 4 Digital, 1 Analog
Record-Playback Time	Five minutes total
Microwave Transmitters	Four, FM, 8 watt output
Microwave Receivers	Four, FM, 12 db noise figure
VHF Transmitters	Two, FM, 1.5 watts output. Two unmodulated, 50 mw output
VHF receivers	Two, "command," 6 db noise figure

the polarization. (Thus a vertically polarized wave, best received by a vertical antenna, would "rotate" toward horizontal polarization, and be missed by the antenna. Or, a horizontally polarized wave would tend to become "vertical." With intermediate polarizations either type of antenna would be inefficient.)

The longer wavelengths are more easily affected because they are so much bigger from crest to crest. They cannot "sneak through" the spaces between the gaseous particles and are rotated as the particles rotate in the geomagnetic field.

Normally, electromagnetic waves, such as radio and light are not affected by magnetic fields because they carry no electrical charge. The Faraday Effect is imposed upon them *indirectly*, by the medium through which they move—if that medium is *isotropic*. That is, if it has the same properties through all directions, as the upper atmosphere has.

An outstanding achievement of Project Courier conquered not only the Faraday Effect but also a similar effect caused by a satellite's spinning and tumbling. These likewise cause a change in polarization of its radio signals, since its antennas are tumbling, too. The two effects together might well have made Courier unreliable for communications. But the Nutley Laboratories of IT&T engineered into Courier's ground-command stations [*Continued on page* 104]

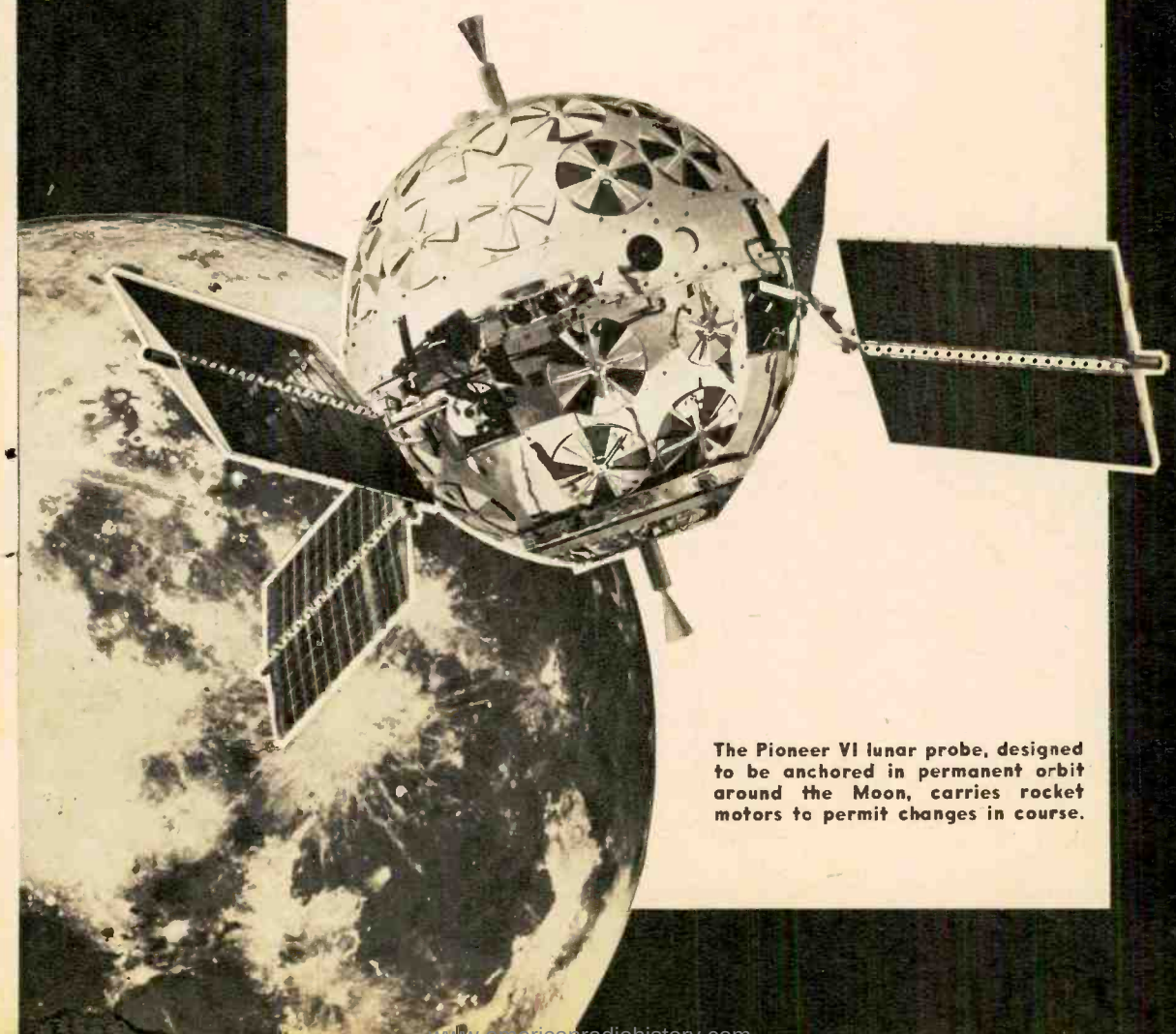
and now...

To The Moon

By N. A. Rosa, Feafure Editor

AMERICAN rocket science has now progressed to where we can put 'a satellite in orbit around a satellite," which is what the Pioneer VI Lunar Probe really is. The Moon is the Earth's natural satellite, and Pioneer VI is designed to circle it, practically forever, and tell us things we have never known before. All we had for thousands of years was naked-eye vision of one side of the Moon. In the last few hundred years we have had telescopes, and their magnified view told us a little more about our nearest neighbor in the universe. In the last couple of years we have had a few blurry pictures of the "far" side of the Moon as Russia's Lunik I made its single pass.

Now, a complete telemetering space laboratory will serve as a



The Pioneer VI lunar probe, designed to be anchored in permanent orbit around the Moon, carries rocket motors to permit changes in course.

lunar scout. It will send back vital information that will advance science generally, and help us design later steps: another telemetering probe that will land on the Moon and travel over its face, exploring directly; and eventually, the first man-carrying expedition vehicle.

Pioneer VI is the responsibility of Space Technology Laboratories, Inc., of Los Angeles, California. STL, coordinator for all the project's subcontractors, designed the probe itself, worked out the rocket combination needed to propel it, and set up and operated the *SpaN* network of tracking and control stations on Earth. (SpaN was first used for Pioneer I, Explorer VI, and Pioneer V.)

Pioneer VI has four separate instrument systems for measuring radiation energy levels, not only near the Moon and in "cislunar" space (the space "this side of the Moon," or between Earth and Moon), but also near the Earth. (This is partly because extra-heavy radiation near Earth, such as in the famous Van Allen belts, will swamp many instruments while the satellite passes through. Since it is not definitely known whether the Moon has such a belt, equipment capable of detecting and measuring one is included, and will also measure Earth's radiation while in its field.)

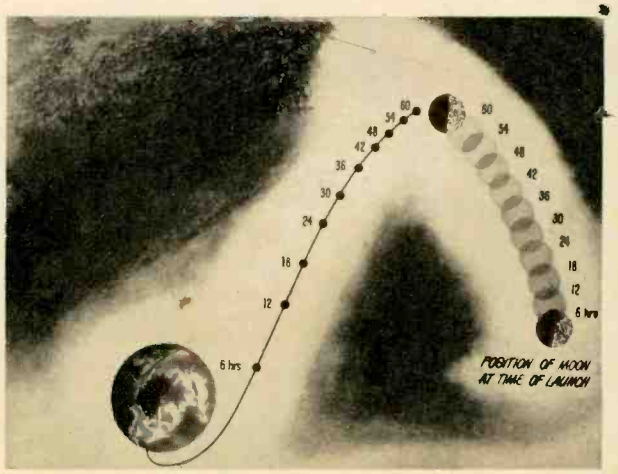
The probe also carries two sets of instruments for measuring the magnitude and direction of magnetic fields in space and near the Moon. For the first time, any magnetic field the Moon may have will be measured and charted. What we can learn about the Moon's magnetic field will throw light on the problem of the Earth's magnetism. (Contrary to the impression we all have had from school science classes, why the Earth is a magnet is still unexplained. It is definitely *not* the result of "deposits of magnetic ores" in the Arctic and Antarctic. In fact, such deposits as exist may be the result of the magnetic field!)

A micrometeorite momentum spectrometer aboard Pioneer VI is to measure both the number of space-debris impacts and their momentum (mass times velocity). It will tally the total micrometeorite traffic (called *flux*) through a given area of space in a given time and separate micrometeorites into two classes, depending on their momentum.

To get Pioneer VI's data on cosmic radiation, magnetic fields, solar radiation density, ionization, micrometeorite flux and momentum, and other phenomena back to Earth, Pioneer VI uses a recording-telemetering system known as "Telebit," also of STL design. Telebit was first tested in the Explorer VI earth satellite, and was used in the deep-space probe Pioneer V. You will recall that

During planning stages, "paper rockets" are "fired" in various possible paths around the Moon via computer, to find best design.

The probe is aimed ahead of the Moon, as hunters "lead" ducks, so that paths will cross. Retro-rockets control approach, insure orbit.

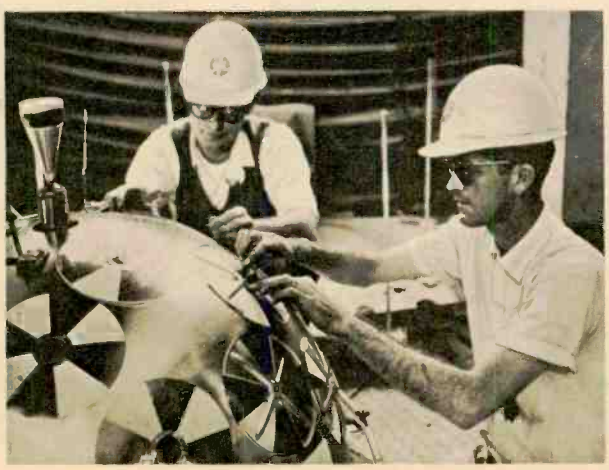


Pioneer V's telemetering signals were still being copied when the probe was 23,000,000 miles out.

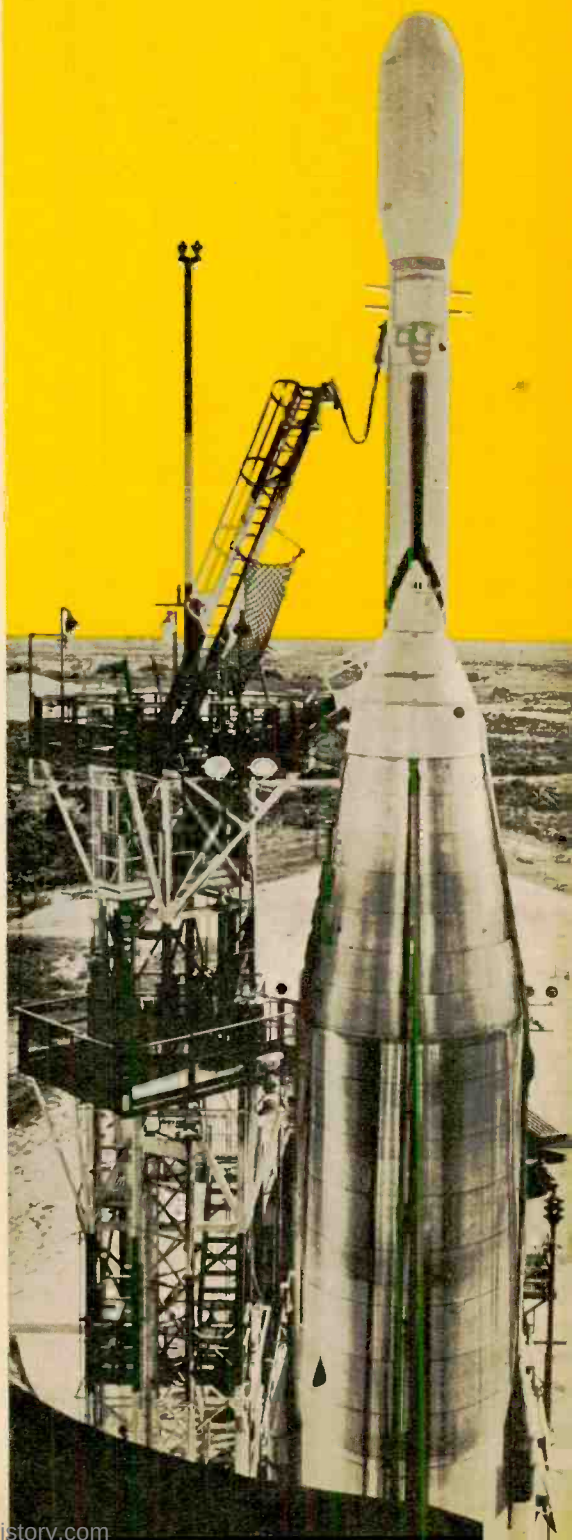
Telebit collects, stores, and *tallies* data sensed by the probe's instruments all at the same time. To save electrical power, data are transmitted back to Earth only on command. Telebit takes the "reports" of each instrument, continuously "shapes" them into digital or "numerical" form, and waits for the query signal from Earth. Then it transmits a complete, tallied report: so many micrometeorite impacts in each momentum class since last report (or other "agreed on" time), cislunar or circumlunar magnetic fields of (certain) shape and intensity, solar radiation of the (proton, electron) type of (a certain) intensity, etc.

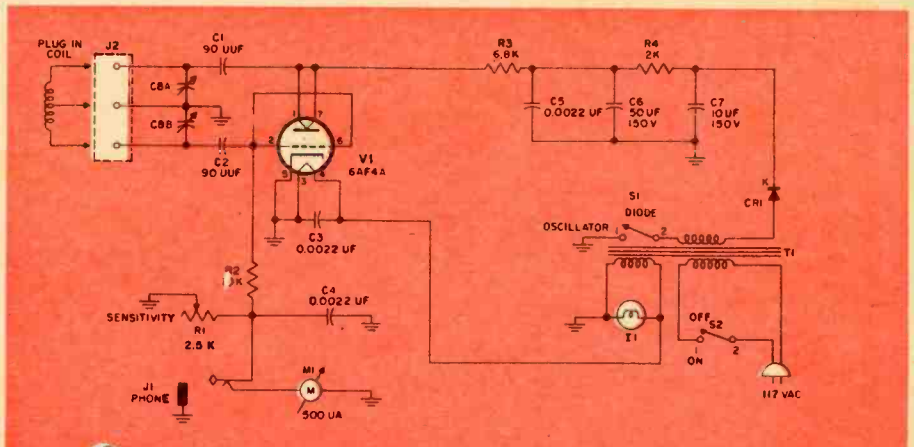
Telebit's two transmitters are each of two watts output. You will not be able to hear them on any equipment you may have—unless you are an engineer or operator at one of the SpaN stations or one of the great radioastronomy centers. One is used for telemetering, the other for tracking. SpaN has four stations: at South Point, Hawaii; Manchester, England; Singapore, Malaya and Cape Canaveral, Florida. All information from SpaN is funneled to STL headquarters in Los Angeles, and most instructions and queries [*Continued on page* 105]

Technicians install temperature control "propellers." These cover and expose light or dark areas, which reflect and absorb heat from Sun.



Almost yearning upward, the Pioneer VI waits at top of its Atlas-Able 3-stage rocket assembly. Once in lunar orbit it will stay there theoretically forever.





Variable high frequency Colpitts oscillator utilizes a 6AF4 tube to provide stable performance to 250 mc.

EI reports on a

Grid Dip Meter Kit

IF you are a radio-television serviceman, ham, or electronics experimenter, a grid dip meter kit is one of the best bargains you can buy. One of the latest to appear is the EICO Model 710.

To insure stability, the 710 uses a 6AF4 ultra-high frequency triode in a Colpitts oscillator circuit. Our unit was as stable as a rock all the way out to 250 mc.

Eight precision wound (±0.5%) plug-in coils provide a wide overlapping frequency range of 400 kc to 250 mc. Matching the plug-in coils are eight frequency scales which are all on an easy-

to-read 3¾" long scale and are wrapped on a cylindrical drum rotating through 340 degrees. A planetary drive makes for smooth and precise tuning.

The oscillator grid return includes a meter and a phone jack. Use of 500 microampere movement makes possible the 710's high sensitivity and sharp dip tuning. If a headphone is plugged into the phone jack, the unit becomes an oscillating detector which may be used for extremely accurate beat frequency measurement. An audio signal applied via the phone jack enables the 710 to be used as a modulated RF generator. A switch will turn off the oscillator plate supply thus enabling the unit to become a tuned RF diode detector with a meter in the diode load circuit.

The construction of the 710 required only two hours of building time. Here are a few hints which may smooth out a few rough spots.

After unpacking the kit and checking the components, you may notice that the meter cutout in the panel is semi-circular instead of round, making it impossible to mount the meter as shown. The new design protects the meter from accidental breakage. However, some of the manuals went out before the change was noted.

To mount the variable capacitor, C8, the spacing bracket must be bent slightly to line up the mounting holes. It would be simpler to mount the solder lugs on C8 before it is installed.

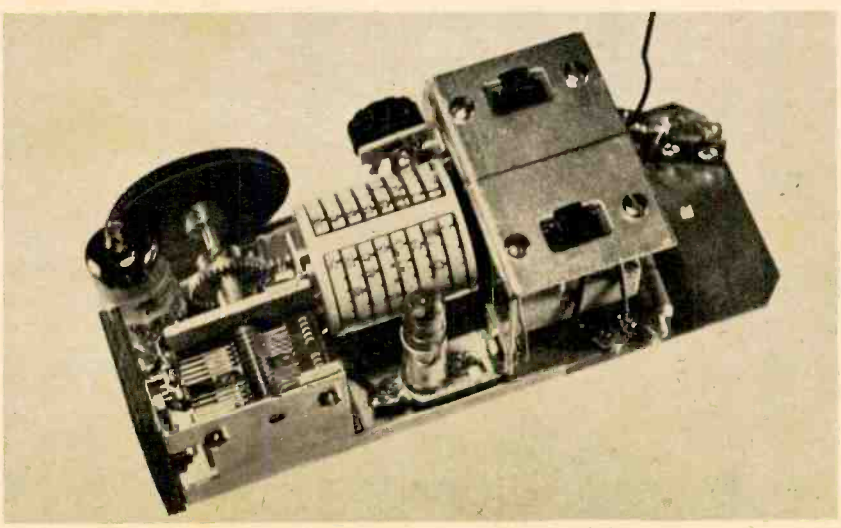
It cannot be stressed too strongly that the layout, lead length and dress must be followed exactly if accurate calibration is desired. Since the grid dip meter is a high-frequency device, these physical factors are critical. A difference of only ½" in lead length or component placement can substantially alter the calibration. As the tech specs show, at $29.95 the EICO 710 grid dipper is definitely rated a *Good Buy*.

TECH SPECS

EICO states that if their construction manual is followed to the letter, the frequency calibration will be accurate to at least 5%. After completing our unit, we checked the accuracy on each of the eight ranges. Our test showed the accuracy of the 710 to be considerably *better* than that quoted by EICO.

The following are our results:

Band	Max. Error	Band	Max. Error
A (400-700 kc)	1.1%	E (7.5-18 mc)	0.8%
B (700-1380 kc)	0.5%	F (18-42 mc)	1.0%
C (1380-2900 kc)	0.3%	G (42-100 mc)	0.3%
D (2.9-7.5 mc)	0.6%	H (100-250 mc)	2.5%



Compact grid dip meter kit is shown complete except for meter and cabinet. Check wiring before installing drum, and gear assembly, center.

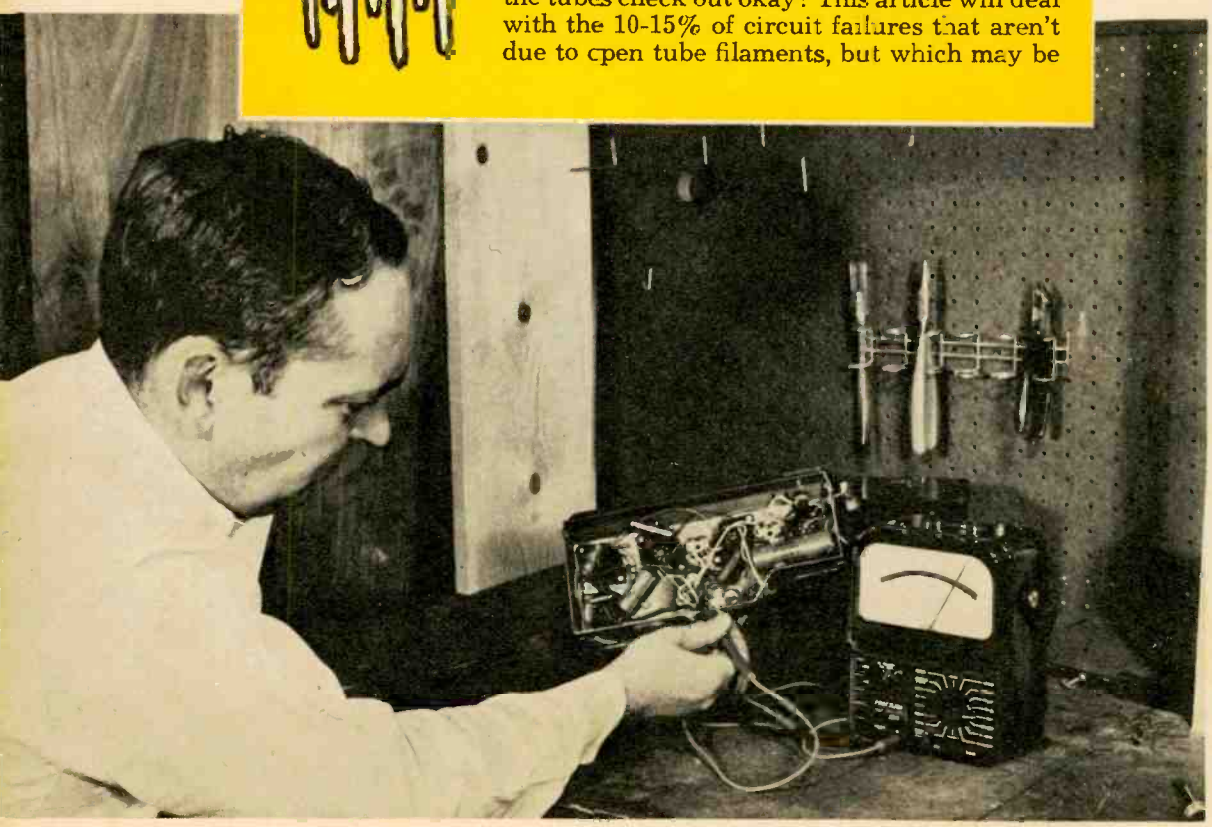
How to Repair Radios

Part I — Circuit Theory

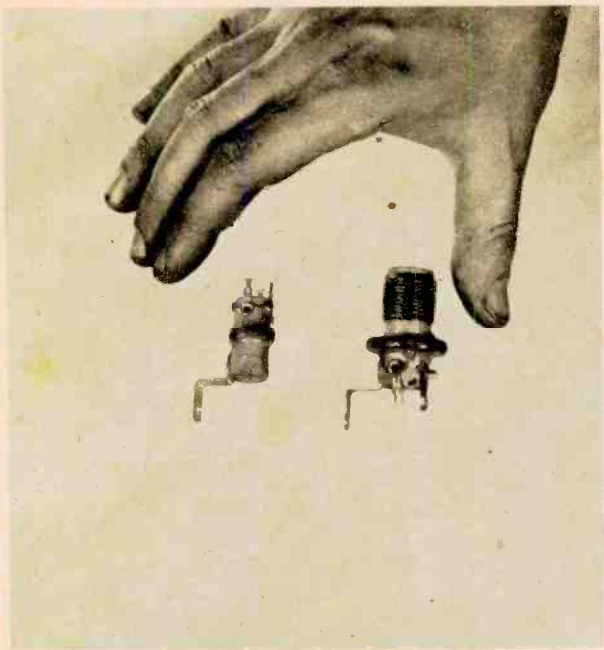
By George Gordon

IF you're reading this article, the chances are you're the owner of at least one AC-DC superheterodyne receiver, the "Model T" of the radio industry, and probably the most popular, practical electronic workhorse ever invented. At the last count, approximately 150 million radios were in use in this country. And about 80% of these are the common garden-variety 5-tube table model, an inconspicuous little sound box that has become as much a part of our daily life as the automobile or the telephone.

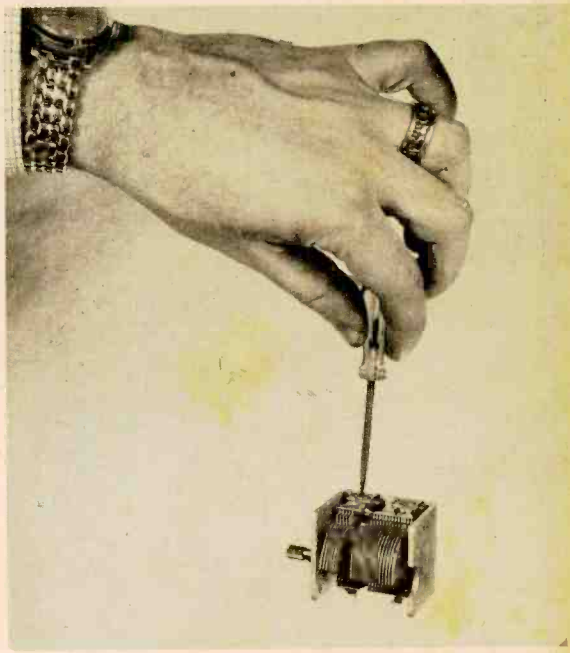
The shape and color of the cabinet may vary widely, but the important part—the "guts" of the set—remains as basic and as simple as ever. When one of these sets goes bad, nine out of ten times a defective tube (usually an open filament) is at fault. But what happens when the tubes check out okay? This article will deal with the 10-15% of circuit failures that aren't due to open tube filaments, but which may be



Superhet oscillator coil is smaller than antenna coil. Most new sets use a loop antenna.



Tracking of two sections of tuning capacitor is set by adjusting trimmer capacitor screws.



due to leaky, open or shorted capacitors, burned out resistors, open IF transformer windings, and dozens of other ordinary breakdowns that will cut a radio dead or make it very unpleasant to listen to.

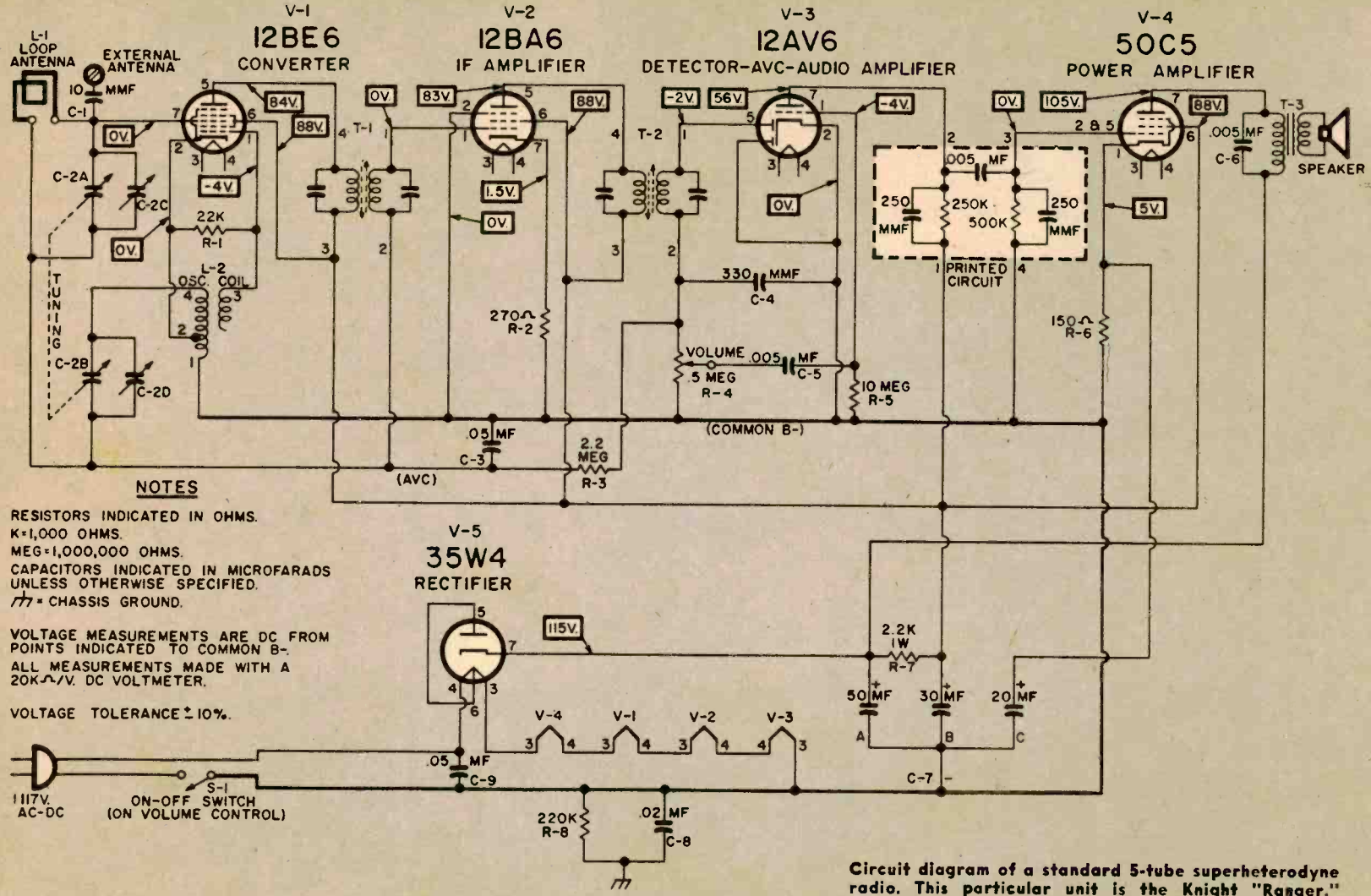
A vast majority of repairs do not require elaborate test instruments. Using a maximum of logic and a minimum of tools, a high percentage of circuit failures can be tracked down. Only two things are necessary—a sound knowledge of the superheterodyne circuit and an inexpensive voltohmmeter. That is why the first part of this article will give you a brief, but concise, description of the superhet circuit. This will enable you to apply the trouble-shooting techniques that follow with intelligence and confidence.

First, let's track the signal—from the microphone in the broadcasting studio to your ear. See diagrams on page 39.

Now, we know that a dozen or more stations can be transmitting at any given time. How does the superhet select the station you wish to hear and reject all the others? This is accomplished quite simply by a tuning circuit consisting of a coil and a variable capacitor connected in parallel. (L-1 and C-2A). Depending upon the position of tuning capacitor C-2A, the tuning circuit will be most "receptive" to a particular frequency. If you want to receive a station transmitting at 1250 kc for example, the capacitor is turned until the circuit resonates (or reaches its highest receptivity) at that frequency. The 1250 kc signal will be fed to the first tube of the superhet, while the other frequencies will be excluded.

The next step in the process occurs at the *mixer* stage. The name is well chosen, for the signal that has passed through the tuning circuit is now mixed with another signal generated by an oscillator inside the superhet. The *mixer* is also called a *converter*.

It is easier to design a circuit for one frequency than a circuit that must handle many different frequencies. Because the broadcast band has a range of 550 kc to 1600 kc (or a bandwidth of over one megacycle) a circuit to tune and amplify all these frequencies would be



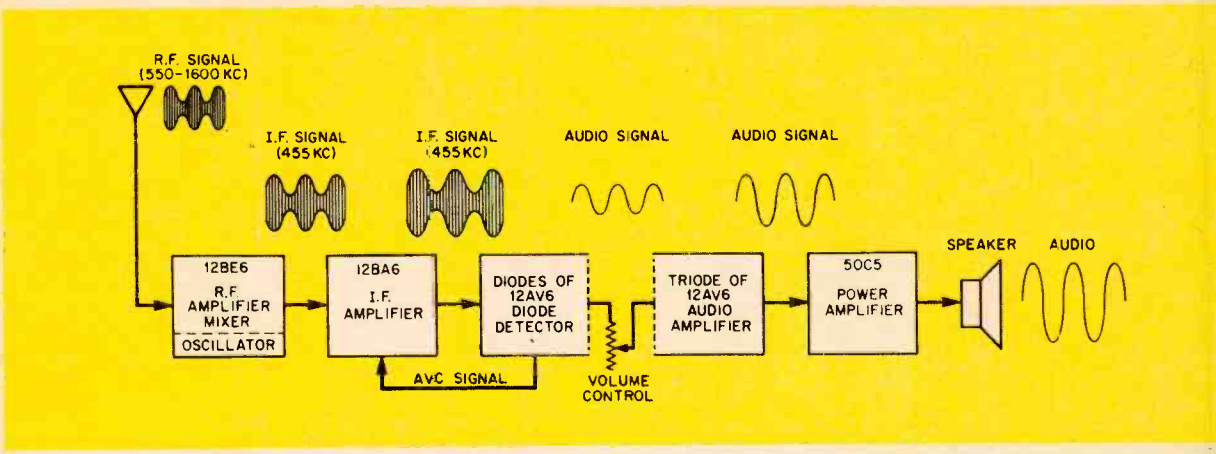
NOTES

RESISTORS INDICATED IN OHMS.
K=1,000 OHMS.
MEG=1,000,000 OHMS.
CAPACITORS INDICATED IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
⏚ = CHASSIS GROUND.

VOLTAGE MEASUREMENTS ARE DC FROM POINTS INDICATED TO COMMON B-.
ALL MEASUREMENTS MADE WITH A 20K Ω/V. DC VOLTMETER.

VOLTAGE TOLERANCE ± 10%.

Circuit diagram of a standard 5-tube superheterodyne radio. This particular unit is the Knight "Ranger."



Block diagram of standard superheterodyne circuit showing progress of the broadcast signal through the various stages. Each stage has specific functions and all are powered by a rectifier circuit supplying about 150-volts DC.

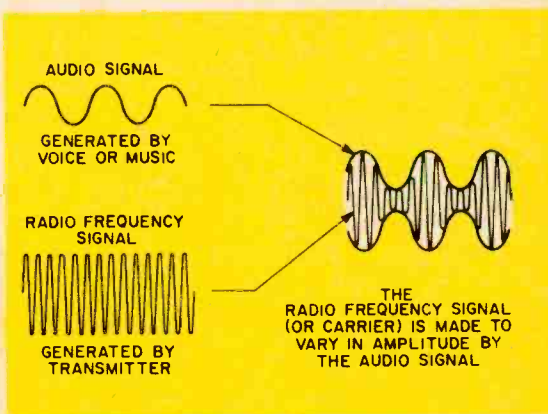
fairly critical, complicated and expensive. But if the incoming RF signal could be changed to a signal standard frequency far greater efficiency could be realized. And this is what the superheterodyne's built-in oscillator accomplishes. By beating the local oscillator signal against an incoming broadcast signal an *intermediate frequency* (IF) is developed.

The local oscillator signal has been standardized at 455 kc *above* the incoming signal. In other words, if a carrier signal of 1000 kc is received, the oscillator frequency is 1455 kc.

To maintain the 455 kc difference, regardless of the carrier frequency, the tuning capacitor is physically joined, or *ganged,* on a common shaft and make up C-2A and C-2B. Regardless of the position of the tuning section, the oscillator is always tuned a precise 455 kc away from the frequency of the incoming broadcast signal.

The next step is to amplify the newly developed IF signal and get rid of the carrier and oscillator frequencies that are still in the mixer stage. This is accomplished by feeding the IF signal into a transformer whose primary and secondary are both sharply tuned to 455 kc. The IF signal is fed from T-1 and amplified by V-2 whose sole function is IF amplification. T-2 is another double-tuned job, this time serving as the output IF transformer. Now is the time to separate or detect the audio signal—which is what we are really interested in—from the IF carrier. The IF signal shuttling back and forth across the secondary winding of T-2 (terminals 1 and 2) ends up at the diode section (pin 5) of the detector-audio amplifier stage. Since diodes conduct in only one direction, the positive half of the carrier is grounded because of the polarity of the diode comprising pins 5 and 2. The negative polarized signal is then taken off terminal 2 of T-2. C-4 grounds out any RF that

In order for audio frequencies to be broadcast they must be combined with an RF "carrier" frequency in such a way that the audio modulates the carrier (becomes part of the signal).



might have gotten through at this point. This detection process is also known as *demodulation*. A potentiometer (R-4) which serves as a *volume control*, determines the amount of audio signal that is applied to the grid of the audio amplifier section. Assuming that somewhat less than 1 volt of signal is fed to V-3's grid (pin 1), V-3 must boost this signal to anywhere from 1-8 volts, depending upon the volume desired. This much is needed in order to drive the final tube V-4.

A *power* amplifier tube (V-4) passes the boosted signal through the primary of step-down output transformer T-3. At the secondary of T-3 we obtain a much lower voltage, but a *high current;* and this current, varying with the intensity and frequency of the audio signal, drives the voice coil of the loudspeaker.

One last aspect of the superhet circuitry should be mentioned—automatic volume control, or AVC. Signal strength from different broadcasting stations may vary greatly, depending upon transmitter power and distance from the receiver. These variations could create uncomfortable listening conditions; blasting when you're tuning from one station to another or fading once you're tuned in.

This problem is eliminated by utilizing an otherwise wasted by-product of the detection process. In addition to the audio signal, a DC voltage is developed at the diode which is proportional to the strength *not* of the audio modulation, but of the *carrier*. In other words this DC voltage is there whether or not anyone is speaking into the microphone at the studio. The few AM radios that have tuning eyes utilize this voltage to indicate correct tuning because the carrier comes in most strongly when the radio is accurately tuned.

In most sets, the AVC voltage is tapped off the top of the volume control and led through a filter to remove the audio signal. In the Knight-Kit radio, R-3 and C-3 perform this function.

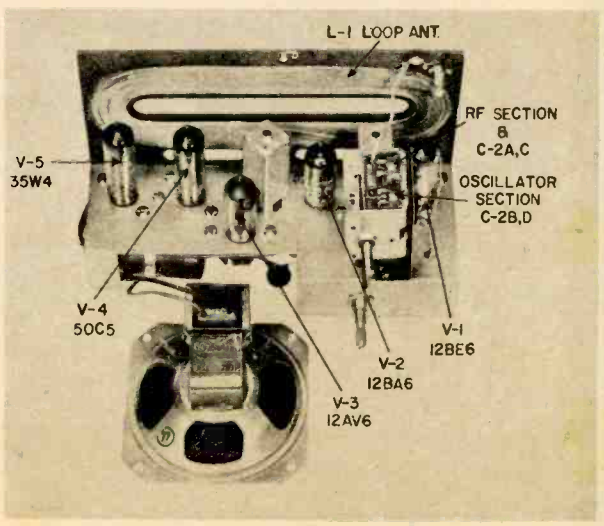
Note that the AVC line splits up, that the AVC voltage is applied to the signal input grids of both V-1 and V-2. This tends to bias the tubes to lower gain. When the signal strength AVC voltage drops, the bias on the tube is less and the tubes gain goes up. As far as total circuit gain is concerned—we are back where we started from. You can see how the Automatic Volume Control circuit earned its name.

The power supply is a simple half-wave rectifier operating directly from the AC line. Either a vacuum tube or a selenium rectifier may be used (in which case we would have a 4-tube and a selenium rectifier). Smoothing of the pulsating DC supplied by the rectifier is accomplished by a pi-type filter consisting of two electrolytics C-7A and 7B and a resistor R-7. This DC supply provides the necessary voltage for the plates and screen grids of the tubes. (It's interesting to note here that this voltage is still called B-plus; before the modern power rectifier was developed, home radios used "B" batteries to supply the higher voltages.) Filament power is obtained by connecting all the filaments in series across the AC line. If you add up all the tube numbers preceding the letter designations, you will get about 115, which is equal to the line voltage.

Next month we are going to get to the heart of the matter and discuss the specifics of radio repair problems; their cause and cure.

(Continued Next Month)

Superhet tube layout showing logical layout. The broadcast signal travels from right to left.



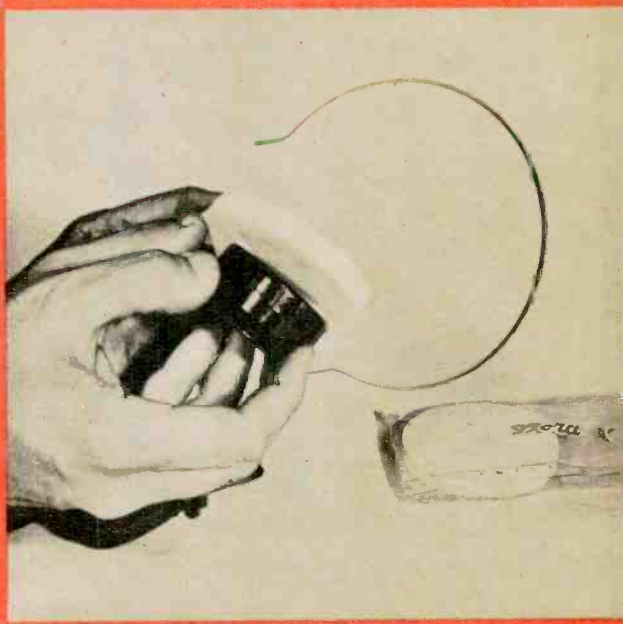
Try These

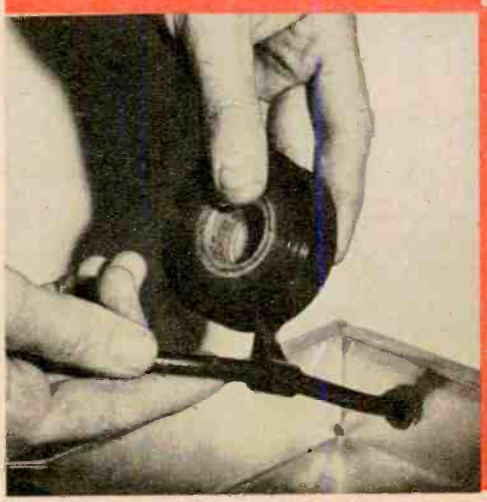
Cement Catches Drill Chips

Rubber cement daubed on the chassis where a hole is to be drilled will catch and safely hold the metal chips which might otherwise drop into wiring and cause short circuits. The rubber cement dries as you drill and is easily peeled off, chips and all, after job is done

Earphone Cushions

You can increase the comfort index of unpadded "cans" 200% by installing foam rubber cushions like those sold as powder puffs. Available at two for a quarter at any drug store, all you need to do is cut out the center of the pad (to clear the perforations in the phone cap) and glue it in place. The tighter coupling to your ears achieved by the cushions will cut down on room background noise and achieve an apparent increase in sensitivity of the phones.





Tape Limits Power Cord

It is common practice to knot a power cord just on the inside of a chassis to prevent the cord from pulling loose. This is a pretty tough task when the cord happens to be one of the larger rubber-covered type similar to the one pictured. A wrapping of several layers of electrician's plastic tape around the cord makes a better stop for large cords as shown.

The two men are setting up a Beryl-ometer, which uses a radioactive source to find non-radioactive beryllium. "Pot" in foreground holds "hot" sample, which is placed in lead shield under detector unit (left). Counter (right) is on six-foot cord so prospectors can back away from the probe unit's radiation danger.

"Hot" New Prospecting Tool

Valuable "wonder metal" is located by using "radioactivity in reverse."

By Lowell Adams

A CENTURY ago it was gold. A decade ago it was uranium. Today the magic word in prospecting is beryllium, the space age's newest wonder metal that costs up to $90 a pound.

Gold required a 15¢ pan, uranium a $100 geiger counter. Beryllium follows the trend by requiring for its discovery an instrument costing about $2,500. It is called a Berylometer.

The Berylometer, brain-child of a team of University of Manitoba physicists, ferrets out beryllium ore deposits by irradiating

them with "hard" gamma rays emitted from a lead-shielded capsule of Sb^{124}, the radioactive isotope of the element antimony. The element beryllium is not radioactive. Nor is antimony until exposed to radiation. The latter's atomic weight then rises from 121 to 124 and it begins to disintegrate, emitting various forms of energy exactly like such radioactive substances as uranium, radium and thorium.

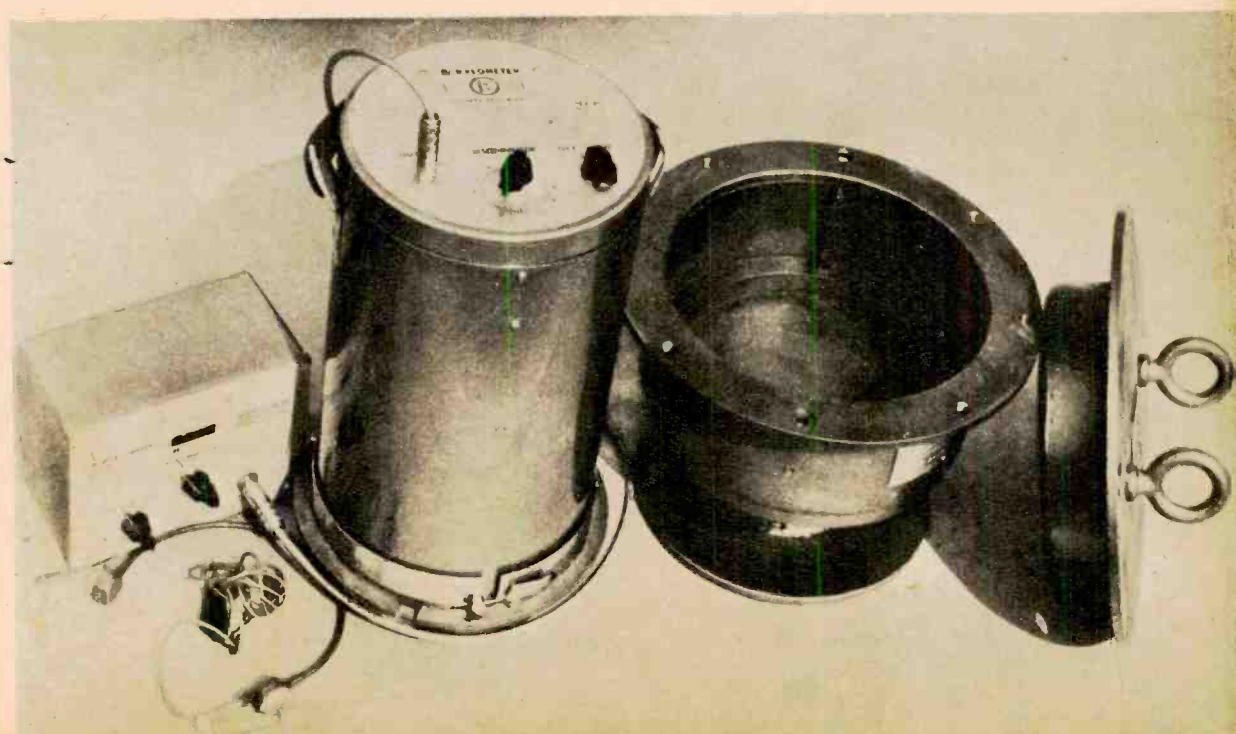
Thus bathed in the Berylometer's gamma rays, beryllium atoms release neutrons which impinge on the instrument's 5-inch diameter boron-impregnated fluorescent screen attached to the face of a photomultiplier tube. Each colliding neutron (but not reflected gamma rays) produces a flash of light on the multiplier and, amplified, becomes a square wave recorded visually on a digital meter or audibly in earphones.

An ore sample's beryllium content (the richest ores contain less than 10%) is proportional to the neutron count per minute, which is compared to master samples supplied with the instrument. Some 30 minerals in a dozen states may contain *beryl*, the usually greenish crystalline form of beryllium aluminum silicate (emerald and aquamarine are varieties). The Berylometer enables prospectors to find non-beryl ores, not as common or easily recognized as beryl-containing rocks like pegmatite.

The Berylometer weighs 39 pounds (the 1-inch-thick lead shielding on the "hot" capsule weighs 25 pounds) and is carried by two men on a litter not unlike a sedan chair. The litter keeps the instrument's operators a safe distance from the capsule. The Berylometer's components:

- *Gamma emitting detector.* Includes radioactive source, photomultiplier tube (DuMont #6364), phosphor screen and an amplifier-discriminator (4 transistors). The unit's 900-volt RF-type power supply is fed by a 7½-volt battery.
- *Counter-amplifier* (set 6 feet from the radioactive source). Its printed circuitry (7 transistors) amplifies the square wave pulses from the detector to drive a visual counter (numbered wheels) or [*Continued on page* 109]

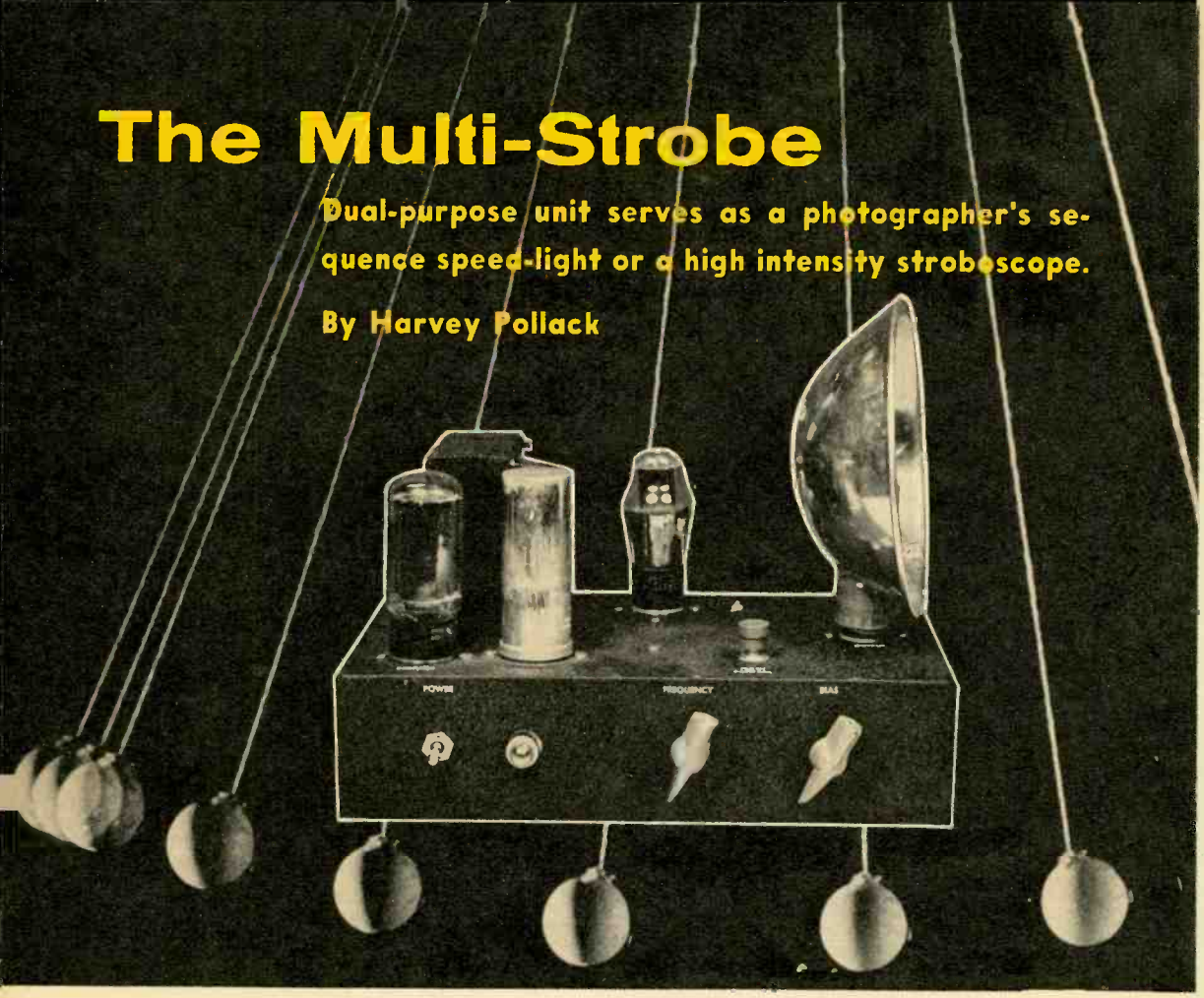
A close-up of the Berylometer's three components: the counter, left, which feeds earphones or indicator; the probe, which contains a fluorescent material and photomultiplier tube, and the container, right, for the radioactive element which causes non-radioactive beryllium to release neutrons for the counter.



The Multi-Strobe

Dual-purpose unit serves as a photographer's sequence speed-light or a high intensity stroboscope.

By Harvey Pollack



THE flick of a single switch converts this high-intensity stroboscope into a multiflash unit capable of taking high-speed sequential action photographs. As a stroboscope, this device is a valuable tool for freezing rapidly vibrating or rotating objects for close study, and for checking revolutions per minute and vibrational frequencies.

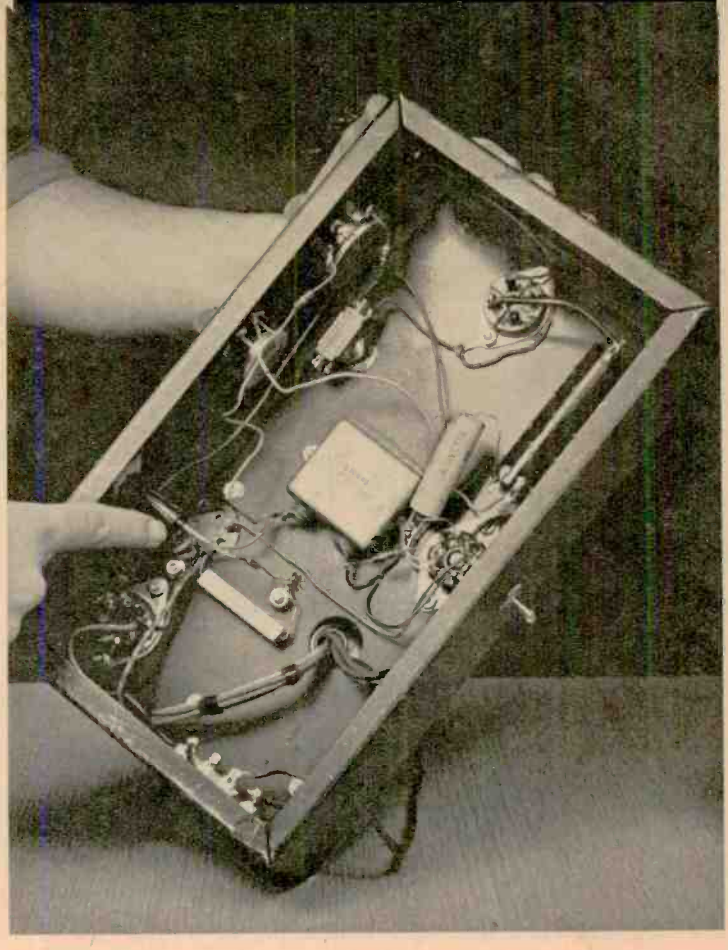
Aside from its double-duty capabilities, this stroboscope is distinguished by a very important characteristic: where other strobes utilize a neon lamp which gives, at best, low-intensity illumination, the Multistrobe circuit has been designed to trigger a standard photographic flashtube with blue-white output of sufficient intensity to be useful in a relatively bright area.

When operated as a multiflash unit, its output is approximately 10-watt-seconds. This illumination will give very satisfactory negatives with a camera aperture of f 4.5 and a moderate speed film such as ASA 100 (tungsten). With a flash duration of only 1/5000 of a second, very high-speed motion can be stopped cold.

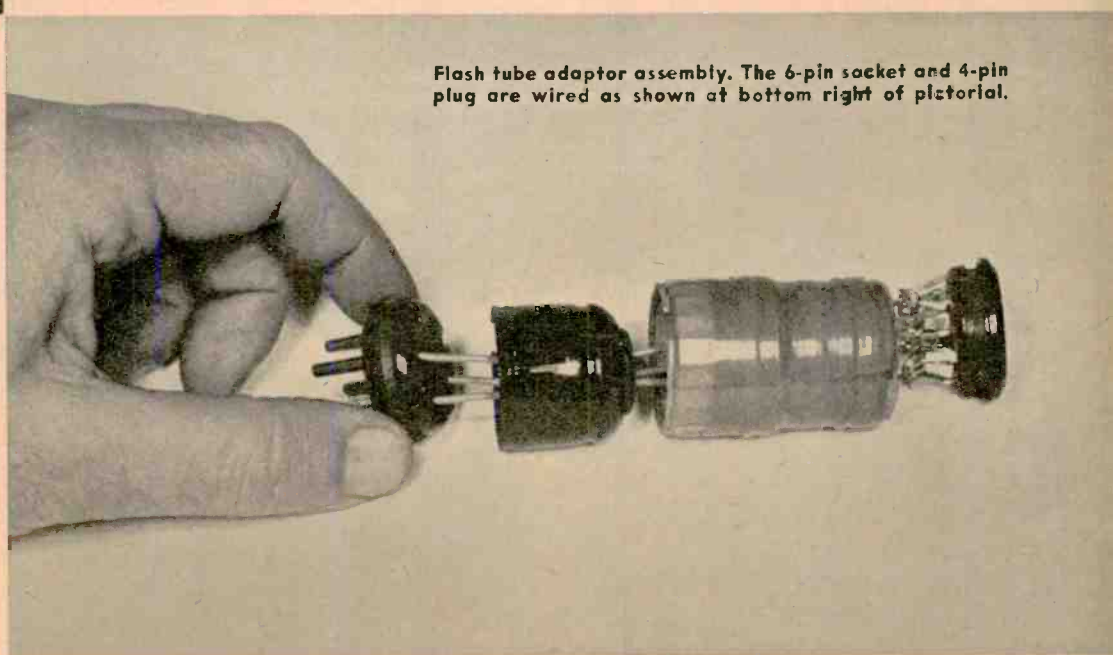
Circuit Details

The rectifier circuit charges C1 and C2 to about 500 volts. With SW2 open (Strobe position) C1 is somewhat isolated from the rest of the circuit by R1. Capacitor C2 alone can store only enough energy to flash the tube at the lower intensity required for the variable-frequency stroboscope function.

Thyratron tube V2 is in a relaxation oscillator circuit with R3, R4, and R5 making up a voltage divider to control the bias, hence the firing point of V2. With pushbutton SW3 depressed, V2's cathode circuit is completed and capaci-



Interior view of unit shows the wide separation of components. High voltage transformer at upper right is insulated from chassis and neon light is both an indicator and discharge unit.



Flash tube adaptor assembly. The 6-pin socket and 4-pin plug are wired as shown at bottom right of pictorial.

tor C3 charges through both R4 and R2. When C3's potential rises to triggering potential, V2 fires and conducts heavily. This current flows through the primary of T2, generating a high voltage (about 15 kv) at T2's H.V. terminal. The strong electrostatic field generated then triggers flashtube V3. Note that the end terminals of V3 are connected right across B+ (2) and B— (3) but this potential is not high enough to cause it to ionize until the electrostatic field produced by T2 appears at the trigger terminal (1).

For Multiflash, with SW2 closed R1 is shorted out and the voltage source for V3 may now be considered to be the 80 mf (C1) and the 1 mf (C2) capacitors in parallel. Pressing SW3 causes the same sequence of operations as before except that much more energy is now available for the flashtube. As a result, its light output is tremendously intensified, enabling the user to take sequential action photographs. Because the flashtube develops considerable heat, the number of sequential high-intensity flashes permissible is limited to about 20. SW2 should not be set to Multi for ordinary stroboscopic purposes because the glass of the flashtube would melt or crack.

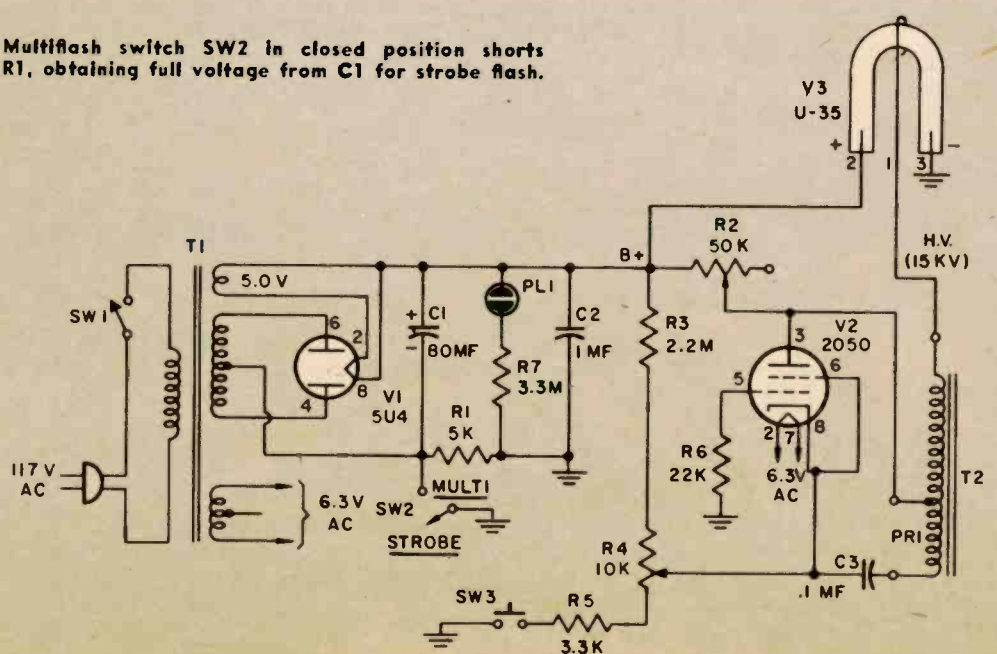
Construction

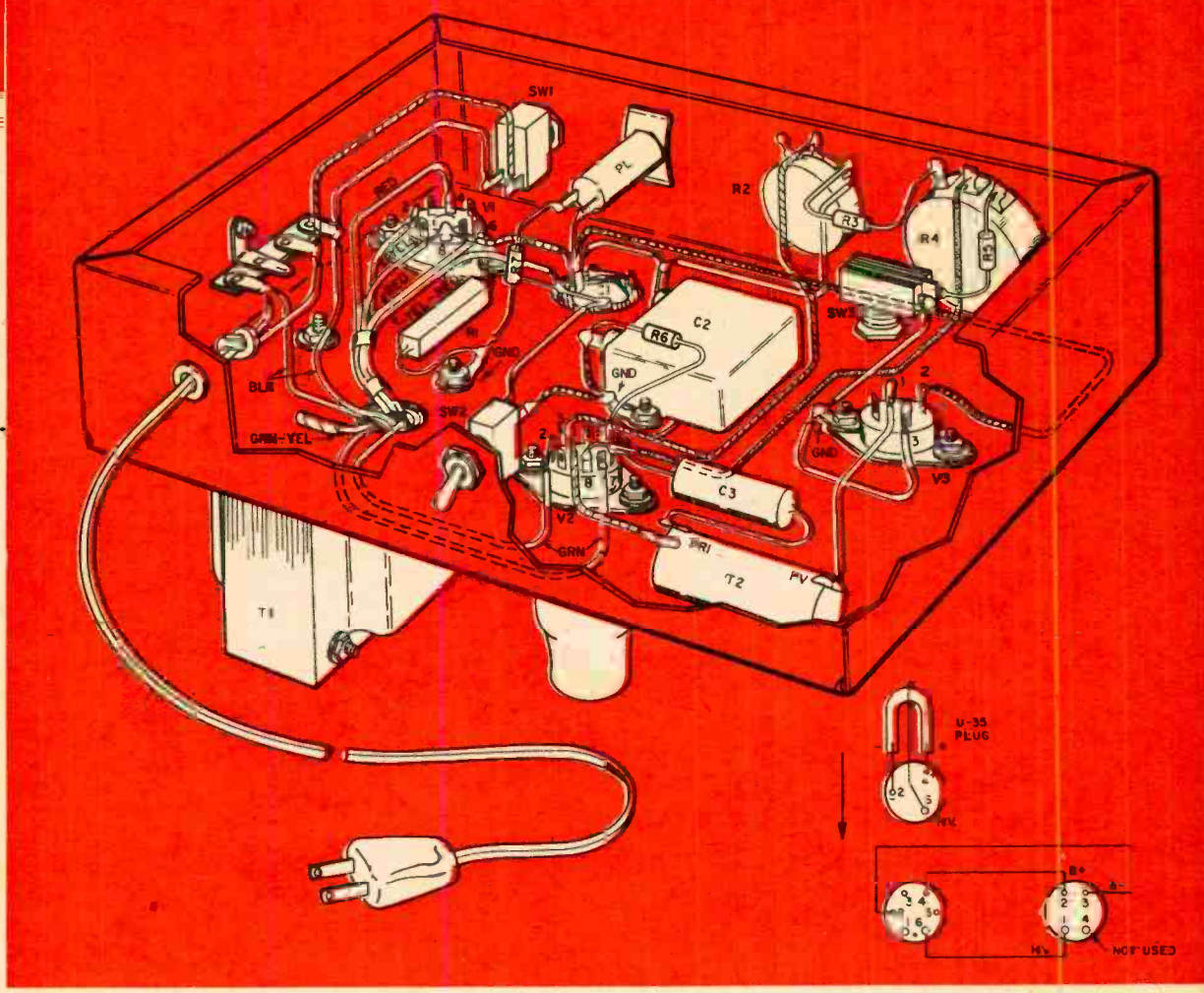
Any metal chassis of convenient size is perfectly suitable. There is nothing critical about parts placement or wiring except for T2. Connection to T2's H. V. terminal *must* be made with heavily insulated wire such as ignition cable, or with ordinary wire protected by thick-

PARTS LIST

R1—5,000 ohms, 10-watt wirewound resistor
R2—50,000 ohms, 4 watt wirewound potentiometer
R3—2.2 megohms, ½ watt
R4—10,000 ohms, 3 watt wirewound potentiometer (Clarostat type 58)
R5—3,300 ohms, ½ watt
R6—22,000 ohms, ½ watt
R7—3.3 megohms, ½ watt
C1—80 mf, 500 volt electrolytic capacitor (Cornell-Dubilier type AO-560, can negative)
C2—1 mf, 600 volt Dykanol bathtub type capacitor, (Aerovox RO-3)
C3—.1 mf, 600 volt capacitor
V1—5U4G or 5U4GA tube
V2—2050 tube
V3—Flash tube. Amglo types U-35 for stroboscope or HD-1-0 for strobe and flash or HD-2-0 for strobe and flash
T1—Power transformer, 720 volts center-tapped at 120 ma, 5 volts @ 3 amp, 6.3 volts @ 3.5 amp (Stancor type PC-8410 or equiv.)
T2—Photoflash trigger transformer, 15 kv output, (UTC type PF-3)
SW1,SW2—SPST toggle switch
SW3—pushbutton switch with insulated plunger (normally open)
PL1—117-volt neon lamp assembly
Misc.—Octal sockets, 4-pin socket (filled Bakelite, not wafer), and 4-pin male plug to match 6-pin socket for U-35, reflector (Kemlite type FA-101, Allied Radio) Brass shell, standard Edison socket type, chassis 7"x12"x3", line cord and plug

Multiflash switch SW2 in closed position shorts R1, obtaining full voltage from C1 for strobe flash.





wall insulating tubing. T2 should be placed in "isolation" so that danger of arcing to chassis or other components is minimized.

Note that capacitor C1 is *not* at ground potential for stroboscopic application (SW2 is open). This means that the can of this capacitor *must* be insulated from the chassis. Electrolytics of this type are furnished with a Bakelite mounting wafer for just this contingency which should be used.

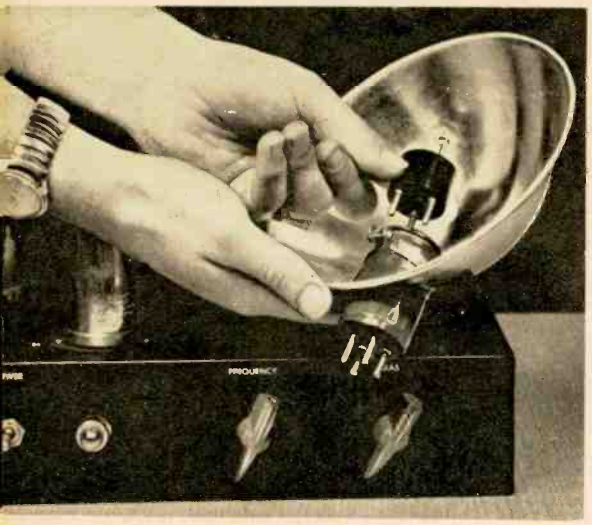
Before planning the adaptor to be used with a reflector, you should give the following points your consideration:

(1) Three different types of flashtubes can be used with equal success. The U-35 is specifically intended for stroboscopic work and comes equipped with a 3-pin base spaced to fit a standard 6-pin radio socket. If you are going to use the instrument only as a stroboscope, this is the tube you will want.

(2) The HD-1-0 tube is not mounted on a base but is supplied with three colored leads which you can wire to any type of plug. This tube runs somewhat cooler than the U-35 on multiflash and is recommended for this purpose. It will also work nicely as a strobe tube, but is slightly more expensive than the U-35.

(3) The HD-2-0 is a double-looped tube having a greater heat dissipation rating than either of the others. It works equally well in strobe or multiflash applications, but provides somewhat lower illumination on strobe than the U-35. It too has no base and may be mounted in any way you see fit.

In the author's model shown, the reflector adaptor was made up from an old brass lamp socket shell on the top of



The reflector is fitted with a screw clamp which holds adaptor. Position flashtube firmly.

which was mounted a 6-pin radio socket to take the U-35. Of course, any tube of the correct size will do. A standard 4-prong plug was friction-fitted to the opposite end of the shell. The adaptor plugs into a 4-pin radio socket mounted on the chassis.

The above arrangement makes it possible to use the strobe tube and reflector at a distance from the main chassis. Merely make up an extension cable with a 4-prong plug at one end and a 4-pin socket at the other, being sure to use ignition cable for the high-voltage triggering wire. The constructor may be as flexible as he likes with respect to adaptors, reflectors, and mounting providing the necessary precautions are taken in insulation and spacing to prevent arcing from the high-voltage connection to chassis or other points.

The Strobe-Multiflash changeover switch SW2 was intentionally located at the rear of the chassis to keep it out of the way and prevent accidental changeover. Capacitor C2, a 1 mf oil-filled capacitor may be made larger if higher strobe intensity is desired. According to the Amglo Corporation specifications, C2 may be as large as 4 mf if the maximum flashing rate is limited to 30 per second. Since the light output energy is proportional to the capacitance, it is therefore possible to obtain 4 times the brilliance with a 4 mf capacitor as compared with a 1 mf capacitor.

Operational Test

Plug in all tubes and with R2 and R4 fully counterclockwise, SW2 *open*, turn on SW1 and allow the unit to heat for at least 30 seconds. While holding SW3 down, slowly rotate R4 clockwise; about ⅛ rotation. V3 should begin to flash quite slowly. The flashing rate should rise quite linearly as R4 is rotated in the clockwise direction. R2 serves as a fine-frequency adjustment. With both R2 and R4 fully clockwise, the flash repetition rate should be about 60 per second or 3,600 per minute.

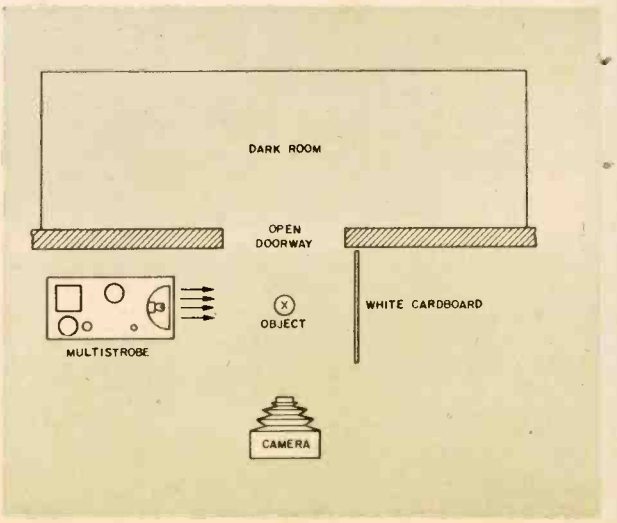
Next, with SW3 open, throw SW2 *on*, and return the controls to their full counterclockwise positions. Again depress SW3 and slowly rotate R4 clockwise until the high-intensity multiflashes begin. Leave R4 at a point slightly beyond the point where flashing starts; in this position, greatest multiflash reliability will be obtained. Repetition rate may now be fully controlled by R2 for picture-taking.

Calibration

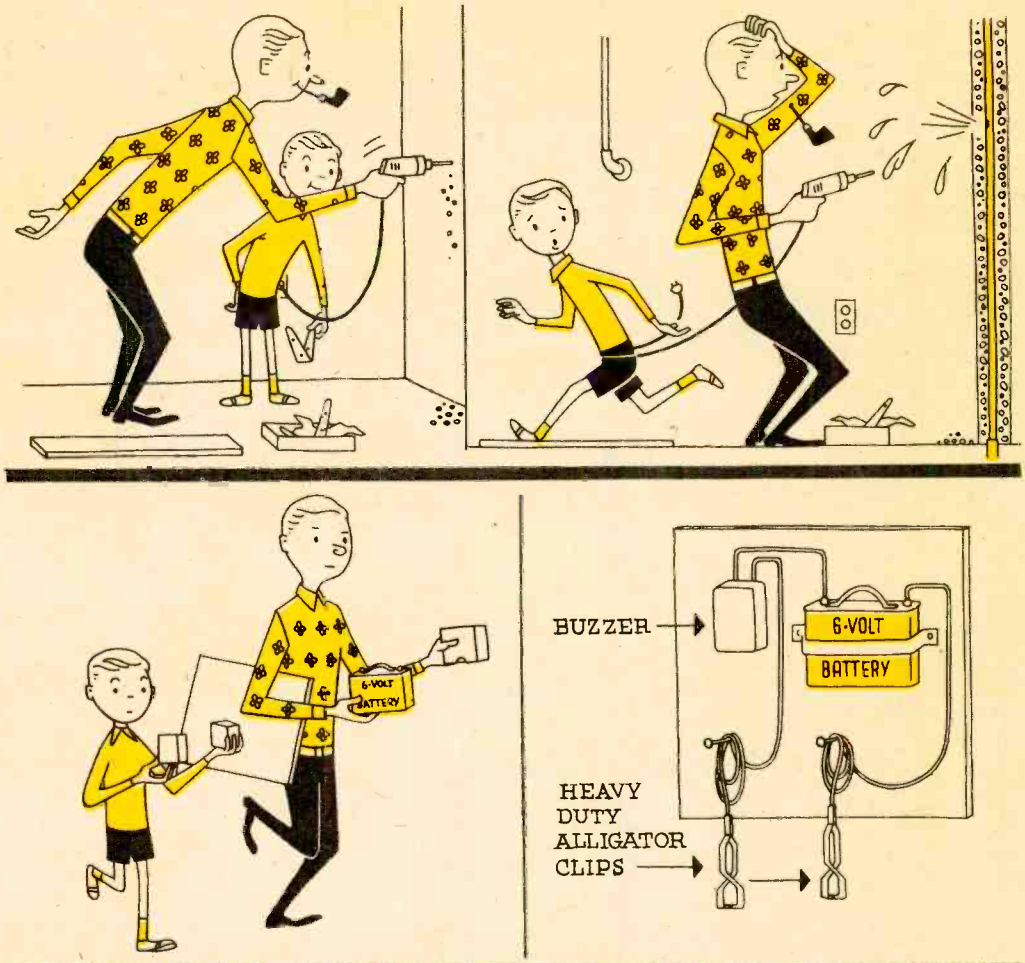
If R2 is left in its full clockwise posi-

[*Continued on page* 108]

Multiflash lighting setup. A dark background is essential to obtain good strobe photos.

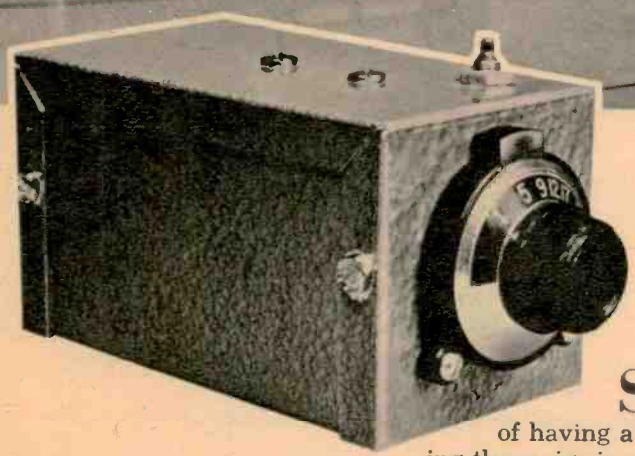


Henry and Me



CB Tuning Adapter

By Herbert Friedman



Small size of this variable tuning unit makes it ideal for permanent or mobile rigs.

SOME Citizens Band units suffer from the handicap of having a non-tunable receiver. Tuning these rigs is accomplished by plugging in the proper crystal which holds you rock-steady to the selected channel. But on the other hand, if you want to roam the frequencies and see who else is cluttering up the channels, you need a fistful of crystals or you're stuck.

Here's a little receiver tuning adapter that can release you from your rock-bound state. The adapter uses no tubes or transistors and the cost of parts is slightly more than the price of one crystal. No modifications are required in the transceiver's wiring, thereby keeping resale or trade-in value of the transceiver at maximum. The adapter plugs directly into the crystal socket, and although originally designed for the Globe CB-100, it is easily adjusted to operate with some other transceivers. Check the schematic of your unit against the oscillator circuit on page 52 to see if this adapter can be used with your rig.

Construction

For home use, the adapter can be wired with solid hook-up wire. If you intend using the unit in an automobile or boat, number 16 or 18 buss bar wire should be used to insure stability under vibration conditions.

Coaxial cable is used for the connecting cable to insure frequency stability. There is no hand capacity effect while tuning and the frequency drift of the several units built has been negligible.

Coil L1 consists of five turns of #16 wire wound on a one-inch form or dowel and then stretched to a length of about one inch. It does not matter if L1 isn't exactly one inch or unevenly spaced as capacitor C3 will compensate.

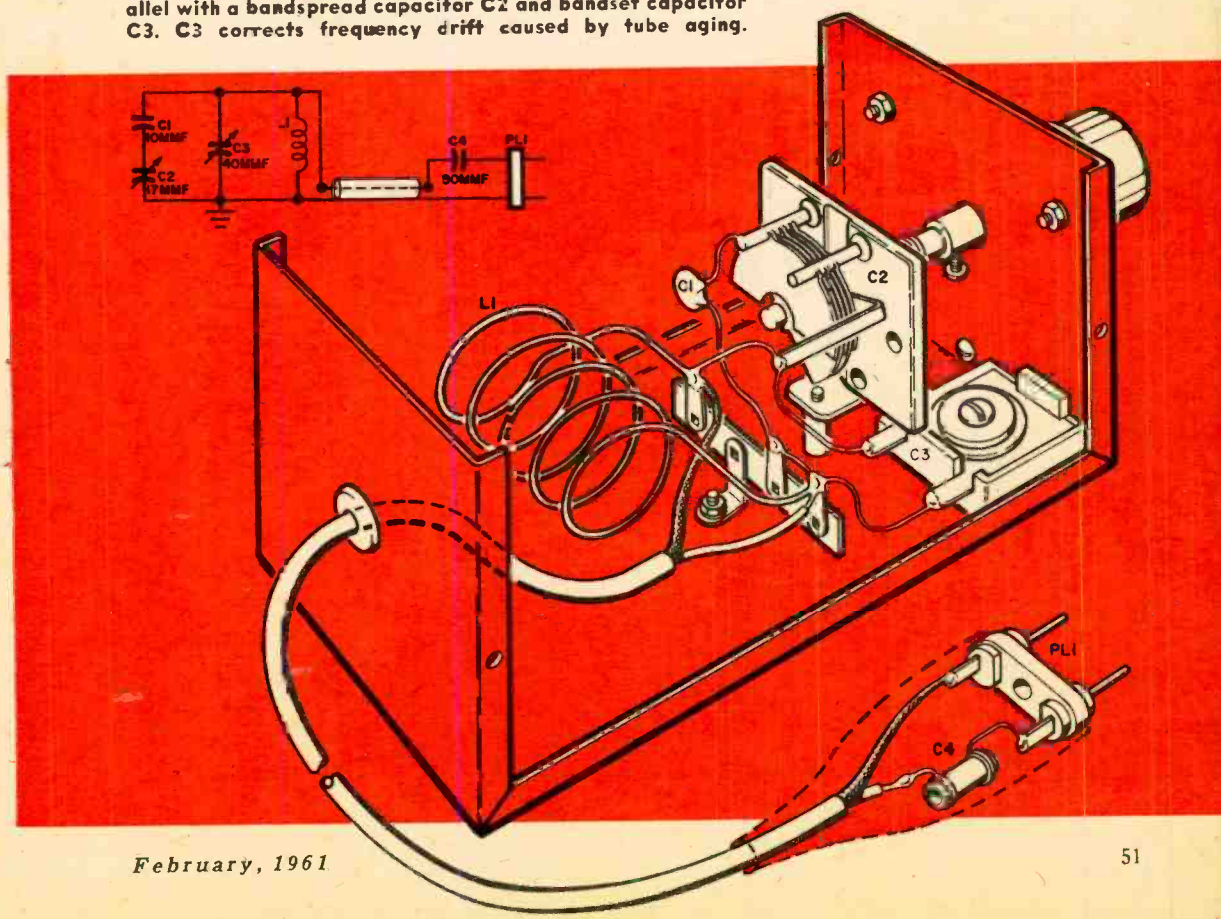
An inexpensive vernier dial is used for tuning ease. The vernier is mounted in the exact center of the front panel. Place a ¼" spacer or a ¼" stack of washers between the C3's mounting foot and the cabinet. Trimmer C3 mounts in a single hole and has sufficient spring loading to prevent a change in setting because of vibration.

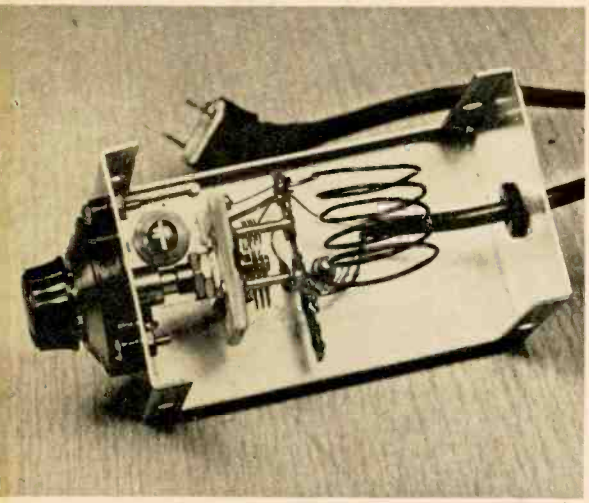
The coaxial cable should be 15 inches before stripping. This length is somewhat critical for the capacity of the cable is used as part of the tuning capacitance. However, if another inch or two is required to simplify mounting it can be added. Strip the rubber outer covering on one end of the coaxial cable for a length of 1.5 inches and pull the center conductor through the shield just

PARTS LIST

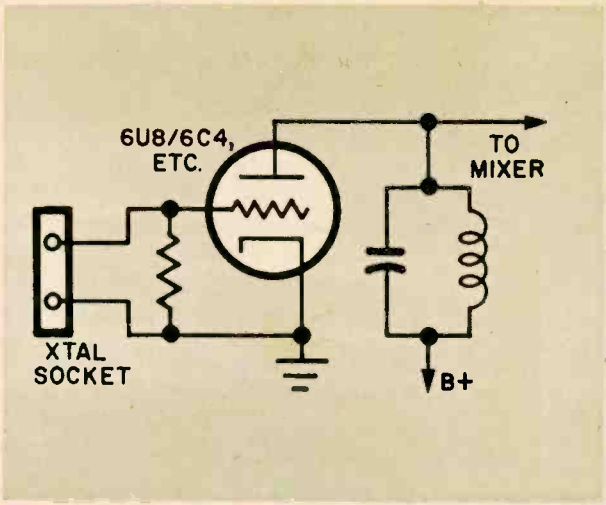
C1—10 mmf disc capacitor
C2—2.8-17.5 mmf variable capacitor (Hammarlund Type HF-15)
C3—30 or 40 mmf maximum capacity trimmer capacitor
C4—50 mmf tubular capacitor
L1—See text PL1—See text
Cabinet, 2¼"x2¼"x4"
Misc.—Vernier dial (Lafayette type F-384 or Calrad), 15" of RG-58/U coaxial cable, wire brads, wire, grommet, 3-lug tie post

Referring to the schematic, the adapter, coil L1, is in parallel with a bandspread capacitor C2 and bandset capacitor C3. C3 corrects frequency drift caused by tube aging.





Interior layout of this unit is straightforward. Tuner is unaffected by hand capacity.



Tuner will work only with this type crystal oscillator circuit. Just plug into Xtal socket.

at the outer covering. This end is wired inside the tuner as shown. For greater rigidity, thoroughly tin the exposed portion of the shield.

Plug Assembly

Plug PL1 consists of a crystal socket and two nails, which are fitted firmly (not forced) into the socket. To insure good contact and prevent rust, tin both nails. Next, sweat solder the nails into the crystal socket, making certain the nails are vertical and parallel. Trim the nails to a length of ⅜ inch using a pair of sturdy side-cutters. This completes the plug.

Connect PL1 to the free end of the coaxial cable as shown. The coax's outer covering is stripped one inch and the center conductor is again pulled through the shield, The shield is soldered to one terminal of the plug. Mark this terminal. The center conductor is soldered close to a 50 mmf tubular capacitor C4. The other end of C4 is soldered equally close to the second plug terminal. Note that C4 is more than a DC grid block. If it is placed anywhere other than specified, the coaxial cable series capacity will cause instability. Tightly bind the plug and coaxial cable with electrical tape. PL1 plugs into the crystal socket on the transceiver. The tuning ratio of C2 must be reduced for the Citizens Band. A 10 mmf disc capacitor (C1) in series with C2 will reduce the tuning ratio, with channels 1 through 22 occupying most of the dial.

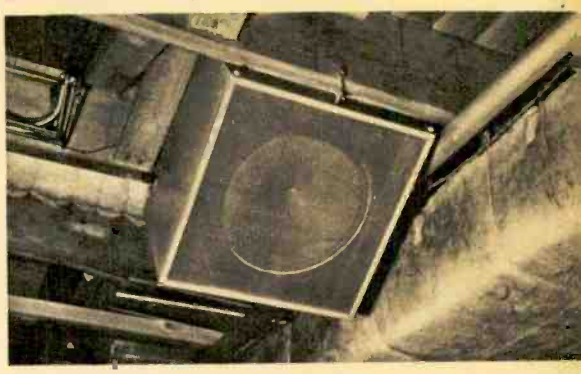
When the tuner is complete punch a 1¼" hole in the transceiver cover directly above the receive crystal socket. Plug the converter's connecting cable in the *receive* crystal socket on the transceiver, being certain the ground terminal is properly oriented. Set the vernier dial to mid-scale, set C2's plates to half mesh and then tighten the vernier drive shaft set screw.

Calibration

Now turn on the transceiver and adjust C3 *slowly* until either a CB station or maximum noise is heard. The converter is now tuned to the Citizens Band. You can attach the cover of the Minibox to the transceiver, then place the converter on the Minibox cover. Tighten all screws firmly. Next tune in a CB station of known frequency and adjust main tuning capacitor C2 to any calibration you desire.

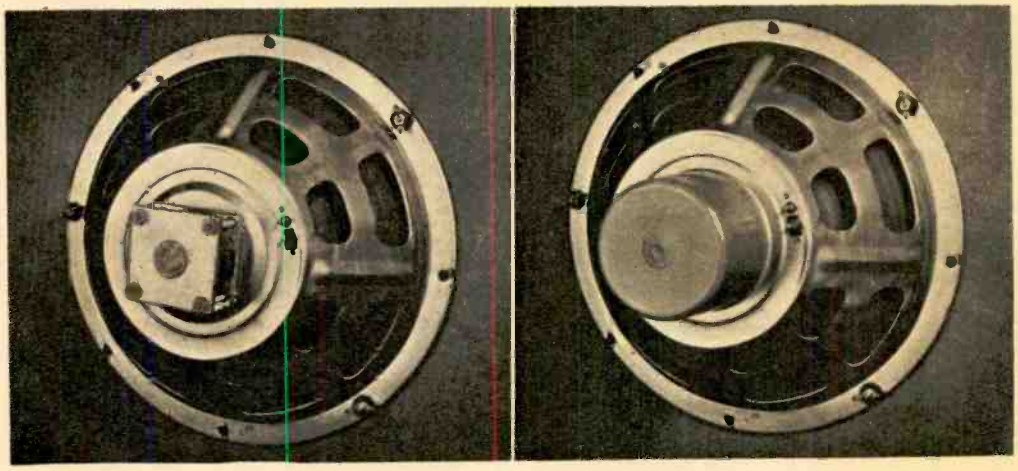
It is suggested that channel 11 be set for mid-scale. This will result in a reasonably linear dial. By adjusting the tuning capacitor toward minimum capacity the stronger 10-meter amateur stations that may be broadcasting can be heard.

Speaker Leads



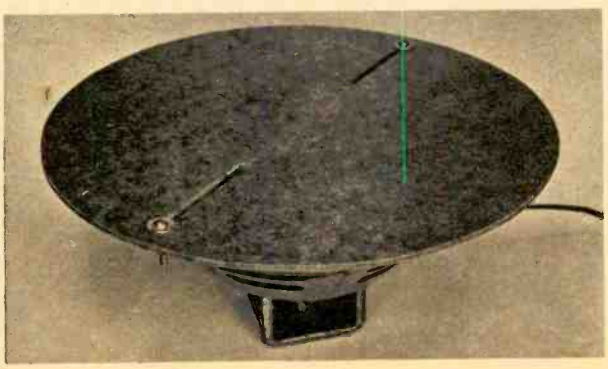
Speaker in the Ceiling

A test speaker is a very useful accessory and since it requires no handling, it should not occupy valuable workbench space. In a basement shop, the ceiling is a good place for it. Suspend it by hooks and eyes (as shown) so that it can be removed readily if desired.



Improving Speaker Appearance

Many PM speakers and field-coil type speakers can be improved in appearance by covering the magnets or coils with plastic or aluminum cups. Sales or trade value will increase also. Plastic or aluminum cups and bowls are available in a variety of sizes, so fitting one should not be a problem. Avoid tin and steel cups for this purpose.



Speaker Protection Shield

A simple cover can protect your speaker cone while it is in transit. As shown in the photos, the cover is simply a 13" diameter disc cut from 1/8" composition board. Two radial slots, each containing a bolt and nut, permits the shield to fit speakers from 12 to 16 inches in diameter. If you use a section of pegboard, it can be left on while the speaker is playing.

EI's Hi-Fi Doctor. . . .

Audio Fact and Fiction—II: "Efficiency"

TO continue our exploration of the "mythology of hi-fi," let's move in this month for a close look at the question of speaker efficiency. As a term that pops up everywhere from casual audio salesroom conversations to high-powered advertising copy, "efficiency" is a concept well worth understanding. For a long time, though, it has been one of the most misunderstood and misused terms in the entire lingo of hi-fi.

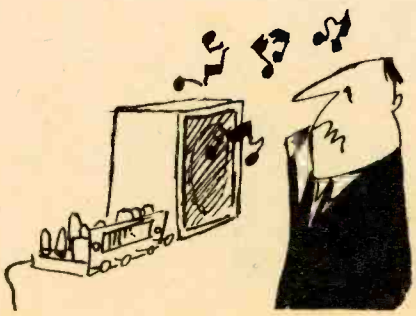
Not too long ago, before the arrival of speakers like the AR-1 and KLH, the average audiophile used "efficiency" as a word of praise. If a speaker was efficient, it was good. At the moment, the situation is reversed, with "low-efficiency" often cited as a virtue by those who read and write speaker advertisements. Unless you're already used to this kind of about-face in automobile advertising, where today's heresy is tomorrow's truth, it's pretty hard to go along with the notion that efficiency can be a good thing one day and bad the next.

By itself, efficiency is simply a word to describe how well a speaker does in turning its input signal into audible sound. If a speaker converts two watts of electrical signal input into one watt of acoustical power, it is 50% efficient—and only two or three expensive horn-loaded speaker systems *are* anywhere near that efficient. But a speaker's efficiency, whether low or high, has nothing to do with its overall quality. It's simply a by-product of a speaker's particular design. Rather than as an index of quality, the real importance of efficiency is in indicating how much amplifier power will be needed for a particular speaker.

Like many other audio specifications, efficiency is usually measured at 1,000 cps—a fact which makes for some interesting by-play with facts and figures. The Klipschorn, for instance, rated as 50% efficient at the 1,000 cps measuring point, takes a sudden sharp drop in output just below 35 cps. At 30 cps, the AR-1, rated at less than 1% efficiency, produces twice as much sound as the Klipsch for a given input power. Which speaker, then, is actually more *efficient*? Unless you listen only to the lowest organ pedal tones, the Klipsch is still the winner, needing only ten watts of amplifier power for most listening situations as against thirty *clean* watts for the AR-1 woofers.

It's easy to see why early audiophiles might have mistaken *efficiency* for *quality*. But why the current use of "low-efficiency" as an index of good performance? Simply because of the popularity of inefficient systems like the AR and KLH, and the desire of other manufacturers to indicate that their units have the same virtues *because* of low-efficiency. Some inefficient systems *are* as good as the AR and KLH, but certainly not *because* they demand high-powered amplifiers.

How important *is* efficiency, then? Well, one point to remember is that efficiency is a *problem* only when you can't afford to buy or build an amplifier of thirty or more watts. As with any audio component, your choice of a speaker should depend on how it *sounds* to you. If your choice turns out to be an inefficient speaker, you'll need a high-powered amplifier, not for loudness alone—which almost any amplifier can produce—but for reserve power to handle loud musical passages without distortion. *More on Power next month.*



and Clinic

Hi-fi questions are all answered by mail. If of general interest they will appear in this column.

Switching Cartridges

I switched from a crystal to a magnetic cartridge in my changer and suddenly my changer began to make sort of a humming noise through my hi-fi system once every revolution of the turntable. Is this due to hum pickup by the magnetic cartridge?

Robert Shearer, Waterville, Maine

On a friend's advice I traded in my old magnetic cartridge for one of the new miniature types with improved frequency response, but it has a type of "buzz" or vibration that comes through the speaker on certain notes. The same cartridge sounds okay on my friend's system. Can you explain this?

George Wolfe, Latrobe, Pa.

There's a lesson to be learned from the two questions above. When dealing with any equipment as sensitive as good hi-fi often is, don't assume any components can be added or replaced without proper adjustment, compensation, or matching. In the first case of the "hum pickup," I doubt that it is *hum* that's bothering Robert. More likely the problem is due to turntable rumble since the noise is described as cyclical (once per revolution). The better low frequency response of the new magnetic cartridge reproduced it when the older crystal cartridge could not. The solution to the problem is either to install a rumble filter or to repair the changer.

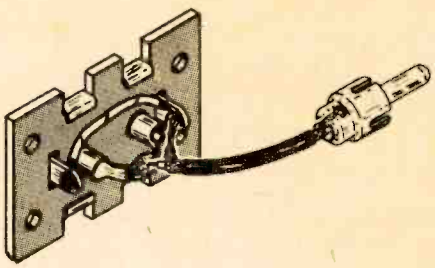
The "buzz" that is bothering George is due to weight differences. I suspect that the old cartridge was physically heavier than the new one, and when the new one was installed no compensation was made for weight difference. The buzz that's heard on certain notes is the result of the stylus bouncing from side wall to side wall of the record groove, rather than riding securely on the groove walls as it would with proper stylus force adjustment. Increase stylus pressure a gram at a time until the buzz disappears.

Tape Output Jack

I recently purchased a tape recorder to round out my hi-fi setup. I want to record FM programs but I find that neither my amplifier nor my tuner have an output for connecting a tape recorder. How would I go about connecting a "tape output" jack?

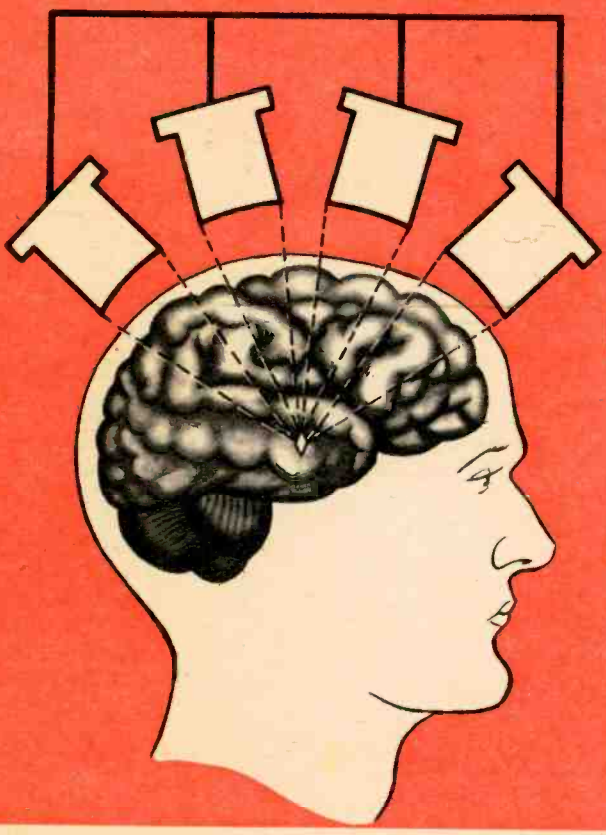
Gerald Armand, San Francisco, Calif.

The best spot to connect a tape output jack would be in parallel with the present output jack on your tuner. You would have the benefit of the usual low impedance output found at this point, and in addition the recording level to your tape machine and the monitoring level of your amplifier could be set independently.



The little adapter shown above can be constructed simply and requires no drilling of the tuner chassis for installation. Prepare a 2" length of shielded wire by installing a standard male phono plug on one end. Now bend the two "hot" terminals of the dual jack (Cinch 81B or G-C 9225) and solder them together with the center conductor of the shielded cable. The shielding of the cable should be brought to the ground lug on one socket of the jacks and a small jumper wire soldered between the ground lugs.

In order to tape off the air and monitor simultaneously, just insert the amplifier and recorder plugs into the adapter which plugs into tuner.



brain surgery by Ultrasonics

Safe and painless, without harming healthy brain tissue, ultrasonic beams can fight tumors deep in the brain.

By James G. Busse

ANESTHETIZED and at peace with the world, a patient is quietly wheeled into the new operating room at the University of Iowa Hospital in Iowa City and propped up on the operating table, half sitting and half reclining under the large surgical spotlights.

It is no ordinary operating room. One wall is almost entirely covered with electronic equipment. Three oscilloscopes hang from the ceiling. Strange-looking control panels surround the operating table.

The patient, an attractive seventeen-year-old girl from Chicago, has been suffering from chronic headaches and, at times, temporary loss of vision.

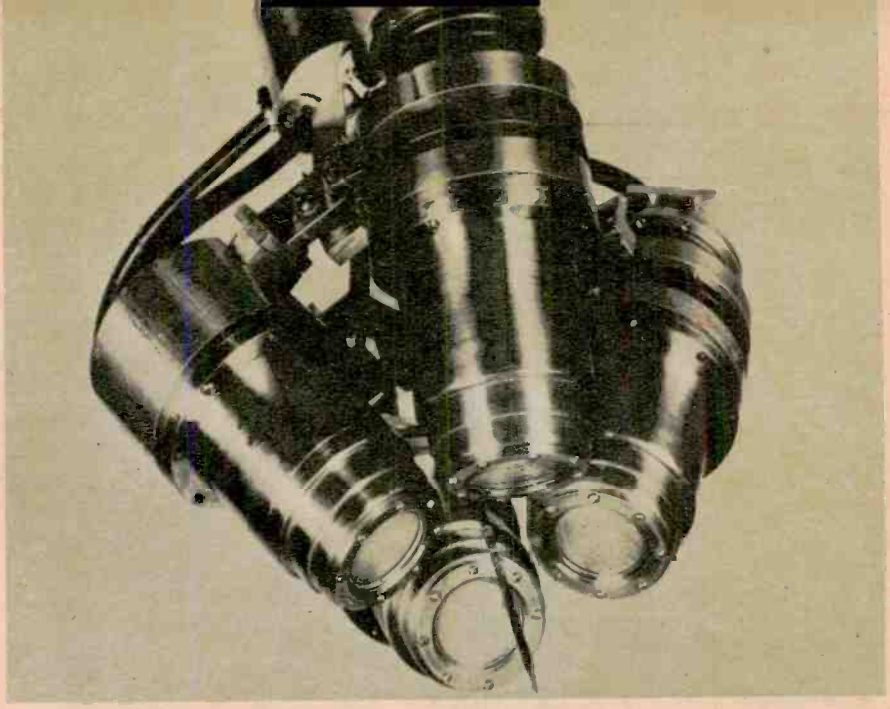
High above her head a motor suddenly comes to life and a long mechanical arm descends through a hole in the ceiling of the operating room. At the end of the arm are four electronic instruments resembling huge microphones.

Deep within the patient's brain is a malignant tumor. Unless it is removed and the pressure on her brain relieved, she will be completely blind in a few months. After that will come paralysis and finally death.

An X-ray technician appears with a fluoroscope to check the depth and exact position of the tumor. He uses four rubber-cushioned braces to secure the patient's head in position. The electronic apparatus attached to the mechanical arm is placed in contact with the patient's skull, and each is carefully aligned.

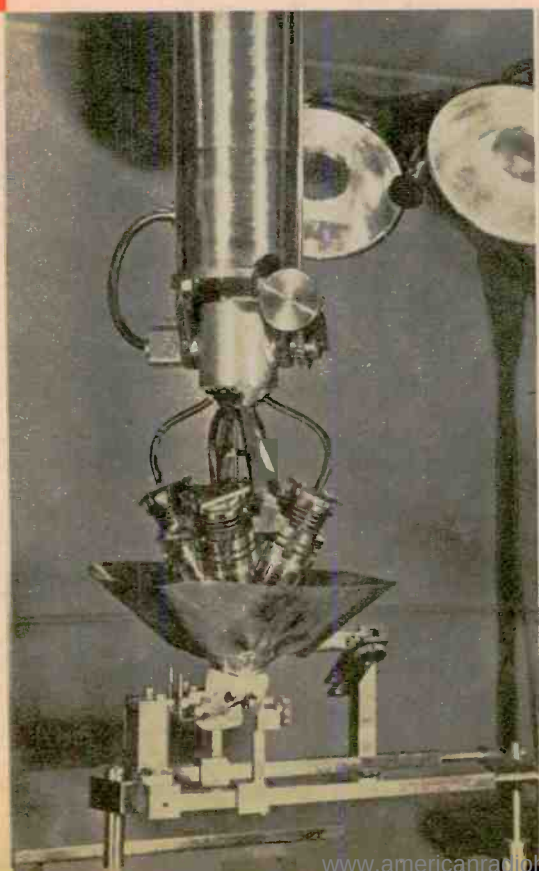
The surgeon is ready to begin the operation. He signals to an electronics technician at one end of the room. The technician quickly switches on to "standby" a battery of power supplies, ultrasonic oscillators, and power amplifiers. He surveys his equipment and nods to the surgeon.

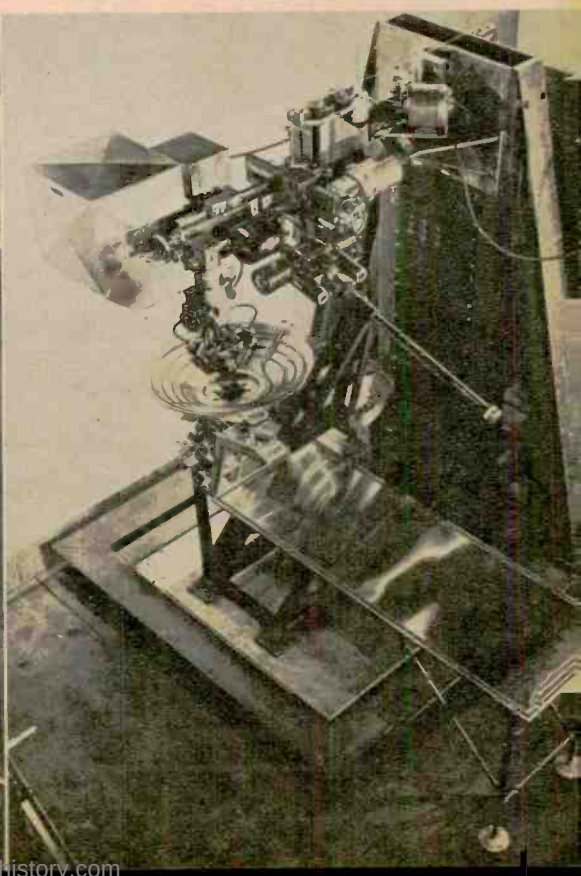
The surgeon turns from the operating table to a small control panel mounted below the three [*Continued on page* 101]



Four transducers each emit an ultrasonic beam too weak to affect brain tissues, but where four beams meet, unhealthy cells are destroyed. No need to cut skull or scalp.

Left, experimental setup focused on animal skull. Joint on boom lets transducers be aimed in optimum direction. "Operation" lasts seconds, may be repeated with beams at a different angle. Conscious patient feels nothing, has no "operating room" fear.





Stan Hatfield, above, makes good use of his test gear in tracking down tape recorder circuit ailments. His shelves are stocked with spare parts for all makes and models of home and professional recorders. At left, Stan marches out of his shop to deliver two "good-as-new" machines.

EI's money making careers in electronics

Tape Recorder Doctor

By James Joseph

In this era of the specialist, there seems to be room aplenty for those with tape machine know-how.

STANLEY R. Hatfield made a wise move when he decided to tune-in on tapes for a living—the billions of feet of magnetic tape reeling through the nation's more than 2.2-million tape recorders.

As a kind of doctor of magnetism, Hatfield cures tape recorders of what ails them, sending them back healthy to their owners—stereo fans, industrial researchers and businessmen with a penchant for putting thoughts on tape.

Hatfield presides over a well-equipped [*Continued on page* 106]

By latching onto a few service warranty deals whereby he backstops the machine maker's 90-day to one-year service warranty, Hatfield has been able to build a thriving business. Local retail dealers also require reliable tape specialists.

More and more business concerns are using magnetic tape dictating machines. This has opened a broad new area of opportunity for the serviceman, in addition to those of home and industrial recorder users. Stan is service agent for the Geloso and Grundig tape recorders.

Printed circuitry is the trend in home and portable recorders, again pointing up the need for specialized servicemen who know how to make repairs on a printed board.

single power transistor doubles in brass as a

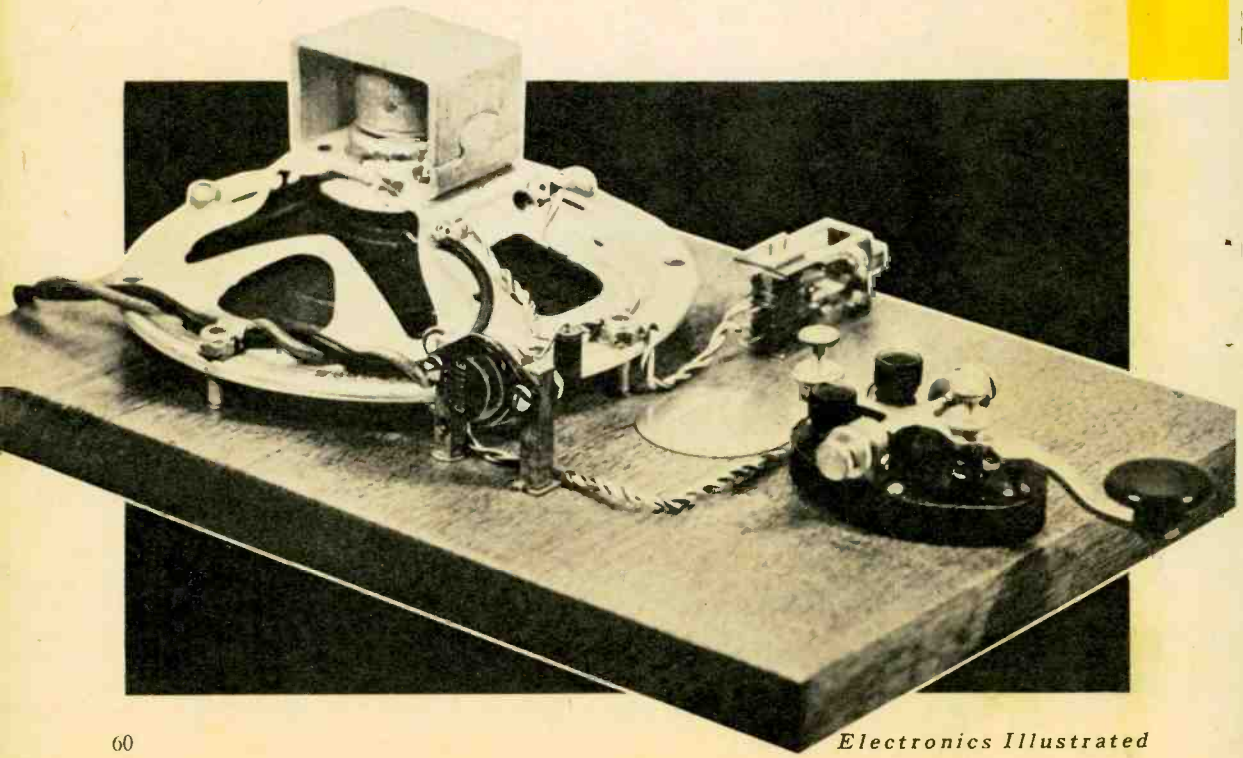
Code Practice Oscillator-Amplifier

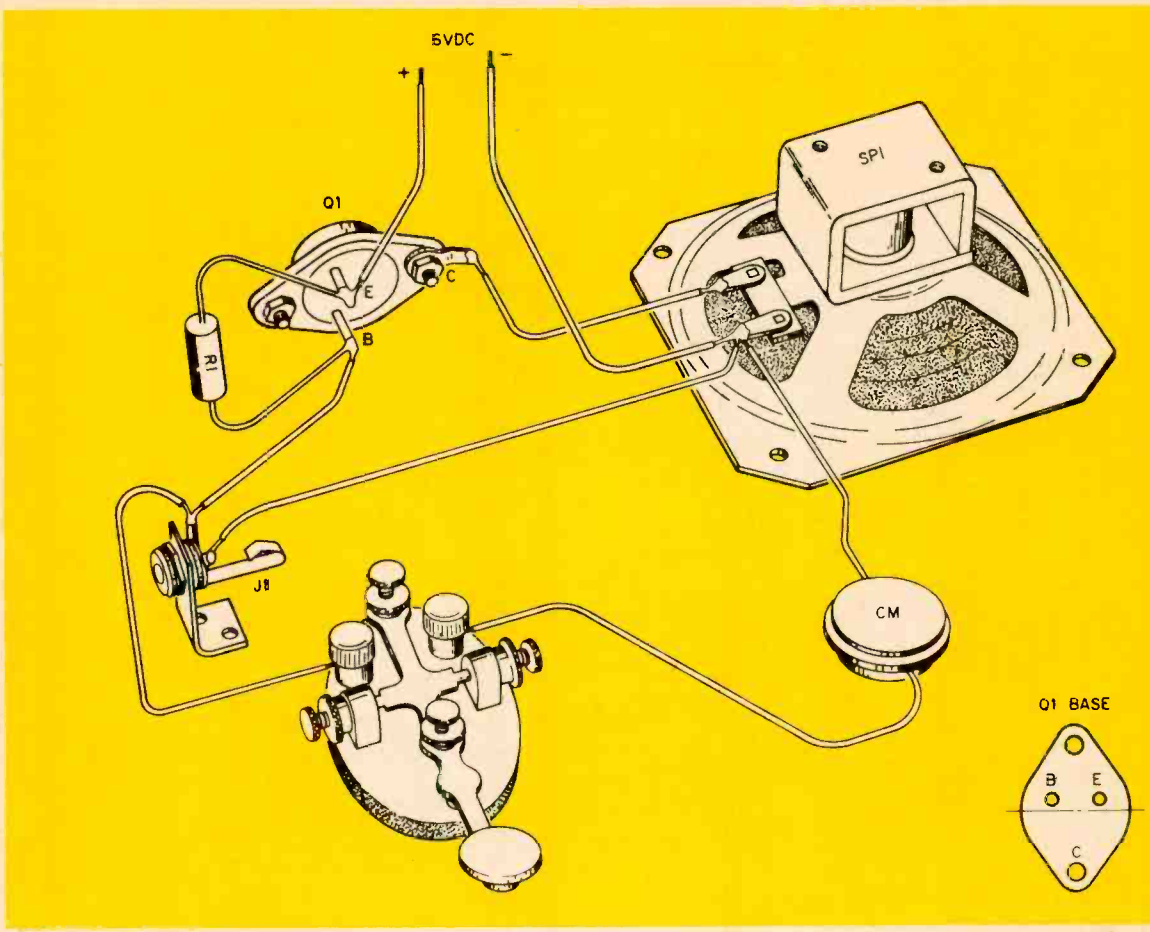
By Roy Pafenberg

THAT old headache, acoustical feedback can be useful—as the performance of this oscillator proves. Full loudspeaker volume and excellent keying characteristics are achieved by combining the simplicity of basic transistor amplifier and an acoustic feedback oscillator.

The instrument shown is probably the simplest that will provide the performance required of a classroom code practice oscillator. It consists of a carbon microphone button (CM) driving a common emitter power amplifier stage directly coupled to the voice coil of a PM speaker. The circuit has been tested with a wide variety of speakers, microphones and power transistors (2N34A, 2N255, 2N256, 2N554) and is completely non-critical.

Any convenient layout may be employed, although the breadboard layout shown offers the advantages of accessibility and ease of construction. No assembly precautions other than the placement of the microphone, are required. All components are mounted to the board with machine screws and the retaining





Only a few simple connections are required. Note ground lug at collector junction of transistor Q1.

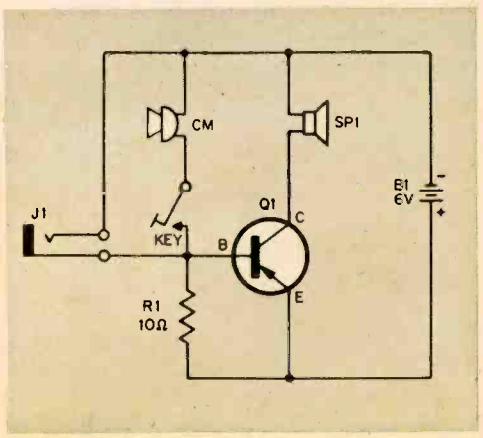
PARTS LIST

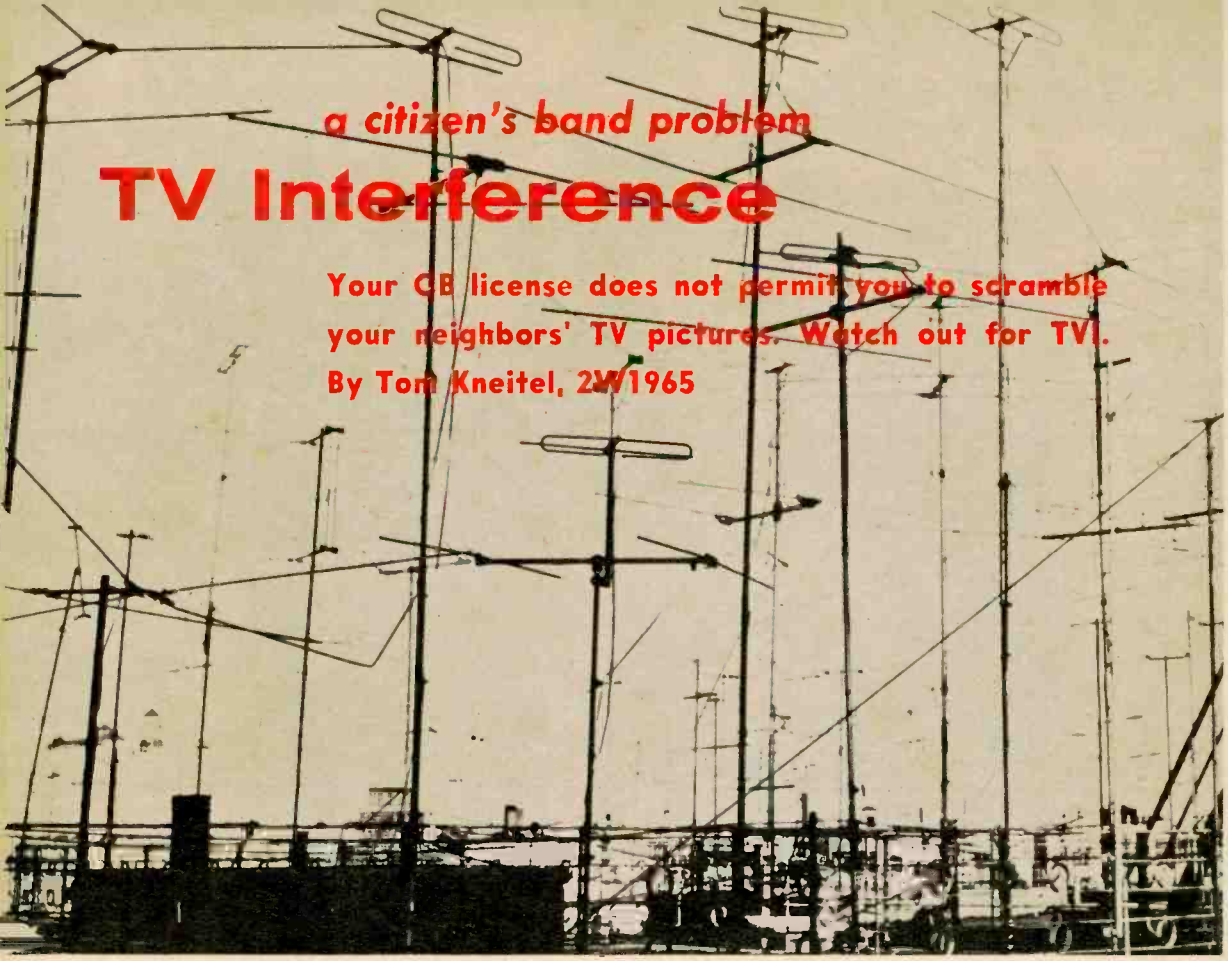
R1—10 ohm, 2 watt resistor
Q1—Power transistor (see text)
B1—6-volt battery (single six-volt battery or four 1.5-volt cells in series)
J1—phone jack
SP1—4" or 5" PM speaker
CM—carbon microphone button
Key—Standard telegraph key

nuts are recessed in the underside of the board. The transistor is mounted on two metal standoff posts salvaged from a surplus transmitter. Since no heat sink is required in this application, any convenient means of mounting the transistor may be used. A solder lug is secured under one of the transistor mounting screws and used as the collector connection. Tube socket pins

[*Continued on page* 113]

With key open, unit functions as a low-power audio amplifier. Jack J1 serves as input.





a citizen's band problem

TV Interference

Your CB license does not permit you to scramble your neighbors' TV pictures. Watch out for TVI.

By Tom Kneitel, 2WV1965

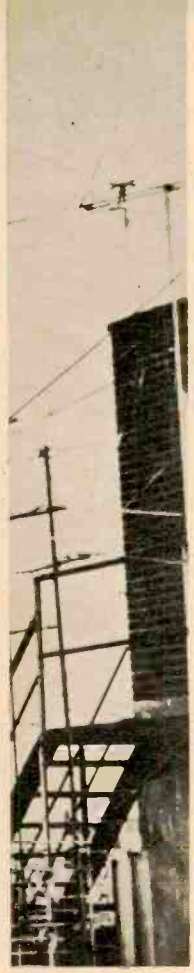
CERTAINLY one of the most vexing problems which can face a CB'er is television interference (TVI); after all, it involves his neighbors. If, like many CB'ers, you are faced with a TVI situation, what can and should you say to your neighbors, what should you do, what is your responsibility?

If you are accused, don't get angry and insulted—for all you know you might actually be the cause of the interference. Invite your neighbor in, listen to his complaint—be sympathetic, see his point of view. After all, he did pay good money for his TV set, and now he can't see the picture.

Show him your equipment. Explain that you have been issued a license by the Federal government for the operation of a radio station which does not transmit over a TV channel, but within a special band of frequencies set aside for the Citizens Radio service. Don't go into any kind of long-winded Rube Goldberg technical explanation—he doesn't want a course in communications engineering, he wants only to regain the use of his TV set. Tell him that, like his TV set, your transmitter is also a piece of commercially made precision equipment. If it is interfering with his TV reception no doubt something is out of whack, either in your set or in his receiver. If you have no TVI on your own receiver, show him. Don't tell him right off the bat that *his* set is no good. Send him home with the assurance that you will take immediate steps to ascertain the reasons for the TVI.

Now you need to understand a few things about how your little rig might kick up.

The circuits in your transmitter can produce more frequencies than the 27-mc output frequency you are using. For one thing, you are probably using a "third overtone" crystal that actually



A harmonic from your transmitter can wreak havoc on nearby TV sets. So can the 27mc fundamental signal. Either the transmitter or the TV set may be at fault.

operates at about 9 mc, with "tripling" in the oscillator output circuit, or in the circuit of another tube, including the final amplifier. The operating conditions that produce these multiples of the original *fundamental* frequency can also produce other *harmonics*. You might be getting whiffs of energy at 36, 45, 54 and other multiples of 9 mc. Furthermore, your nominal "fundamental" of 27 mc may be splitting up into multiples, too, like 54, 81, 108 mc, etc., especially if the output stage is being driven a little hard ("souping up" a Citizens Band transmitter can result in heavy harmonic production). The output circuit of your transmitter is designed to be efficient only at 27 mc, but it *can* pass these other frequencies. Even if they are passed "inefficiently" they can do a lot of harm. Incidentally, harmonic power is wasted power; your [*Continued on page* 96]

High pass filters for the TV set, shown here, low pass filters for CB rig are easy remedies.

Tune Your Antenna

Get the most out of your ham rig. This unit will resonate most antennas in the 10-80 meter band.

By Howard S. Pyle, W7OE

LOOKING for something simple, inexpensive and easy to build in an antenna tuner? Here's your answer! Designed primarily for use with the *Pogo Stick* antenna described in the August, 1960 *Electronics Illustrated*, it will give an excellent account of itself on any random-length antenna, horizontal or vertical, using a single-wire feeder or coaxial cable.

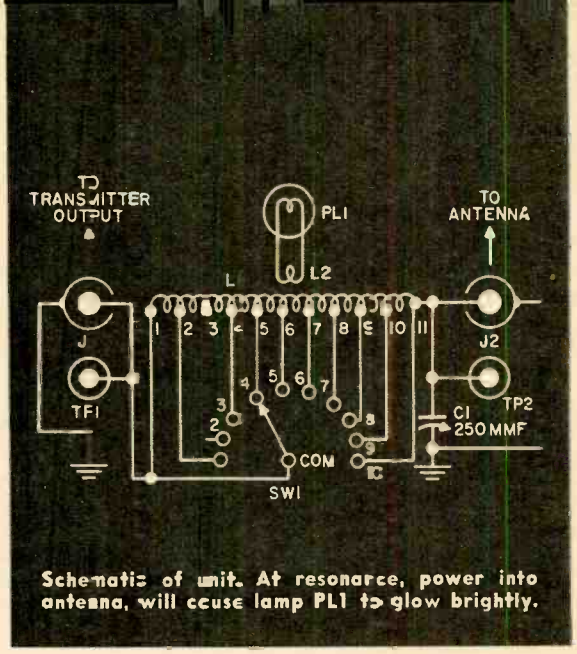
The circuit will be recognized as a conventional L/C network. With the constants shown in the Parts List, the writer has had no trouble in resonating several types of antennas and transmitters in the bands from 10-80 meters. Provision is made for input to the Tuner from the transmitter either by means of coaxial cable or a single insulated wire. Coaxial cable (the writer uses RG-58/U) is preferable however, and should be kept short; not over 18″ if possible. If coaxial cable is chosen for the input line, J1 may be omitted. The same arrangement is provided on the output side of the tuner. If you use coax line, TP2 may be omitted; conversely, if an open-wire feeder is used J2 need not be installed.

The coil L1, is tapped every fifth turn and the turns connected in numerical sequence to ten points of the tap switch. (The writer used an 11-point switch which he had on hand, setting the stop for ten positions.) L2 is merely one turn of #14 solid wire in a spaghetti insulating sleeving, wrapped around L1 and the two ends soldered to tuning lamp bracket PL1. Note that the actual number of turns in L2 and its positioning along L1 is a variable and is dependent on transmitter power. Using a Knight-Kit T-50 transmitter running 50 watts input, two of the indicator lamps burned out initially! With a Johnson *Navigator* transmitter, at

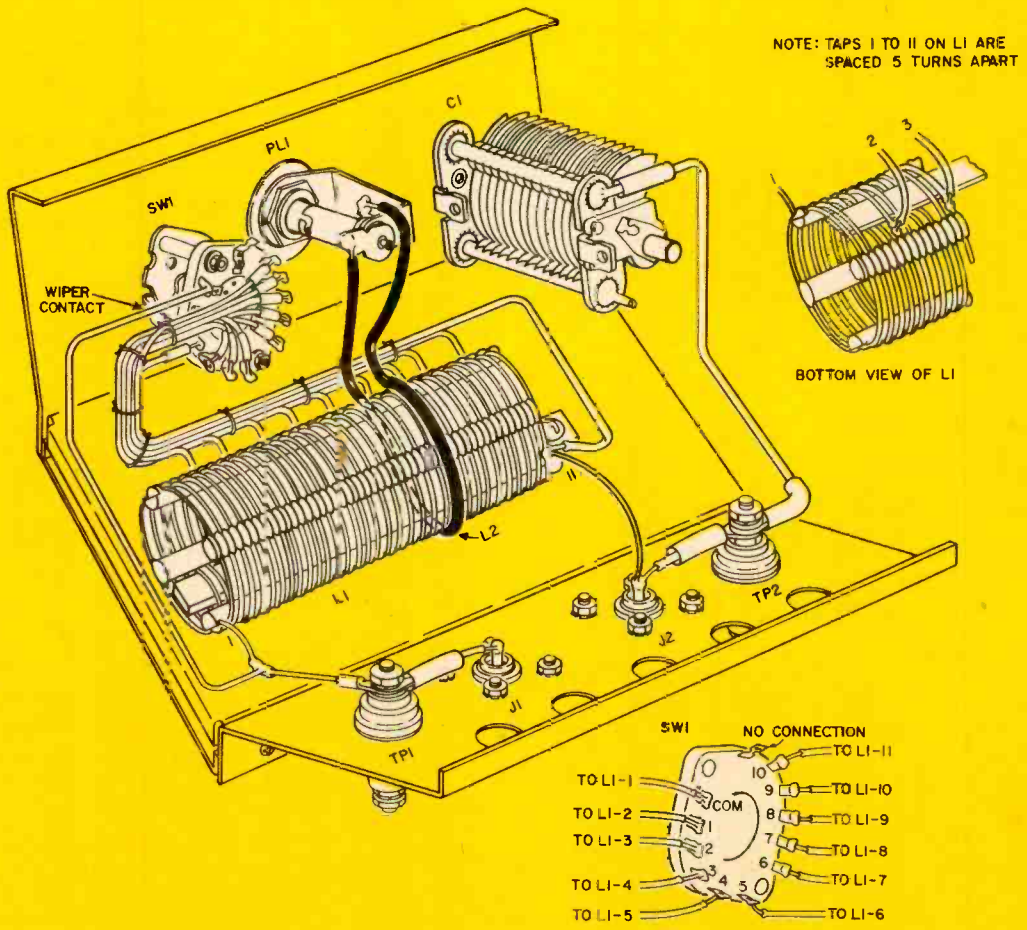
PARTS LIST

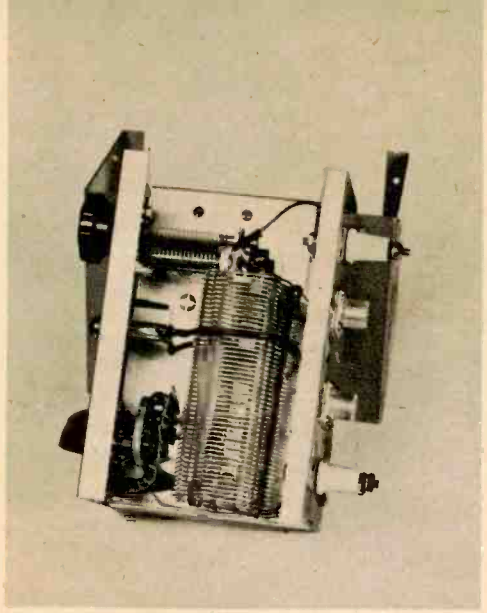
C1—250 mmf variable tuning capacitor (Hammarlund MC-250-M or equiv.)
L1—Tuning coil, 2" diameter 48 turns (Illumitronic 1610T or equiv.)
L2—1 turn #14 wire (insulated, see text)
PL1—#47 pilot lamp and assembly
SW1—Single pole, 11-position non-shorting, switch (10 used)
J1,J2—Coaxial chassis receptacle (Amphenol SO-239 or equiv.)
TP1,TP2—Porcelain feed-through insulators (Johnson 135-40 or equiv.)
Cabinet—The author used a special cabinet, however, a Minibox CU-3008A will do
Misc.—Knobs, dials, hardware.

Main wiring connects tuning coil L1 to the rotary switch SW1 in sequence.



Schematic of unit. At resonance, power into antenna, will cause lamp PL1 to glow brightly.





Interior view. Adequate space is provided for all components. Coil L1 is insulated.

35 watts input, one turn for L2 produced normal brilliancy of PL1 at peak adjustment. Experiment a bit with your input power reduced before securing L2.

If your transmitter is in the 75 watt or higher class, put about a 1-watt resistor of about 47 ohms across the bulb initially, otherwise it may burn out. You may wish to leave this shunt in place permanently; I did when using a Johnson *Ranger* at 85 watts input! If the brilliancy of your #47 pilot lamp is too great before reaching peak, you might try replacing it with an NE-51 neon lamp (without a shunt). This worked well with the *Ranger* although it's not quite as sensitive as the #47 lamp.

Coax feed automatically "grounds" the tuner chassis to the transmitter, but for longwire antennas (and the "other" wire of a 2-wire feeder) a chassis screw is installed near T2.

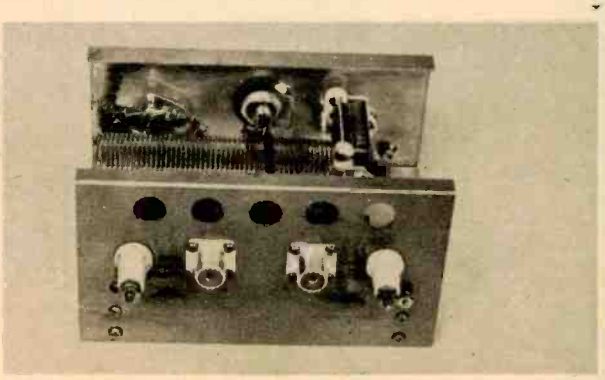
Tuning is simple, but your first attempts may take a bit of "juggling." Set your transmitter band switch on ten meters (15 for novices!), and keep your transmitter input w-a-y down, but in resonance. Set switch SW1 on the antenna tuner to the first position. Rotate C1 very slowly, watching the final plate current meter, keeping it at resonance (dip point). Check the antenna load control on your transmitter frequently because all of these controls interact. As you approach resonance in the antenna tuner, PL1 should begin to glow. Slowly bring it up to greatest brilliancy by alternately adjusting your final amplifier plate current, antenna loading coil and C1 on the antenna tuner. Then try other taps on SW1 to attain the greatest brilliancy of PL1.

If, after going through the entire range of C1 in the Antenna Tuner, you have found no glow in PL1, increase the current in your final amplifier stage a bit and repeat the process. Do this several times, always keeping the final stage resonant. If still no results, check your wiring and components of the tuner, you may have goofed somewhere.

The object is to get the greatest glow possible within PL1's rating on each band. *Less* than normal brilliance is nothing to be concerned about provided that the lamp glows brightest at *some* setting of C1 and SW1 and falls off rapidly on either side. Leave it at the peak setting, mark your dials or make up a chart for each band, and you'll find it quick and easy to return to maximum performance wherever you work.

As a final check for the dubious, hold a little NE-51 neon lamp on your antenna lead (if open wire). You'll find that at peak brilliance on the antenna tuner, you'll get peak glow in the neon. Your antenna is getting all that your transmitter can give it; what the antenna *does* with it in the way of radiation, is something else again; that's between you and the antenna!

Flexibility is insured by using either a coaxial or single wire input jack on the tuner.



New Life For Your Record Changer

PART II

By Walter Salm

LAST month we discussed the basic repair and replacement procedure. Now after reassembly of the mechanism, there are a number of adjustments that should be made to wrap up the job.

On the Level

A frequent contributor to distortion is a record changer "that's not on the level." The turntable must be exactly horizontal or the tone arm will be pulled toward the inner or outer grooves. Rotate the turntable slowly with a spirit level resting on the mat and make sure that the bubble is centered in all positions of rotation. (Fig. 1) Some cardboard shims under the base of the changer or adjustment leveling screws in the feet of the cabinet will do the trick.

Stylus Wear

A worn needle is worst possible villain you can encounter in the department of "how to ruin records." The proper groove position is shown in Fig. 2. The wear is never visible to the naked eye, and if you try to tell by how the record sounds, the needle is already wreaking all kinds of havoc on tender record grooves. The best way to tell if a needle is worn is to check it under a microscope looking for "flats." Microscopes are generally available for your use in most large record stores. Buy a diamond replacement stylus, the only

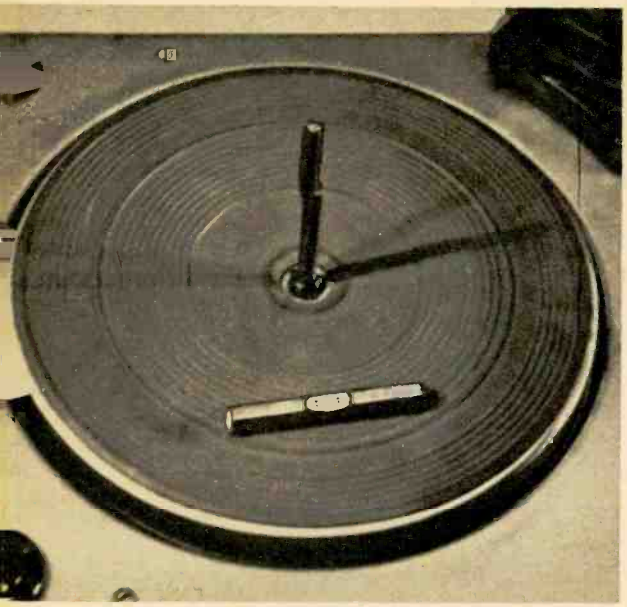


Fig. 1 ➤

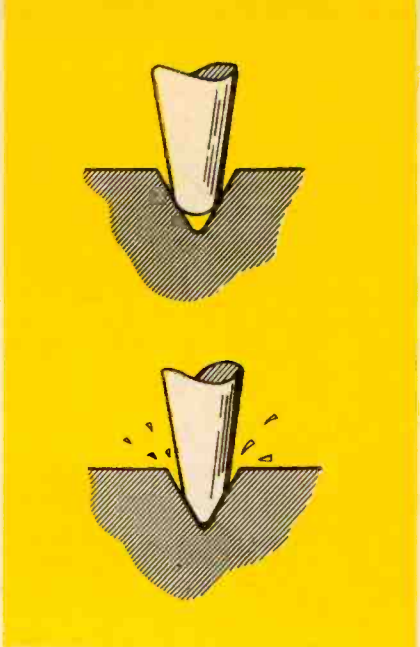


Fig. 2 ➤

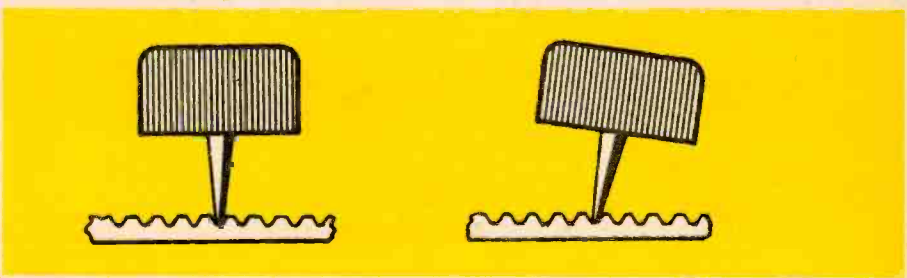


Fig. 3 ➤

needle that is long-wearing. Cost per playing time for the diamond is a small fraction of the cost of a sapphire tip.

Tilt Troubles

A new needle can still ruin records if it is not exactly perpendicular to the turntable surface (Fig. 3). Frequently the cartridge will not line up properly, causing disastrous needle tilt. This trouble is characterized by a whoosh-whooshing sound that gets louder and softer as the record revolves. Tilt can cause excessive needle talk also. The best way to check for stylus alignment is to place a mirror on the turntable and rest the pickup arm on it. (Fig. 4) When you observe the alignment of the stylus and its reflection from the edge of the turntable, it's easy to see if the stylus is exactly in the proper playing position.

A tilted condition can be easily remedied by placing one or two small flat washers on the mounting screw between the cartridge and the pickup arm shell (Fig. 5). You will probably have to experiment with the thickness and number of washers to get the right alignment. If your cartridge is of the magnetic type, be sure that the washers are fiber or a nonferrous metal. A steel washer used next to a magnetic cartridge can cause distortion.

Stylus Pressure

Before closing up shop check the stylus pressure with a commercial gauge. For LP records anywhere from two to eight grams may be specified by the manufacturer of the cartridge. Note

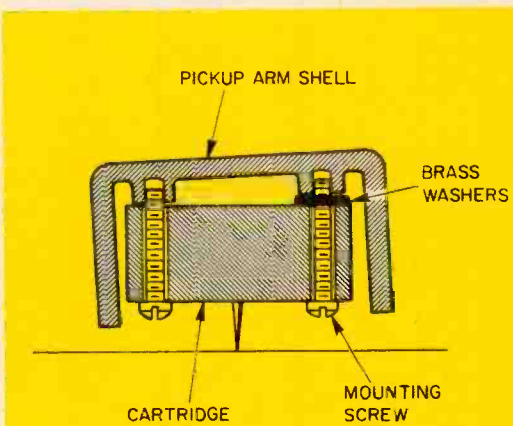
that too light a stylus pressure for a specific cartridge can cause just as much trouble as too much pressure. Most changers have a weight adjustment in the form of a tension spring near the pivot end of the pickup arm like one of those shown in Fig. 6. There will be a screwdriver or thumbscrew adjustment that you can make very easily. Different models will have variations in the mechanism, but the idea will be the same for almost all models. Consult the manufacturer's literature if in doubt.

Check Again

After you have finished all the servicing and adjustments, check the turntable once again with the spirit level, since you may have thrown it off balance by handling it. When everything checks out, put on your favorite jazz combo or Beethoven symphony and enjoy the fruits of your labor. You'll agree that it's been worth the trouble.

Fig. 4

Fig. 5



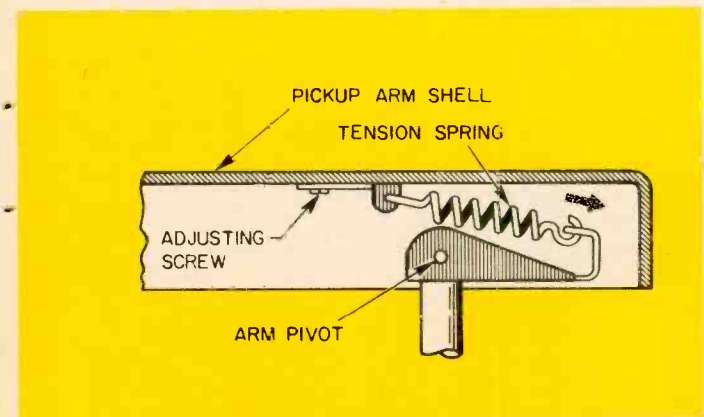


Fig. 6A

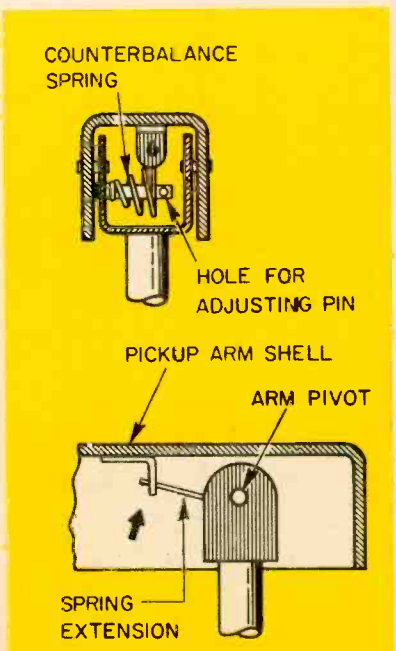


Fig. 6B

Automatic Tape Switch

By Ernest Wayland

This inexpensive, easily added switch turns off your recorder when tape ends or if a break occurs.

THERE are certain problems shared by most tape recording fans. The flap-flap-flap as your tape beats itself to shreds at reel's end after rewind is possibly one of the most common and annoying. Unless you have a professional machine, you've probably resigned yourself to a tense wait—finger poised over the "stop" button or to a "40-yard dash" at what you hope is in the nick of time. Of course, if you're the devil-may-care type who lets his recorder go its own merry way, then by now you expect the last several inches of each reel of tape to be mangled, and make proper allowances.

The automatic cutoff of the more expensive machines, not only turns the machine off when the tape has finished, but also functions during playing, as a safety device. Suppose there's a tape break during playback. The usual result is a snarl around the cap-

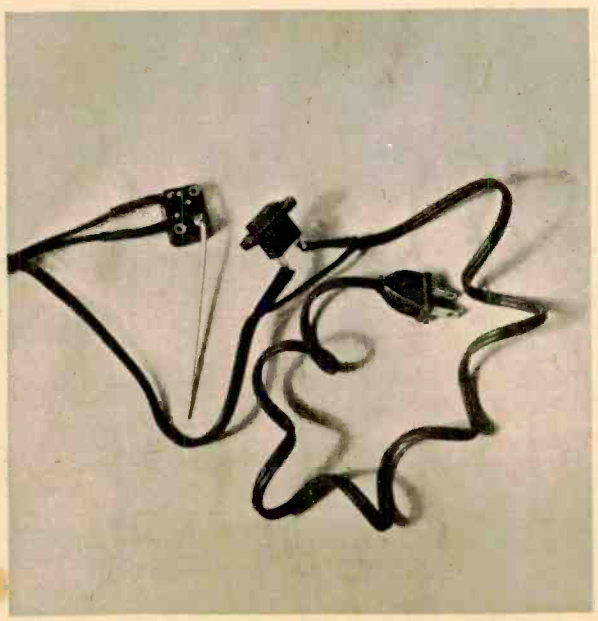
stan and perhaps several ruined inches of your favorite taped musical composition. If an automatic cutoff was in operation, tape movement would have stopped the moment the break occurred. You can install such a cutoff feature on your own machine in about an hour and at a cost of less than $2.00.

The heart of the cutoff device is a MicroSwitch model V4-12 (MicroSwitch 24-30 Skillman Ave., L. I. C., N. Y. or a local dealer). A 3" length of #18 or heavier copper wire, which serves as a "feeler" is soldered to the brass actuator nub. Insulating sleeving (spaghetti) is slid over the wire to present a smooth surface to the tape. This wire is later bent to the appropriate shape for use with your specific tape deck. (Do not use iron or steel for the feeler rod, as it may develop a magnetic charge and induce noise onto your tapes.) A 1" length of heavy spaghetti is slid over each of the AC line cord wires before they are connected to the terminals of the MicroSwitch. When soldering is completed, the spaghetti is slid down over the terminals to insulate them.

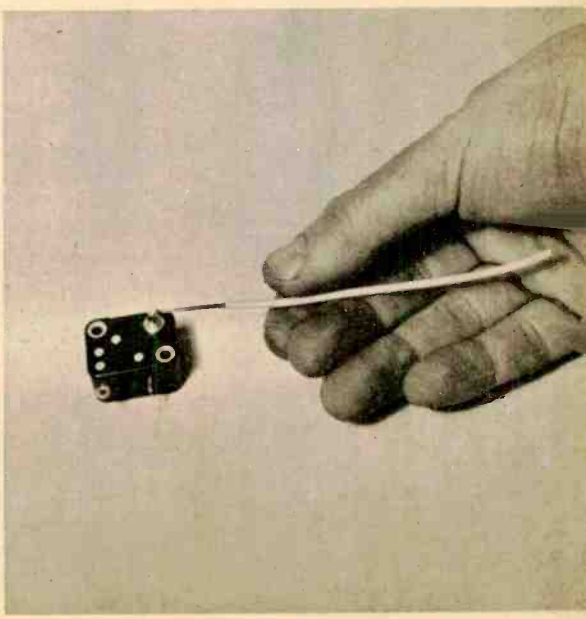
Break into the line cord at a convenient distance from the switch and wire in an AC female outlet. With the AC plug on the end of the wire, connected into a wall outlet, you should now have a simple series circuit with the MicroSwitch turning on and off any device plugged into the AC female socket.

Placement of the switch on your recorder depends mostly on the physical layout of the transport mechanism. A little experimentation may be necessary, but no difficult problems will be encountered. Placement and adjustment are facilitated because the feeler wire can be bent to provide the exact action desired. The switch assembly can be mounted on the tape deck plate by means of a self-tapping screw or even a good grade of glue.

If the mode of operation of your recorder makes it inconvenient to shut off the entire mechanism including amplifier by the MicroSwitch, then the switch can be wired so as to interrupt the current to the motor(s) only, leaving the amplifiers unaffected. In that case no extra line cords need be run to the AC power outlet.



Assembled parts of cutoff system. MicroSwitch goes on tape deck, AC outlet is for recorder.



Flexible insulated copper feeler rod, soldered to MicroSwitch, can be bent to fit as needed.

Electronic Brain

Have you any question on electronics? Send it in and the Electronic Brain will provide the answer.

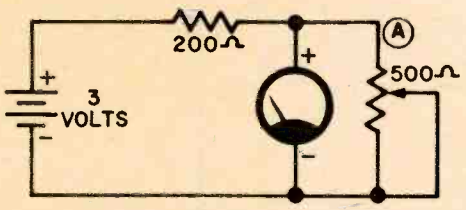
Meter Accuracy and Conversion

(1) What is the best way to check the accuracy of microammeters, milliammeters, and voltmeters?

(2) How can I convert a 0-100 ma meter to one that will read full scale when 20 ma flows through it?

Ralph Haglund, Blanchester, Ohio

(1) The easiest way to check the accuracy of any meter is to match its reading against another meter of known precision in an operating circuit. Current reading instruments are tested connected in *series* with the standard meter, while voltmeters are connected in parallel with the standard.



If precise meters are not available, accuracy of questionable instruments may be checked by using Ohm's Law. For example, suppose you wanted to test a 0-10 ma meter. The recommended procedure is to select a source of known voltage, say two fresh dry cells in series to provide 3 volts, then compute the resistance required to make the meter read ¾ full-scale with this source. Thus:

$$R = \frac{E}{I} = \frac{3 \text{ volts}}{.01 \times .75}$$

since 10 ma = .01 amperes. This gives:

$$R = \frac{3}{.0075} = 400 \text{ ohms}$$

If a 1%, 400 ohm resistor can be obtained, then you can count on this precision in testing; in other words, if the meter is accurate, the reading should be within 1% of 7.5 ma. Deviations from this value will tell you the precision of the meter. Voltmeters are checked merely by connecting them across a source of known voltage.

(2) Assuming that the sensitivity of the meter movement will permit it to read full-scale when 20 ma flows, all you need do is remove the shunt now in it and replace it with one of higher resistance. Unless the exact resistance of the meter coil is known, the calculation of the shunt resistance value is impossible. It can be determined experimentally, however, without difficulty. Using the same 3 volts previously mentioned, connect the circuit shown in the diagram. Before connecting the battery, be sure that the potentiometer is short-circuited by bringing the wiper up to point A. Connect the battery and then gradually rotate the wiper until the meter reads exactly 15 ma. The potentiometer may be left at this setting permanently, or its circuit value may be measured by a good ohmmeter and a fixed resistor substituted for it.

Mine Detector Modification

Can a Signal Corps mine detector be modified so that it will detect gold and silver? If so, how could this be done?

Leo Hampton, Edmond, Okla.

The mine detectors used by the infantry in World War II were almost exclusively of the beat-frequency oscillator type. In principle, they were quite similar to the metal locator described in the September 1959 issue of *EI*.

Such detectors can differentiate between ferrous (or iron-like metals) and non-ferrous metals since the pitch of the beat-note goes one way for the ferrous and the other way for non-ferrous metals as the lode is approached. But there are many, many non-ferrous metals beside silver and gold: aluminum, copper, tin, and zinc are but a few examples. Thus, a metal detector cannot tell you whether the hidden lode is silver, or other non-ferrous metal.

Tube Parameters

What is meant by the word parameter *as used in descriptions of tube and transistor characteristics?*
Robert Royale, Rapid City, So. Dakota

In the strictest sense of the word, a parameter is a quantity that *can* vary, usually between well-defined limits, but which may also be held constant during tests to determine the effect of other variables. An example will help to clarify this.

When you study a group of Average

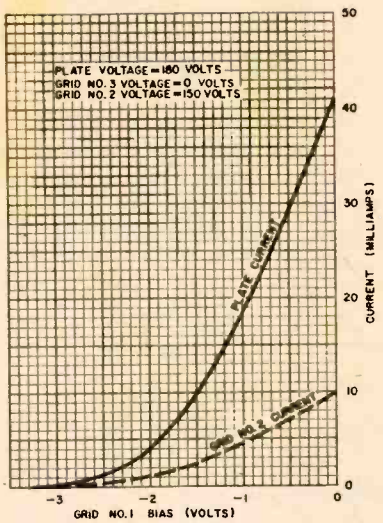


Plate Characteristic curves as found in receiving tube manuals, you find that any single curve is obtained by determining the plate current of the tube for various values of plate voltage with the *grid voltage held constant.* The curve itself is labelled with the constant value of grid voltage. Now when you go to the next curve of the family, you find a different grid voltage being used. The various values of plate current for the same plate voltages as used in the first curve are now very different from their former values. Such a set of curves should be called "Average Plate Characteristics with Grid Voltage as a Parameter." In other words, the grid voltage is a parameter because it is held constant for any given curve, but is allowed to vary to obtain the family of curves.

Signal Drop in Portable Radio

Why does the output of my portable transistor radio drop to an unusable level in an automobile or bus? Is there any way to cure this?
Jay Dean Kirk, Gallup, New Mexico

A car or bus is virtually an all-steel enclosure. Thus, it acts like a magnetic or "Faraday" shield with respect to anything inside it. The energy of the passing wave merely produces eddy currents in the metal of the enclosure rather than usable signals in the receiver antenna.

The only way to cure this is to erect an antenna outside the car or bus. Such an antenna need not be more than a few feet in length, but should project outward at right angles to the mass of metal. Connection is then made to the transistor input via a very small capacitor, such as 50 mmfd mica or ceramic. The capacitor must be kept small, otherwise it may detune the receiver and necessitate alignment for the new conditions. In the case of the family automobile, the normal car radio antenna may be used nicely, if the car is so equipped. It is necessary to make actual mechanical and electrical connection to the existing ferriloop or other antenna in the radio.

Line Voltage Fuse Check

Sometimes when I replace a blown fuse in my house, the new fuse burns right out. Is there some easy way to tell when the condition that caused the original burnout has been corrected?
Roy Castiller, Pueblo, Colorado

Yes. There is a very neat and very simple trick you can use to do just exactly what you describe.

When you have located the burned-out fuse, remove it and replace it with a standard incandescent lamp of 100 or 150 watts, the larger the better. If the lamp lights to full intensity, the line is short-circuited and a new fuse SHOULD NOT BE INSERTED. Go round to receptacles and other circuits that are controlled by this fuse, removing plugs and turning off switches one at a time. Each time you do this, check the light bulb screwed into the fuse receptacle. When the light extinguishes, you've found the faulty receptacle.

Add Interstation Muting To Your FM Tuner

By Daniel Horowitz

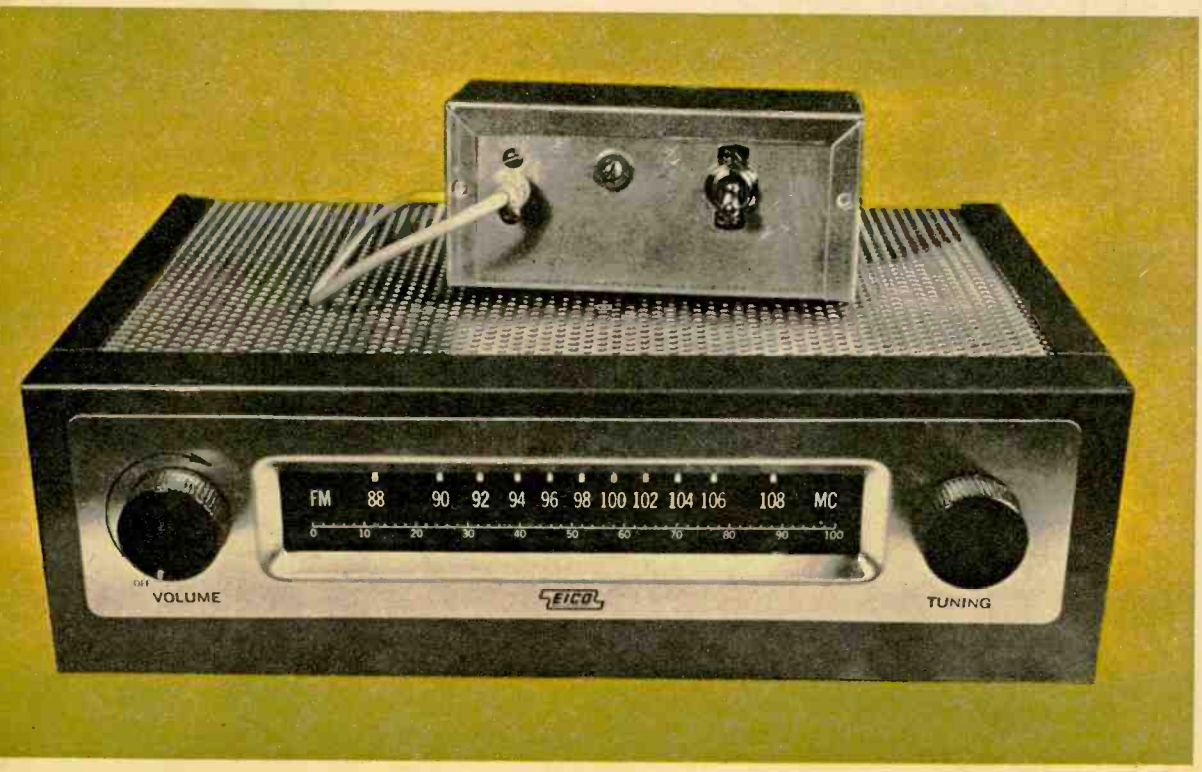
If you've ever had the yen to cut out the interstation noise while tuning your FM receiver, here's a little gadget that will do the job for you.

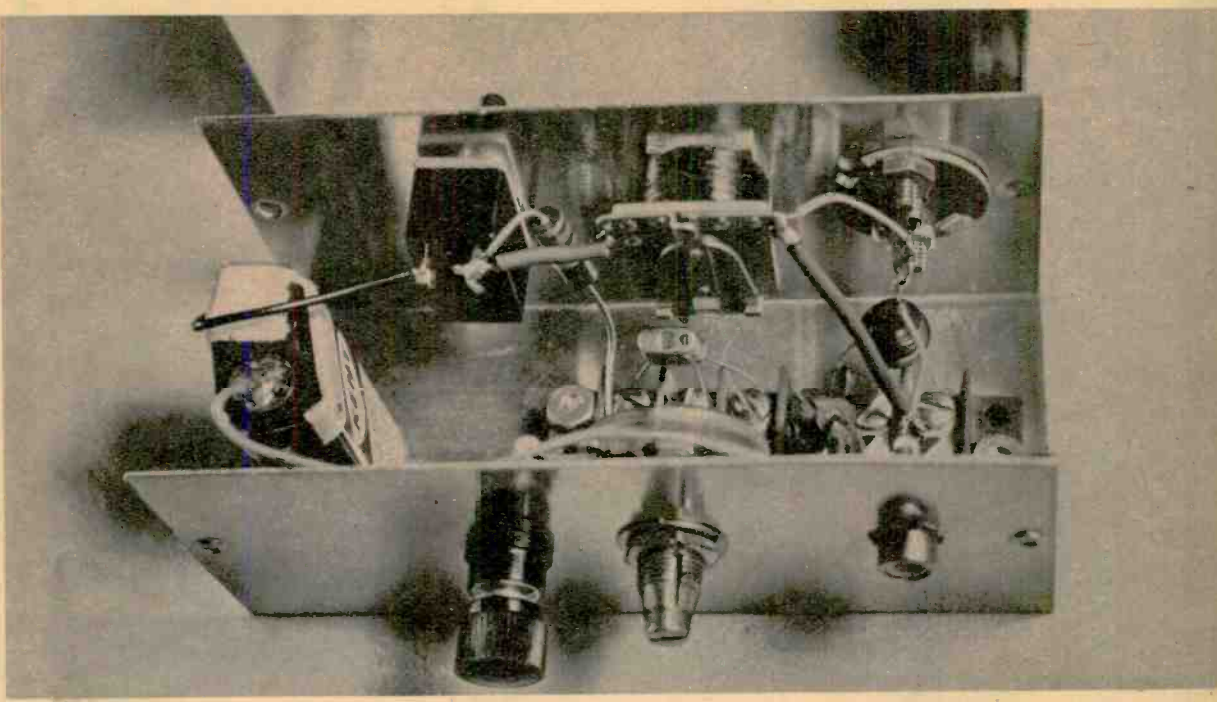
ARE you bothered by between-station noise when tuning your FM receiver? If so, here is a way to add a Squelch without disturbing the critical circuits of your tuner. The Squelch Unit itself is entirely external and requires only *one* non-critical soldered connection inside the tuner. The circuit employed is a transistorized computer-type Schmitt trigger which flips on and off depending on the exact level of the AGC voltage. The AGC voltage in turn, is determined by the carrier of the incoming frequency modulated signal.

Construction

When constructing the circuit inside its cabinet wire up the barrier strip first before attaching it to the chassis, leaving leads of the proper length for making connections.

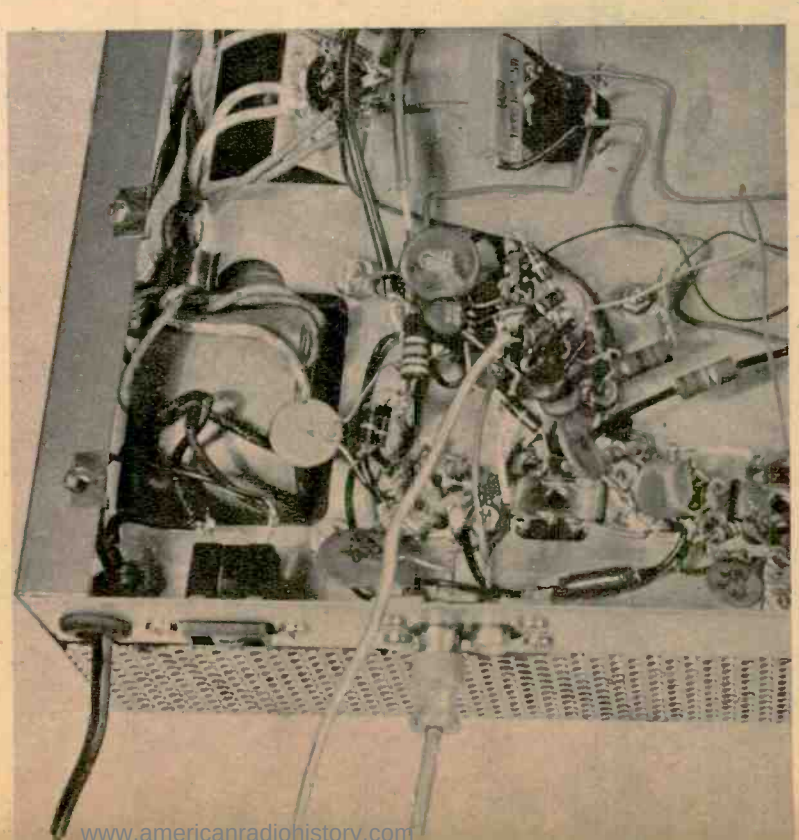
Transistors Q1 and Q2 are PNP types, which means that their collector voltages are negative. Be sure to observe proper polarity of the battery. The input connection for the AGC voltage (J1)

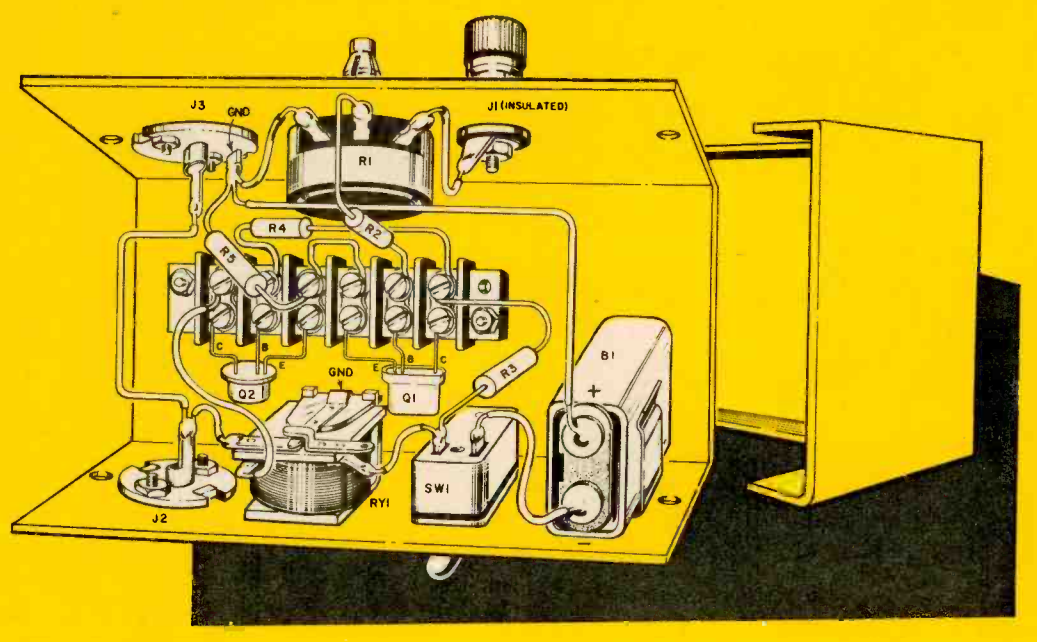


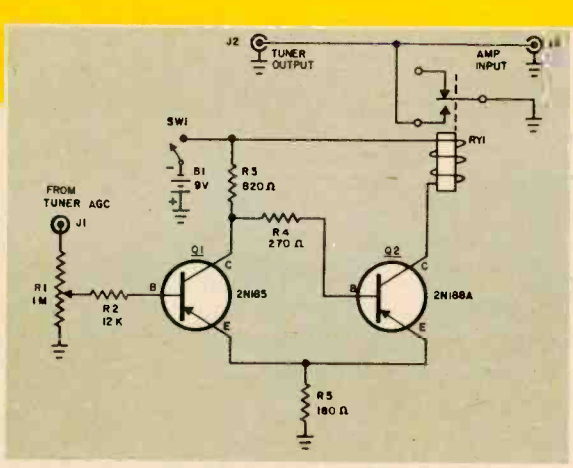


Interior closeup of Squelch chassis reveals screw-on connection of transistors to terminal board at bottom. The miniature relay is mounted on rear.

A short length of hookup wire must be connected to detector circuit of a typical FM tuner. Exact location is specified on schematic, next page.







PARTS LIST

All resistors ½ watt, 10%
R1—1 megohm potentiometer (slotted shaft)
R2—12,000 ohm R3—820 ohm
R4—270 ohm R5—180 ohm
Q1—2N185 transistor Q2—2N188A transistor
RY1—6-volt, 335 ohm sensitive relay (Potter and Brumfield RS5D)
SW1—SPST toggle switch
B1—9-volt battery (RCA VS 312 or equiv.)
J1—Insulated binding post J2,J3—Phono jacks
Cabinet—Minibox, 5" x 2" x 2¼"
Misc.—Battery clip, hardware, audio cables with phono plugs at each end. Screw-terminal, 6-connection Jones strip

Note AGC input J1 is insulated from ground and collectors are negative.

must be insulated from the chassis by a fiber washer so that the AGC voltage is not shorted out. All interior wiring of the unit (except the grounds of J2 and J3) must be insulated from the chassis.

After the Squelch Unit is constructed, it is necessary to identify the AGC line in the tuner. This is easily done if you have a schematic diagram of the tuner. If the tuner has a *ratio* detector, the AGC voltage is taken from the negative end of the large low-voltage electrolytic capacitor associated with the detector tube (usually a 6AL5).

If the tuner uses a *discriminator*, the voltage is taken from either pin 5 or pin 1 (whichever is *not* grounded) of the 6AL5 discriminator tube. When the proper point is located, solder a piece of hookup wire to it and run the lead outside the case. Replace the tuner bottom plate.

Next make up a short length of shielded audio cable with phono plugs

at both ends. This will be used to connect from the tuner output to the Squelch input (J2). The cable from the tuner input of your amp or plugs into J3 on the Squelch Unit. Adjust the Squelch sensitivity control R1 for proper action.

The squelch may be added to AM receivers by connecting into the AVC line. (See *How to Repair Radios* on page 36.)

Theory of Operation

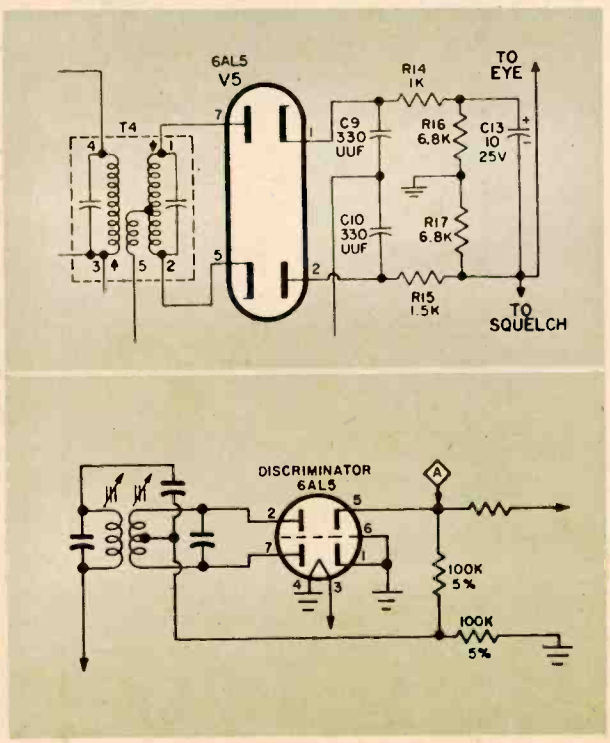
The circuit kills the sound from the FM tuner by grounding the audio output line except when a station is tuned in. The AGC voltage developed when a station is tuned in is used to trigger the squelch so that it restores the sound by removing the ground.

The circuit consists of a transistorized Schmitt trigger which drives a relay. The Schmitt trigger is a type of multivibrator circuit used to secure proper switching action. Relays will pull in at one voltage and will tend to stay closed until the voltage is reduced to a much lower value. This characteristic would be inconvenient if the relay were driven by a simple amplifier. With the circuit used, the circuit controls the switching and the relay characteristics have no importance.

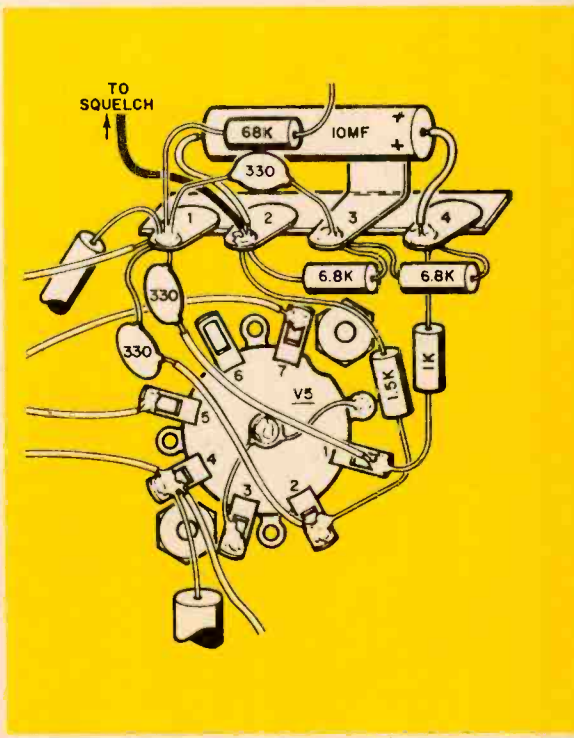
With no AGC input, Q2 conducts and Q1 is cut off. Current flows through the coil of RY1 closing its contacts and grounding the audio output line from the tuner. When the input AGC voltage rises to a certain value Q1 begins to conduct, and Q2 is cut off. When this happens, the RY1 opens and sound is restored.

This switching process is repeated when tuning from station to station. The circuit is adjusted using R1 so that the audio is heard normally when a station is exactly tuned in. Exceptionally weak stations may be received by switching off the Squelch unit using switch SW1. This removes battery power and leaves Relay RY1 in its open position.

A standard ratio detector and discriminator circuit. Letter "A" or output arrow to Squelch.



Connection should be made to negative end of capacitor in EICO detector circuit below.



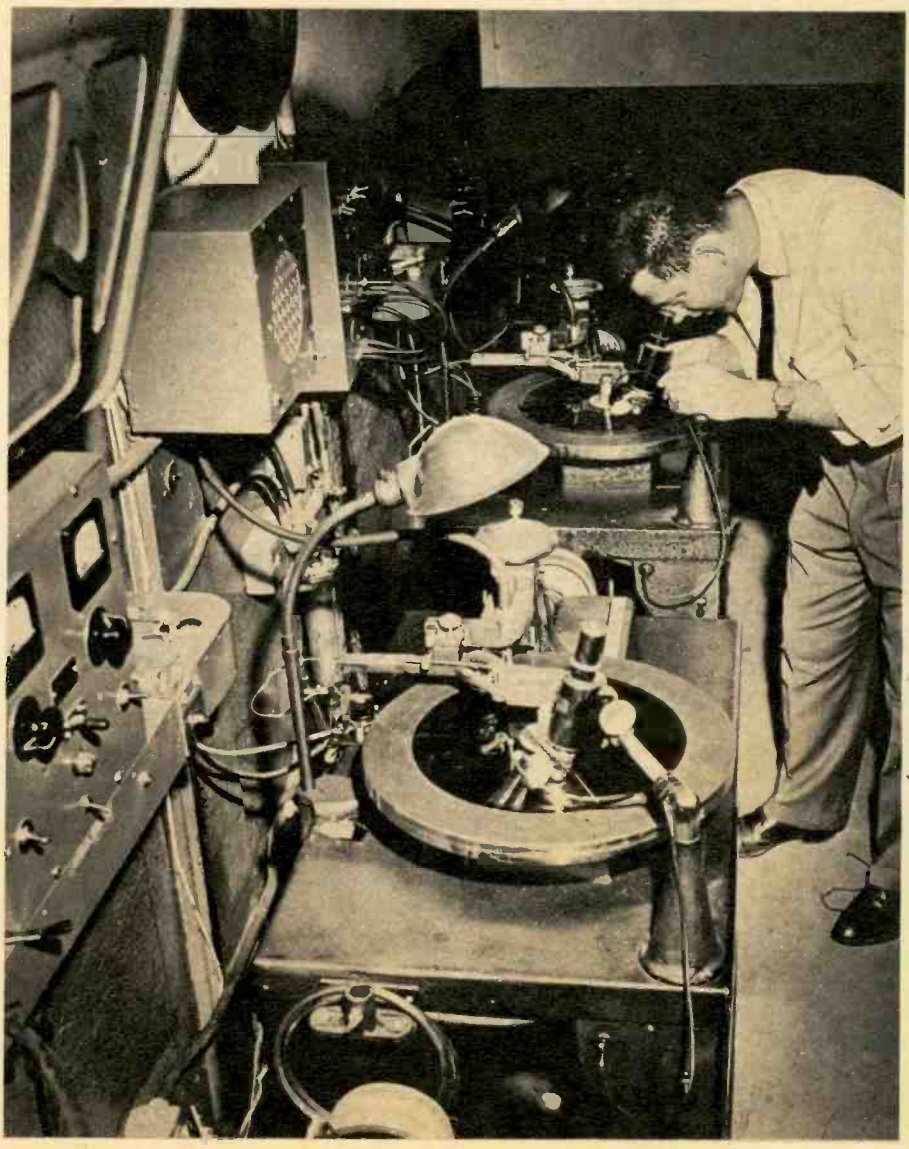
EI's Money Making Careers in Electronics

Dollars from Discs

Everywhere the demand for good disc recordings means profits for the enterprising technician.

By James Joseph

Alan Gottschalk inspects groove in platter being cut at recording studio he and his father own. Equipment can cut four master discs simultaneously.





Left, Al monitors taping of singing hopeful's sample. Center, Al and Bert, his father, transfer tape to master disc at dubbing table. Right, Bert Gottschalk at turntable used for making 20 or fewer copies. Larger orders are sent out for pressing. Studio's business has a $450 potential daily gross. Schools, churches, politicians, advertisers create demand for its services.

YOUR profits from discs can be "long-play" if, like Bert and Alan Gottschalk, a high-fidelity father-son team, you cater to sound sources: local ad agencies who hanker to cut a commercial groove, vocalists who want to hear themselves sing and businessmen big-wigs who have something to say . . . for the record.

The Gottschalks' Electro-Vox Recording Studio, geared both to grooves and tape, obliges them all:

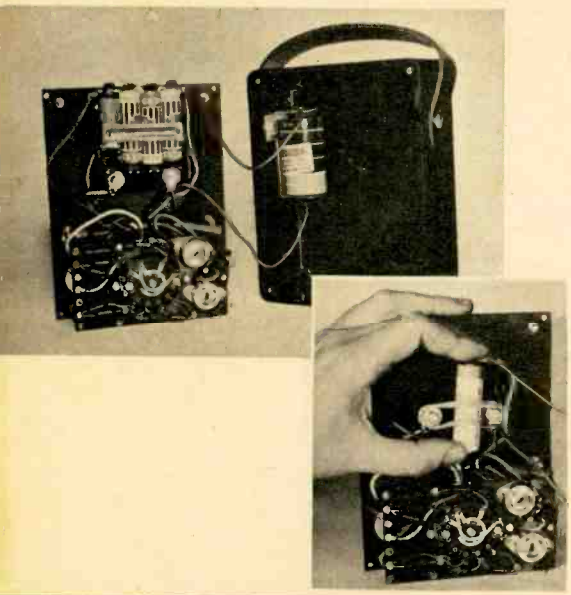
- Its two wired-for-sound studios (rental fee: $15-$22.50 hourly) cater to ad men with a sales message (usually the 60-second variety).
- Its stable of *Ampex 350* recorders can tape the vocal works: a musician's hour-long recital, a minister's Sunday sermon, a young wife's audio "letter" for mailing home to friends and relatives, the spiel of a sales exec as he cajoles his far-flung field force to higher profits. Cost: $15-$25 for a recorded hour, plus the price of the tape.
- Its Gottschalk-designed record cutters (four of them) serve up freshly-grooved long-play records, from the new 16 rpm's to 78's, from 7-inch platters to giant-sized 16-inchers which may carry upwards of a dozen 60-second spot commercials. A high school choral group, as typical, may order 100 seven-inch, 45 rpm discs for $125-$135. A single 12-inch, 33⅓ rpm recording, grooved both sides, runs $6.50-$7.50.

Just as lucrative is the Gottschalks' mobile recording unit, its tape machines dedicated to after-dinner speakers, corporate meetings and politicos. Rates: $30 for the first hour of on-the-spot recording, $12.50 hourly thereafter.

Then, too, Electro-Vox runs "air checks"—monitors radio-TV programs and commercials. The Gottschalks will tape a commercial, put it on record, have it next morning in a product peddler's hands (so he can check the commercial's continuity, be sure he got his air-time money's worth). Service fee: anywhere from $5 to $25, depending on recording time and whether a monitor tape must be transferred to discs. [*Continued on page* 110]

VOM Battery Conversion

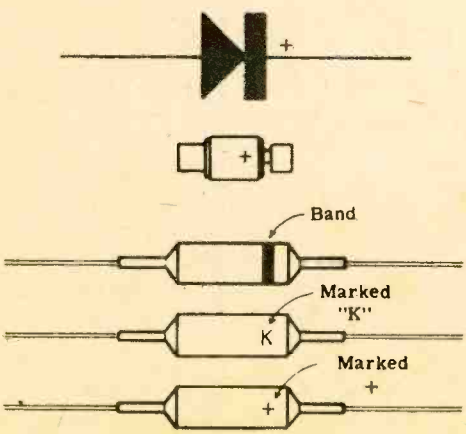
IF you own a volt-ohm-milliammeter (VOM) you know how annoying it can be to have its batteries go dead while the instrument is sitting on the shelf. In addition, certain of the 20,000 ohms-per-volt jobs have battery holders that tend to short out the cells if the instrument is jarred or hit. In that case, you not only have a dead ohmmeter, but the cells may leak all over the range switch. This will not only foul up your instrument but the low resistance of the battery fluid will probably short out the range switch.



There's a simple solution to the VOM battery problem made possible by the development of the new 6.5-volt mercury transistor radio batteries. Replace the four 1.5-volt "AA" penlight cells with a single mercury battery. In the unit shown, the battery holder was removed and the leads soldered directly to the mercury cell. The new cell is held in place by a heavy rubber band wrapped around the meter terminals.

—Dave Gordon

Diode Polarities



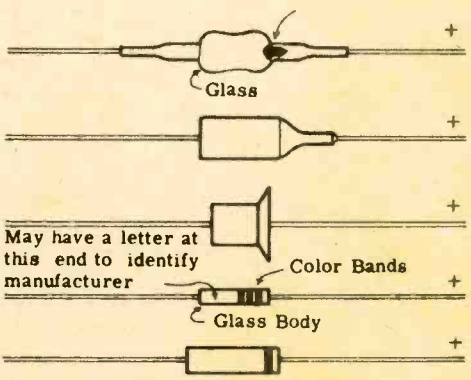
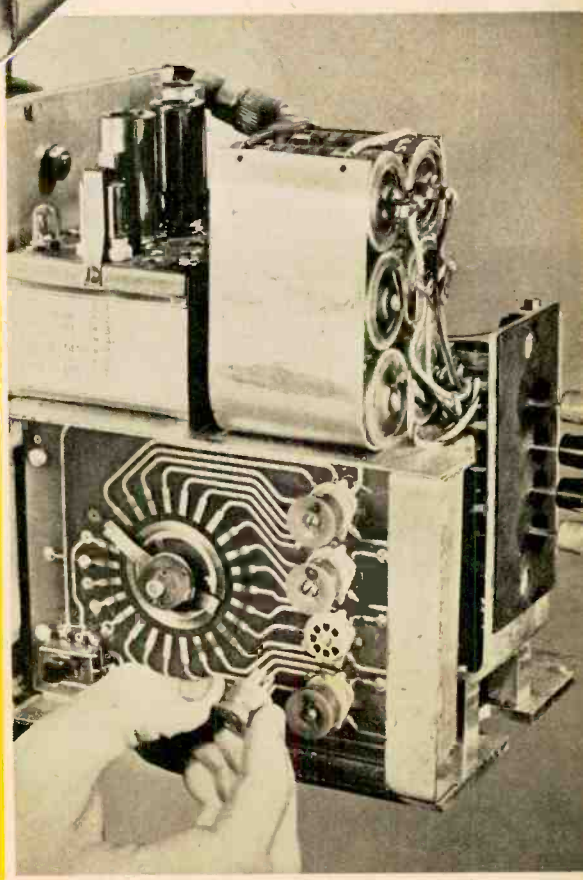


Illustration Courtesy Heathkit

FOR proper operation of semiconductor diodes, it is vital that they be installed with the proper polarity. If you slip up, you may not only ruin the diode, but in addition, damage some associated component. Since almost every semiconductor manufacturer seems to have his own idea as to the proper way of indicating polarity (there are colored dots, bands, caps, letters, and, of course, plus signs), here's a handy reference chart covering most of the diode codes now in use. Refer to it often and avoid errors.

Pushing any button once makes this unit send a message. Below, jumper plugs make circuit board connections for different messages. Circuit can be designed for many applications.



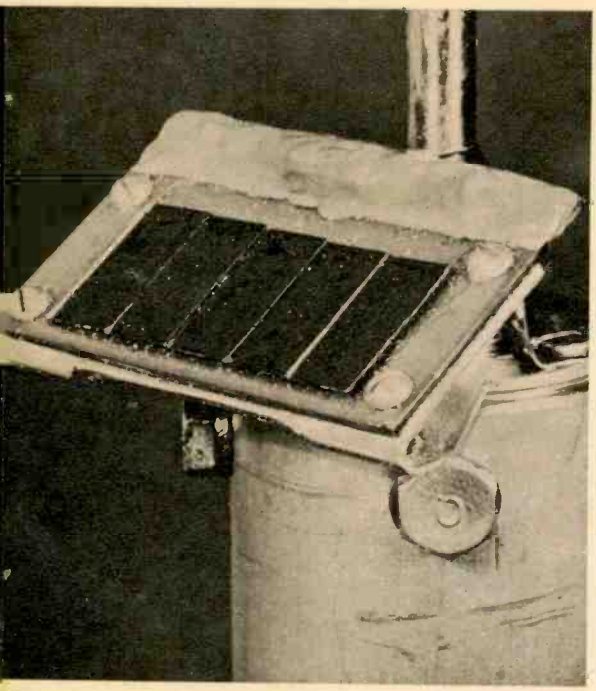
Sun Powered Lifesaver

Solar cells power this remote "call box" for highway safety use or for any isolated area.

By James Joseph

A CAR suddenly fishtails on a crowded, high-speed turnpike. There's a grinding three-car crash . . . and casualties. Yet help is but a push-button away . . . as close, in fact, as the cigar-box sized, solar-powered "emergency call" radio transmitters installed every quarter mile both sides of the highway.

Now, moments after the crash, a motorist punches those buttons—labeled



Five silicon solar cells are mounted on the sleeve of the coaxial antenna, out of reach of vandals. They recharge set's storage cells.

Receiver interprets coded signal, flashes information in lighted letters on panel. The system can be used for telemetering purposes.

"police," "ambulance," "service truck" and "fire," each one once.

The warning flashes across 18 miles to a police control board. On the board the emergency radio signals, decoded, are spelled out in illuminated letters: "Hollywood . . . in-bound . . . 2.5 miles . . . police, ambulance, fire, service".

To the on-duty police officer the message has complete meaning: "Accident on the Hollywood freeway, 2.5 miles in-bound from the interchange . . . rush police, ambulance, firemen and a service truck."

Sun-power has saved lives, as it may save your own, whether you are a motorist, a sportsman trekking wilderness America, or a weekend skipper.

Key to it all: Hoffman Electronics' "safety satellite," a revolutionary low-cost, sun-powered transmitter which, without overhead wires, buried cables or even a power source (save for the sun) can turn lifesaver almost anywhere.

All the user need do is push a button. The transmitter sends its message, then shuts off automatically. Push the buttons again, and the signal cycle is repeated.

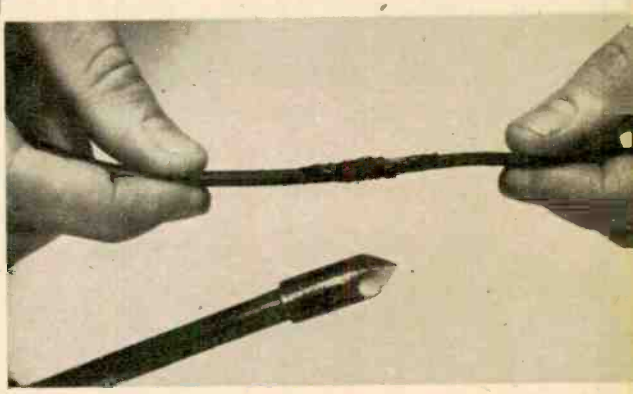
The 3-tube "emergency call" transmitter, its six 1.25-volt nickel cadmium batteries recharged by five antenna-mounted silicon solar cells, can reach more than 25 miles line-of-sight, put out as many as 100-150 distress calls between rechargings, and remain operative even though its power source, the sun, doesn't peek from behind the overcast for 10 to 15 days running.

Moreover, its circuitry can be quickly [*Continued on page* 100]

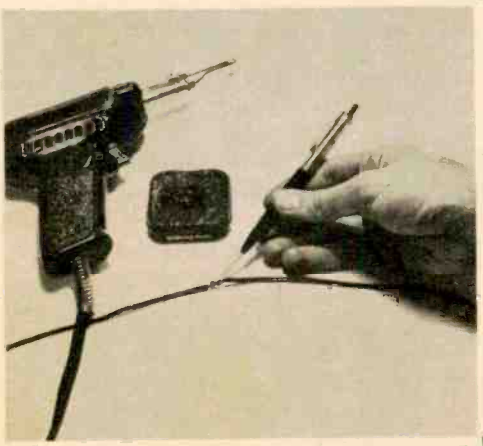
El's Hot Tips

By John Comstock

Roll a 3" wide scrap piece of fine mesh window screen into a cylinder and push it into the center of solder spool. The sharp wire ravelings will clean tips easily without sticking.



Hold a spliced wire that has been covered with black plastic electrical tape over the hot tip of a soldering iron. The heat will soften the tape causing it to contract and grip the splice snugly. Helps to waterproof the joint also!



Remove the ink cartridge from an old ballpen and insert a removable pipe cleaner. Use it as shown to apply soldering paste, or to apply liquid and paste lubricants or cleaners to band switches and other electronic components.

Need a cutting tip for your soldering gun? A brass wheel removed from an old alarm clock can be attached to the gun's tip with a nut and bolt. The wheel heats and cuts most plastics easily.

By Leo Sands

FOR about a two-dollar investment, you can make a substantial improvement in the sound of a table-model radio. And, a set with an 8" or larger speaker can be made to have an even better tone. This is accomplished by adding selective feedback to improve bass response and a treble booster to bring up the high frequencies.

The bass response of a small table model radio is limited by the size and quality of both the loudspeaker and the output transformer. But, without changing them, and by adding only a few inexpensive parts, the bass response can be boosted sufficiently to make a noticeable improvement.

Fig. 1 shows the circuit of the audio amplifier and output stage found in most table model radios. To improve the bass response, a resistor (R7) and coil (L) are added. Disconnect one side of capacitor C and resistor R as indicated by the "X." Now connect R7 (10,000 ohm resistor) between the free ends of R and C. One lead of choke L is connected to the junction of R and the new resistor R7, and the other lead is grounded.

Here is how it works. The audio signal that appears at the plate of output tube V2 is divided across capacitor C, resistor R and choke L. As the audio frequency gets higher, more voltage appears across choke L because its reactance increases with frequency. The voltage across L is fed back to the grid of the power output tube V2 through the bottom of the grid resistor (R). Since this fedback voltage is *out of phase* with the incoming

signal, it reduces the gain of the power output stage. But, it reduces the gain more at the higher frequencies than at low frequencies. Hence, the low frequencies predominate and bass boost results.

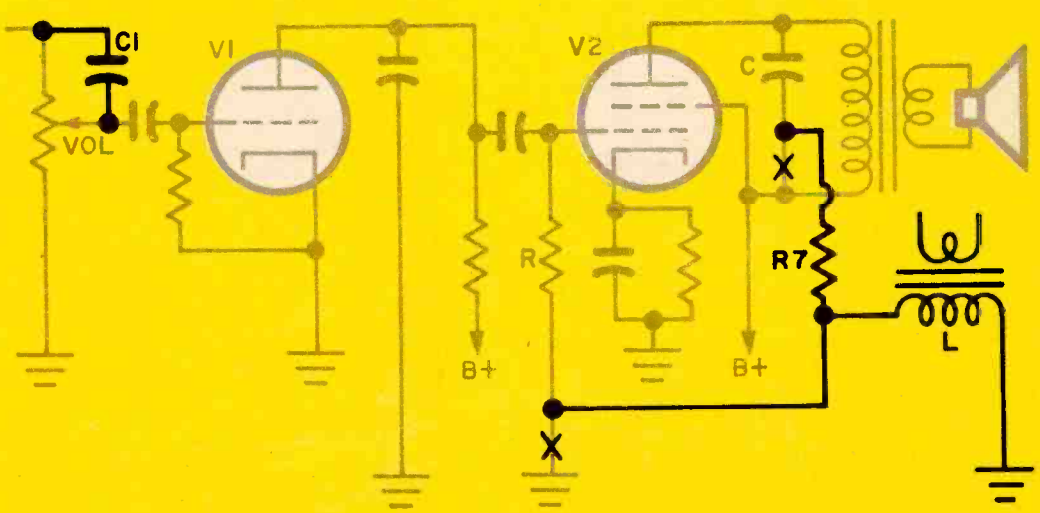
The effect of the feedback on the high frequencies is barely noticeable because the small speaker and output transformer already favor the highs. But, you can give the highs an additional boost if you like by connecting a small capacitor (C1) from the center arm to the right hand lug (as viewed from the rear) of the volume control.

Treble is boosted because the capacitor allows the highs to take a short cut around the volume control. The reactance of capacitor C1 rises as the frequency becomes lower and decreases as frequency becomes higher. Hence, the high frequencies see a low reactance path through C1 thus jumping the attenuation effect of the volume control. But, the low notes and middle frequencies see a very high reactance path and go the long way around via the volume control. When the volume control is set for low level sound, the highs are emphasized. At higher sound levels, the treble boost becomes less noticeable.

The value of C1 depends upon the resistance of the volume control and the amount of treble boost desired. Usually a 100 mmfd to 250 mmfd capacitor works fine, but don't be afraid to experiment. The choke L may be a small filter choke or an under-a-dollar output transformer with its secondary unused. To get the best results, it might be necessary to replace C with another value; usually .02 mfd provides the desired amount of feedback. If C is not present, add it as shown.

While this circuit does cut the gain of the radio's amplifier, the loss is slight. When the right combination of values of C1, C, R7 and L is found, the results are often spectacular. For several other modification ideas, see *"Improve the Sound of a Small Phono"* in the April 1960 *Electronics Illustrated*.

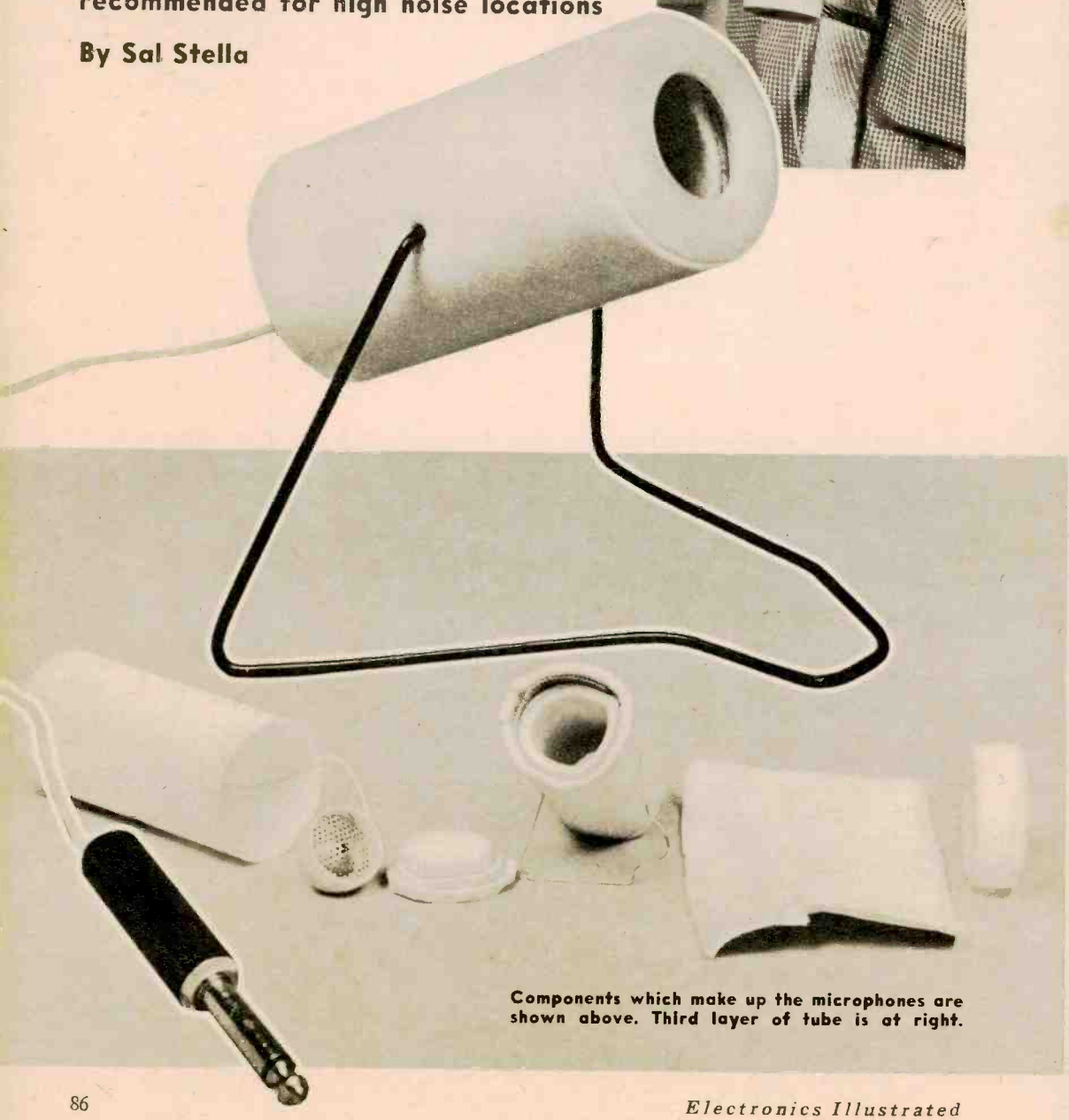
Audio section of a typical radio. Components to be added are shown in black. The two "X"s on the schematic indicate points in the circuit to be broken.



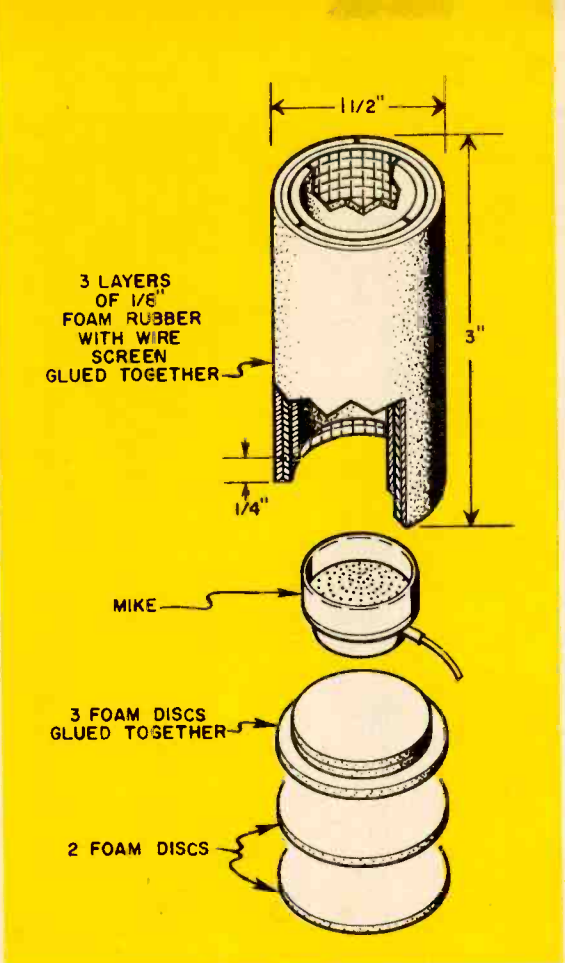
Economy Directional Microphone

Easy to build acoustically damped mike recommended for high noise locations

By Sal Stella



Components which make up the microphones are shown above. Third layer of tube is at right.



PARTS LIST

1—Microphone (Lafayette MS 439 or equiv.)
1—piece of 1/8" foam rubber, 6" x 18"
1—piece of 6" square wire screening
Plastic squeeze bottle, nursing bottle top, wire clothes hanger

The foam rubber is assembled in this manner to create the proper baffling setup. A plastic bottle serves as case.

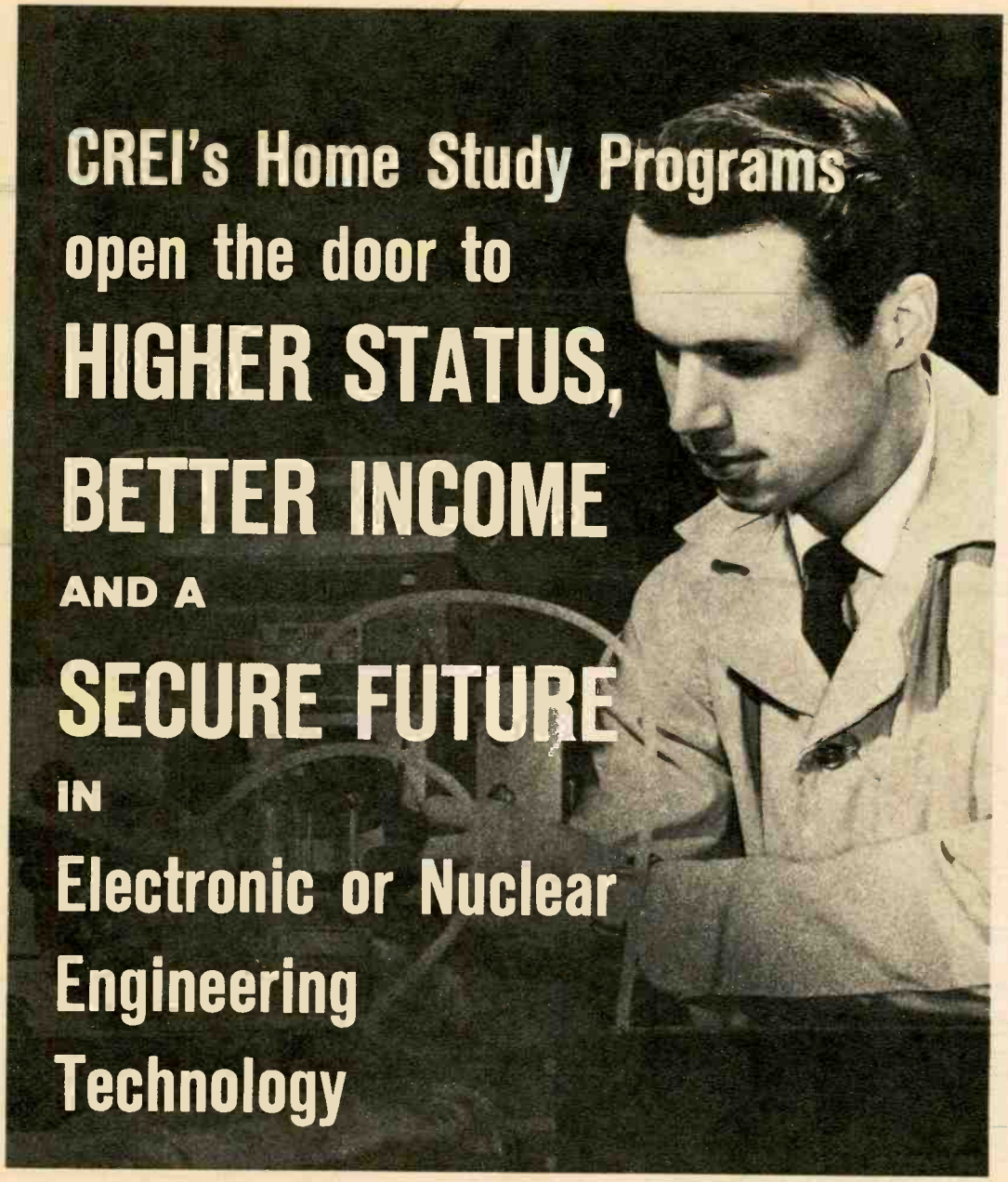
FOR about $2.00 you can build a microphone with enough directional properties to eliminate acoustic feedback or background noise effects in a PA installation. The one shown here actually can be held at right angles, within a foot of the speaker of a tape recorder amplifier at full volume, without feedback. Directionality is achieved by using foam rubber as acoustic insulating material. The arrangement shown in the exploded view slides inside a 4" long tube and serves to absorb sound originating at an angle to the opening of the assembled microphone.

The crystal earphone-microphone used is supplied with an auxiliary mouthpiece. The "funnel" section of the mouthpiece was cut off, but the threaded collar was retained to make a protective ring for the crystal.

The foam rubber tube is constructed using wire window screening as a form. The inside of the screen is lined with one layer of the foam rubber, and the outside with three layers of foam. This held the microphone securely in place when later installed in its case. Several foam discs are placed behind the mike also.

A plastic squeeze bottle (such as is used as a ketchup or mustard dispenser) serves as the microphone casing. The bottle top is cut off, and the screw top of a nursing bottle is force fit over the end of the plastic tube to serve as a cap.

A coat hanger, bent as shown in the photos, serves as a desk stand, or with the help of a small piece of string, it functions as part of a chest mike bracket.



The world of science is the world of the future. Deep space probes and orbital satellites . . . air-transportable nuclear power plants for use anywhere on the globe . . . electronics and radioisotopes for use in medicine, agriculture and industry . . . missile systems for the armed forces . . . computers and data processing for finance, industry and government . . . developing these and hundreds of similar concepts will make our world a better place for all. You can have a career . . . or speed your present career . . . if you qualify for a CREI home study program in electronic or nuclear engineering technology . . . a program recognized everywhere as excellent insurance for a secure future, high professional stature, and better income.

CREI now offers you college-level programs combining the technological content of advanced residence courses with the convenience and economy of home study.

The proven fact that the demand for CREI graduates in recent years far exceeds the supply speaks for the recognized quality of a CREI education. Many leading electronic firms and government agencies visit CREI's Placement Bureau every year to hire graduates and students for their technical staffs.

There are now more than 20,000 CREI students in all the 50 states and most countries of the free world. You, too, can benefit from a CREI program while you stay in your present job. You study at home, when and as you choose . . . and you avoid the time and expense of commuting to a residence school. Within 2 to 4 years, depending upon the program you select and the time you have to apply, you can complete a CREI program in engineering technology. The home study courses are written in an easy-to-understand format, and your personal progress is carefully guided by experienced instructors.

CREI programs are designed to meet your present and future employment needs

CREI students frequently gain promotions and raises long before they complete their program. As a graduate you will find that you gain stature and respect among your professional colleagues and supervisors, and that you enjoy the personal satisfaction of work on interesting and important projects. Your employer will recognize and reward your ambition . . . and your increased technical capabilities.

CREI is recognized and accredited by industry and government

Founded in 1927, CREI is one of the oldest technical institutes in the country. CREI co-founded the National Council of Technical Schools, and was one of the first three institutes whose curricula was accredited by the Engineers' Council for Professional Development. The U. S. office of Education lists CREI as "an institution of higher learning."

Over 50 electronic organizations actually pay *all or a substantial portion of the tuition* for employees taking a CREI Home Study program. Right now, there are 5,240 U. S. Navy personnel enrolled in the CREI extension program.

CREI conducts a residence school in Washington, D. C. for those who wish to attend classes. The regular program of 27 months leads to an AAS degree. No previous training or experience is necessary for the residence school.

Qualifications for enrollment in the home study program

If you have a high school diploma or the equivalent, and if you have some basic training or experience, you can qualify for a CREI program. Tuition is reasonable, and veterans can take advantage of the G. I. Bill.

SEND Attached Post Card for new 56-Page Catalog Without Obligation

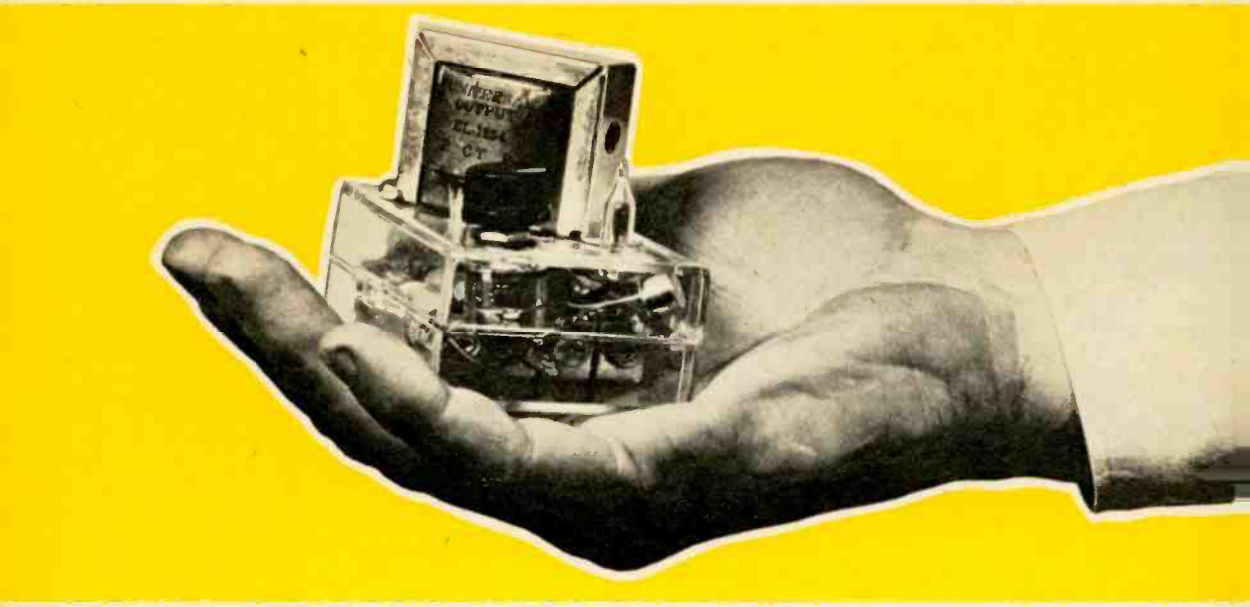
Learn all about the promising future of electronics and nucleonics just published to include new courses being offered by CREI. This informative catalog discusses the electronic and nuclear industries, and answers searching questions about future manpower requirements and career opportunities. The catalog describes all the courses, the alternate programs . . . it introduces the faculty who will be guiding your progress . . . and it points out how the courses are designed for home study.

This catalog is free, and is of vital importance to every man wishing to progress in the field of science and technology. You owe it to your future to investigate this college-level, home study program as soon as possible.

CREI **The Capitol Radio Engineering Institute**

Home Office:
3224 16th Street, N.W.
Washington 10, D. C.

England:
CREI London, Granville House
132-135 Sloane Street, London, S.W. 1, England



Electronic Blinker

Four penlight cells power novel attention getter.

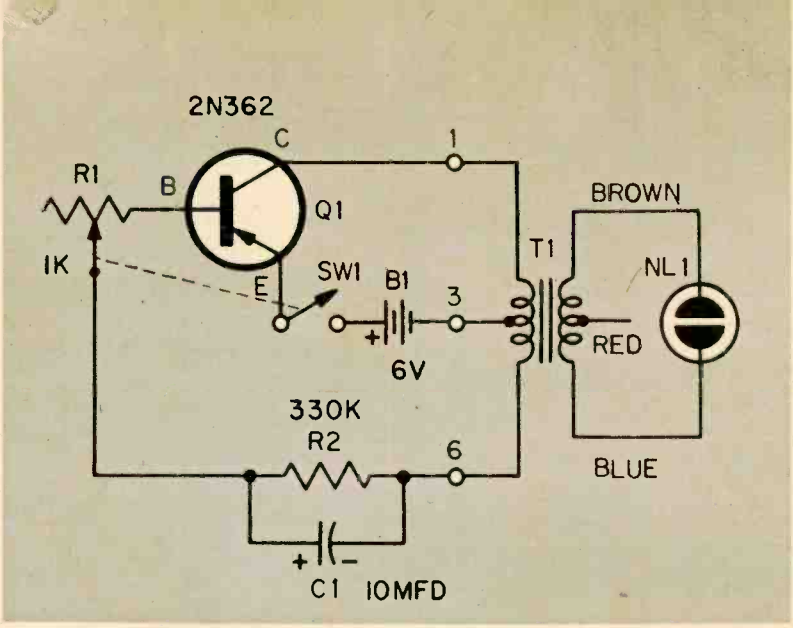
By Forrest H. Frantz

FLASHING lights always attract attention. This in itself recommends this electronic gadget as a display device, parlor gadget, conversation piece, or toy. We are all familiar with the relaxation oscillator circuits employing neon bulbs, but how many of us are aware that a transistor may also be used to periodically discharge a capacitor.

In the electronic flasher described, a step-up transformer is employed to convert the low voltage pulses from the transistor to a high voltage pulse sufficient to flash the lamp. Note that the regular secondary of the output transformer serves as the primary in this circuit and the regular primary is the secondary. The correct numbers and colors are noted in the pictorial. Although the transformer specified is moderately expensive, there is nothing to prevent you from trying out other cheaper units from your junk box. Just remember the transistor terminals connect to the low impedance secondary of the transformer.

When control R1 is at maximum resistance, flash frequency is greatest. At minimum resistance, the flash frequency is low with several seconds between flashes. Battery life is approximately equal to its shelf life.

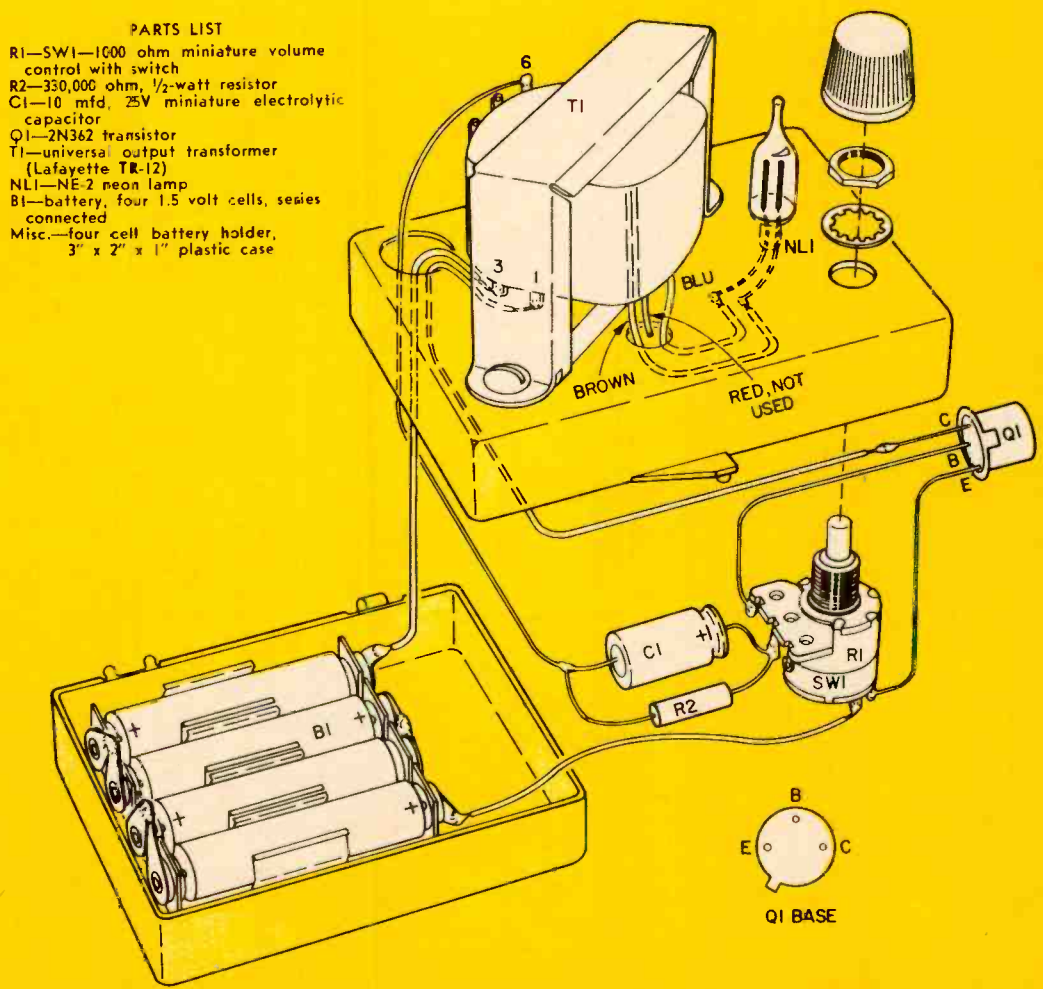
The battery holder terminal lugs must be bent over and soldered together to form a *series-connected* circuit. It's also a good idea to fill the battery holder contacts with solder to assure good contact with the cells when they're inserted.



Low voltage pulse from transistor Q1 is stepped-up by transformer T1 to fire neon lamp NL1. R1 controls flashing cycle of neon lamp.

PARTS LIST

R1—SW1—1000 ohm miniature volume control with switch
R2—330,000 ohm, ½-watt resistor
C1—10 mfd. 25V miniature electrolytic capacitor
Q1—2N362 transistor
T1—universal output transformer (Lafayette TR-12)
NL1—NE-2 neon lamp
B1—battery, four 1.5 volt cells, series connected
Misc.—four cell battery holder, 3" x 2" x 1" plastic case



SIXTEEN-PAGE SPECIALS

ABC's of Electronics (F) ..... 65 May 60
Boat Electronics, Small (F) ..... 65 Aug. 60
Computer, Build a; Benrey (C) ..... 65 Jan. 60
Loudspeakers and Enclosures (F, C) ..... 67 Nov. 60
Novice Ham Station; Buckwalter (C) ..... 69 Sept. 60
Organ, All-Transistor; Maynard (C) ..... 65 Mar. 60
Power Supplies, Build and Design; Pollack (C) ..... 65 Feb. 60
Photography (C, F) ..... 65 July 60
Schematic Diagrams, How to Read; Pollack (F) ..... 67 Oct. 50
TV, How to Fix Your (F) ..... 65 Apr. 60

TAPE RECORDING

See also *Kits*
Electronic Age School (F) ..... 64 Mar. 59
Prerecorded Hi-Fi Tape (F) ..... 92 Jan. 60
Sleep-Learning; Eisenberg (F) ..... 42 Mar. 60
Sound Movies; Zuckerman (F) ..... 82 Sept. 59
Sound to your Movies, Add; Zuckerman (F) ..... 60 Dec. 58
Tape Cartridges; Eisenberg (F) ..... 38 Mar. 59
Tape Cartridge Player (F) ..... 36 May 59
Tape Cutoff; Wayland (C) ..... 60 Sept. 58
Tape off the Air (C) ..... 31 May 59
Tape Recorder, Improve Your; Anderson (F) ..... 72 Dec. 58
Tape Recorder, How to Buy (F) ..... 48 Jan. 60
Tape Recorder Interference (Brain) 94 Feb. 60
Tape Recorder on Vacation; Gorman (F) ..... 64 Aug. 59
Tape Recorder Tune up; Comstock (F) ..... 104 July 60
Tape Recorders, New Tiny (F) ..... 34 Feb. 50
Tape Spillover (C) ..... 52 Feb. 59
Telephone Recording Beeper; Frye (C) ..... 53 Dec. 58
$30 Tape Recorder (F) ..... 90 Sept. 58
Tape Tricks; Zuckerman (F) ..... 62 Nov. 60
VU Meter, Add a; Kolbe (C) ..... 49 June 60

TELEVISION

Antenna for Channel 3-5 (C) ..... 62 Jan. 59
Antenna Hints (C) ..... 83 May 59
Antenna, How to Install (C) ..... 36 July 59
Antenna Matching (C) ..... 82 Apr. 59
Battery Operated TV Sets (F) ..... 30 Aug. 60
Camera Tube, Sensitive TV (F) ..... 57 Apr. 60
Conventions, 1960 Political (F) ..... 25 Aug. 60
Educational TV; Gregory (F) ..... 27 Jan. 59
Headphones for TV (C) ..... 84 Nov. 58
Hi-Fi Sound from TV; Wynn (C) ..... 43 Apr. 59
Interference Filter, TV (C) ..... 52 Nov. 59
Picture Tubes, Rebuilt; Delman (F) ..... 59 Nov. 59
Portable, Transistor TV (F) ..... 34 Nov. 59
Repairs, TV
Fix Your TV Set; Herrick (F) ..... 63 Nov. 58
Fix Your TV Set; Greenberg (F) ..... 81 Dec. 58
Fix Your TV (F) ..... 65 Apr. 60
Picture Tube, Change Your (C) ..... 32 Mar. 59
Tubes, Check Your TV; Herrick (C) ..... 72 Oct. 58
TV Overload, Eliminate (C) ..... 86 May 60
Screen, World's Smallest TV (F) ..... 82 Mar. 60
Station, World's Smallest TV R. Hertzberg (F) ..... 40 May 58
Tape Takes to Road, TV (F) ..... 68 June 60
Torture Test (F) ..... 82 June 60
TV Around the World; Frieborn (F) ..... 88 Feb. 60
TV in Your Car (F) ..... 43 Sept. 58
TV Inputs (C) ..... 94 Feb. 60
TV Over the Horizon; Hindley (F) ..... 78 Aug. 59
TV, Report on Community (F) ..... 90 Jan. 59
TV to Circle Globe; Johnson (F) ..... 68 July 58
TV, New Look (F) ..... 41 Oct. 58
TV Top Hot for Doctor (F) ..... 86 Sept. 59
TVI, What You Can Do About; Smith (C) ..... 40 Oct. 60

TEST EQUIPMENT

See also *Courses* and *Kits*
Alignment Generator CB; Cohen (C) ..... 47 Aug. 60
Ammeters, How to Check (Brain) ..... 61 Dec. 59
Cable Adapter, Universal; Trauffer (C) ..... 100 Feb. 60
Capacitor Checker, Electrolytic; Winklepleck (C) ..... 81 Aug. 60
Check Your RPM's; Wayland (C) ..... 65 Sept. 58
Galvanometer (Brain) ..... 86 Mar. 59
Ham Station Monitor; Doherty (C) ..... 57 Oct. 58
Hi-Fi Tester; Pollack (C) ..... 64 Apr. 59
Meter, Protect Your; Winklepleck (C) ..... 60 Mar. 59
Ohmmeter Circuit (Brain) ..... 82 Oct. 59
Power Indicator, CB; Hollander (C) ..... 32 June 59
Probes, Make Your Own; Rocke (C) ..... 56 Feb. 60
Protect Your Meter; Winklepleck (C) ..... 60 Mar. 59
Radio-TV Troublefinder; P. Hertzberg (C) ..... 82 Nov. 59
RF Field Indicator; Pollack (C) ..... 81 July 60
Signal Generators; Eisenberg (F) ..... 58 Oct. 59
Signal Pencil; Winklepleck (C) ..... 74 June 60
Stop That Capacitor Leak; Wayland (C) ..... 96 July 60
Test Bench Control Panel; Johnson (C) ..... 59 Sept. 60
Test Equipment Theory (See *Courses*)
Test Instrument, 39c; Stanley (F) ..... 76 Dec. 58
Transistor Tester (F) ..... 82 May 58
Transistor Tester; Benrey (C) ..... 48 May 60
Voltmeter, Electrostatic (Brain) ..... 56 June 60
VTVM Theory (F) ..... 82 July 58
Wattmeter, Wide Range; Jurgen (C) ..... 86 June 60

F—Feature Articles
C—Build-it Projects
Brain—Electronic Brain

Electro-Magic in March *El*

TV Interference

Continued from page 63

output is being squandered on several frequencies, and you really want it concentrated on your 27-mc fundamental, for communication.

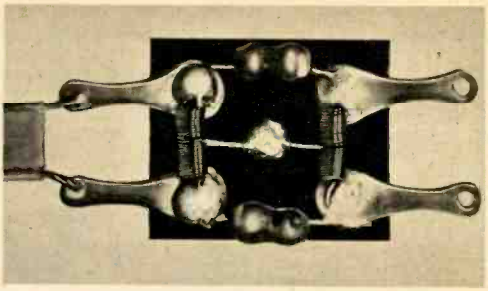
The TV channels begin at 54 mc, which is the second harmonic of your signal. 81 mc falls inside channel 6. The FM band and "utility" stations between channels 6 and 8 can be affected, too. So can the "high" TV channels. It's horrible to contemplate.

Notice that we said that harmonics *can* be produced. If they are being *transmitted*, you are at fault in a TVI complaint, maybe not wholly at fault, but enough for your neighbor to raise a ruckus with the FCC. When you transmit harmonics you are radiating radio signals on frequencies not allocated for the Citizens Radio Service, which, of course, makes your station's operation illegal.

As your CB rig is commercially manufactured, you may presume that the manufacturer has made a reasonable effort to design a set which will keep his customers within the law. If you have already determined that your transmitter's crystals are good and that the set is tuned for its maximum output (a properly tuned transmitter is less likely to produce harmonics) your best bet is to obtain one of the commercially made "low pass filters." A low pass filter is a small gizmo which is connected by a short length coaxial cable to the antenna jack on the rear of your rig. The antenna lead-in is then attached to the filter instead of directly to the rig. The function of a low pass filter is, as its name implies, to prevent all but signals lower than its cutoff frequency from leaving the transmitter. A filter with a 40- or 50-mc cutoff will permit your 27 megacycle fundamental signal to radiate freely while smothering its potentially annoying second, third, fourth, seventh and eighth cousins.

If, after a low pass filter is installed, the TVI still continues, then chances are that the fault lies in the TV receiver (although your transmitter may have been jointly at fault before you filtered the output). The TV set is supposed to reject non-TV signals, but not all can be depended upon to do that job.

There are several reasons why a fundamental frequency CB signal can blitz a TV set. One may be that your transmitting antenna is so close to the TV antenna that your signal overwhelms (or "overloads") the delicate circuitry in the TV set. Once



The completed high pass filter. "Chassis" is a piece of insulating material such as Bakelite.

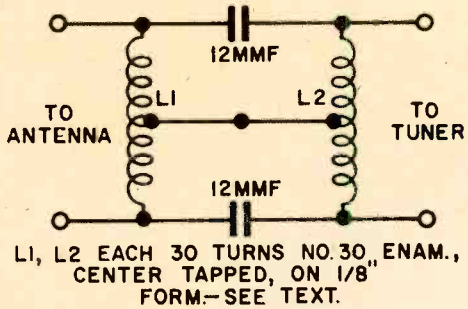
inside the TV receiver the signal causes the set itself to generate harmonics. It's also possible for the TV set to overload from "cross modulation." This means that your 27 mc signal "mixes" *inside* the receiver with the signal from another station on a higher frequency. If the other station happens to be in the FM broadcasting band it could cause interference on TV channels 2, 3, or 4. Should your signal mix with a TV station on channel 6, interference would be caused on channel 2. The above forms of TVI will occur only on certain channels—some will remain clear.

Possibly the most common cause of TVI is when a fundamental frequency CB signal leaks into the TV receiver through the intermediate frequency ("IF") amplifier. Some older TV sets have IF circuits *tuned* to 27 mc, which is already resonant to the fundamental frequency of your CB rig. This leaves a veritable "open door" for any reasonably strong CB signals to sneak in. This type of TVI, which is characterized by the interference appearing on all TV channels, is *always* the fault of the TV receiver.

Just for kicks you can fiddle with the TV set's fine tuning control to see if you can tune out the TVI. Sometimes this works. However, if this fails (and if I know your luck, it will), you'll have to use a little psychology.

The task of de-TVI'ing receivers belongs to the TV service industry. In other words, if the TVI is definitely due to inadequate IF rejection in the TV receiver you should not, under any circumstances, offer or attempt to correct it. Nor should you agree to foot the bill for the set's work by a technician. It is the sole responsibility of the TV set owner to maintain his equipment so as to provide him with satisfactory service. You can, however, suggest a TV technician for the owner to call.

The TV service technician will probably install a "high pass filter" in the TV set's antenna circuit. It works like the low pass filter, only in the opposite direction; the



Circuit of a simple, cheap high pass filter to be installed at TV set's tuner input terminals.

high pass filter will permit only signals on TV frequencies to pass while rejecting unwanted lower frequency signals. In order to be fully effective this filter should not be installed at the antenna terminals on the rear of the TV set, but wired directly across the set's tuner input. It might be worthwhile for you to keep one of these gimmicks around your CB station so that you can take it over to your neighbor's place to prove, by demonstration, that the corrective measures are on his shoulders and not yours. For demonstration purposes, the filter can be hooked to the receiver's antenna terminals. Tell him what you have hooked up but don't sell him your filter. Let the service technician do the work, so that if the picture tube blows in two years nobody can blame your tinkering.

An inexpensive high pass filter may be constructed from the diagram. (The same unit is manufactured by Regency as their Model HP-45. It sells for less than a dollar from most electronics supply houses.)

To make this unit (which was originally described in General Electric's "Ham News") all you need is a piece of insulating board (bakelite, lucite, anything!) 1x1¼ inches in size, five 4-40 screws (½" or even smaller), four solder lugs, two 12 mmf capacitors, a few feet of #30 enamel wire, and something for ⅛" coil forms—say a couple of old 2-megohm resistors. Drill screw holes near each corner—a quarter inch from the edges—of the board, and one in the exact center. Fit the holes with brass screws—use nuts, of course—putting soldering lugs under each corner screw. Solder your capacitors to the screw heads according to the diagram and photo.

Take two pieces, each 15" long, of the #30 wire. Fold each in half and scrape off half an inch of enamel at each fold. Taking each wire, solder the stripped sides together and bend up at a right angle. From the bend, measure off 6⅜", cut, and tin about ⅛" at each end. Each coil is wound on one of your ⅛" forms, starting from one end of each wire. Now you have two center-tapped coils, about 30 turns each. Solder the ends of the coils to the corner screws and the center taps to the middle screw, and *voila!* you have a high-pass filter.

Another solution (if your CB antenna and the TV antenna are near each other) is to lower the TV antenna until it is below the radiating section of the CB antenna. It might also help to change the TV set's lead-in from 300 ohm twin-lead to coaxial cable.

Closely akin to TVI is "P-I"—CB interference on phonographs and radio output sections. The cure is a 100,000 ohm resistor in series with the grid of the unit's first audio amplifier tube. Let the complainant have a service shop install it.

One final word, before you go through the whole bother with the filters and the explanations. You might do well to go over to your neighbor's house and take a gander at the interference on the receiver in question. Possibly it isn't even being caused by your station. It might be motors, a taxicab, a police car, diathermy, industrial equipment, appliances, a ham, auto ignition, another CB'er, another TV set's oscillator, or even a dying tube within the guy's own TV set—especially if he gets interference when you're not on the air!

Intermediate State Study

The "intermediate state" between superconductivity and normal conductivity is being studied by a new technique developed at the General Electric Research Laboratory, Schenectady, N. Y. A combination of optical and magnetic methods enables scientists and engineers to see, directly and literally, the condition of materials in the "intermediate state." In this state some of the material is superconductive while some is normally conductive—some has absolutely no electrical resistance while some has normal resistance. The way materials pass through the "intermediate state," or fall into it because of strong magnetic fields, depends on impurities and metallurgical treatment. Since superconductive materials are expected to find heavy use in computers, missile and space guidance systems, etc., this state is of great importance to the designer as well as to the scientist.

Sun-Powered Life Saver

Continued from page 82

"instructed" to monitor ski trails, indicate a pleasure boat's position or read gauges of distant, unattended industrial processes.

● Installed along ski slopes, solar transmitters promise to turn electronic Saint Bernards, cutting rescue operations by hours.

● Rangers in our National Parks and Forests see the wireless, sun-run transmitters as low-cost lifeguards in America's most rugged wilderness country.

● As silent sentinels at hundreds of isolated emergency landing fields, the transmitters would bail a downed pilot out of his predicament . . . even though storms had cut telephone communications.

● A single $300 solar-transmitter, set in an oil company's isolated tank farm, can pick up trouble signals from pumps and motors, warn engineers at distant field offices.

● But it's along our turnpikes, toll roads and freeways where the sun-system bids to save your life and mine . . . and without the costly necessity of overhead wires or buried cables essential to telephone call-boxes. Engineers figure it costs about $8000 a mile to install a freeway with emergency telephones. By contrast, eight solar-transmitters (sited a quarter mile apart each side of the turnpike) can be installed for less than $3000 a mile.

A storm-caused power failure could not put the solar system out of action.

Grins an engineer for Hoffman Electronics, "the only major 'power' failure that would affect them . . . would be if the sun burnt out."

The transmitters—frequency shift modulated—put out about 1 watt. Although the FCC hasn't yet assigned a system frequency, prototypes are tesing on 72-76 megacycles.

As many as 1000 transmitters can beam emergency-coded signals (each containing 25 data "bits") to a single narrow-band receiver (typical: a modified standard 14-tube FM receiver). In highway nets, the receiver feeds a solid-state digital decoder which both prints the message (on tape) and displays it visually on a monitor board.

The five silicon solar cells—mounted atop a 20-ft. coaxial antenna to keep them from the reach of vandals—are the same type Hoffman supplies for U. S. space satellites (thus the name, "safety satellite").

The power for a single 1.5 second emergency message is generated by about five minutes of sunlight. During solar recharging, a transmitter's six nickel cadmium batteries are in parallel. For sending, batteries are switched in series, five of them powering the transistorized power supply, the other energizing tube filaments and supplying keyer voltage.

A transmitter's printed code circuit can be quick-changed to send almost any message. Industrial engineers, for example, may want pressure readings one day, temperature data the next. To get it, they merely plug into the circuit a small button called a "code plug."

Substituting Code Plug X for Plug Y might, for instance, "instruct" the transmitter to monitor only process temperatures where, previously, it had watch-dogged flow rates and pressures.

Plugs make appropriate connections in pre-printed circuits. Dozens of different message circuits may be pre-printed on a transmitter's code board.

Says one process engineer, whose company plans shortly to install "safety satellites" at a remote tank farm, "substitute circuitry data plugs . . . and you change the whole pattern of data . . . without changing a single wire or calling in an expert to 'program' the device."

So far-spanning a monitor system carries a modest price tag: about $300 for the solar-powered transmitter, another $250-$275 for the FM receiver. More complex decoding and display consoles, however, can up the monitor station tab to $3000. This is not expensive for industrial or public installations.

Solar Modules

"Solar Modules," containing five shingled, plastic-encased silicon solar cells, are announced by the Semiconductor Division of Hoffman Electronics Corp. They can be used separately or arranged in series, parallel, or series-parallel combinations to meet particular output requirements. Tabs at each end of the plastic case carry terminals and battery polarity markings. Type H5B provides 32 ma. at two volts (64 milliwatts) and Type H5C supplies 42 ma. at two volts (84 mw) in sunlight at an illumination level of 100 mw per square centimeter. They can also be used in "electric eye" applications in artificial light. Prices: H5B, $16.00; H5C, $22.40. Hoffman Electronics Corp., 3761 South Hill St., Los Angeles, Calif.

Brain Surgery by Ultrasonics

Continued from page 57

scopes. He throws a master switch, sending the amplifiers' output energy down several shielded cables inside the mechanical arm to energize the four "microphones" touching the patient's head.

But the "microphones" are actually ultrasonic transducers, "loudspeakers" of a sort. Instead of changing sound waves into electrical energy, they do just the opposite. They begin to vibrate and emit ultra-high frequency waves.

Except for the hum of the electronic equipment and the slow, steady breathing of patient, the room is quiet. The "sound" waves flooding the room have frequencies up to a million vibrations per second (1000 kc), far above our range of hearing.

Each transducer sends a separate beam of ultrasonic waves into the patient's brain. As *EI's* readers know, ultrasonic waves can be focused like light waves. Special acoustical lenses, mounted at the end of each transducer, focus the beams upon a single point.

Deep within the patient's brain, the cancerous cells begin to vibrate as they are bombarded by the ultrasonic waves. The vibration produces heat which kills the diseased cells.

In a matter of seconds, an automatic timer shuts off the electronic equipment. One of the most delicate surgical operations has been performed without even scratching the patient's skin!

The credit for the development of the equipment which makes electronic brain surgery possible goes to a remarkable research team of two brothers at the Biophysical Research Laboratory in the University of Illinois College of Engineering.

Professors Frank and William Fry are members of a new breed of electrical engineers who are busy applying some of the latest developments in electronics to the advancement of medical science.

Instead of the conventional scalpel, as old as surgery itself, they envisioned an invisible scalpel—a narrow, powerful beam of ultrasonic waves penetrating the brain and destroying diseased cells. They knew that such an electronic scalpel would be able to probe many regions of the human brain formerly forbidden to surgeons—perhaps saving countless lives.

At first glance it appeared to be an impossible feat. If they kept the energy at a "safe" level, the energy waves would harmlessly pass through the brain without damaging either diseased or healthy tissue. If they applied a much stronger beam of waves, it would destroy almost every cell through which it passed.

In other words, a beam sufficiently powerful to do some good would "bore" a tunnel of destruction right through the brain. The solution was to use two or more weak beams that met right at the target. No single beam would be powerful enough to do any damage, yet when they met their combined energy would destroy everything in the target area. However, ordinary mechanical controls weren't accurate enough to make the scheme work.

The answer, of course, was in electronics. Not only could precision electronic controls accurately aim the ultrasonic beams, they could also measure their intensity and time the exposure. A surgeon using the equipment by itself would be operating blind. Electronic eyes and hands, however, enable him to enter the deepest part of the brain.

Now came the hard part of the project. The Frys had to teach surgeons how to operate with electronic controls. Once brain tissue is destroyed, it is gone forever. Only a brain surgeon is prepared to accept the responsibility for the use of the equipment in an actual operation. The electronic technician can only make sure the surgeon's tool won't fail him at a critical moment.

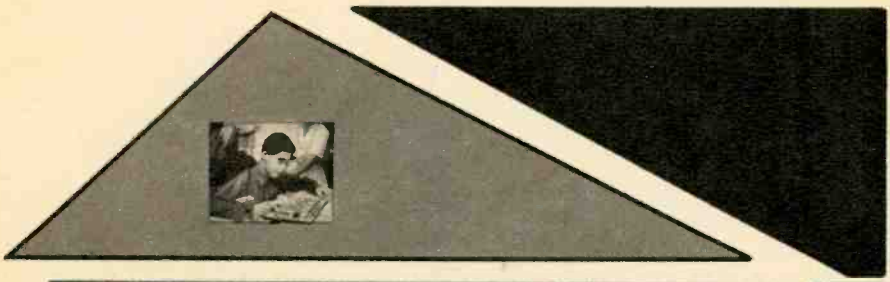
Years of animal experimentation had to be performed before the Frys were convinced their equipment was reliable and safe. Then came the big day. For the first time in medical history, a completely electronic operation was to be performed. The patient was a man suffering from Parkinson's disease, an ailment in which a nerve center of the brain is attacked, causing the person to tremble constantly. The ultrasonic beams passed through the patient's brain and for the first time in years his hands stopped shaking. Frank and William Fry then and there received their reward for almost ten years of hard work.

Although the University of Iowa Hospital is the first institution to perform electronic surgery on a routine basis, the University of Chicago, MIT, and the Burden Neurological Institute in England are but a few of the other places where scientists are experimenting with this unusual application of electronics. In the near future, electronic operations may be performed on other parts of the body. Electronic surgery spells new hope for sufferers from many diseases—including patients for whom little or nothing could be done only a few years ago.

THERE'S A NEW HEATH KIT FOR EVERYONE IN THE FAMILY!

NOW ONLY
HEATH
BRINGS YOU
ALL 3!

1. HEATHKIT for do-it-yourself hobbyists
2. HEATHKIT factory-built, ready to use
3. HEATHKIT learn-by-doing Science Series for youngsters

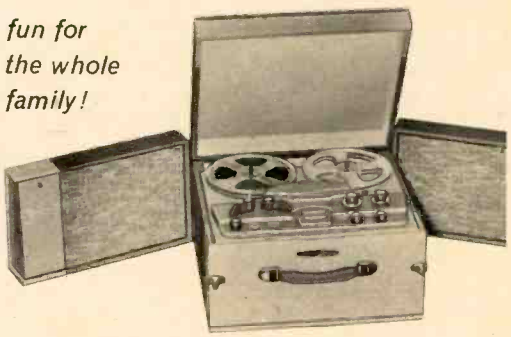


PORTABLE 4-TRACK STEREO TAPE RECORDER KIT

The whole family will be brought together for delightful hours of home tape recording in 4-track stereo! And you'll enjoy the treasures of prerecorded tapes in sparkling, life-like stereo! Two speeds (3¾" and 7½" per second). Controls for complete command of tone and stereo-balance. Can even be used as a "hi-fi" center to power and control tuners and record players. Stereo speaker wings are detachable. Preassembled tape mechanism and cabinet. 9¼" H x 22¼" W x 14" D. 49 lbs.

Model AD-40...$18 dn., $16 mo.....**$179.95**

fun for the whole family!



fits space & dollar budgets

COMPLETE STEREO-PHONO CONSOLE—WIRED OR KIT

Less than 3' long and end-table height, yet its 6 speakers assure life-like stereo sound! The 4-speed automatic stereo/mono record changer with diamond and sapphire styli has a special anti-skate device to protect your records. Concentric volume and separate dual bass and treble tone controls are easily reached on the front. The cabinet has a solid walnut frame and walnut veneer front panel with matching "wood-grained" sliding top. Whether you buy in ready-to-play or kit form, the cabinet is factory assembled and finished; to build the kit just wire the amplifier and install the changer and speakers. 31¾" L x 17⅝" W x 26¾" H. 70 lbs.

Model GD-31 (kit)...$13 dn., $11 mo.....**$129.95**
Model GDW-31 (wired)...$15 dn., $13 mo.....**$149.95**

HEATH COMPANY / Benton Harbor, Michigan

HEATHKIT DAYSTROM

top value in

portable stereo!

STEREO/MONO PORTABLE PHONOGRAPH KIT

From Jazz to Classics, the younger set will have stereo wherever they go! Plays either stereo or mono records with equal brilliance and fidelity. Top quality 4-speed automatic changer with turnover diamond and sapphire stereo cartridge. Detachable stereo speaker wing. Complete tone and stereo balance controls. Record changer and cabinet are factory-assembled . . . just wire the amplifier and install components. 15½" W x 18" D x 8¾" H. 28 lbs.

Model GD-10...$7 dn., $7 mo.....**$69.95**

MONEY BACK GUARANTEE

Heath Company unconditionally guarantees that each Heathkit® product, whether assembled by our factory or assembled by the purchaser in accordance with our easy-to-understand instruction manual, must meet our published specifications for performance or your purchase price will be cheerfully refunded.

HI-FI RATED 50-WATT DELUXE STEREO AMPLIFIER

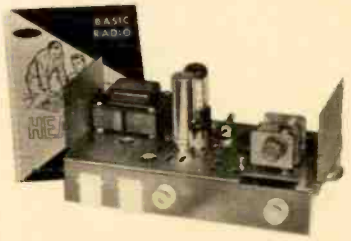
For finest stereo, two 25 watt channels jam-packed with extras: mixed-channel center speaker output; "function selector" for any mode of mono or stereo operation; "stereo reverse"; "balance" and "separation" controls; ganged volume controls; and separate concentric bass and treble tone controls. 5½" H x 15¾" W x 13½" D. 31 lbs.

Model AA-100 (kit)...$8.50 dn., $8 mo.....**$84.94**
Model AAW-100 (wired)...$14.50 dn., $13 mo....**$144.95**

HEATHKIT BASIC RADIO COURSE

Here's a new 2-part series in basic radio for youngsters and adults! "Basic Radio—Part 1," available now, teaches radio theory in everyday language, common analogies, and no difficult mathematics. Actual experiments are performed with radio parts supplied which result in a genuine regenerative radio receiver. "Part II" of the series, which will be ready March 1, advances your knowledge of radio theory and supplies additional parts to extend your Part 1 receiver to a 2-band superheterodyne circuit.

Model EK-2A, "Part 1", 8 lbs.....**$19.95**



2-way radio

for everyone!

"WALKIE-TALKIE" CITIZENS BAND TRANSCEIVER

Mom, Dad and the kids will go wild over this fun-to-use, yet highly practical and dependable set. No license required . . . anyone can use this 2-way radio! Operates up to a mile between units . . . more with regular Citizen's Band stations. It's ideal for hunting, fishing, boating, around home . . . most anywhere you need 2-way communications. Features 4-transistor circuit; fixed-tuned super-regenerative receiver and crystal-controlled transmitter. 6½" x 3¼" x 2⅛". Less battery. 3 lbs.

Model GW-30 (kit)...$3.30 dn., $5 mo.....**$32.95**
Model GWW-30 (wired) $5.10 dn., $5 mo.....**$50.95**

HEATHKIT DAYSTROM

ORDER DIRECT BY MAIL OR SEE YOUR HEATHKIT DEALER

ORDERING INSTRUCTIONS

Fill out the order blank below. Include charges for parcel post according to weights shown. Express orders shipped delivery charges collect. All prices F.O.B. Benton Harbor, Mich. A 20% deposit is required on all C.O.D. orders. Prices subject to change without notice.

HEATH COMPANY
Benton Harbor 39, Michigan

Please send the following HEATHKITS:

ITEM	MODEL NO.	PRICE

Ship via ( ) Parcel Post ( ) Express ( ) COD ( ) Best Way
( ) SEND MY FREE COPY OF YOUR COMPLETE CATALOG

Name_____

Address_____

City_____ Zone____ State_____

Dealer and export prices slightly higher.

FREE CATALOG!

Send today for your copy of the 1961 Heathkit catalog describing over 200 do-it-yourself and factory-built items in hi-fi, ham radio, test, marine and general fields.

Courier Satellite

Continued from page 30

a system of *circular* polarization.

By polarizing the command signals from the ground circularly, the satellite always receives a signal, regardless of its orientation or the Faraday Effect shifts. In addition, by receiving the Courier's transmitted energy at the ground station on complex antennas polarized in many planes, and combining their energy in phase before feeding it into the receiver, the satellite signals are recorded without interruption.

Apart from the many other remarkable electronic "firsts" achieved by Project Courier, this system of circular polarization for transmission and reception stands by itself as a feat of radio engineering. For even though the Faraday Effect decreases as frequencies are raised, the effect is still noticeable through the VHF channels. Only above about 2,000 megacycles does it become negligibly small. The reason for this is that higher frequencies have greater energy and smaller wavelengths. They can more easily penetrate the spaces between molecular and atomic particles of the atmospheric gases.

On the other hand, microwaves, as everyone knows, are normally a *line-of-sight* proposition. They do not follow the Earth's curvature, and are not reflected by atmospheric layers. They behave like visible light: solid objects "shadow" them, and they cannot be detected "below the horizon."

Microwave communications are more dependable and freer from atmospheric interference than all other kinds of radio communication. The big problem is in overcoming their line-of-sight-limitation. Courier solves that. In the process it has also solved many other formidable problems inherent in communications via space.

An outstanding example is the self-sufficiency of Courier. It has a power source of almost 20,000 solar cells. Its control circuitry rejects any command or query not properly coded. In other words, it cannot be jammed, either accidentally by interference or consciously by a potential enemy. Through "redundant" components, it "carries spare parts" for repairing itself.

The specially developed equipment aboard Courier for storing information can handle three and a half million data "bits" per minute. (*Bit* is jargon for an information element.)

Courier 1-B can also be used for "real time" transmission: the simultaneous reception and retransmission of messages or facsimile images between any ground stations visible to the satellite.

This last-described achievement proves the *feasibility* of instantaneous worldwide communications, including television. In fact, Courier is "merely an experiment." It is part of a much more advanced program now being worked out by the Department of Defense and the Army's Signal Research and Development Laboratory, at Fort Monmouth, New Jersey. The total program is called *Project Advent*. Its aim is to place three Courier-type satellites in "stationary" orbits about the Earth before the end of this decade.

If three such satellites could be accurately spaced around the world in an orbit 22,500 miles above the Equator they would remain always above the same spot on the Earth, and every square inch of the globe would be in sight of one or another of them. (They would seem stationary because, at that distance, it would take them 24 hours to circle the planet—which is turning on its axis at the same rate.)

The present Courier, in its 600- to 750-mile orbit, can handle three and a half million words daily. This is nearly equivalent to the wordage handled by America's combined major news services. It includes what is carried by all transcontinental main news trunks, financial, sports, and special-purpose wires, regional and state loops and the ocean cables plus the radioteleprinter circuits of all foreign bureaus.

Imagine the savings in time, money and accuracy if the news alone were instantaneously transmitted from one part of the world to another via Advent's three orbiting active-repeater stations high above the Equator. The cost of maintaining millions of miles of cables would be eliminated. Costly breakdowns and delays because of electrical storms would be unknown.

Yet this is only one aspect of Project Advent. There are many others. The most important, naturally, is global military communications to maintain the security of the free world. There is also the fact that telephone communications could be extended to the most remote regions on Earth. What a benefit this would be to scientific expeditions! (*It might also be a curse.—Editor.*) It would certainly help to stimulate the settling and exploitation of remote places rich in natural resources.

For the success of the even more ambitious Project Advent, the rocket is also already available—the Martin-built Titan ICBM. It only remains for the electronics researchers to design and "prove out" their equipment. They are working on it now.

To The Moon

Continued from page 33

to the probe will originate from there.

Power for all equipment is provided by solar cells on the vehicle's "paddle wheels." These convert about 8 per cent of the energy striking them into electricity, which is stored in batteries to keep the supply even and constant in spite of the spinning of the probe and of passes through the Moon's shadow. The minimum lifetime of the system is one year.

A remarkably simple and clever temperature control system keeps Pioneer's internal temperature from swinging to the wild extremes caused by space conditions. Past space probes have used patterns of light and dark paint or finishing to reflect and absorb solar energy in the right proportions. The fixed pattern treatment doesn't work very well. Pioneer VI uses propeller-like shutters to vary the proportions of light and dark areas as needed. Each propeller is shaped like a Maltese cross and partly covers a circle divided into alternating white and black areas—two interwoven Maltese crosses. Each one is turned by its own temperature sensor, a bimetallic spring that bends in one direction when heated, in another direction when cooled. Each sensor tends to keep itself at a "comfortable" temperature by turning the propeller vanes to cover and expose more or less white or black finish.

Pioneer VI's space guidance system is one of its most interesting and important features. For the first time in history, a lunar probe has its own control rockets. Pioneer has two. By command from Earth, either nozzle can be fired to speed up or slow down the hurtling ball, and give it the right speed for "falling" into an orbit around the Moon. (Alternatives: swinging past the Moon because of too great a speed, or crashing on the Moon, Lunik II style, because of too little speed.) The decision to make the firing depends on Pioneer's position and speed at certain critical moments. Position is determined by the bearing of the tracking antennas plus knowledge of Pioneer's speed.

Pioneer's speed is measured by a Doppler system. The Doppler Effect is famous, and not hard to understand: the frequency of any kind of radiation from a moving object seems to *shift*. The favorite example given is the locomotive bell on a train passing a railroad station platform. Its pitch rises as the moving bell approaches a listener on the platform, drops abruptly as it passes and moves away. This is because the speed of sound in air is constant, at any given moment, and approaching sound waves crowd together, receding waves spread apart. The same is true of radio waves. The speed of electromagnetic (radio or light) waves in space is a constant 186,300 miles per second, no matter how fast or slowly their source is moving. For a transmitter in a lunar probe moving away from the Earth, each individual wave will be "spread" a little farther in space from the one emitted before it. Since the speed of all the waves is constant, the probe's radio waves will arrive at Earth spread out *in time* as well as in space. Thus their frequency will have *shifted* to a lower value. Measuring the shift accurately measures the speed; speed times time gives distance.

Interestingly, Pioneer VI carries no television or film equipment, unlike our earlier Moon probe designs or Lunik I, which took pictures of "the back of the Moon." This will infuriate some people: those who feel we must show the world that we can do whatever the Russians do. The furious ones probably number most of the people who felt we didn't need space-exploration programs at all, until after Russia launched her first two Sputniks. Since we can certainly build TV satellites (we originated them) and can put a satellite into lunar orbit, there is no question whether we can put a TV satellite into orbit about the Moon.

The most useful satellite ever launched has turned out to be Vanguard I, the 8-pound "grapefruit" satellite that went up two years ago, our second successful launching. It is still "beeping," as it may for a century, and it may stay up for a thousand years. It is still being observed closely. More has been learned from this one simple "bird" than from all the thirty-odd satellites we and the Soviet Union have launched put together. Pioneer VI will likewise circle the Moon for centuries, since there is no atmosphere to hinder it. When men are building bases on the Moon, Pioneer VI will still be giving them valuable information.

History will probably credit the United States with the "invention" of space science *provided* we stick to our policy of putting up scientifically useful spacecraft, rather than striving for propaganda feats to impress the ignorant. Crashing Lunik II on the Moon was sensational, but was simply like shooting a man. Orbiting a satellite around the Moon is more like shooting a cigarette out of a man's mouth, and then requiring the bullet to circle his head endlessly and report on his reactions.

Tape Recorder Doctor

Continued from page 59

"consulting room," where he earns upwards of $15,000 a year—and he has never lost a patient.

The average tape recorder needs an electronic examination about every 18 to 24 months (average overhaul costs $20-$30). And there simply aren't magnetic specialists enough to handle all the patients. Last year, for example, some 500,000 tape machines were sold, their value pegged at $80,000,000. Yet back in 1954, when home tape units first hit the market in quantity, not more than 100,000 were produced. At first, their owners generally turned them over to any handy electronic repairman.

But as tape machines grew more complex and higher in fidelity, more specialized and complex became their electronic ailments. Increasingly, recorder owners, private citizens and corporations alike seek out the specialist like Stan Hatfield, whose Hatfield Electronics, in Los Angeles, makes a year-round business of magnetic recorder repair. Also in need of the specialist are the several score recorder makers who must provide service-after-sales for their customers.

Admittedly, a few tape makers field their own service staffs. Such self-servicing applies mainly to dictating tape machines (the office-common variety). Most other makers look to independent electronic servicemen.

"Latch onto a few service warranty deals, where you backstop a tape maker's 90-day to 1-year warranty," says Stan, "and you'll find yourself tape-deep in work." One reason this is true is that local retailers refer their customers to you for service.

Hatfield's shop, typically, is warranty headquarters for the German-made Grundigs and for Geloso, the Italian recorder maker. Even though upwards of 50 percent of Stan's annual repair gross stems from these two companies, he's set-up to cure any recorder ailment.

Essential to the tape recorder specialist's kit are a phalanx of machine tools: a lathe (preferably the 10-inch variety for turning parts); a hydraulic press for holing through chassis; and motorized bench saws for customizing consoles. (For a vocal studio, Stan recently wrapped up a $4000 custom job, including installation of a Presto stereo recorder.)

Though Stan picks up some choice custom jobs, it's day-to-day repairs that build his bank account. Hatfield pegs his labor at $6.50 an hour and may bill a customer $26-$30 for the 4-hours it takes to overhaul a precision recorder. He also pockets profits from parts—anywhere from 30-40 percent of their retail price.

Audio accessories not only add to his take, but pay his overhead (about $150 monthly, which includes the $75 rent he pays for about 550 square feet of shop space).

"When it comes to audio accessories," explains Stan, "I stock the works—everything, you might say, except tape recorders themselves." Microphones—both crystal and dynamic—cost customers $8 to $30, about 40 percent of it profit. The more than 30 varieties of recorder cables in his stock bins sell for $1-$6 apiece, and some of the more complex go higher.

Biggest profits, though, come from magnetic tapes, both unrecorded reels (1200-feet are priced at $3.50, 33 percent of it profit) and the burgeoning "albums"—the tops in recorded music, which cost listeners anywhere from $3.95 to $11.95 (and return Stan a third of their list price as profit).

How do you turn tapes to profit? Hatfield turned tape recorder specialist after a few years as a radio-TV repairman. As a kid he liked to tinker with circuits, and he kept on tinkering through his hitch with the Air Corps during WWII. Out of service, he set up a radio-TV repair shop, and gradually turned to tape recorders.

Hatfield Electronics opened for tape recorder servicing in 1956, backed by a few thousand dollars (most of it invested in test gear and spare parts, including precision resistors, capacitors, and 500,000 assorted items of hardware, from terminal tie points to tube sockets).

CHOOSE YOUR JOB TRAINING—THEN LEARN BY DOING

Exciting work—if you can get it. To land a job as a Telephone Lineman, you need **training.** The kind of training you get through the Army Choose-it-Yourself System.

If you qualify (by passing aptitude and physical exams), this system lets you choose your job training **before** you enlist.

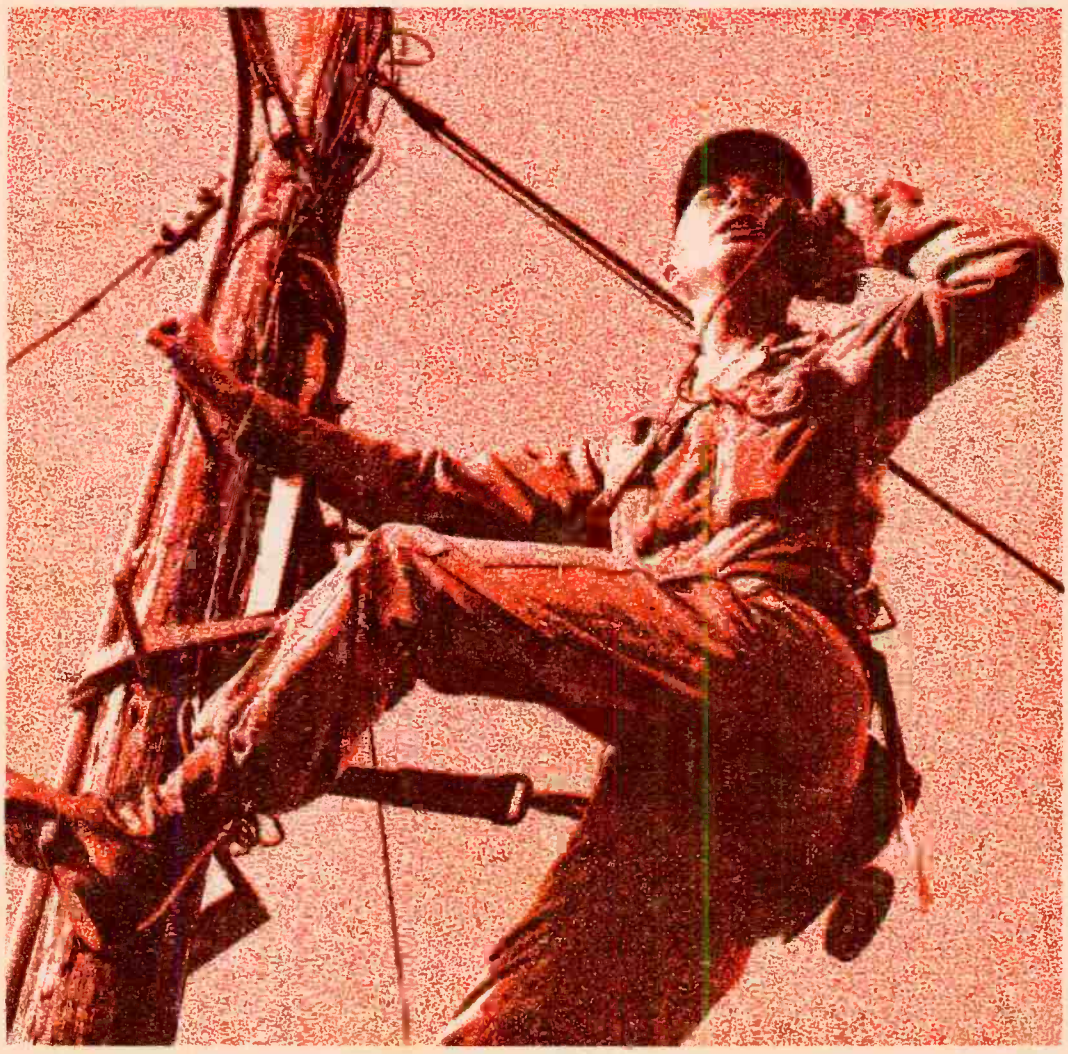
On-the-job or in school, Army training is practical. You learn by doing, and it helps you move ahead fast in the Army.

You can choose from many different kinds of job training. Telephone Maintenance is one possibility. There's also Motor Mechanics, Electronics, Missiles, Military Police, Aircraft Maintenance—to name a few. Ask your Army recruiter to show you a complete list.

Can you qualify for the job training you want? It's easy enough to find out.

Before enlistment. Without obligation.

CHOOSE-IT-YOURSELF VOCATIONAL TRAINING SYSTEM **US ARMY**



The Multi-Strobe

Continued from page 48

tion, permanent single-control calibration may be applied to R4. This is done with the help of a cardboard strobe disc used for checking record turntable speeds. Using a turntable whose speed is exactly 78 rpm, illuminate the disc with the strobe light flashing at its maximum rate. Now back off R4 until the 78 rpm ring becomes stationary and mark the scale either 60 cps or 3600 rpm. Continuing counterclockwise very slowly, a number of other settings will be found for which the ring appears to stop rotating. In order, these are:

78 rpm Ring Stopping Point	Flash Repetition Rate cps	rpm
1	60	3600
2	40	2400
3	30	1800
4	24	1440
5	20	1200
7	15	900
9	12	720
11	10	600
6, 8, 10	no calibration	

Testing

With V1 *only* in its socket, SW1 closed, SW2 open, potentiometers R2 and R4 fully counterclockwise. Measurements taken with 20,000 ohm/volt meter between indicated points and chassis.

V2 socket	Pin #3	500 volts DC	
	Pin #5	0 volts	
	Pin #6, 8	495 volts DC with SW3 undepressed	
		3.5 volts DC with SW3 depressed	
4-prong flash tube socket (V3)	Pin #1	500 volts	
	Pin #2	500 volts	
	Pin #3	0 volts	

Caution: The 80 mf capacitor C1 retains a very healthy charge. While PL1 remains lit, keep your hands out of the circuit! C1 may be discharged by short-circuiting C2 (*not* C1) with an insulated screwdriver after power is removed. SW2 must be open (set to Strobe) during the shorting process

Hot New Prospecting Tool

Continued from page 43

generate audible clicks in earphones. Power source: two 7½-volt batteries.

An ideal space-age metal, beryllium slows neutron bombardment, weighs one-third less than aluminum and is nearly twice as strong. Moreover, its melting point—2,350°F—is twice that of aluminum.

It has some drawbacks. The metal is the cause of an obscure disease, tuberculosis-like in its effects, called berylliosis. It was recognized only a decade or so ago after workers in X-ray tube and fluorescent-lamp factories had come down with it. The metal is no longer used in fluorescent lights but a common form of the X-ray tube uses a beryllium target. Electrons from the filament bombard the target and cause it to emit gamma or X rays, the way gravel hitting a piece of sheet metal will cause it to emit sound. Properly handled, beryllium is safe to work and its strong, light alloys, with their resistance to high temperatures, are finding more and more uses.

Nobody expects a beryllium rush—not, at least, by amateur prospectors. The Berylometer's cost is high and the Atomic Energy Commission must issue you a license to operate the highly radioactive tool. Also, the radioactive source must be replaced about every four months, whether the Berylometer is used or not. Cost of a replacement capsule: about $120.

Berylometers may be seen in many areas because known deposits of the different kinds of ore are distributed throughout the country. The best-known, pegmatite, is a form of granite (containing beryl crystals) found in cracks and fissures of other rocks in fourteen states. Non-pegmatite and non-beryl deposits are found in seven of these as well as five more. About 8000 tons of ore were used in the United States in 1959, but only about 300 tons were mined in this country. A beryllium "rush" currently is on in Utah's Topaz county.

If you are interested in prospecting and are able to ante up the high cost of the equipment (and can get a partner to help you carry it around) your state university's geology department, or your state bureau of mines, can locate the prospecting areas for you. The Berylometer is manufactured by the Isotope Specialties Co., a division of the Nuclear Corporation of America, 170 W. Providencia, Burbank, California.

Dollars from Discs

Continued from page 79

"Sound," says 29-year-old Al Gottschalk, "makes nothing but dollars and sense."

And it can make as much for you.

The Gottschalks' Electro-Vox, at the hub of things audio in Los Angeles, figures that, with all turntables spinning, it can gross upwards of $450 daily. Electro-Vox's annual take from sound: about $100,000.

Recently, for example, the Gottschalks contracted to supply 3000 discs of a high school's spring sing. Working from tapes supplied by the school, they cut a master disc, dispatched it to a local record presser who turned out the production run. The school paid 35 cents apiece for the 8-inch, 33⅓ rpm disc which cost the Gottschalks 18 cents. Profit from so routine a job: $510.

Just as routine was another recent assignment: monitor a half-hour radio speech and put the 30 minutes on record. The Gottschalks billed the client $12.50 for taping the broadcast, another $9 for grooving it into a 12-inch, 33⅓ rpm disc.

This simple assignment required an *Ampex 350* tape recorder (cost: about

$1450), a dubbing table (price-tagged $500-up) and a disc recording machine (priced from $1000 up, depending on the model, and whether you purchase it new or used).

Actually, however, many a local sound man grubstakes his audio career with only a few thousand dollars. Rather than expensive Ampex units he substitutes low-cost but serviceable home-type tape machines. He shop-fabs his own dubbing table —builds his own turntable, amplifiers and audio-mixing console.

He doesn't necessarily invest in a disc recorder. Instead, he sends his tapes to any of a dozen grooving companies (located in as many cities) who will make up records in any size and quantity . . . and rush them back to him air mail parcel post. Such speedy and professional service comes modestly priced: an average of 16 cents each for 100 pressings of a 7-inch vinyl 45 rpm record, about $1.35 per copy if the record is fancied up with a special printed label and jacket.

"A photographer," says one expert, "doesn't have to process his own negatives . . . nor does the sound man need to process his own tapes."

Regardless of how you do it, essentially you'll be concerned with only four essential audio processes: dubbing tapes to tape, discs to discs, tape to discs and discs to tape.

Why not, you may wonder, a strictly specialized career—dedicated solely to tape?

The reason: client preference varies. A corporate sales manager, typically, may well spiel his pep-talk to a tape recorder. But for distribution to his 100 salesmen scattered around the country, he needs records (since few salesmen can scrounge up a tape machine for the playback).

On the other hand, a local ad agency (paying you $15-$22.50 an hour for studio time), may prefer tapes—since tapes are more easily edited. Having taped a spot announcement, the agency may ask you to edit it, re-record it on fresh tape . . . and ship the works off to a local broadcasting station (which, as most, is equipped to handle tapes). Your fee for the works—studio time, editing and re-recording—may run $50-$100 for what, on the air, spans only 60 seconds.

Long-play profits? They're considerable —for the fellow who wants to earn a sound dollar.

See Electroplating in March *EI*

ELECTRONICS ILLUSTRATED Classified Ads

Your advertisement can reach this mail-buying audience for only 35¢ per word . . . payable in advance (Check or M.O. please) . . . minimum 10 words. Closing dates are the 20th of 3rd preceding month i.e. copy for the May issue must be in our office by February 20th. Mail to ELECTRONICS ILLUSTRATED, 67 West 44th St., New York 36, N. Y. Word count: Zone number free. Figure one word: Name of state (New Jersey), name of city (New York); sets of characters as in key (14-D); also abbreviations as 35MM, 8x10, D.C., A.C.

SAVE MONEY • ORDER BY MAIL

• • • FOR SALE

BUY GOVERNMENT Surplus: Electronics; Test Equipment; Oscilloscopes; Transceivers; Radiotelephones; Jeeps; Boats; Aircrafts; Misc.—Individuals can now buy direct from Govt.—Send for: "U. S. Depot Directory & Procedure" $1.25. To: Brody Surplus, Box 425-EL, Nanuet, New York.

FREE! GIANT wholesale catalog on electronics, Hi-Fi, transistor, scientific, hobby, optics, photographic, housewares, jewelry, tools, novelties, toys. Write: Lektron, 2418 Everett Ave., Chelsea 50, Mass.

EXCELLENT BUYS on Tubes and equipment all listed in the "Green Sheet." Send .25¢ for your copy today. Cash paid for unused tubes. Write. Barry Electronics Corp., 512 Broadway, Dept. EI, NYC 12, NY.

ELECTRONIC SURPRISE Package! 5 pounds assorted parts. $25.00 value. Only $2.98. KPJ Sales, Box 1252-F, Studio City, California.

• • • PRINTING, MULTIGRAPHING, MIMEOGRAPHING

QUALITY PRINTING: Economically Priced: Embossed Business Cards $3.95 per 1000. Catalog on request: Edward Printing Service, 7430 Selwick Dr., Parma 29, Ohio.

CARDS: — WPE-QSL-GAG, business. Photo, rubber stamps. Labels, stationery. Samples Dime. Riesland, Del Mar, California.

• • • TAPE RECORDERS

LEARN WHILE Asleep with your recorder, phonograph or amazing new "Electronic Educator" endless tape recorder. Details free. Sleep-Learning Research Association, Box 24-EI, Olympia, Washington.

NEW CONCEPT of self-hypnosis teaches you quickly, easily. New tape! New record! Free literature. McKinley-Smith Co., Dept. T-3, Box 3038, San Bernardino, Calif.

TAPE RECORDERS, Hi-Fi components, Sleep Learning Equipment, tapes. Unusual values. Free catalog. Dressner 69-02 Z 174 St., Flushing 65, N. Y.

RENT STEREO Tapes—over 1500 different —all major labels — free catalog. Stereo-Parti, 811-AY Centinela Ave., Inglewood 3, California.

• • • BUSINESS OPPORTUNITIES

GROW MUSHROOMS. Cellar, shed and outdoors. Spare, full time, year round. We pay $4.50 lb. dried. We have 29,000 customers. Free Book. Mushrooms, Dept. 315, 2954 Admiral Way, Seattle, Wash.

VENDING MACHINES—No selling. Operate a route of coin machines and earn high profits. 32-page catalog free! Parkway Machine Corp., Dept. 33, 715 Ensor St., Baltimore 2, Md.

• • • EMPLOYMENT OPPORTUNITIES

PRINTING - ADVERTISING SALESMEN. Excellent moneymaking sideline selling Decalcomania Name Plates. Advertising Specialties. Sign letters, Automobile initials. Free Samples. "Ralco"-EI, Box L, Boston 19, Mass.

• • • HI-FI

HI-FI FROM Japan. Finest imported tuners, amplifiers, recorders, etc. Free catalog. KPJ Sales, Box 1252-F, Studio City, California.

COMPONENTS, RECORDERS. Free Wholesale Catalogue. Carston, 125-G East 88, NYC 28.

• • • RADIO & TV

FREE! 1961 CATALOGS for newest, best electronic bargains available. Stereo, hi-fi, ham radio, 1000 other items. Alco Electronics, Lawrence 4, Mass.

TRANSISTOR EXPERIMENTS, 15 One-tube distance plans, catalog—25¢. Laboratories, 1131-K Valota, Redwood City, California.

DIAGRAMS FOR Repairing Radios, Television $2.00. Give make, model. Diagram Service, Box 672EI, Hartford 1, Conn.

• • • EDUCATION & INSTRUCTION

ENGINEERING EDUCATION for the Space Age. Northrop Institute of Technology is a privately endowed, nonprofit college of engineering offering a complete Bachelor of Science Degree Program and *Two-Year* accredited technical institute curricula. Students from 50 states, many foreign countries. Outstandingly successful graduates employed in aeronautics, electronics, and space technology. Write today for catalog—no obligation. Northrop Institute of Technology, 1116 West Arbor Vitae Street, Inglewood 1, California.

• • • MISCELLANEOUS

INTERCEPT CONVERSATIONS 100 yards away, completely assembled parabolic mic. $15.95 postpaid. Also, other interesting devices, information sent free. D'Imperio, P. O. Box 4281, Philadelphia 44, Pa.

"MAN'S MOST useful tool," wooden 10" slide rule with detailed instructions $1.00. Tanjo, Box 505, Marion, Indiana.

• • • PERSONAL

LOANS BY Mail. $50 to $600 for any purpose. Confidential. 2 years to repay. Write for free loan application. American Loan Plan, City National Bldg., Dept. EI-1151, Omaha 2, Nebraska.

LOANS ENTIRELY By Mail—$600 Or Less. Repay in 24 monthly payments. Write: Budget Finance Co., Dept. AL-11, 114 S. 17, Omaha 2, Nebr.

• • • STAMPS & COINS

FREE $1.00 CHOICE U. S. or Foreign, from first selection. Handling 10¢. Presque Isle Stamp Co., Box 3083, Erie Pa.

• • • DETECTIVES

DETECTIVES—WORK Home—Travel. Experience unnecessary. Detective Particulars free. Write, Wagner, B-125 West 86th, New York 24.

Code Practice Oscillator

Continued from page 61

can be used to make contact with Q1's base and emitter pins. The speaker is mounted on the board with ½" standoffs.

Microphone button CM should be wired with about 6" of lead to permit shifting its placement. If a telephone-type microphone button is used, the connections may be soldered directly to the contact rings.

After the wiring is checked, connect a milliammeter in series with the battery. Current flow should be under 1 ma. Close the key and position the microphone button near the speaker. Violent audio feedback will result and the current should rise to between 200 and 300 ma. Considerable variation should be expected here as the current will be dependent on the battery voltage and characteristics of Q1 and CM. By shifting the position of CM, a variation of tone and volume will be noted.

The proper placement of the microphone button is far simpler to accomplish than describe. With the particular microphone button used, it was most convenient to mount the button under the speaker. Both resonance to the desired frequency and reduction of feedback to the required level was accomplished by gluing a plastic poker chip to the face of the button. Other simple expedients may be used, dependent on the individual layout, characteristics of the microphone and speaker, and the frequency desired.

No volume control was used in the unit described since lowering the battery voltage from 6 to 3 volts results in a considerable drop in output level.

This unit may also be used as a conventional audio amplifier. Jack J1 is installed as shown. To use as an amplifier, open the key and plug in a carbon microphone. The use of a long microphone cord is required to avoid undesired audio feedback.

All in all, this is a very worthwhile project, either for the novice who is interested in learning the code or for the old timer who desires some experience with transistor circuitry. —

HOME STUDY SCHOOL

RCA TRAINING CAN BE THE SMARTEST INVESTMENT YOU EVER MAKE

With RCA Institutes Home Study training you set your own pace in keeping with your own ability, finances and time. You get prime quality equipment as a regular part of the course . . . and you never have to take apart one piece to build another. Perhaps most important, RCA's liberal Pay-As-You-Learn Plan is the most economical home study method *because you pay only for lessons as you order them* . . . one study group at a time! If you drop out at *any* time, for *any* reason, you do not owe RCA one penny! No other obligations! No installment payments required! Licensed by New York State Education Department.

Choose YOUR FUTURE from this list of courses:

- Radio and Electronic Fundamentals (see reverse side)
- Television Servicing
- Color Television
- Electronics for Automation
- Transistors

RESIDENT SCHOOLS

START YOUR CAREER IN ELECTRONICS NOW AT RCA INSTITUTES in Los Angeles-New York City

CHOOSE FROM THIS LIST...

	Course	Qualifications	Length of Course
A	Advanced Electronic Technology (T-3)	High School grad. with Algebra, Physics or Science	Day 2¼ yrs. Eve. 6¾ yrs.
B	TV and General Electronics (V-7)	2 yrs. High School, with Algebra, Physics or Science	Day 1½ yrs. Eve. 4½ yrs.
C	Radio & TV Servicing (V-3)	2 yrs. High School, with Algebra, Physics or Science	Day 9 mos. Eve. 2¼ yrs.
D	Transistors	V-3 or equivalent	Eve. 3 mos.
E	Electronic Drafting (V-9)	2 yrs. High School, with Algebra, Physics or Science	Eve. Basic 1 yr. Adv.: 2 yrs.
F	Color TV	V-3 or equivalent	Day 3 mos. Eve. 3 mos.
G	Audio-Hi Fidelity	V-3 or equivalent	Eve. 3 mos.
H	Video Tape	V-3 or equivalent	Eve. 3 mos.
I	Technical Writing (V-10)	V-3 or equivalent	Eve. 3-18 mos.
J	Computer Programming	High School grad	Day 6 weeks Eve. 24 weeks Sat. 30 weeks
K	Radio Code (V-4)	8th Grade	Eve. as desired
L	Preparatory Math & Physics (P-O)	1 yr. High School	Day 3 mos.
M	Preparatory Mathematics (P-OA)	1 yr. High School	Eve. 3 mos.

FIRST CLASS
PERMIT NO.
10662
NEW YORK, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Necessary if mailed in U. S.

Postage will be paid by –

RCA INSTITUTES, INC., Dept. EI-21
350 West Fourth Street
New York 14, N. Y.

RCA Institutes is one of the largest technical institutes in the United States devoted exclusively to electronics. Co-educational Day and Evening classes. Free Placement Service. Applications now being accepted.

SEND FOR THIS FREE ILLUSTRATED BOOK TODAY

Fill in the other side of the postage-free card and check Resident School.

RCA INSTITUTES, INC.

A Service of Radio Corporation of America • 350 W. 4th St., New York 14, N. Y. • 610 S. Main St., Los Angeles 14, Calif.

The Most Trusted Name in Electronics

RCA training at home can be the smartest investment you ever made

Look what you get in the Course in Electronic Fundamentals

40 Fascinating THEORY LESSONS

Containing all the basic principles of radio and electronics in easy-to-understand form.

40 EXPERIMENT LESSONS

Each containing absorbing, practical experiments bound together in 20 books.

40 SERVICE PRACTICES

Full of practical, time-saving and money-saving servicing tips, bound into 20 books.

15 KITS

to build a Multimeter, AM Receiver and Signal Generator. Kits contain new parts for experiments, integrated so as to demonstrate what you learn in the lessons and to help you develop technical skills. Each kit is fun to put together!

PLUS ALL THIS AT NO EXTRA COST···

MULTIMETER

A sensitive precision measuring instrument you *build* and *use* on the job. Big 4½" meter with 50 microamp meter movement. 20,000 ohms-per-volt sensitivity d-c, 6,667 a-c.

AM RECEIVER

Have the satisfaction of building your own radio receiver with this high-quality 6-tube superheterodyne set. Big 5" speaker, fine tone!

SIGNAL GENERATOR

A "must" for aligning and trouble-shooting receivers. Build it for your own use. 170 KC to 50 MC fundamental frequencies for all radio and TV work.

Practical work with the very first lesson! Pay-only-as-you-learn! No long-term contracts to sign! No monthly installment payments. Pay only for one study group at a time if and when you order it!

Stake out your future in electronics now!

SEND FOR OUR FREE HOME STUDY CATALOG TODAY!

Just fill out this card and drop it in the mail—*no postage needed.*

RCA INSTITUTES, INC.

A Service of Radio Corporation of America • 350 W. 4th St., New York 14, N. Y. • 610 S. Main St., Los Angeles 14, Calif.

The Most Trusted Name in Electronics

RCA INSTITUTES INC. Home Study School, Dept. EI-21
A Service of Radio Corporation of America
350 West Fourth Street, New York 14, N.Y.

Without obligation, rush me the FREE 64-page illustrated book describing your electronic training program (check one). No salesman will call.

Home Study ☐ Los Angeles Resident School ☐ New York Resident School ☐

Name .....
(Please Print)

Address .....

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

Veterans: Enter discharge date.....

CANADIANS—Take advantage of these same RCA courses at no additional cost. No postage, no customs, no delay. Enclose this card in envelope and mail to: RCA Victor Company, Ltd., 5581 Royalmount Ave., Montreal 9, Quebec.