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FEBRUARY 1958

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VOLUME 8 NUMBER 2

FEBRUARY 1958

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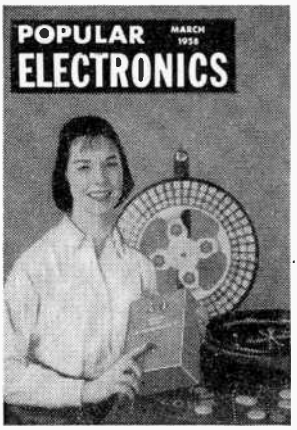
DEPARTMENTS

COMING NEXT MONTH (MARCH)



(ON SALE FEBRUARY 25)

Two electron tubes that glow on top with numbers from zero to ninety-nine form the basis of an electronic gamester that is featured in our March issue. The cover picture shows the complete unit being operated by a young player. Pressing the button starts motors that spin contacts and permits completely random stops on different numbers when the button is released. To illustrate a few of the variety of games possible, we borrowed some from Abercrombie and Fitch of New York.

Other articles include one describing a very low cost resistor-capacitor tester, a special feature on amateur radio, how to mount your new pickup, and construction of a two-tube square-wave generator.

IN THIS MONTH'S

RADIO & TV NEWS

(FEBRUARY)

Radio Astronomy and the Jodrell Bank Radio Telescope

Which Way to High Fidelity?—Buy Now or Later?

An Electronic Photoflash

"Muscle Mouse"—A Compact 50-Watt Transmitter

What Do You Know About Recording Tape?

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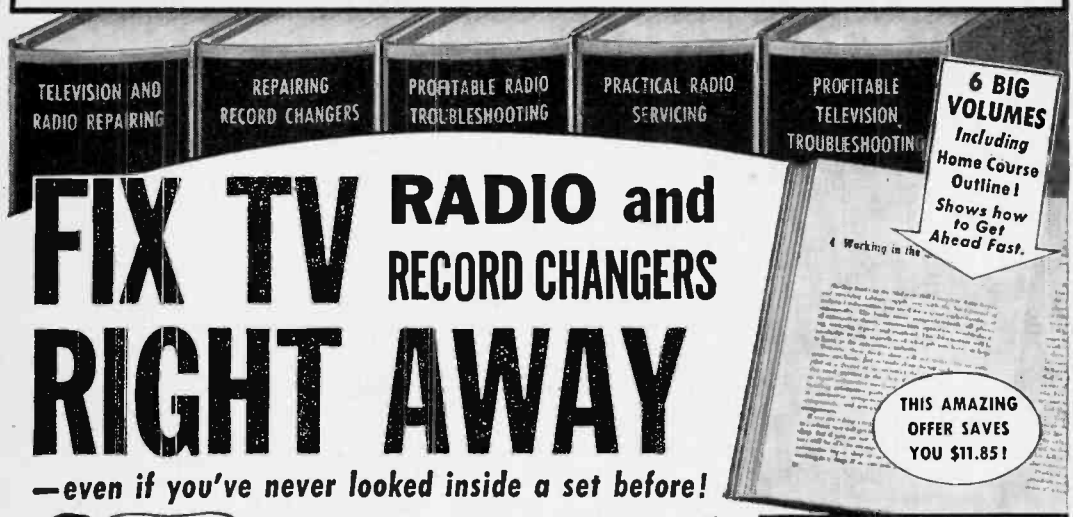

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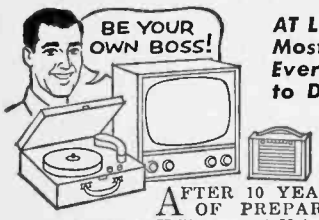

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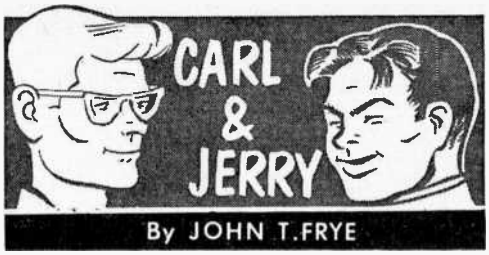

Electronic Detective

A FEBRUARY SNOWSTORM was swirling around outside as Carl Anderson came stamping into the basement laboratory of his friend, Jerry Bishop. His horn-rimmed glasses instantly steamed over in the warm room, and when he took them off he saw that Jerry had company. A pleasant-featured young man was sitting on the worn leather sofa watching Jerry doing something at his workbench.

"Hi, Carl; this is Mr. Singer who owns that hobby shop at Fifth and High," Jerry announced. "He's got a problem."

"Glad to know you, Carl," Mr. Singer said, as he stood up and shook hands. "I've got a problem all right. Shoplifters have really started working me over. As you know, our merchandise is mostly on open display so that the youngsters who make up a large part of our trade can handle it. That makes it easy picking for anyone so inclined. Naturally we expect some losses of this nature, but recently they've become serious."

"What sort of things are snitched?"

"Everything from a bicycle on down! However, that fancy cap pistol Jerry has over there on the bench seems to be a favorite. We've lost a couple of dozen of those since school started."

"Then it must be children doing it."

"That's right; and that's what makes catching the sticky-fingered person such a ticklish proposition. Maybe I'm a softy, but I don't want to call the police in on this and maybe send some kid to reform school. I just want to find out who's doing it and put a stop to it. I feel I have to show the kid doing it that no-one gets away with what he's pulling for long; otherwise he may develop into a real criminal."

"Don't you keep an eye on things?"

"We try, but you can't appreciate what a job it is until you see the after-school crowd that jams into our store. We have all we can do waiting on trade, stopping scuffling, etc., without trying to watch all the counters and aisle displays at once. And the thief is pretty crafty. We thought we could stop the loss of the pistols by wir-

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19. The Great Melodies of Tchaikovsky
20. Suddenly It's the Hi-Lo's
21. King of Swing—Benny Goodman
22. Brahms: Symphony No. 3
23. The Merry Widow
24. Wonderful, Wonderful—Mathis PE-1

Carl & Jerry (*Continued from page* 8)

ing them in their boxes; but they kept right on disappearing, box and all!"

"CARL, you're just in time to help me try something," Jerry interrupted. "I read the other day that some big department store had installed an electronic shoplifting detecting device that was triggered whenever a special price tag, actually a miniature printed tuned circuit, was brought near it. Price tags were removed from all merchandise when sold; so if anyone tried to carry something off without buying it, the electronic gadget would squeal on him.

"I figure the detecting device must be simply a glorified grid dip oscillator such as the one I have here on the bench. As Carl knows but possibly you don't, Mr. Singer, a 'GDO,' as we call it, is simply a vacuum-tube oscillator with a meter that reads the rectified grid current which flows from the tube grid to ground as long as the tube is oscillating. The amount of grid current is proportional to the vigor of oscillation. Whenever another circuit tuned to the frequency at which the GDO is oscillating is brought near the coil of the oscillator, this tuned circuit absorbs energy from the oscillator by induction. This cuts down on the vigor of oscillation and produces a reduction or 'dip' in the current reading of the meter."

"I see that this loop of wire strung around the door frame is replacing the coil ordinarily plugged into the GDO," Carl observed.

"That's right. And this little coil-and-capacitor combination is tuned to the frequency at which the grid dip oscillator is working. I want you to walk back and forth through the door without it first—then again with it in your hand."

As Carl made the last trip, Mr. Singer walked over and watched the meter.

"The pointer moved!" he exclaimed.

"Yes, but not enough I'm afraid," Jerry said. "I was hoping we'd get a really strong kick that would operate a sensitive relay. And there was a current change caused by body capacity effect when Carl went through the loop without the tuned circuit. Probably we could get away from that by housing the loop of wire in some sort of Faraday shield which would stop capacity effects without interfering with magnetic induction . . . and we could amplify the grid current change with a d.c. amplifier until it would kick a relay. But I'm afraid all that wouldn't be practical for just this one job."

"Well, I'm sorry you can't help, but I certainly appreciate your trying," Mr. Singer

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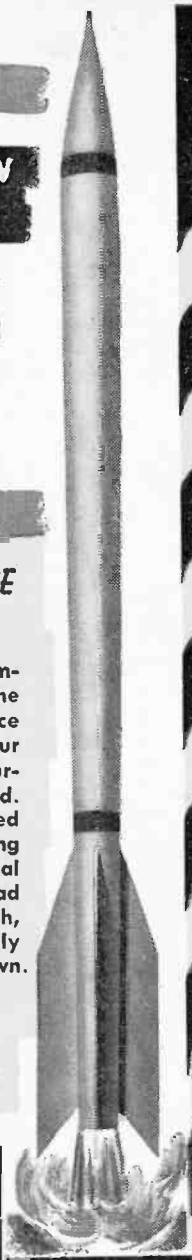

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Carl & Jerry (*Continued from page* 10)

said with obvious disappointment as he began buttoning his overcoat.

"Wait a minute!" Jerry exclaimed. "We don't give up that easily. I've got another idea that should be sure-fire."

"Let's hear it," Mr. Singer said, sitting down again.

"WELL, I've been looking at this cap pistol carton, and I see there's plenty of room beneath the cardboard insert that holds the pistol for us to conceal a transistorized, tone-modulated transmitter. This will have a range of only about 50 feet; so if the pistol is placed on a counter at the rear of your store, the signal won't be heard on the receiver we'll place near the front door—with an antenna lead from the receiver fastened around the door frame. However, if anyone tries to carry the pistol and transmitter *through* the door, the signal from the transmitter will be heard very loudly in the receiver."

"Sure it will work?" Mr. Singer quizzed.

"Sure I'm sure," Jerry said confidently. "Carl and I have played around with these transistorized wireless mike circuits a lot, and we know how to build them and what they will do. Suppose you don't display the cap pistols for a couple of days while Carl and I build up the transmitter and check it out. Then you can put this special one on display, and the kid pinching them will probably snap it right up."

"That's exactly what I'll do," Mr. Singer agreed. "Just let me know when you're ready."

The door had hardly closed behind him before Carl and Jerry were busy laying out the little transmitter. There was no problem with the circuit, for all they had to do was combine a transistorized "wireless mike" transmitter and a simple transistorized audio oscillator. The audio oscillator replaced the microphone of the transmitter and modulated the ouput with a steady tone of about 500 cycles per second. The transmitter was set to work on an unused area near the low end of the broadcast band so that an ordinary radio could be used to pick up the signal. Everything was built on a flat sheet of Bakelite that fitted easily beneath the cardboard shelf to which the pistol was securely fastened.

When the equipment was working to their satisfaction, the boys contacted Mr. Singer; and that evening the three of them went down to the store and set up "Elmer, the Electronic Flatfoot," as Carl insisted on calling it. Everything worked exactly as

I saw my job failure in my family's eyes

. . . but how they smiled when I. C. S. pulled me through

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- ☐ Architectural Drafting
- ☐ Drafting Machine Design
- ☐ Electrical Drafting
- ☐ Mechanical Drafting
- ☐ Sheet Metal Drafting
- ☐ Structural Drafting

ELECTRICAL
- ☐ Electrical Engineering
- ☐ Elec. Engr. Technician
- ☐ Elec. Light and Power
- ☐ Practical Electrician
- ☐ Practical Lineman
- ☐ Professional Engineer (Elec)

HIGH SCHOOL
- ☐ High School Diploma
- ☐ Good English
- ☐ High School Mathematics
- ☐ Short Story Writing

LEADERSHIP
- ☐ Industrial Foremanship
- ☐ Industrial Supervision
- ☐ Personnel-Labor Relations
- ☐ Supervision

MECHANICAL and SHOP
- ☐ Diesel Engines
- ☐ Gas-Elec. Welding
- ☐ Industrial Engineering
- ☐ Industrial Instrumentation
- ☐ Industrial Metallurgy
- ☐ Industrial Safety
- ☐ Machine Design
- ☐ Machine Shop Practice
- ☐ Mechanical Engineering
- ☐ Professional Engineer (Mech)
- ☐ Quality Control
- ☐ Reading Shop Blueprints
- ☐ Refrigeration and Air Conditioning
- ☐ Tool Design ☐ Tool Making

RADIO, TELEVISION
- ☐ General Electronics Tech.
- ☐ Industrial Electronics
- ☐ Practical Radio-TV Eng'r'g
- ☐ Practical Telephony
- ☐ Radio-TV Servicing

RAILROAD
- ☐ Car Inspector and Air Brake
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Name_____ Age_____ Home Address_____

City_____ Zone_____ State_____ Working Hours_____ A.M. to P.M._____

Occupation_____

Canadian residents send coupon to International Correspondence Schools, Canadian, Ltd., Montreal, Canada. . . . Special tuition rates to members of the U. S. Armed Forces.

Carl & Jerry (*Continued from page* 12)

Jerry had predicted. It was agreed the boys would rush right to the store from school the next day and that Mr. Singer would not put out the pistol until they arrived.

It seemed as though school would never let out the next afternoon, but when it finally did Carl and Jerry really hot-rodded their bikes down to the store. Mr. Singer was waiting for them. Jerry switched on the hidden transmitter, and the "bait" was provocatively displayed.

ALMOST IMMEDIATELY the store began to fill with a crowd of shouting, shoving, noisy boys. Jerry and Carl stayed near the front of the store and deliberately avoided even looking at the counter holding the cap pistol. Mr. Singer, his wife, and two clerks were busy waiting on customers.

A good half hour passed without anything happening. The boys were just beginning to think that no one was going to try to make off with the pistol when they heard a weak musical tone in the receiver. Steadily it increased in strength. Mr. Singer heard it and came over to stand by Carl and Jerry. As two well-dressed boys carrying school books went through the door, the tone reached a very loud level and then began to subside.

Mr. Singer called after them: "Say, fellows, come back here a minute. I want to talk to you."

The two schoolboys exchanged a long

. . . Everything was built on a flat sheet of Bakelite that fitted easily beneath the cardboard shelf to which the pistol was securely fastened . . .

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tests all tubes completely, accurately and in seconds — RIGHT ON THE SPOT

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Checks quality of over 600 tube types, which covers more than 99% of all TV and radio tubes in use today, including the newest series-string TV tubes, auto battery-type 12 plate-volt tubes, 0Z4s, magic eye tubes and gas regulators • Checks for cathode-heater and cathode-grid shorts and detects inter-element leakage up to 1.5 megohms • Checks for life expectancy.

Model FC-1W factory wired **$58.50 Net**

Model FC-1K semi-kit form **$48.50 Net**

Model AD-1 PICTURE TUBE ADAPTER — Also available for the FC-1. Checks all picture tubes (including the new short-neck 110 degree RCA-type picture tubes) for cathode emission, shorts and life expectancy. Also rejuvenates and restores cathode emission of weak picture tubes.

Model AD-1 (factory wired only) **$4.50**

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Checks each section of multi-purpose tubes simultaneously. If one section is defective the tube will read "Bad" on the meter scale • 41 tube sockets accommodate all present and future tube types • Less than 10 seconds required to test any tube • Large D'Arsonval type meter is extremely sensitive, yet rugged . . . with two multi-color "Good-Bad" scales • Selection of 12 filament voltages • Line isolated • 7-pin and 9-pin straighteners mounted on panel • Large easy-to-read quick reference chart for over 600 tube types in use today • New tube listings furnished periodically.

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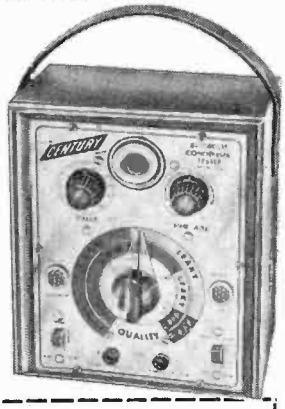

Checks in-circuit:

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- ☐ Model AD-1 CRT Adapter (wired) $4.50
- ☐ Model CT-1W (wired) ..... $34.95—$9.95 within 10 days. Balance $5.00 monthly for 5 months.
- ☐ Model CT-1K (kit) ..... $24.95—$9.95 within 10 days. Balance $5.00 monthly for 3 months.

Name.....

Address.....

City..... State.....

Carl & Jerry (*Continued from page* 14)

look and then slowly came back to the store. As they crossed the threshold, the receiver once more built up to a peak of sound.

"Come on back to my office," Mr. Singer said.

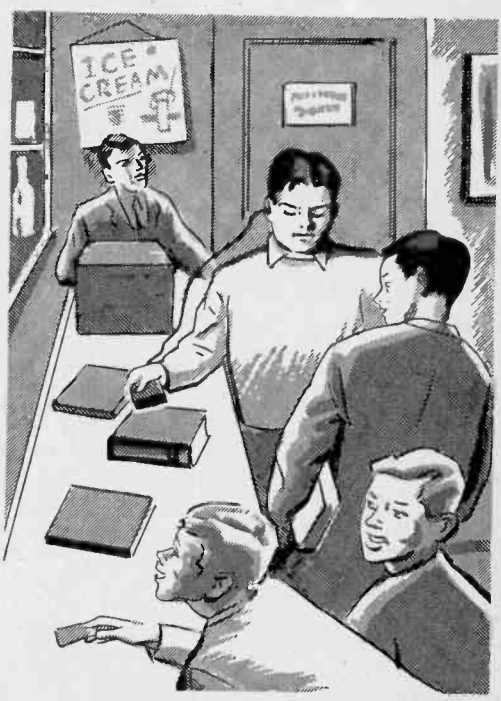
They walked back with him, tossing their books on an empty counter as they went past. Carl and Jerry followed, and for the first time Carl noticed that Jerry was wearing his little shirt-pocket transistor receiver with its earphone tucked in his ear. Carl also noticed that as Jerry walked along just behind the two boys he kept fumbling with the tuning control of this receiver, and his face had begun to wear a puzzled, worried look.

"I was going to use this to tell which one had it," he whispered to Carl, "but I can't pick up the signal near either of them!"

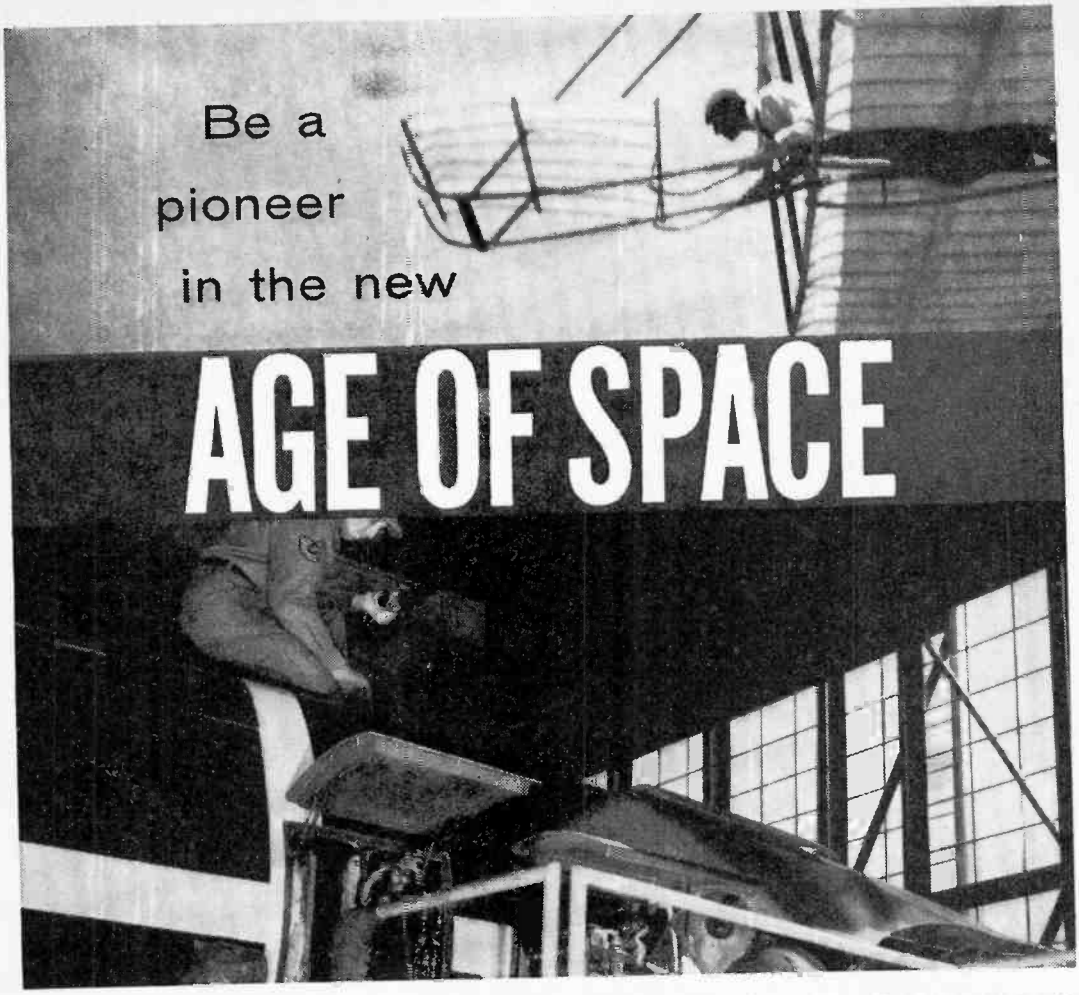
"Maybe the transmitter's gone dead," Carl suggested.

"Nope, I can still hear it faintly on that receiver up front," Jerry observed as they reached the door of Mr. Singer's office. "You tell Mr. Singer to stall," he said desperately, "while I see if I can find what's gone wrong."

AS THE REST of them filed into the office, Jerry turned around and started



. . . Removing the receiver from his shirt pocket, he used it as a search wand to go over each one . . .



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NAME_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

Carl & Jerry (*Continued from page* 16)

walking slowly toward the front of the store, tuning his little receiver back and forth across the low end of the broadcast band as he did so. Suddenly he began picking up the tone signal, but after he had walked about two-thirds the length of the store it began to fade out again. Backtracking, he found that the signal reached a peak when he was standing by the books the boys had tossed on the counter. He quickly spread the books out on the counter. Removing the receiver from his shirt pocket, he used it as a search wand to go over each of them. One large, fat volume on ancient history gave out a very loud signal.

Jerry opened the book and made an astonishing discovery. The first and last few pages of the book were intact, but the center of all the middle pages had been cut out. Inside this opening was the cap pistol still wired in its box.

He picked up the book and, holding it behind him, stepped into the office.

"Which one of you boys is named William Palmer?" Jerry demanded.

The boy with dark auburn hair and freckles spoke up hesitantly: "That's me."

"Then this must be your book with your name in the front of it," Jerry said quietly as he placed the book on the desk in front of Mr. Singer and opened it.

The Palmer boy's face turned so deathly white that his freckles seemed to stand out in three-dimensional style.

"I didn't really mean to steal," he stammered. "Honest, I didn't. It just seemed a kind of game, and the other fellows kept egging me on. Are—are you going to send me to jail?"

"Come on, Carl," Jerry said as he headed for the door.

CARL FOLLOWED, but even after the door was closed behind them Carl and Jerry could still see the pale frightened faces of the two boys and the stern serious look on the face of Mr. Singer.

"What do you suppose Mr. Singer will do with them?" Carl wondered.

"I'm not sure, but it will be what's best for the boys," Jerry declared with conviction. "They just don't know how lucky they are that they were caught by a fine man like Mr. Singer. You can bet he'll not let them off too easy. From the looks on their faces, though, I think they've already learned their lesson."

"But they'll never know it was Elmer, the Electronic Flatfoot, who put the arm on them!" Carl said with a grin. —30—

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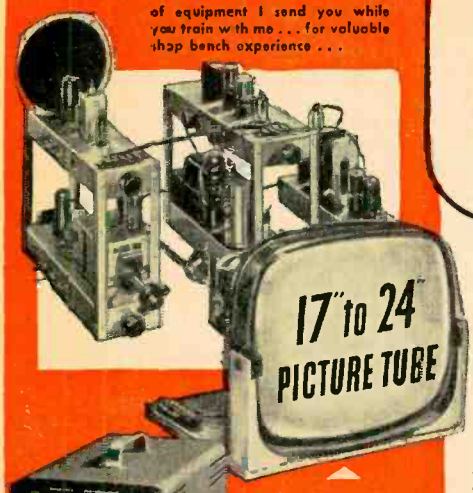

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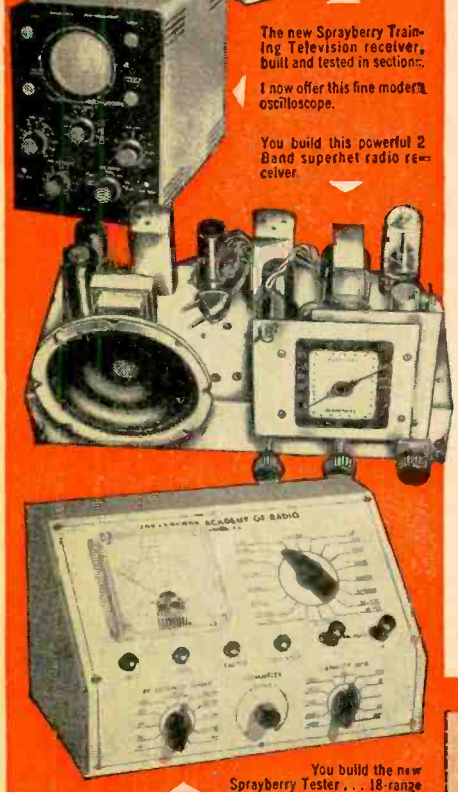

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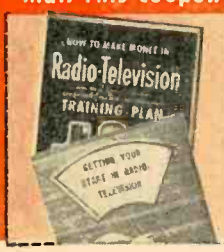

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LETTERS FROM OUR READERS

A Reader's Scoop on Sputnik II

■ Here is an example of what can happen to people who read your magazine.

When I bought the November issue of POPULAR ELECTRONICS, I was most intrigued by the "Listen to the Voices of the World" story. On Saturday, November 2, I finally found time to try to get the stations listed as "Best Heard in Eastern North America." I was also curious to hear what Moscow would have to say in Russian about the dismissal of Zhukov. When, at 44 minutes past midnight, I tuned near the 20-meter band and heard a Russian announcer say "standby for a special bulletin," I thought it would be about Zhukov.

Imagine my amazement and surprise when a solemn voice declared in Russian: "We have just launched the second Earth satellite." Luckily, I had my tape recorder handy.

Having recorded the special news bulletin, I telephoned one of the New York newspapers. The man at the night city desk refused to believe the story about the launching and practically told me to go back to sleep. However, I persuaded him to take down my name and telephone number.

About half an hour later, the city desk called me back. This time they were willing to believe anything I had to say: their monitor had managed by then to hear the news but was not able to supply the details about Sputnik II. In all the excitement, I forgot about my tape and dictated the description from memory. I was told that I was the first man in the USA to know about the Sputnik II launching and that my story would appear on the front page.

My Sunday issue of the newspaper had nothing to say about the satellite but the story was printed in the very last edition, available in New York City only.

On Sunday afternoon, a reporter came to see me. He wanted to know what kind of radio receiver I was using and if he could hear the Moscow station then. I told him about my Philips Concerto FX 824A-54 high-fidelity radio-phonograph combination and the Wollensak dual-speed, dual-track recorder; however, I was unable to satisfy his latter request—reception was exceptionally bad.

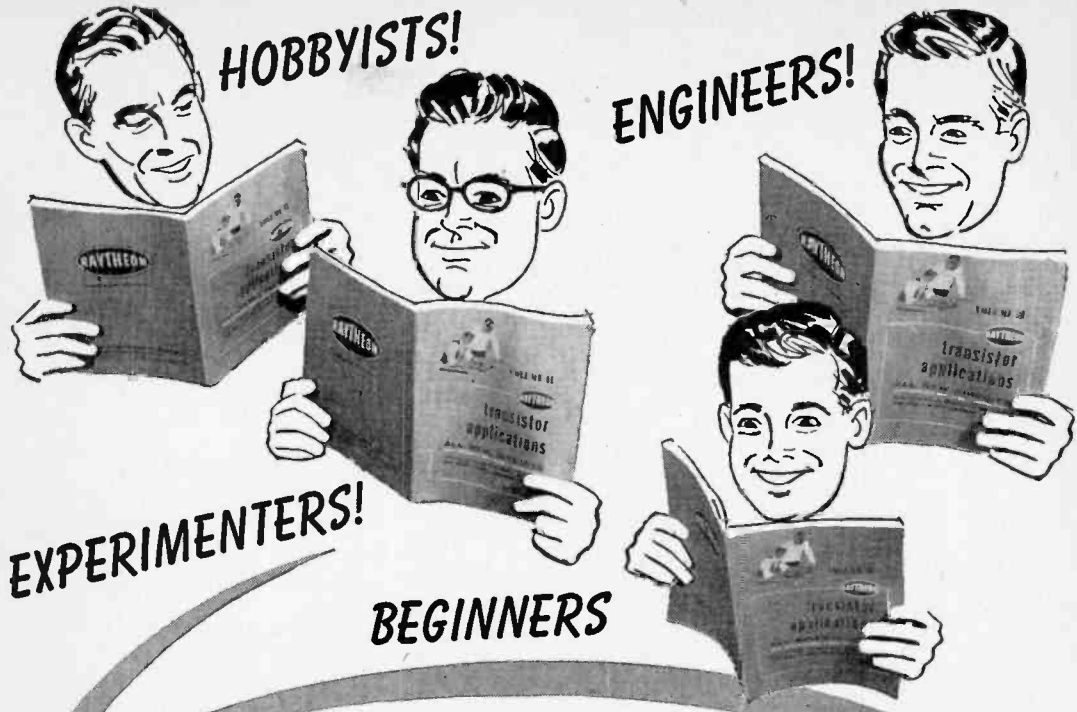
Thus, thanks to "Listen to the Voices" in your November issue, my story about the Sputnik II launching appeared in a New York newspaper and two of my local papers.

GEORGE CHAPLENKO
Perth Amboy, N. J.

The Editors were extremely interested and pleased that our article started this chain of events. Many other readers have written to tell us that the article has been very useful as an aid to their short-wave listening.

Modified V.H.F. Ear

■ I built the V.H.F. Ear as described in POPULAR ELECTRONICS, July '57, with one exception. I



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Letters

(*Continued from page 20*)

made a sort of conical antenna with #18 wire, and with the 2N35 transistor wired in as you described I pulled in several FM stations and a plane that was about 15 miles away.

I enjoy "POP'tronics" very much and I hope there will be more transistor articles in it.

P. C. HANSON
Verona, N. J.

The Girls Talk Back

■ Here's another feminine reader for Dave Kavanagh (August 1957 *Letters* column). I subscribe to POP'tronics and find it a must on my bookshelf. I wouldn't miss an issue of it as I am a student in electronics and find your magazine not only helpful to me but most interesting, page after page.

Also to Ruth S. Congram (December 1957 *Letters*), I raise that estimated figure for women readers. More and more women are entering this particular field and achieving success even though you don't hear about them as often as the men.

JEAN ARTHUR
Detroit, Mich.

Those Scarce Back Copies

■ Your *Letters* column in the December '57 issue included a request for a back copy and listed other issues which were also out of circulation. I would like to mention that I have one or two copies of each issue from October 1954 to September 1955 inclusive that anyone can have for fifteen cents in stamps or coin per copy.

ALBERT W. ALLEY
4045 N. Kostner Avenue
Chicago 41, Illinois

Sure sounds like a very good deal for some lucky readers who get there first. Hope you're not deluged with mail.

An "Economy" Fan

■ I am 14 years old and an avid POP'tronics reader. I thoroughly enjoy your articles on "Economy" testing instruments. Could you publish a series of articles on basic radio repair and some tricks of the trade! I am trying to get a job in a local repair shop.

Please keep up your wonderful work. I would also like to see more of the fabulous Carl Kohler.

LEWIS PHELPS
765 Humboldt St.
Denver 18, Colo.

Aid to Future Scientists

■ I just saw the item on page 70 of the November 1957 issue on the Westinghouse Scholarships. I believe that this subject deserves more than two sentences, for it is supplying our nation with future scientists.

I am a sophomore at Niles Township High School in Skokie, Illinois, and have joined a seminar directly connected with the Westinghouse Scholarship Foundation. It is composed of students who have a true interest in science.

Each of these students will choose a project on which to work. The seminar will look for a scientist who specializes in this field, and assign him to a student. In this way, each student has a teacher.

(*Continued on page 26*)

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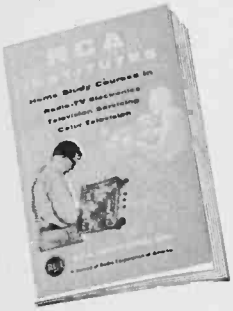

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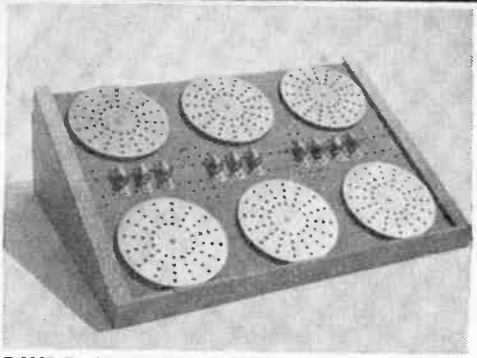

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The GENIAC Calculator carries 66-inch spiral scales yet measures only ten inches fully extended and six inches when closed. Four to five figures accuracy can be relied on. It is indispensable to the scientist, research worker and student. Administrative staff and business men will find it of tremendous value for a host of estimating and checking calculations, and quite simple to use. On non-warping, metal construction, with plastic-coated scales, it will give years of service.

Model L solves multiplication, division, percentage calculations, and gives logarithms as well.

Model L shipped postpaid for only $19.95 (add 3% city sales tax in N. Y. C.). Use the GENIAC Pocket Calculator for a week and if you are not satisfied repack and mail it back.

What typical users say about the GENIAC Calculator

"May I congratulate you on such an instrument at so modest a price, combining engineering and mathematical skill, simplicity of operation in such a small space. It does all you claim—four or five figure accuracy without eyestrain or magnifiers. Half an hour's study is ample for its use." *(A.E.B.—M.Sc., M.R.S.T.)*

"I have tested the GENIAC Calculator in my office and find it much superior in clearness and accuracy to ordinary slide rules." *(F. H. G. B.—, E. Croydon.)*

"We could not contemplate being without the GENIAC Calculator." *(T & C Ltd., Manufacturing Chemists, Liverpool.)*

"I use the GENIAC Calculator for all my slide-rule work, and need the extra digit which normal slide-rules cannot give. I had to get one of my customers a GENIAC last month, after using mine in his office." *(E. & G. H., Textile Manufacturers, Blackburn.)*

GENIAC POCKET CALCULATOR ..... **$19.95 Postpaid**

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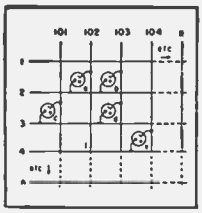
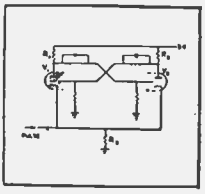
An essential part of every computer is the memory—a storage device for retaining bits (binary digits) of information. The ELECTRONIC MEMORY course contains instructions for building relay memories, magnetic core "Matrix" memories and "SEAC" tube storage memories, with detailed descriptions of over 15 different methods of storing information and automatically giving instructions to electronic devices now in use. The booklets, texts and manuals are a complete course in this fascinating subject. Suitable for all levels—particularly designed for people who have some knowledge of electronics but want to know specific details of electronic computers for professional reasons. Complete question answering service. The memory "Matrix" can be expanded to any desired degree and can be used in conjunction with the digital computer kits as an outside memory store. Price of course with all instructions and training manuals, texts, etc., postpaid.....C1- **$28.00**



SECTION OF MATRIX Diagram of a Neon Tube Digital Storage Unit.

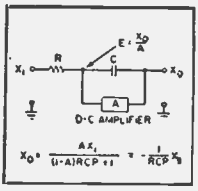
DIGITAL COMPUTER COURSE

Have you ever wanted to build a small digital computing device? One that reproduces in miniature what computers like ENIAC, SEAC, BIZMAC, etc., do on a large scale? Our DIGITAL COMPUTER course shows how to set up and build computers and experiment with pulses, storage, gates, flip flops, adding, subtracting, multiplying and applications of Boolean Algebra to circuit design. You get an introduction to programming. More important, you learn how and where to buy computer parts to build your own computers. Manuals, wiring diagrams and texts provide a complete introduction to theory and practice of DIGITAL COMPUTERS clearly explained. We have a complete question answering service. This is the finest and only DIGITAL COMPUTER course on the market, postpaid.....C2- **$28.00**


A modulo 2 counter. More commonly a flip-flop arrangement of 2 triodes. This is the main elementary component from which counters and accumulators are assembled.

ANALOG COMPUTER COURSE

ANALOG COMPUTERS are widely used in engineering and scientific research to duplicate actual physical conditions and to integrate and differentiate directly. Our ANALOG COMPUTERS course lists sources of materials, parts, theory and practical instructions, plus wiring diagrams and schematics for adding, multiplying, integrating and differentiating specific experiments, give practice in calculating scale factors, choice of time scales, machine equation and block diagrams, phase inverting amplifiers, use of parallel imputs, solution of simple differential equation. We show you how you can build computers at home. Texts discuss theory and design of computer elements, network and operational amplifiers, multiplication and function generation. This is your best and only comprehensive introduction to ANALOG COMPUTERS. Each course is a complete introduction to the subject with all necessary instructional material and parts. Course, Manuals, postpaid.....C3- **$28.00**



Block diagram for a simple integrating circuit.

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Is your knowledge of these new technical fields rusty? Perhaps you never had time to study them but need to now. Write for free information about our new, modern, low-cost course. Work at your own speed at home. Check those that interest you.

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- ☐ Memory Storage C1
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- ☐ Rapid Reading PS6
- ☐ Construction of Robots PS7

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OLIVER GARFIELD CO., Dept. PE-28A, 31 Broadway, New Haven, Conn.

Name.....Age.....Occupation.....

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

Letters

(*Continued from page 22*)

These people get a salary for their services of one dollar per year. When the student has spent three years on the project he selected, it is entered in the talent search.

As far as the seminar faculty knows, the system outlined here is only in use at Niles, but we think it will soon be in widespread use in America.

Don't you think this system will insure America's security?

JOE CROWTHER
Lincolnwood, Ill.

We certainly agree. Science Service, the nonprofit institution for the popularization of science, and the Westinghouse Educational Foundation have been doing a wonderful job for many years. Several thousand winners and honorable mentions have received aid since the first Annual Science Talent Search.

Short-Wave Listener Responds

■ Congratulations on publishing the article "Listen to the Voices of the World" (by Stewart West) in the November 1957 edition of your magazine. It is, among other superlatives, one of the most usefully classified listings of short-wave listening data I have ever seen.

As one who has written 52 similar newspaper articles during the past year (*The Winnipeg Tribune*), I appreciate the immense amount of research which must have gone into the preparation of Mr. West's article. The publication of this kind of information, which can be understood and used by anyone with a short-wave band on his radio, indicates progressive management. Good show!

HARRY DE PAIVA
Manitoba, Canada

On the "Hi-Five"

■ I read your article on building a "Hi-Five" speaker system and built it. However, I would like to know what kind of speakers you used, and if you did anything about treating them, such as coating the cones, etc. I would certainly appreciate this information, as Sherwood crossovers are hard to find around here. I was figuring on perhaps a Jensen Crossover.

JIM FAHLSING
Richmond, Ind.

Try the following for the Sherwood crossover:
Sherwood Electronic Labs, Inc.
2802 West Cullom Ave.
Chicago 18, Ill.

Message from a CAP Member

■ I have bought POPULAR ELECTRONICS for several years at the newsstand, and have built several of your projects. They all worked beautifully. I'm just breaking into the radio game—hope to get my ham ticket next year.

I read with a great deal of interest the article "On The Air With The Civil Air Patrol" by Maj. Wayne Winters, CAP. I'm also a member of the CAP. If you could add another page to POPULAR ELECTRONICS for the CAP, I think it would be a

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WHAT THE "EDU-KIT" OFFERS YOU

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.

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 & 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 16 Receiver, Transmitter, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for Television.

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 $22.95. 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 sixteen Receiver, Transmitter, Code Oscillator, Signal Tracer, and Signal Injector circuits. These are not unprofessional "broadboard" 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 16 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable mica, electrolytic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, wire, solder, 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 & Electronics Tester. The "Edu-Kit" also includes Code instructions and the Progressive Code Oscillator, in addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive all parts, tools, instructions, etc. Everything is yours to keep.

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 troubles 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. This "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.

———UNCONDITIONAL MONEY-BACK GUARANTEE———

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☐ Send me FREE additional information describing "Edu-Kit."

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PROGRESSIVE "EDU-KITS" INC.
497 Union Ave., Dept. 541D, Brooklyn 11, N. Y.

Letters

(*Continued from page 26*)

mighty big help and would be welcomed by all CAP members. We (CAP) are in dire need of lightweight and as small as possible radio equipment for use on our frequencies, and would like to see some schematics for transmitters, receivers and other necessary equipment.

I have a CAP licensed station with both high and very high frequency equipment aboard. My call is Red Bird 103.

Thanks again for printing Wayne Winter's article.

R. G. (SKIPPER) MCLAURY
St. Joseph, Mo.

Thank you for your suggestion for expanding our service to the readers. We certainly plan to consider it for the future and welcome comments from other readers.

A Plug for Plug-Ins

■ Just wanted to drop you a line to tell you how much I appreciate your magazine. I built that little plug-in amplifier and it makes my old crystal set sound pretty good. Keep up the good work.

LARRY PRUSAK
Brooklyn, N. Y.

Spectacular Window

■ The *Carl & Jerry* story concerning the Tesla coil was very good. How about showing a schematic on how to build one? Sounds like a good display gimmick for the front window.

C. V. JONES
Hialeah, Florida

We expect to publish complete data on how to build a Tesla coil shortly. It presents some problems, however, especially in its applications.

Clarification

■ I enjoyed the article on the Oval-Flex enclosure, but think you left something out. The speaker shown in the photographs and mentioned in the text is the SK-75—a 6″ x 9″ oval speaker with tweeters in the middle. The same company also sells a 5″ x 7″ speaker of similar design. Care should be taken not to confuse them. I hope this letter will help others to avoid momentary confusion. The Oval-Flex is quite impressive—both my friends and I are amazed at the performance it gives.

S. C. JONES
4411 So. 4th St.
Arlington, Va.

Junk Box Circuits

■ I enjoy your magazine very much and especially the build-it-yourself items. How about putting in more items about junk box circuits? I find them interesting, easy to build, and enjoyable to use. My junk box consists of a small chest of drawers chock full and overflowing. So please help me get some of the parts into use. Thanks for the article on the saw for plastic—this was a blessing for me.

PAT VOSBURG
Auburn Heights, Mich.

More junk box items coming up. —30—

AT LAST!

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....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, Eleven 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 100 More Shops for 1957

This 35 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, 36 such shops are NOW IN BUSINESS AND PROSPERING. We are signing contracts with 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!

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find out how you can open
A REPAIR SHOP OF YOUR OWN

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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:

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9. The right to use RTS Seal of Approval, and the RTS Credo.
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you build all these units

*tubes excluded

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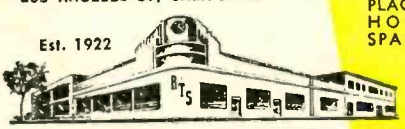

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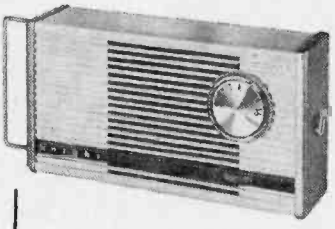

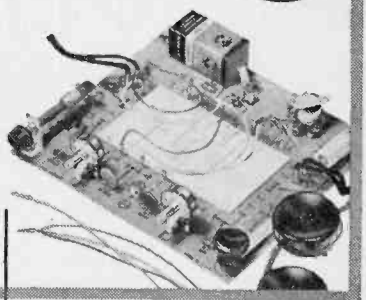

knight-kit "Trans-Midge" Transistor Receiver Kit

Model Y-767 $2.45

Tiny, cigarette-pack-size 1-transistor radio kit—fascinating to build. Covers the local AM broadcast band with exceptional sensitivity and selectivity. Features: ferrite core tuned coil; low-drain transistor operating for months from single penlight cell; handsome plastic case. Complete with all parts, transistor, battery and easy-to-follow instructions. (External antenna required.) A wonderful value. Shpg. wt., 8 oz.

Model Y-767. Net only.....$2.45

J-149. Headphones. 1¼ lbs....$2.15

C-100. Antenna Kit. 1½ lbs....$1.03

knight-kit 5-Transistor Superhet Portable Radio Kit

Model Y-766 $29.95

Handsome, easy-to-build personal portable with every ultra-modern design feature: 5 transistors (up to 200 hours playing time from 9v. battery supplied); printed circuit for easy building; big 3½" speaker; push-pull audio output; built-in ferrite loopstick antenna. Sensitive reception of AM broadcast band with exceptional tone. In ultra-smart high-impact ivory plastic case with handsome gold trim; size only 7½ x 3¾ x 1¾". With all parts, transistors, battery and instructions. Shpg. wt., 2 lbs.

Model Y-766. Net only.....$29.95

knight-kit 10-Circuit Transistor Lab Kit

Model Y-299 $15.75

Sensational transistor hobby kit! Assemble the basic parts once, then complete project after project (10 in all), just by plugging leads into proper jacks on printed-circuit board—no wiring changes needed. Make the following: AM radio; amplifier; wireless oscillator; code practice oscillator; electronic timer, switch or flasher; voice-operated, capacity-operated or photoelectric relays. Includes all parts, 2 transistors, battery, headphones, instructions for each project. Shpg. wt., 3 lbs.

Model Y-299. Net only.....$15.75

Model Y-262 $14.65

knight-kit 2-Transistor Pocket Radio Receiver Kit

It's fun to build this pocket-size two-transistor radio—enjoy loud, clear local broadcast-band reception wherever you go! Completely self-contained with built-in ferrite loopstick antenna—no external antenna needed. Extremely efficient reflex type 2-transistor circuit actually does the work of 3 transistors! Printed circuit board reduces building time to about one hour. Has air-dielectric variable capacitor for easy, accurate station tuning. Operates for months and months on long-life alkaline battery supplied. Sensitive miniature earpiece provides remarkably fine tone. Complete with all parts, including plastic-impregnated case, earpiece, battery and transistors. 4 x 3¾ x 1¾". Shpg. wt., 1½ lbs.

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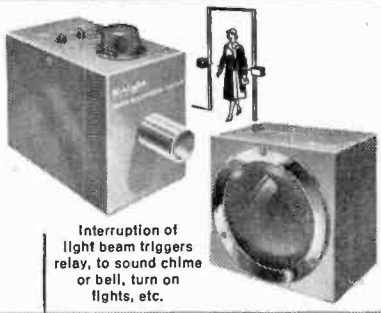

Interruption of light beam triggers relay, to sound chime or bell, turn on lights, etc.

knight-kit Transistorized Code Practice Oscillator Kit

Model Y-239 **$3.95**

Advanced-design code practice oscillator—ideal for beginners learning the code. Uses transistor circuit—operates for months from a single penlight battery. Has clear, crisp tone of approximately 500 cycles. Includes jacks for headphone tips; screw terminals for key. Compact black bakelite case with aluminum panel, only 2⅜ x 3¾ x 1½". Complete with all parts, transistor, battery and step-by-step instructions for quick, easy assembly. (Less earphones and key.) A fine code practice kit at very low price. Shpg. wt., 1 lb.

Model Y-239. Net only.....**$3.95**

knight-kit Photo-Electronic Relay Kit

Model Y-702 **$13.50**

Advanced-design, ultra-sensitive photo-electronic relay—build it yourself and save! Covers 250-ft. with white light; 125-ft. with "unseen" (red filter) light (made available in Light Source Kit listed below). Ideal as announcer, counter, burglar alarm (can be set to ring bell continuously when beam is broken). Hundreds of uses. SPST relay contacts. 6.3v. terminals provide power for accessories. 105-120 v. 50-60 cy. AC use. 6 lbs.

Model Y-702. Relay Kit. Net..**$13.50**

Model Y-703. Light Source Kit. With long-life sealed beam bulb and red filter. Shpg. wt., 3½ lbs. Net.**$6.75**

knight-kit 2-Way Intercom System Kit

Model Y-295 **$14.75**

Easy to build—ideal for home or office. Consists of Master and Remote unit, each with press-to-talk switch. Remote can be left "open" for switchless answering and baby-sitting. In "closed" position, Remote is private", but can be called and can originate calls. High-gain 2-stage amplifier and 4" PM speakers. Delivers full volume from only a whisper. With tubes and 50-ft. cable (up to 200-ft. may be added). Antique white finish. Size each unit, 4¾ x 6½ x 4⅜". For 110-120 v. AC or DC. Shpg. wt., 8 lbs.

Model Y-295. Net only.....**$14.75**

knight-kit "Space-Spanner" Bandswitching Receiver Kit

Model Y-243 **$15.95**

Thrilling 2-band receiver, easy to build, fun to operate—a terrific value. Bandswitch selects exciting short wave, including foreign broadcast, amateur, aircraft, police and marine radio (6.5 to 17 mc), and standard broadcast. Features highly sensitive regenerative circuit. Includes built-in 4" PM speaker and beam-power output for strong volume. Headphone connectors are available for private listening; switch cuts out speaker. Kit includes calibrated panel, punched chassis, all parts and tubes (less cabinet). Easy to build from step-by-step instruction manual. 7 x 10 x 6". For 110-120 volt, 50-60 cycle AC or DC. Shpg. wt., 5 lbs.

Model Y-243. Net only.....**$15.95**

Y-247. Matching cabinet for above.....**$2.90**

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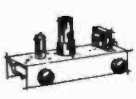
ELECTRONIC PHOTOFLASH KIT
Y-244 **$28.50**



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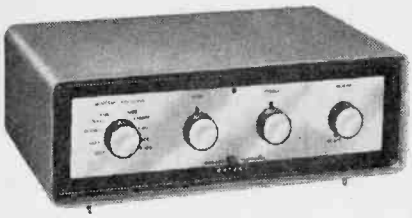

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knight-kit Complete 18-Watt Hi-Fi Amplifier Kit

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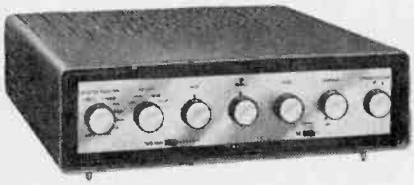
Here is a custom-styled, easy-to-build complete Hi-Fi amplifier at unbeatable low cost. Features 8 inputs for every possible signal source, including NARTB equalized tape head input. Delivers full 18 watts output at only .5% distortion; uses new RCA 6973 hi-fi output tubes; frequency resonse, ± 1 db, 20-30,000 cps; tape head and magnetic cartridge sensitivity, 5 mv for 18 watts output; hum and noise level better than 60 db below 18 watts; output taps for 4, 8 or 16 ohm speakers. Separate bass and treble controls; full record equalization. Simplest assembly is made possible through use of exclusive printed circuit switch and two printed circuit boards—no critical wiring to do. With beautifully styled custom cabinet; 4 x 13 x 8". Complete with cabinet, tubes, step-by-step instructions. Shpg. wt., 15 lbs.

Model Y-786. 18-Watt Hi-Fi Amplifier Kit. Net only..... **$39.95**



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- Three Printed Circuit Boards
- 8 Inputs • Full Equalization
- Full 30 Watts • Custom Cabinet

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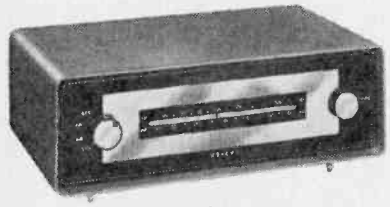
Comparable to the best—and you SAVE MONEY! Advanced features include: Linear-deluxe, Williamson-type circuit; equalization for all records within ½ db of recommended accuracy; 2 exclusive new printed-circuit switches; 3 printed-circuit boards for time-saving, error-free assembly; separate continuously variable Level and Loudness controls; 8 inputs for every signal source; DC on all filaments of preamp tubes; exclusive 3-way speaker selector switch (use speakers of mixed impedances without mismatch!); Power Amplifier response, ± ½ db, 15-100,000 cps at full 30 watt level; distortion—harmonic, 0.55% at 30 watts—IM, 0.74% at 20 watts; rumble filter switch; variable damping. Output 8 and 16 ohms. With cabinet, 4¼ x 15 x 15". Ready for easy, money-saving assembly. Shpg. wt., 32 lbs.

Model Y-762. 30-Watt Hi-Fi Amplifier Kit. Net only..... **$76.95**



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- Flywheel Tuning • Built-in AFC
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- Advanced Custom Styling

knight-kit FM-AM Hi-Fi Tuner Kit

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Model Y-787. FM-AM Hi-Fi Tuner Kit. Net only..... **$49.95**

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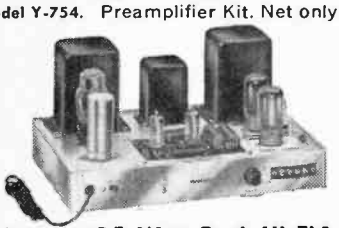

Model Y-755

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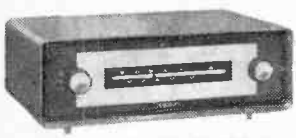
Here's superb Hi-Fi performance at less than half the cost of a commercially assembled unit. Williamson-type linear-deluxe circuit delivers full 25 watts of virtually undistorted reproduction; use with KNIGHT-KIT preamp above. Printed circuit board. Response: ± 0.5 db, 10-120,000 cps at 20 watts. Distortion: 0.15% at 30 watts. Output impedance: 4, 8 and 16 ohms. Includes balance control, variable damping control. Chrome-plated chassis; 6¼ x 14 x 9". Ready for easy assembly. Shpg. wt., 25 lbs.

Model Y-755. 25-Watt Amplifier Kit. Net only...**$44.50**

Y-759. Metal cover for above. Wt., 3 lbs.....**$4.25**



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Model Y-751. Hi-Fi FM Tuner Kit. Net only. . **$38.95**

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Model Y-128. Net.....**$16.95**

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Model Y-125. Net.....**$24.95**

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Anyone engaged in technical reading, whether professionally or as a hobby, profits by the precise definition of terms. This dictionary is particularly valuable because it presents electronic concepts in the context of the over-all science of physics. The experimenter often neglects this more comprehensive approach, which is indispensable for serious reading in science. As the most complete and up-to-date reference work available in this field, this large dictionary is well worth its price.

Recommended: to serious students, professionals and school librarians.

"THE HOW AND WHY OF HIGH FIDELITY" by Milton Sleeper. Published by the Heath Company, 305 Territorial Rd., Benton Harbor, Mich. 48 pages. Soft cover. 25 cents.

Not only will this liberally illustrated booklet answer your questions about the nature of high fidelity, but it spells out fundamental principles for hi-fi system planning that will benefit even the experienced enthusiast. Without fancy technical jargon or high-sounding terminology, Mr. Sleeper tells the complete high-fidelity story and leaves the reader with a sound basis of knowledge with which to evaluate performance and selection of equipment.

Recommended: as a fact-filled hi-fi handbook which you will want for yourself and your friends.

"MARINE RADIOTELEPHONE PERMIT Q & A MANUAL (3rd Class Operator)" by Milton Kaufman. Published by John F. Rider Publisher, Inc., 116 West 14th St., New York 11, N. Y. 48 pages. Soft cover. $1.35.

The questions and answers likely to arise on the FCC examination for a third-class permit are given in this manual. There are fine follow-through discussions which pro-

(*Continued on page* 38)

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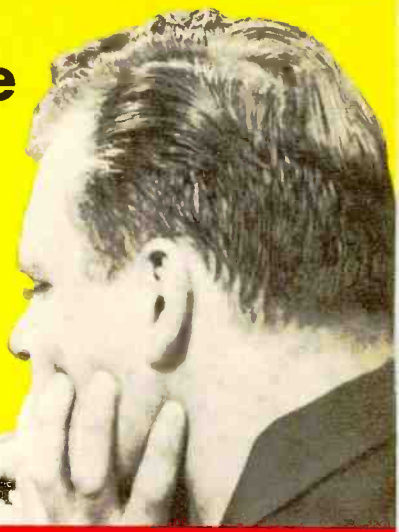

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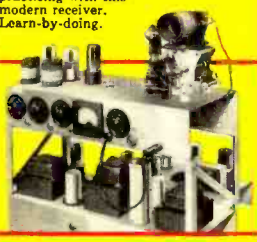

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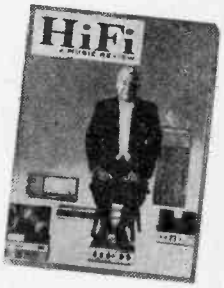

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(*Continued from page* 34)

vide information necessary for fully understanding the material involved in the questions. Appendices cover types of radiotelephone equipment which meet FCC requirements for shipboard use and a list of FCC field offices.

Recommended: to all who require ship-to-shore third-class permits under the new FCC regulations.

"ATOMIC ENERGY FACTS" issued by the U. S. Atomic Energy Commission. Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. 216 pages. Soft cover. $2.00.

Providing an up-to-date compilation of information in the atomic energy field, this volume is entirely devoted to peaceful uses of the atom. It describes the technical information services the AEC provides and how to use them, the special materials and services that are available, how to obtain patents and licenses—and the rules and regulations pertaining to them.

Other topics discussed include the Atomic Energy Commission's program for training and education in nuclear science and technology, cooperation with friendly nations in peaceful applications of atomic energy, raw and feed materials, reactor development, and radioisotope development. *Atomic Energy Facts* is one of the first in a series of books sponsored by the AEC which will cover a wide range of nuclear applications of interest both to the layman and to the specialist.

Recommended: To all needing information on the working of the atom for education and industry.

"RECEIVING TUBE SUBSTITUTION GUIDEBOOK (Third Supplement)" by H. A. Middleton. Published by John F. Rider Publisher, Inc., 115 West 14th St., New York 11, N. Y. 72 pages. Soft cover. $1.35.

This easy-to-follow service aid lists over 1200 receiving tube substitutions and more than 200 picture tube substitutions including European types, along with necessary wiring changes. It also contains a cumulative index to all the previous tube substitution manuals.

Recommended: to servicemen and technicians who need to keep up with the latest in tube type equivalents.

Don't forget our own "Hi-Fi Guide and Yearbook"—see pages 124 and 125 for details. —30—

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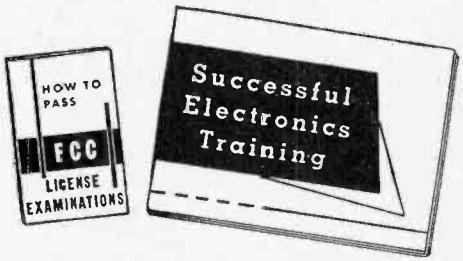

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Prentice Harrison, Lewes, Del.	1st	27 weeks
William F. Masterson, Key West, Fla.	2nd	24 weeks
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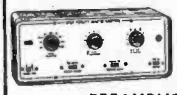

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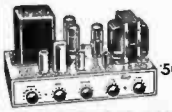

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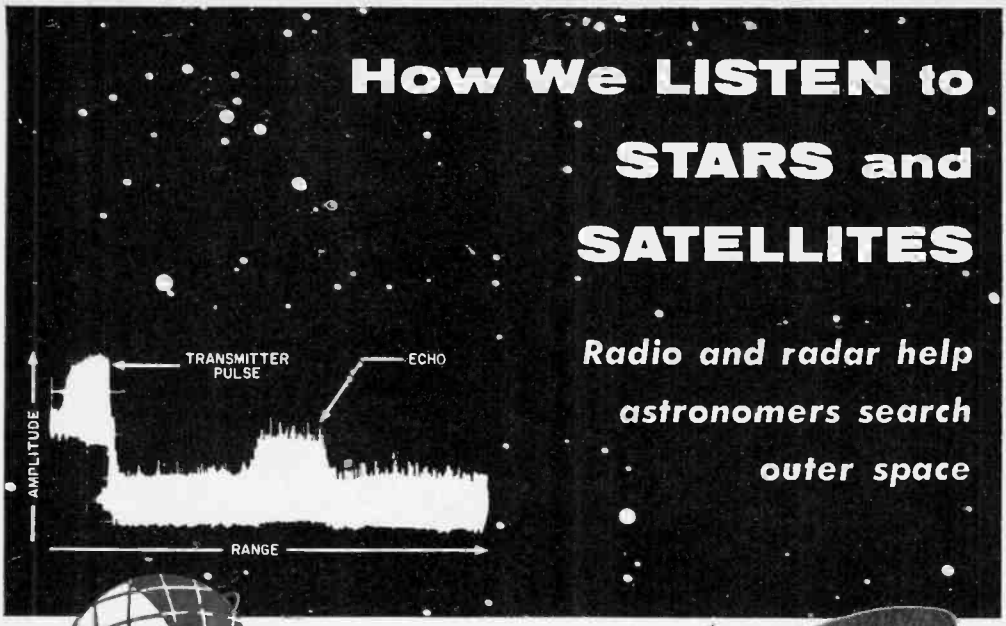
How We LISTEN to STARS and SATELLITES

Radio and radar help astronomers search outer space

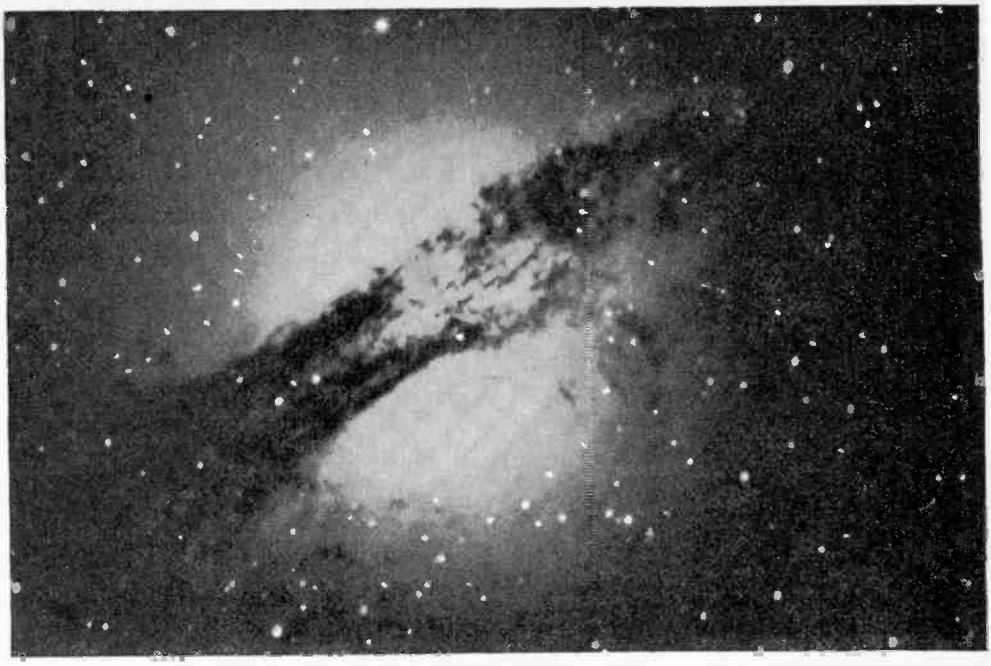


By MIKE BIENSTOCK
Associate Editor

Long-range radar is used to track the Sputniks in their orbits. A typical transmission-response pattern appears above the symbol for the International Geophysical Year.

IT WASN'T VERY LONG AGO that astronomy, like the mythical Cyclops, had only one eye—the optical telescope. Astronomers expected that bigger and better giant "eyes" would unlock the remaining closed doors of the universe. Everything, it seemed, was progressing quietly in its well-ordered way.

Then a second eye was developed, that of radio astronomy. A whole new universe opened—an incredible dimension they didn't know existed. Today



radio astronomy is flourishing like a lusty youngster; it may some day equal or even exceed in importance the 4000-year-old science of visual astronomy.

Another branch of the science is long-distance radar, which is now coming into its own in tracking the Russian Sputniks. As a matter of fact, some of the giant radiotelescopes have had radar antennas installed in them for this job.

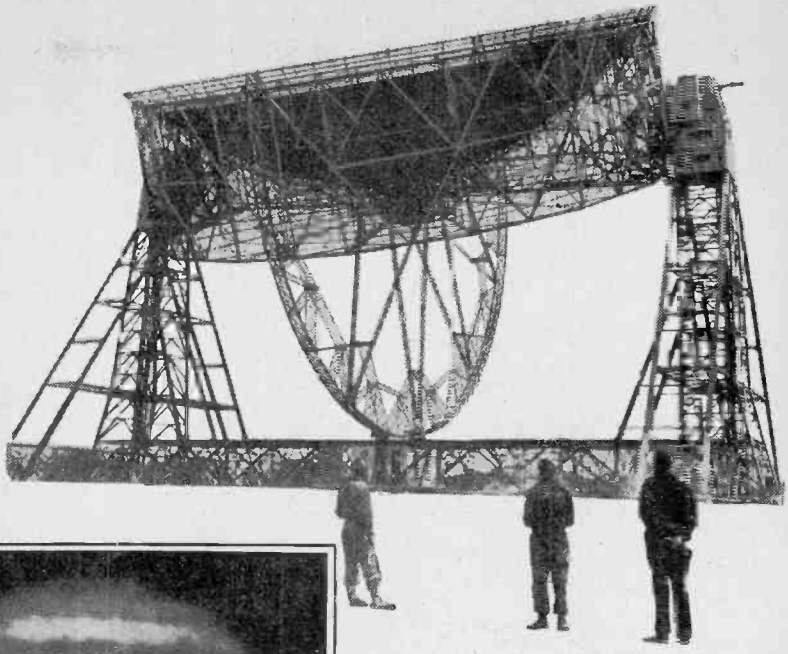
Static Identified. Radio astronomy is the science dealing with radio-frequency emissions from the stars, a phenomenon never suspected until about 1930, when Karl Jansky, a Bell Laboratories engineer, began to study and measure different kinds of static at frequencies around 20 mc. Before long he realized that the hiss-type static which he encountered was being emitted from definite points in space. Working in his own backyard observatory, Grote Reber, another radio engineer and a radio amateur, confirmed Jansky's discovery. Using a small parabolic antenna, he plotted the first radio star sky map.

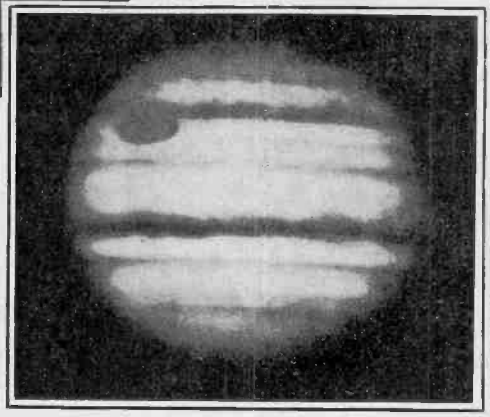
Giant strides have been made from these small beginnings. Dozens of radiotelescopes are scattered across the earth, their sensitive antennas constantly probing the heavens, recording the strange radio impulses. We now know that three types of "stars" emit radio waves: huge hydrogen gas clouds, made up of such a thin diffusion of atoms that they would be called vacuums on earth; novae, which are stars that have exploded with awesome violence; and collisions of huge star clusters or universes called galaxies.

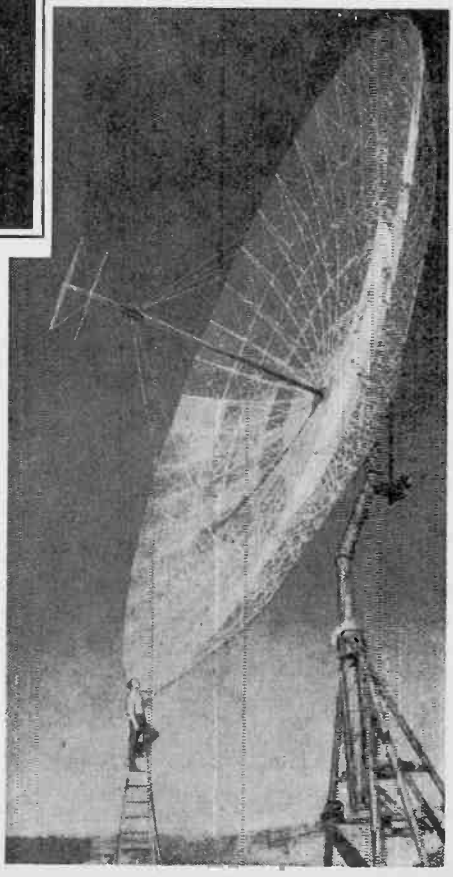
Heretofore, one of the stumbling blocks for astronomers had been the huge masses of dust scattered about the galaxies which prevented light from more distant stars from being seen on earth. Scientists could only guess what lay beyond them. Now, however, radio astronomy is unlocking even this secret. By focusing on gas cloud signals coming from behind the dust pockets (at a frequency of 1420 mc.), astronomers have been able to "count" the number of stars beyond. Mind you, they are not only counting the number of gas clouds whose radio emissions pass easily through the dust but —mathematically—the actual number of "visual" stars. They have learned that the greater the radio emission from an area, the greater the number of stars that are located there.

Sources of Emission. Radio emission from gas clouds was first predicted in 1944. It wasn't until 1955, however, that the signal was picked up on radioscopes. But since then astronomers have made up for lost time. They have used the 1420-mc. signal, and shifts in this frequency caused by the Doppler effect, to determine how fast and in which direction the gas clouds are moving. Such data have allowed them to plot the movement of our own galaxy, the Milky Way, as well as to gather more information on our expanding universe.

The second most intense radio source, in the constellation of Cygnus, has been found







Astronomers call the probable radio source at the upper left "NGC 5128"—it is thought to be two galaxies in collision. This photo was made with the 200-inch Palomar optical telescope. Immediately above is a photo of Jupiter, showing the huge "Red Spot" in the upper left-hand segment; this largest of planets is a radio source as well. The largest parabolic radio-telescope (above, right) is at Jodrell Bank, England; a movable dish, it is a 250-foot monster which has also been used in tracking the Russian Sputniks. At the right is the 61-foot movable parabolic antenna at Stanford Research Institute in Menlo Park, Calif.

Scientist measures and records radio observations of satellites at Lincoln Lab's new long-range radar station, Lexington, Mass.

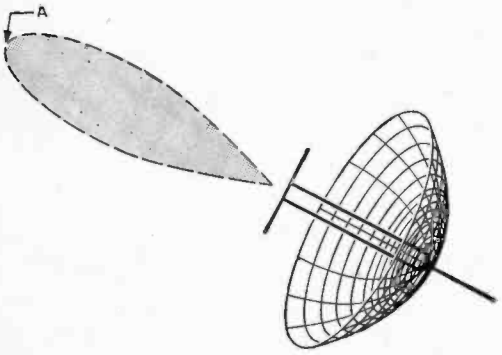


FIG. 1

HOW A RADIOSCOPE WORKS

Radiotelescopes are tuned to receive certain radio frequencies and indicate the direction from which they come. The two most common, the parabolic reflector (dish) and the interferometer, use two different methods to gain the same end. Note that in the dish (Fig. 1) there is a single response pattern, a fairly wide one. The dish is used just like an optical telescope: it "focuses" on a point as closely as possible—by using the maximum response point "A" on the radio source. On the other hand, the interferometer (Fig. 2) responds with a series of lobes as the angle of observation of the radio source changes, alternately reinforcing and canceling. Using the angles between these peaks, such as between "X" and "Y," the position of the radio source can be calculated with a somewhat better degree of accuracy.

to be from two whole galaxies in collision about 200 light years away. Another is listed only as NGC 5128 by astronomers. Others are being charted.

Our own sun has been proving a fruitful source of radio propagation. Although the study of the radio spectrum of the sun was begun only within the past few years, it has been determined that a huge amount of radio energy comes from the areas around large and active sunspots. This is in the 5-meter band. It is thought that the flares, being highly ionized gas, may produce strong electric fields when given rotational motion, which in turn may be the cause of the radio emissions.

Of the planets, Jupiter was the first to be picked up on radioscopes; the signals are apparently due to large-scale atmospheric disturbances. Venus was next to be detected. Radio-frequency measurements showed this planet to have a temperature higher than that of boiling water. Optical measurements had shown only half that temperature, but since Venus is covered by a layer of clouds, the optical measurements only took the cloud surface into account. Mercury, Mars and Saturn are expected to be heard from soon via their radio signals. And some cosmic static comes from "dark" areas, where stars have never been seen.

Two Types of Scopes. The radiotelescope is usually one of two types, the parabolic reflector (dish), and the interferometer. There are other types—helical, horn, and combinations of two or more types. The first two, however, are most generally used.

The largest "dish" is the one just completed and now being tested at Jodrell Bank in England. This has a diameter of 250 feet, and is steerable, which will allow it to cover all of the visible sky. It will complement the fixed 220-footer in operation there for many years. Work has also begun on a 140-foot steerable dish at Green Bank, West Virginia, which will be the largest of its type in the United States.

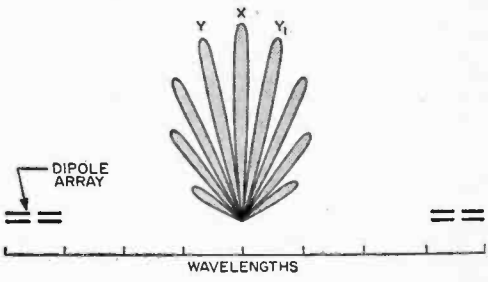
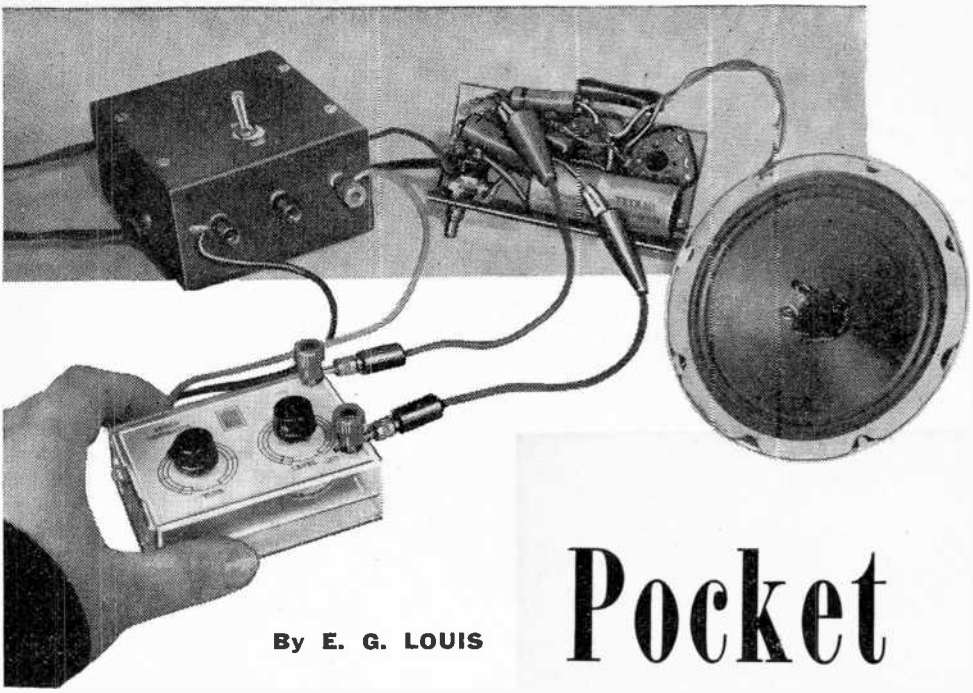


FIG. 2

Another new scope is under construction at the University of Michigan—this 85-foot dish will be completed in time to aid the International Geophysical Year effort. Recently completed was a long-range radar station at Lexington, Mass. Built by the Lincoln Laboratory, this radar has been used successfully to track the Sputniks. It is also being used to check the radio effects of meteors and the aurora.

(*Continued on page* 123)



Pocket Size Test Instruments

Part 2

Simple audio generator helps you to trace a signal through amplifier stages

By E. G. LOUIS

ALL ELECTRONIC EQUIPMENT that feeds earphones or loudspeakers contains stages which handle the audio signal. Our receivers, whether old or new, AM, FM or TV, all include audio amplifier stages. So do all audio systems, from hi-fi types to intercoms. For testing newly completed projects or repairing old ones, the audio generator is a very useful instrument.

As you know, commercial audio generators are usually large and fairly expensive bench-type instruments. They supply low-distortion sine-wave signals over a wide range of frequencies and with excellent frequency calibration. Such instruments are needed for *precise* measurements or tests.

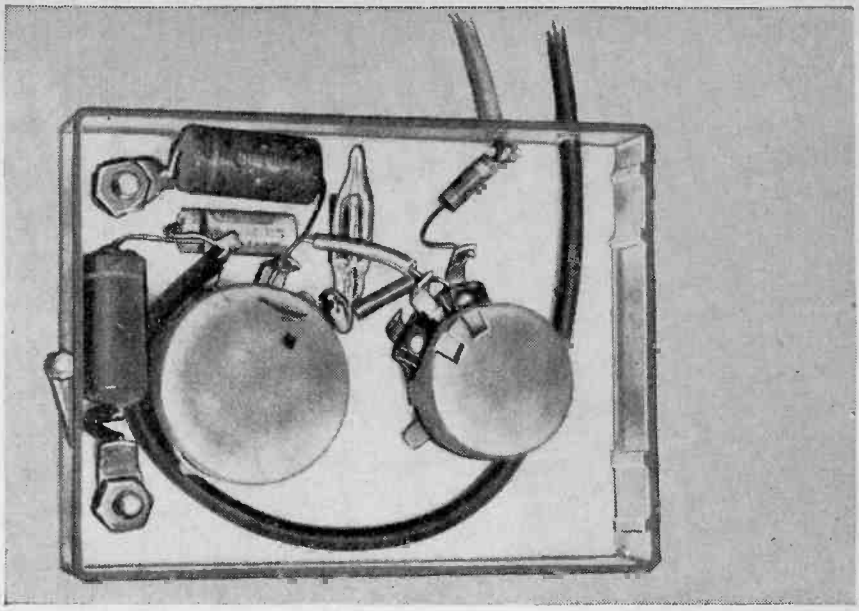
However, for servicing and signal-injection trouble-shooting techniques, we don't need a "perfect" sine wave. What we do need is a test signal with a frequency in the middle of the audio range and an output variable from near "zero" to about a volt.

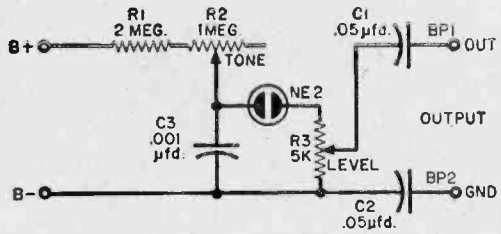
You can construct a midget audio generator in a single evening which will meet these basic requirements. Truly "pocket-sized," the completed instrument is not much larger than a package of cigarettes. It can be operated from the equipment under test or from its own power supply. A versatile separate power supply circuit will be discussed later in this article.

AUDIO GENERATOR

This audio generator will supply a pulse-like signal at a moderately low output im-

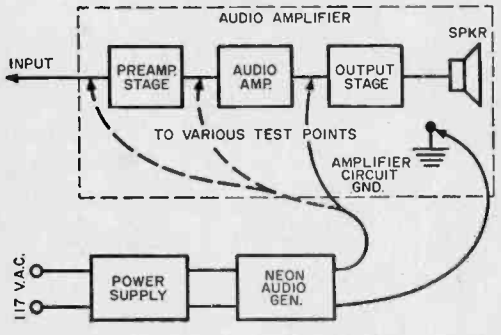
Internal view of generator shows parts layout. When drilling lead and component holes, do not use excessive pressure on the brittle plastic. When soldering to the lugs, take care not to melt the cabinet. Schematic below shows method of obtaining low impedance output.





PARTS LIST

BP1, BP2—Binding posts
C1, C2—0.05-μfd., 400-volt miniature capacitor
C3—0.001-μfd., 400-volt capacitor (see text)
R1—2-megohm, ½-watt resistor
R2—1-megohm potentiometer (Tone)
R3—5000-ohm potentiometer (Level)
1—NE-2 neon bulb
1—Small plastic box or metal case
Misc. knobs, machine screws and nuts, wire, solder, etc.



Interstage test points will enable rapid trouble-shooting of audio stages in hi-fi equipment or receivers.

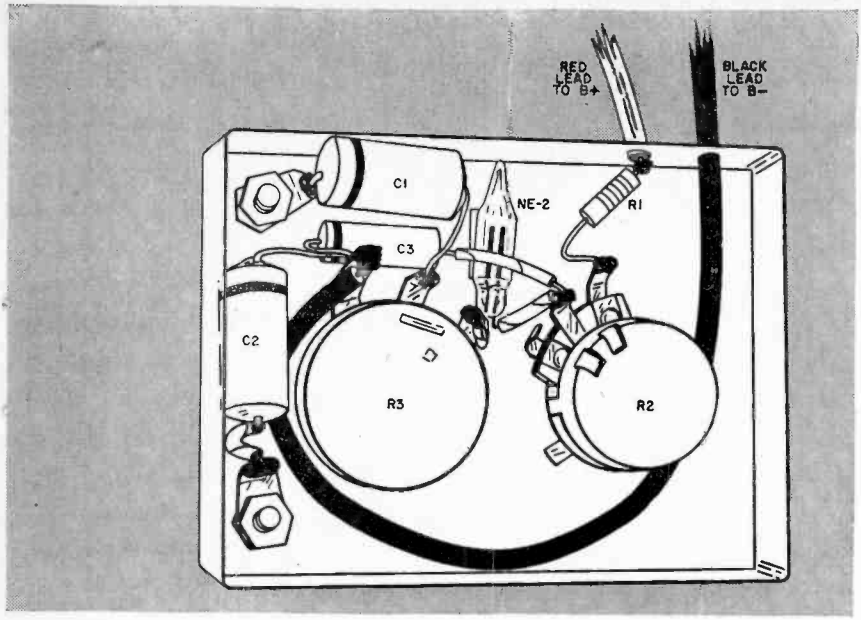
pedance. A neon bulb is used instead of a tube or transistor. And two controls are provided to adjust amplitude and frequency for special tests.

The NE-2 neon bulb is employed in a relaxation oscillator circuit and need not be visible as far as the use of the instrument is concerned. However, if you leave a cutout in the housing so that the bulb can be seen, it will serve as an attractive pilot light.

Five-way binding posts (*BP1, BP2*) or any similar type of connector can be used for the output terminals. Two flexible leads are provided for connecting the instrument to a d.c. power supply source. These leads may be terminated in spade lugs, banana plugs, 'phone tips or small insulated alligator clips.

House the unit in a small plastic box or metal case. If you use a transparent plastic box, you can make an attractive front panel by drawing a dial layout on a piece of colored cardboard with black ink. Mount the cardboard tightly against the inside of the cover. Controls and output terminals may be labeled by hand or with a typewriter. If a metal case is employed, you can give the completed unit a professional appearance by labeling it with standard radio decals.

To use the instrument, first connect the B+ and B— leads to a suitable d.c. voltage source (95-150 volts). This may be the B supply of the equipment being checked, batteries, or a separate power supply. Then connect standard flexible test leads to the generator's output terminals and to appropriate points in the equipment under test. Adjust the frequency and amplitude con-



Completed generator is seen below. Neat control panel markings can be achieved by typing or hand lettering the appropriate markings.

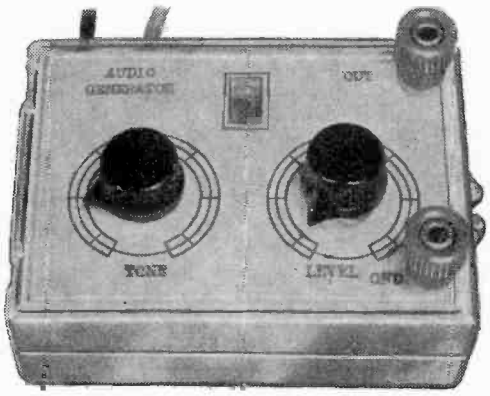
trols as needed. The basic signal injection test technique is illustrated on page 46. With this approach, trouble-shooting audio stages is a "snap."

Connect the audio generator's *Gnd.* lead to the amplifier ground. Then connect the *Output* lead to the input of the amplifier's output stage. This may be either the grid of a vacuum tube or the base of a common emitter transistor amplifier stage. If the amplifier's power supply circuit and output stage are operating normally, an audio tone will be heard from the loudspeaker. Set the audio generator's *Level* control to the minimum level that will give an audible signal.

Next, transfer the generator's output signal lead to the input of the previous stage. Again, an audio tone should be heard from the loudspeaker, but with *increased volume,* due to the added gain of the second stage. Again reduce the generator's output level until the signal is just audible, and transfer the output lead to the input of the next preceding stage.

Continue this technique, stage by stage, until you reach the input of the amplifier. There should be an increase in volume as each stage is added to the amplifying chain. Stage gain is indicated by the relative increase in volume between adjacent stages. If there is a *drop* in volume, or if the tone disappears entirely, you have isolated the defective stage. The final step is to check operating voltages and components in that stage until you isolate the defective part or connection.

This basic servicing technique can be used both with factory-built equipment and



HOW IT WORKS

This audio generator is basically a simple relaxation oscillator, modified to provide an output signal across a low-impedance load. Its output signal has a rounded waveshape instead of the usual saw-tooth waveform that a neon bulb oscillator produces.

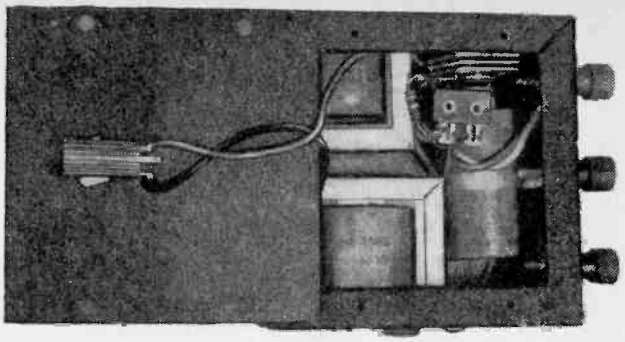
In operation, a d.c. voltage (from 95 to 150 volts) is applied to the two power supply leads (B+ and B—). Capacitor *C3* charges slowly through series resistors *R1* and *R2* until the voltage across it reaches the firing potential of the NE-2 neon bulb. Then the bulb fires and discharges the capacitor through the *Level* control (*R3*).

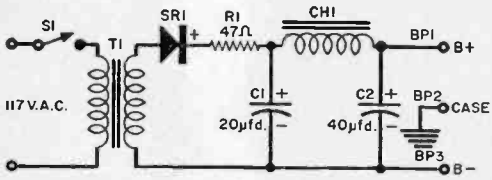
With *C3* discharged, there is no longer sufficient voltage available to keep the neon bulb conducting, and it extinguishes, allowing the capacitor to recharge. This action keeps repeating, developing a signal voltage across *R3*.

Operating frequency is determined by the time constant of *R1*, *R2* and *C3* and by the applied voltage. Since *R2* is variable, it serves as a *Tone* (or *Frequency*) control.

The setting of *R3's* center arm determines the portion of the available signal voltage that is applied to the two output terminals (*BP1* and *BP2*) through isolating and d.c. blocking capacitors *C1* and *C2*.

The power supply shown at right may be used for a number of purposes in addition to that of powering the generator. Schematic below includes a surge resistor and line isolation.





PARTS LIST

BP1, BP2, BP3—Binding posts
C1, C2—20-40 μfd., 150-volt, dual electrolytic capacitor
CH1—10-henry, 65-ma. filter choke
R1—47-ohm, ½-watt resistor
S1—S.p.s.t. toggle switch
SR1—65-ma. selenium rectifier
T1—1:1 isolation transformer, secondary rated at 65 ma. (minimum)
1—4" x 4" x 2" metal case (ICA No. 3810)
Misc. rubber feet, terminal strip, line cord and plug, machine screws and nuts, wire, solder, ground lugs, etc.

for "debugging" home-built amplifiers. The investment made in components (about $4.00) will be more than compensated for by the time and effort saved in servicing.

POWER SUPPLY

Since the audio generator's current requirements are low, the d.c. needed to operate it may be obtained from the equipment (receiver, phono amplifier, etc.) being tested. Simply connect the B+ and B− leads to appropriate terminals in the equipment. Connection across the second filter capacitor will usually be correct.

However, many receivers do not have 90 volts or more of d.c. available in their circuits which we can borrow for powering the audio generator. Portable sets using 45- or 67-volt batteries and transistor sets are in this class, and a separate power supply for the audio generator is necessary when testing them. Some of you might want to employ the separate power supply at all times for convenience and for safety.

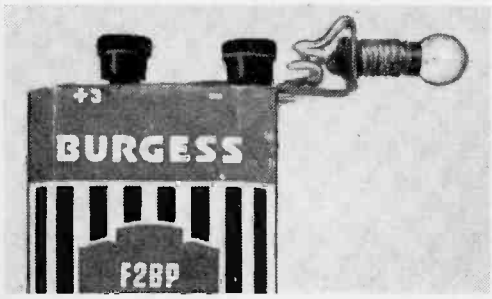
A suitable power supply circuit is shown at left. Supplying about 130 volts, d.c., this unit may be assembled from easy-to-obtain, low-cost parts in a single evening. Its exact output voltage will depend on the load. House the power supply in a standard 4" x 4" x 2" metal case, so that it will require relatively little space on the workbench or in the tool box.

HOW IT WORKS

In operation, the rectifier circuit is isolated from the a.c. power line by transformer *T1*. S.p.s.t. switch *S1*, in the primary circuit, serves as an "on-off" switch. A single selenium rectifier stack (*SR1*) is used as a half-wave rectifier, with ripple filtering provided by a "pi" type *LC* filter, consisting of electrolytic capacitors *C1* and *C2*, and iron-core filter choke *CH1*. A small series resistor (*R1*) serves to limit the surge currents as *C1* charges, and thus protects the selenium rectifier against accidental burn out.

By using a "shock-free" design with the chassis isolated from the power line circuit, you can also use this power supply as a *safe* substitute B supply for table model receivers, small phonograph amplifiers and portables. And, since *either* output terminal may be connected to circuit "ground," you can even use it as a negative bias supply for a moderate-sized radio transmitter. —30—

Make Close-Range Light in Two Minutes



An emergency lantern can be quickly made with a 3-volt A battery, such as the Burgess F2BP or equivalent, a screw base pilot lamp socket and a flashlight bulb. Straighten the pilot socket clip and drill a 5/32" hole near its end to enable it to be installed on the battery terminal screw. The battery is comfortable to grip and no switch is needed. The bulb can be given a twist in for "on" and a reverse half twist for "off." —*George P. Pearce*

By MYRON JOSEPH

Can You Spare the Time?

Tune in Station WWV to set your watch or use any of its other precision services

Some of the antennas used by Station WWV on its eight frequencies.

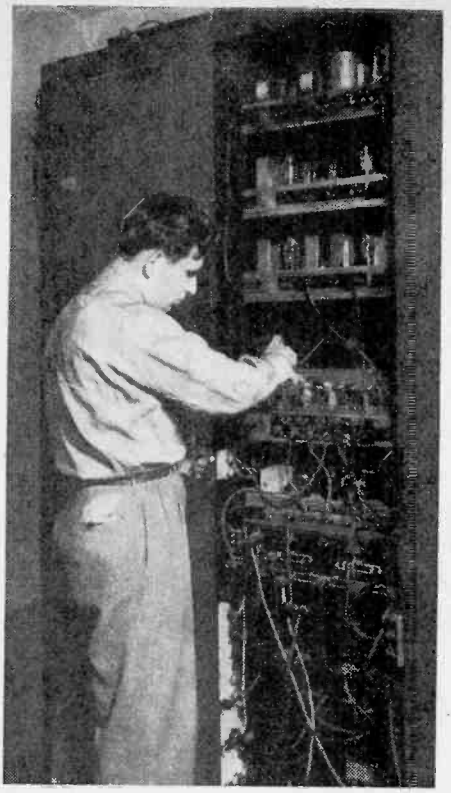
JUST how important is the right time? If you're a carpenter, or a storekeeper, or a salesman, or a bookkeeper, it probably doesn't matter much if your watch is a minute or two off. It's no life-and-death problem.

But what if you run a radio station . . . or you're a scientist involved in delicate measurement . . . or a ship's captain who has to check his position at sea? Then time may be of the greatest importance—accurate time, to the very fraction of a second.

Fortunately for the United States—and a good part of the rest of the world—the National Bureau of Standards maintains a service which broadcasts time checks every hour of the day, seven days a week, 52 weeks a year. This is Station WWV in Beltsville, Md., as unusual a radio station as ever transmitted a signal.

In operation since 1923, the station broadcasts six widely used technical services: standard radio frequencies; standard audio frequencies; standard time intervals; standard musical pitch; time signals; and radio propagation forecasts.

Checking Sputniks. When American scientists began tracking the Russian earth satellites, they relied on the WWV broadcasts for coordinated timing. Amateurs and short-wave listeners depended on it to determine the frequency on which the Sputniks were transmitting. (One of the frequencies WWV uses is 20 mc. The first Sputnik used a frequency of 20.005, as well as a higher one, 40.002 mc. SWL's and hams found it



Audio frequency and time interval generating equipment at WWV is adjusted by a technician at the station.

easy to tune to WWV, then detune slightly to pick up the satellite transmission.)

When a piano tuner in Chicago wants to find out if his tuning fork is on pitch, he can dial WWV and listen for the audio frequencies broadcast most of the time during each hour. He listens for the 440-cycle tone which is standard in the U. S. for A above middle C.

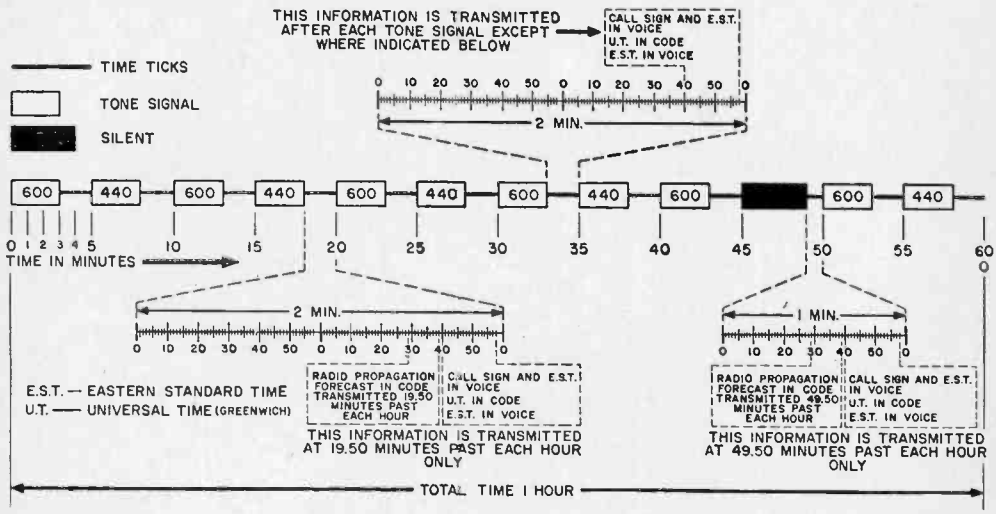
In addition, a 600-cycle tone is broadcast, because this frequency can conveniently be converted by electronic instruments into other frequencies, and it can be divided by ten to get 60 cycles, to be compared by power stations with their a.c. frequency of 60 cycles. Since electric clocks remain accurate only if the power frequency is maintained accurately, utility companies find this service a blessing.

The audio frequencies are interrupted precisely two minutes before each hour. They are resumed precisely on the hour and each five-minute period thereafter. In this way, they accurately mark the hour and each successive five-minute period.

Fine Adjustment. A watch manufacturer in New England must check his inspection instruments to insure the accuracy of the watches he makes. He will tune in on WWV for the pulses spaced at inter-

(*Continued on page* 130)

The chart below outlines the six functions of WWV. In box at bottom of page, letters indicate current conditions, numbers tell the conditions expected in the following six hours.



STATION WWV TRANSMITS 24 HOURS DAILY ON THE FOLLOWING FREQUENCIES——

2.5 Mc	15 Mc
5 Mc	20 Mc
10 Mc	25 Mc

RADIO PROPAGATION		
DISTURBED GRADES (W)	UNSETTLED GRADE (U)	NORMAL GRADES (N)
1—USELESS 2—VERY POOR 3—POOR 4—POOR-TO-FAIR	5—FAIR	6—FAIR-TO-GOOD 7—GOOD 8—VERY GOOD 9—EXCELLENT

TRAP THOSE UNWANTED STATIONS

Tune out interfering signals with a wave trap—knock whistles, howls or intruding programs dead

By LOUIS E. GARNER, JR.

YOUR PROGRAM is spoiled, and you pick yourself up with a sigh and snap off your receiver. As you take a couple of aspirins to calm that throbbing headache, you quietly resolve to drop the offending set into the trash can when you take out the rubbish . . . or, at the very least, to pester the operator of the offending transmitter—be it the local broadcast station, a commercial or government code station, or a nearby amateur. But after a while, when the ache caused by the unwanted station dies away, you sit down and try to figure out what to do about the situation.

Figure no further. What's been troubling your reception has been, of course, some station beating its own frequency—either as a harmonic or image—against the frequency to which you're tuned, or some close and powerful station overriding it and cross-modulating. For practically peanuts, you can build a wave trap to sidetrack the offending interference.

What Is a Wave Trap? It's a tuned circuit, adjusted to resonate at the frequency of the interfering signal, and connected to a receiver in such a way as to weaken seriously or eliminate the undesired signal. It is generally used in the antenna circuit.

A wave trap is not a general-purpose "interference filter." Since it is tuned to a specific frequency, it reduces interference only at that frequency. There are two basic types of wave traps: *series-resonant* and *parallel-resonant*. They are shown schematically in Figs. 1 and 2.

Types of Traps. A series-resonant circuit has a very low impedance at its resonant frequency; in fact, an ideal series-resonant circuit is equivalent to a short circuit. At other than its resonant frequency, it offers appreciable impedance. When connected across the antenna and ground terminals, it acts to short out signals at its resonant frequency, but has little effect on other signals.

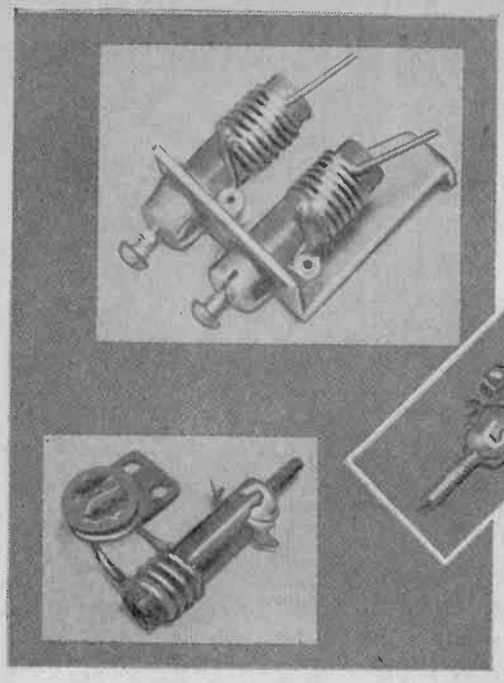
A parallel-resonant circuit is just the opposite. It has a very high impedance at its resonant frequency—an "ideal" parallel-resonant circuit would act like an open circuit. At other than its resonant frequency, however, it offers relatively low impedance. When this circuit is connected in series with the antenna lead of a receiver, it forms a voltage divider with the input circuit of the set. Then, at its resonant frequency, the greater portion of the available signal is dropped across the wave trap and relatively little is applied to the receiver. At other than its resonant frequency, since it offers a low impedance to these signals, little or no attenuation occurs and all the signal picked up by the antenna is applied to the receiver.

Since the series-resonant wave trap acts like a short circuit at its resonant frequency, it is most effective when connected across a relatively high impedance circuit. The parallel-resonant wave trap, on the other hand, is most effective when connected in series with the antenna lead of a receiver having a low input impedance.

Unless you know the input impedance of your receiver, it is best to try both types of traps against an interfering signal, permanently connecting the one which gives the best results. The same coil and capacitor (L and C) combination can be used for assembling either type of wave trap.

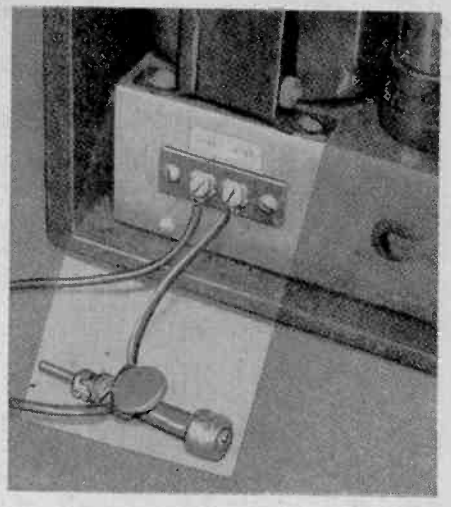
BROADCAST and SHORT-WAVE SETS

In broadcast and communication receivers, station interference can be caused by a transmitter operating at a frequency close to the desired signal, by strong harmonics of a transmitter operating at a lower frequency, or by a *very strong* nearby trans-



Typical wave traps designed to help reduce interfering signals at widely different frequencies. See text to determine the best type for your problem.

Before installing the wave trap, it is best to hook it on temporarily to check out its performance, as in photo below. If it works properly, you can mount it.



mitter which tends to "blanket" a portion of the band.

In the case of a superhet receiver, interference might be caused by a transmitter operating at the image frequency of the station being received. This is usually above the desired signal by twice the i.f. value. For example, suppose the receiver is tuned to a station at 560 kc. and, further, that the i.f. is 455 kc. The image frequency would be 1470 kc. (twice 455 plus 560), and a transmitter operating at this frequency could cause interference.

Wave traps are effective against all these types of interference.

The Procedure. When use of a wave trap is indicated, the first step is to determine the frequency of the interfering signal, then to choose a coil and capacitor combination which will resonate at this frequency.

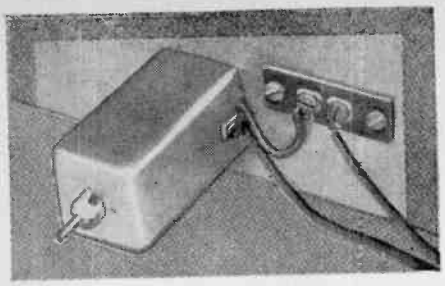
The wave trap should be adjustable to permit precise tuning after it is installed. A fixed coil and a variable (trimmer or padder) capacitor can be used, or if preferred, a fixed capacitor and adjustable coil with a movable powdered iron core gives similar results. For the maximum range of adjustment, the coil and capacitor can both be variable.

You can determine the frequency of the interfering signal by listening for the station's call letters and then checking a log book. If the frequency of the interfering station is in the AM broadcast band (550 to 1500 kc.), you can assemble a suitable wave trap from a standard Loopstick antenna coil and a small fixed or variable capacitor (value from 30 to 370 $\mu\mu$fd., depending on frequency of interfering station).

If the interfering signal is below the broadcast band, a suitable wave trap can be assembled using the coil from a discarded 455-kc. i.f. transformer or an adjustable r.f. choke shunted with a small ceramic capacitor. If the interfering signal is slightly above the broadcast band, you can use a local oscillator coil. And if the signal falls within the short-wave bands, you can choose a suitable coil from a coil catalog.

With the wave trap assembled, connect it into the receiver circuit temporarily, using one of the arrangements shown in Figs. 1 and 2. Make a preliminary tuning adjustment while the interfering signal is being received. If the interference is rejected adequately, install the wave trap permanently on a small bracket, and give it a final adjustment.

If the first trial does not give adequate



You may find that your wave trap will pick up an undesired signal on its own. Such tendencies can be reduced or eliminated by shielding the trap as shown at left.

Schematics for the various types of wave traps appear below (Figs. 1-6). A complete explanation of each type of trap and its proper use is given in the text.

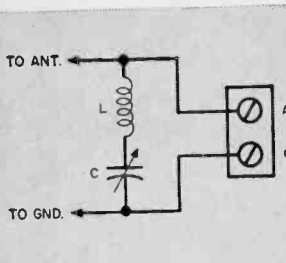


FIG. 1

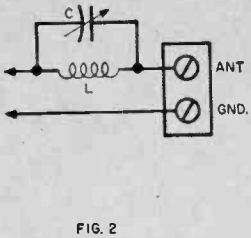


FIG. 2

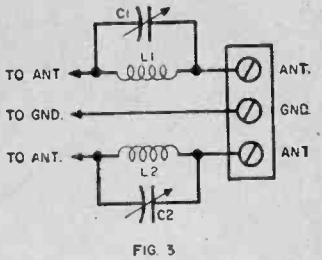


FIG. 3

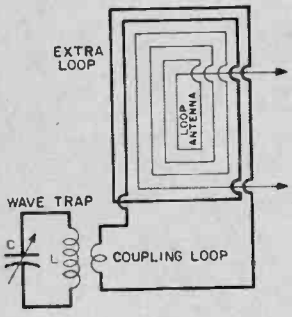


FIG. 4

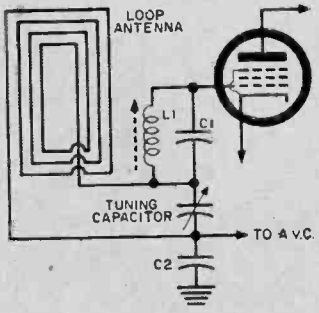


FIG. 5

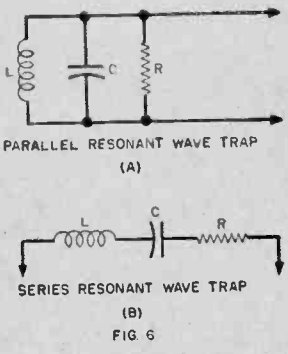


FIG. 6

rejection, try another arrangement. For example, if the series-resonant wave trap is tried first and proves ineffective, then use the parallel-resonant wave trap.

Doublet Antennas. While single long-wire antennas are probably the most popular, and require but a single wave trap, doublet antennas (dipoles) are often used with short-wave receivers. Although a single wave trap in one of the two antenna leads will sometimes give acceptable results, much better rejection of an undesired signal, as well as a better "balance" in the antenna system, can be obtained when two identical wave traps are used, with one connected in each of the two antenna leads.

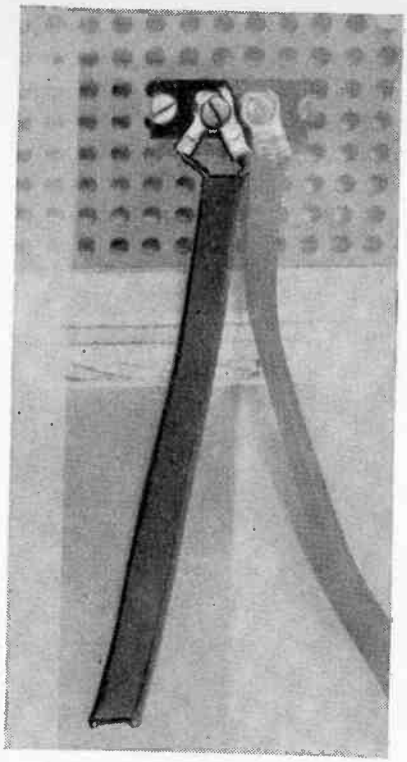
Such an arrangement is illustrated in Fig. 3, using parallel-resonant wave traps. Of course, dual series-resonant wave traps could be used instead. In this case, one wave trap is connected from each antenna lead to ground.

Another technique which often gives good results is to connect a single series-resonant wave trap between the two antenna terminals.

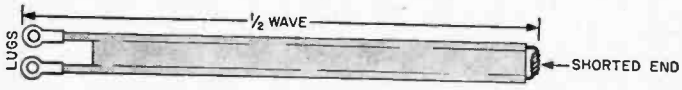
Loop Antennas. Fortunately, loop antennas have an inherent directional characteristic. This minimizes the need for a wave trap, since the antenna can be oriented to reduce the pickup of an interfering signal from a particular direction.

It is difficult to add a conventional wave trap to a loop antenna because the loop is a part of the receiver's input tuned circuit. At other than the wave trap's resonant frequency, it acts like either a coil or a capacitor and may seriously detune the loop. Two techniques which have been used with loop antennas are shown in Figs. 4 and 5.

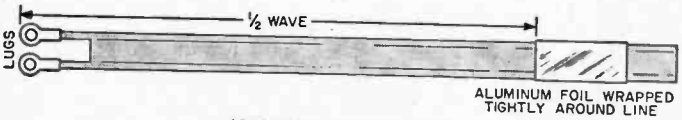
With the arrangement in Fig. 4, an external wave trap is loosely coupled to the loop antenna by means of a *coupling link*. This consists of 10 or 15 turns around the wave trap's coil (*L*) and one or two turns around the loop antenna. At the wave trap's



OPEN STUB
FIG. 7



SHORTED STUB
FIG. 8



ADJUSTABLE SHORTED STUB
FIG. 9

Transmission line stubs are better in the v.h.f. range than LC wave traps. Photo at top shows a typical installation of a line stub on a TV receiver. Diagram above (Figs.7-9) shows different types of stubs.

resonant frequency, it tends to absorb r.f. energy from the loop and thus to cut down on the strength of the interfering signal.

A parallel-resonant wave trap may be used between the loop antenna and the grid of the first tube in the receiver, as in Fig. 5. This system is not too effective because the high input impedance of the tube limits the amount of attenuation which the wave trap can introduce. However, acceptable results may be obtained if the interfering signal is not too strong.

Shielded Wave Traps. In some rare instances, you may find that a wave trap will, itself, pick up an interfering signal at a frequency other than the one to which it is tuned.

You can correct such a condition by using a different *LC* combination to tune out the undesired signal, or by mounting the wave trap in a small shield can. A shield salvaged from an old i.f. transformer or a small frozen-juice can, mounted with spade lugs, can be used for this purpose.

Modifications. Depending on conditions, different amounts of selectivity are required. For example, you might need a sharp response to attenuate a specific station without affecting adjacent stations. In another instance, you might wish to attenuate a fairly broad band of frequencies.

You can broaden the response of a wave trap by adding a small loading resistor. A series resistor is used with a series-resonant wave trap, as in Fig. 6(B), while a shunt resistor is used across a parallel-resonant wave trap as in Fig. 6(A). The value of the resistor can be determined experimentally, depending on the final response needed.

When a series resistor is used, however, its value will be quite small compared to that of a shunt resistor. For example, the value of a typical series resistor may fall in the range from ten to several hundred ohms. A shunt resistor's value will probably fall in the tens of hundreds of thousands of ohms.

TV RECEIVERS

While conventional coil and capacitor combinations may be used to assemble wave traps operating within the TV and FM broadcast bands, the higher frequencies of these bands make it practicable for low-cost transmission line stubs to be employed here.

Use of Line Stubs. An open length of transmission line acts like a series-resonant circuit at a frequency at which its length is equal to one-fourth the electrical wavelength of the signal at that frequency. Such a line is called a quarter-wave open stub (Fig. 7).

Similarly, a shorted length of transmission line acts like a series-resonant circuit at a frequency at which its length is equal

(*Continued on page* 130)

German Radios

How Good Are They?

This Grundig-Majestic console combines AM, FM, short-wave and phono with stylish cabinetry. Multi-speaker sound emerges from flared bottom.

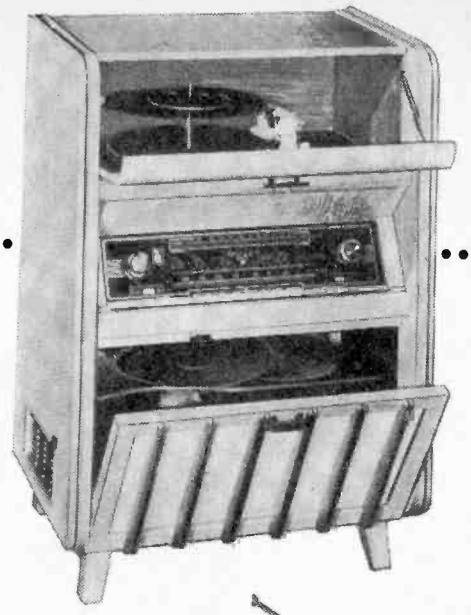
By H. H. FANTEL

A GERMAN INVASION is taking place clear across the entire United States. It is a peaceful and constructive invasion, spearheaded by some of the most versatile and unusual radio receivers ever offered to the American public.

Sleek lines, cabinets of fine wood and elaborate dials immediately mark these German designs as something rather special. A closer look reveals their fascination to be more than skin-deep; for behind the glossy façade lies a chassis combining AM, FM and multiband short-wave reception.

Such versatility is almost unknown among our domestic radios. Most American designers tend to leave short-wave to communications receivers, and our short-wave receivers are rarely equipped to receive FM.

Many of the German receivers are designed to capture practically any radio signal sent out on the air—regardless of frequency and type of modulation—even tuning down to 100 kc. In Europe some broadcast stations are on these "long



Designers of this small all-wave radio-phono combination tried to do too much in too little space. Even record storage is provided for behind the hinged speaker door; it would have been better to use the space for proper loudspeaker baffling.

A truly remarkable portable is the Telefunken Elite, with AM, FM, short-wave, battery recharger, treble and bass controls, and very good sound for its size. But a portable can't be hi-fi.

waves," but in the U.S. we get mostly airport beacon signals on that band.

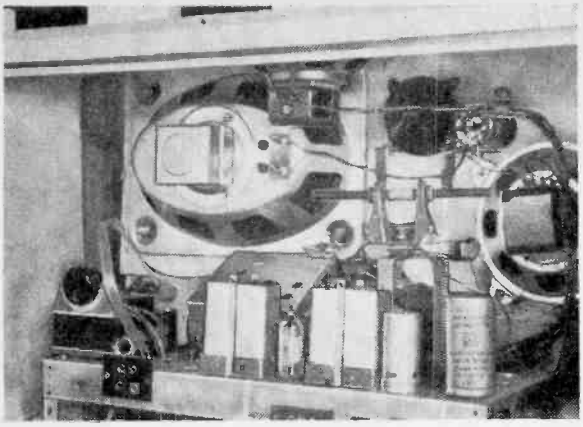
Putting a lot of eggs in one basket always entails the danger that a few may get slightly cracked. Similarly, loading a single chassis with so many functions requires some compromise, especially in models where the price tag enters into design considerations. Unquestionably, these German sets are remarkable designs and offer amazing value. But in fairness to the technically aware hi-fi and/or short-wave fan, a few drawbacks should be pointed out.

S.W. Performance. In any all-wave receiver, American or foreign, there is the problem of crowding the various bands within the tuning range of a single gang of variable capacitors. In the better communications receivers designed specifically for short-wave listening, this is overcome by electrical bandspread, an auxiliary tuning capacitor. The German all-wave models have no bandspread. This lack does not really detract from the general usefulness of the German sets, except for critical short-wave reception.

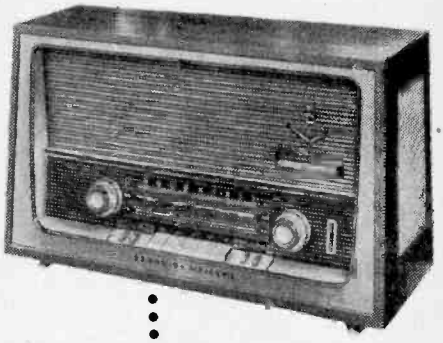
As short-wave receivers, most German all-wave models are also somewhat handicapped by the absence of a tuned r.f. stage. They do not have noise limiters, particularly useful to listeners in cities where man-made static is a problem, nor do they contain beat-frequency oscillators. The latter are most useful to amateurs for code reception; many short-wave listeners also use them for locating weak carriers whose modulated signals cannot be readily heard but which may "fade in" later. Of course, some low-priced American short-wave receivers share these deficiencies, and to call special attention to them may be a case of the pot calling the kettle black.

Should these drawbacks discourage a prospective buyer? It depends on the use for which he intends his radio. If he is primarily a short-wave listener, he might do better to get a set designed specifically as a high-quality communications receiver, for its many technical features. If he is only a casual short-wave listener, who likes a good-sounding radio for all-wave reception but can get along without spectacular DX capabilities, these drawbacks will hardly bother him, and the all-around versatility of the imported set well makes up for them.

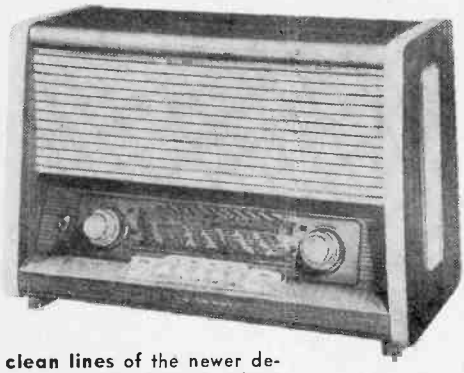
Sound To Astound. A German table model radio usually turns out to be a real "surprise package" in terms of sound. The larger models boast what is probably the most musical sound ever attained with a



Revealed in the interior of this Graetz receiver is an upward-pointed speaker for better sound distribution in addition to an oval woofer and a small (black) tweeter, resulting in surprisingly good sound for a table model.



Like most German radios, this Grundig table model has visual tuning indication for all bands. Again note the electrostatic tweeters on the sides, which provide good distribution of highs.



The clean lines of the newer designs are exemplified in the Olympic Opta receiver. Note openings at the sides of the receiver, which contain electrostatic tweeters.

table set. The credit for this goes partly to the solidly built hardwood cabinet and judicious placement of tweeters to attain wide-angle sound distribution. But most of the credit is due to careful electronic compensation of audio circuits to prop up the response where it sags under the natural limitations of relatively small speakers and cabinets. German radio-makers apparently design their sets "by ear."

Separate treble and bass controls are standard equipment on the better German imports. Thus the sound obtained from a good table model is quite adequate for music reproduction and record playback. Moreover, additional loudspeakers can usually be plugged in at the back of the set for extended frequency range and sound distribution.

But are they hi-fi? If we insist on a reasonably flat bass response down to 50 cps as a minimum hi-fi standard, *no* table model can qualify as "high fidelity." Of course, some advertisers will stick a "hi-fi" label even on three-tube a.c./d.c. equipment, but that's like putting a fancy front grille on a scooter and saying it's better than a Cadillac. The German table radios sound clean and sweet, far superior to the usual sound expected from table models. They produce a balanced tone spectrum within their range; but the range just doesn't go far enough down to qualify as hi-fi.

Moreover, most German imports have single-ended output. (Only the most expensive models have the push-pull output stages required to furnish the wattage necessary to reproduce full bass without distortion.) Consequently, while providing good listening qualities at relatively low volume, they are unable to achieve full concert-hall volume without serious distortion.

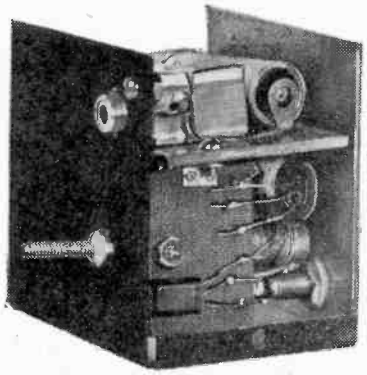
This limitation, of course, applies only to the table models. Some of the consoles are quite capable of full range at reasonable power levels. Yet even they cannot compare in performance with genuine hi-fi equip-

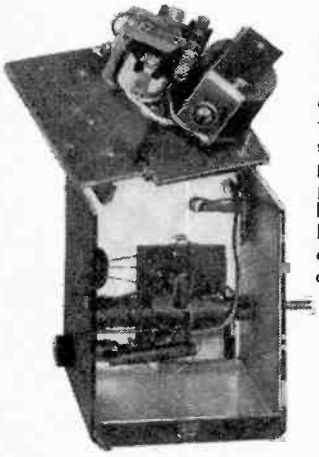
(*Continued on page* 128)

By I. C. CHAPEL

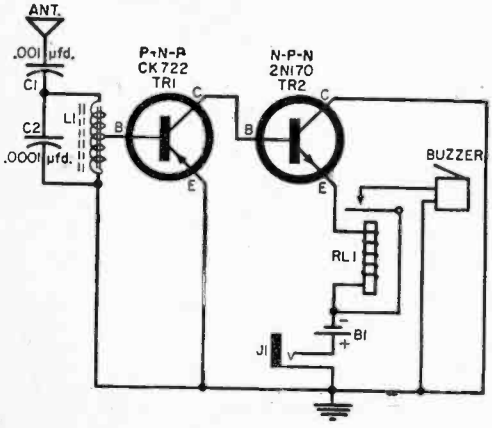
Conelrad Your Home

All of us should use a receiver that warns when the Conelrad alert begins





Location of parts is shown in the photos. Use of larger "D" cells instead of the penlite cells specified would provide more power for the buzzer and longer life but would require a bigger cabinet.



WANT a Conelrad alarm receiver that is self-contained and doesn't require a connection to your AM or FM receiver? A receiver that needs a minimum of maintenance (if any), with the exception of a battery check? Well, here's one that's hard to beat. It has nine parts (costing about $8.00), requires a minimum current drain from batteries and is "fail-safe" in operation.

As most readers know, the first step in a Conelrad alert is shutting off the transmitter of all AM, FM and TV broadcasting stations. This period of inactivity lasts for five seconds and is followed by a similar five-second period with the carrier on (without programing), and then another five-second "carrier-off" period. This is followed by a tone and a message about the alert, with the station finally shutting down.*

The unit to be described gives an alarm when a pre-tuned broadcast signal *stops*. It uses transistors in a very efficient circuit and a small number of parts. At the author's location, the unit is tuned to broadcast station KPH and, in the event that the radio-frequency carrier is stopped for any reason, the alarm buzzer will operate.

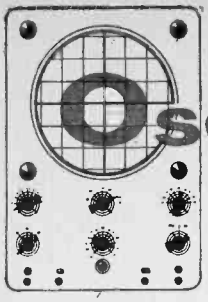
Circuit Details. The only special component in the alarm circuit is a modified ferrite rod antenna coil (*L1*). This is reworked by unwinding 20 turns from the coil

(*Continued on page* 114)

* Except stations on 640 and 1240 kc. Obviously, in building an alarm unit it is not a good idea to tune it to either of these channels. Although they will observe the five-second warning periods, there will be stations on these frequencies at all times during the air raid.

PARTS LIST

B1—Three 1½-volt penlite cells in series
C1—0.001-µfd. mica capacitor
C2—0.0001-µfd. mica capacitor
J1—Phone jack and plug
L1—Ferrite rod antenna coil
RL1—1000-ohm relay (Sigma 4F)
TR1—CK722 transistor
TR2—2N170 transistor
1—2" x 2¾" x 2¾" metal box
1—6-volt buzzer (see text)
1—Phono jack for antenna



Oscilloscope Traces

The Z Axis

A third dimension is provided through use of intensity modulation of electron beam

By HOWARD BURGESS

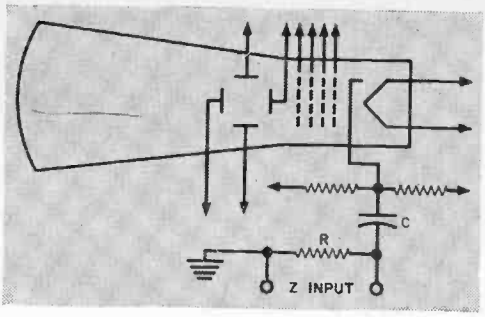
FEW ENGINEERS can produce readable handwriting, but give them an electron beam and they *will* produce precise figures and graphs. This electronic illustrating began with the birth of the modern oscilloscope. Somewhere in the development stages, it became desirable to label the various directions of travel of the trace. And so, borrowing from the math department, horizontal motion of the trace to the left or right is described as being on the "X axis," and any motion up or down is tagged as the "Y axis."

The Third Dimension. A graph on paper necessarily has only two dimensions—length and width. By proper manipulation, the graph on the oscilloscope can be given a third dimension—depth. This third axis, which can be considered the dimension *perpendicular* to the face of the cathode-ray tube, is labeled "Z."

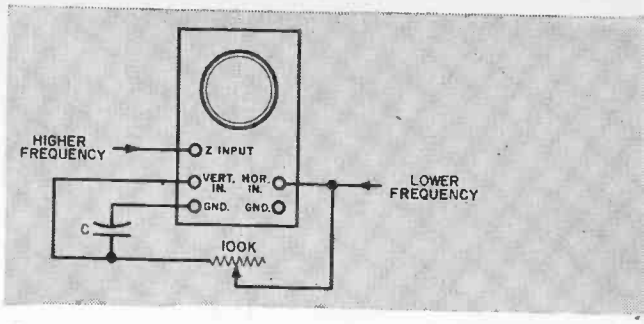
The only way the Z axis could be indicated on paper would be to vary the thickness or density of ink on the drawing. In the oscilloscope, however, it can be accomplished by applying the third signal—or dimension—to the cathode or another element of the oscilloscope tube. When the voltage is varied on this element, the intensity of the beam will change. When this signal voltage has a relationship to the signals on the deflection plates, interesting and useful effects result.

One of the most widely used examples of the Z axis or intensity modulation effect is found in television sets. Here the X

It may not help to consult the book. Some of the oscilloscope patterns obtained by intensity modulation won't be found on any printed page.



1 **This partial** schematic shows a connection to the CRT which provides intensity modulation.



2 **Potentiometer** above will require adjustment to achieve a perfect circle during testing.

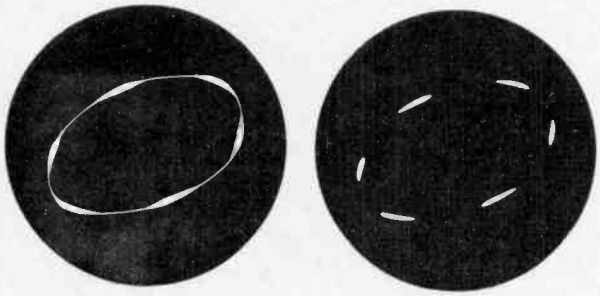
and the Y movements are continuous and the picture's highlights and shadows are built up by varying the intensity or brightness of the beam.

Bright and Dim. Intensity modulation can be accomplished in several different ways. The modulating signal can be fed to the cathode-ray tube directly through a very simple circuit as shown in Fig. 1 or through a separate amplifier. Almost any type of voltage can be used to intensity-modulate a cathode-ray tube. The requirements are that it have the proper polarity and amplitude to give the desired results.

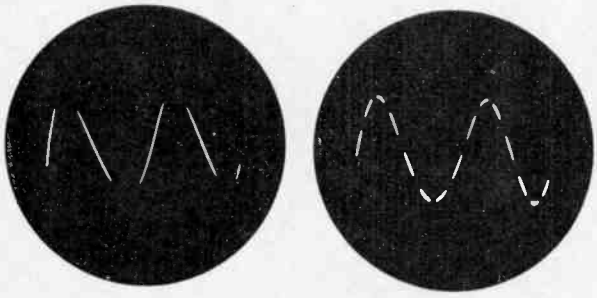
To increase intensity, a negative signal is applied to the cathode of the tube or a positive signal is applied to the grid. If opposite polarity signals are applied, the intensity is reduced. This last method is frequently used as a means to blank the return trace in many oscilloscopes when the internal sweep circuit is used.

Many oscilloscopes on the market have the "intensity" connection brought out to a separate terminal on the front panel or at the rear of the cabinet. The amount of voltage required for full modulation varies from model to model. If no separate blanking amplifier is used for the Z input, the voltage required will probably be between 20 and 60 volts.

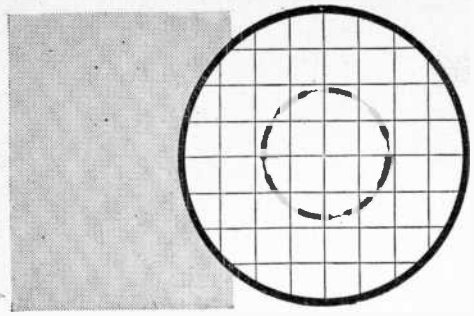
An earlier article in this series (March, 1957) told how two frequencies could be compared by means of Lissajous figures. In



Oscilloscope photograph at the far left shows pattern with intensity control set too high for proper trace viewing. The trace at its right is properly adjusted.



Differing ratios between blanking voltage frequency and frequency of sine wave applied to vertical plates are shown here.



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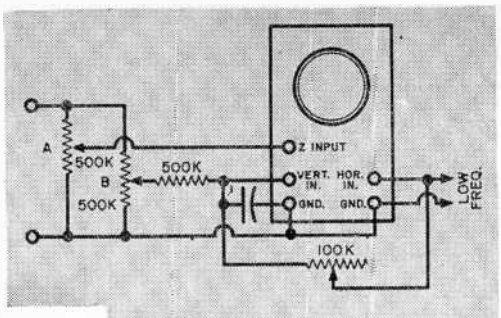


4

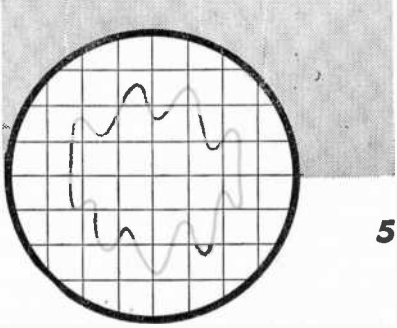
Perfect circle above is achieved by proper adjustment of the controls in the hookup of Fig. 2.

this method, the voltage of one frequency is placed on one pair of deflection plates and voltage of the unknown frequency is placed on the other set. The oscilloscope will show a series of loops from which the frequency of the unknown can be determined. However, this method doesn't work too well when one frequency is more than 10 times the other. The intensity modulation method, on the other hand, will enable comparisons with ratios of 40 or more.

The Dotted Ellipse. As shown in Fig. 2, the low-frequency voltage is applied to the horizontal input of the oscilloscope. By coupling the horizontal input to the vertical input with the 100,000-ohm potentiometer, a circular pattern will be formed. However, when using low frequencies, a capacitance will have to be added across the vertical input to give a circle. This capacitor can be any value that will give a circle or wide-spaced ellipse. Several values between 0.0005 and 0.1 μfd. should be tried at *C*.

When an ellipse or circle has been developed by the low-frequency signal, the high frequency is placed on the Z input. As the input signal voltage to the cathode is increased, bright and dark spots will appear on the circle. If enough signal is fed to the

(*Continued on page* 116)



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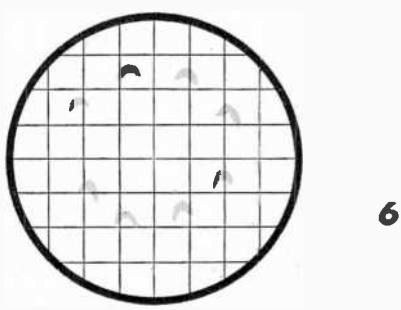

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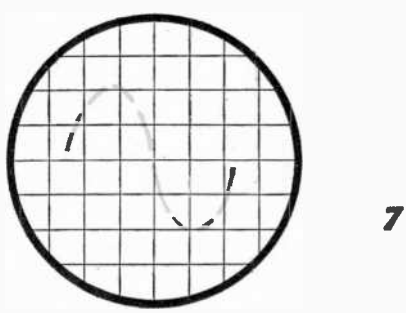

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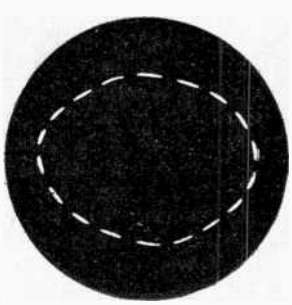
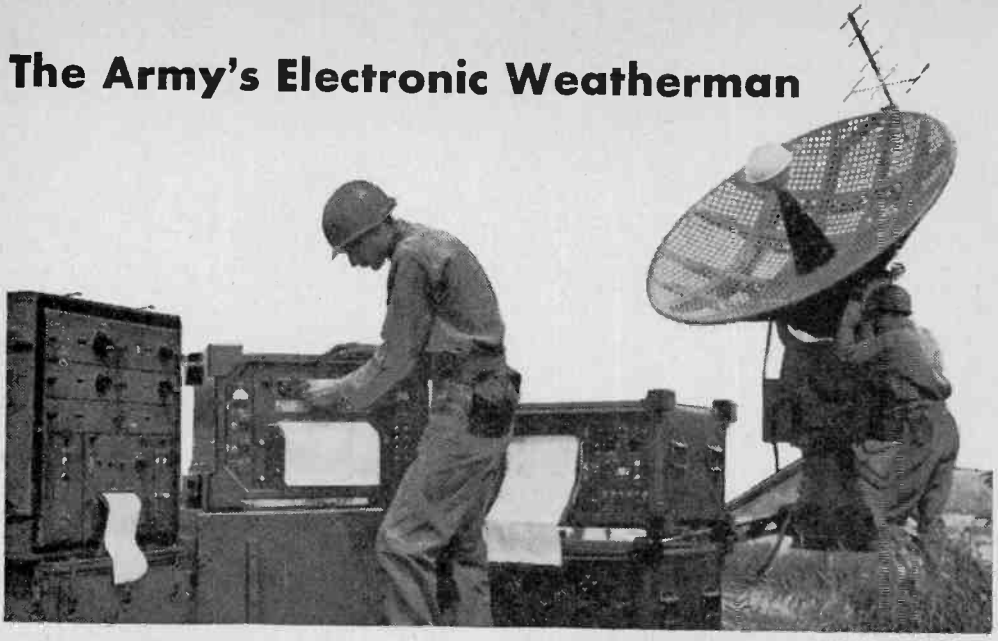
The circuit in Fig. 4 is for experimenters only! Figure 5 shows one trace formed by hookup. Peak counting (Fig. 6) is easy with remainder of trace blanked out. Markers spaced at 45° intervals on a sine wave can be seen in Fig. 7.



Photograph at left shows ease of obtaining high ratio comparisons between high and low frequency signals when Z axis is used for the higher frequency input.

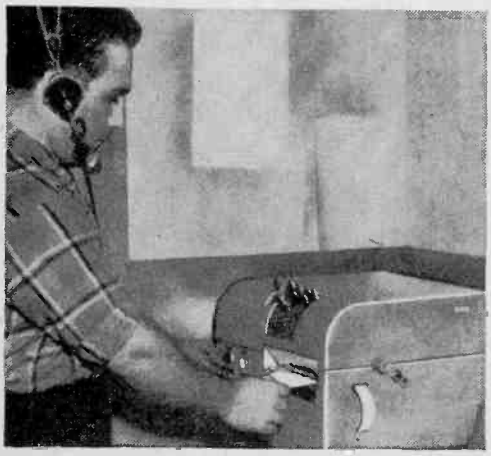
The Army's Electronic Weatherman



They're doing something about the weather! Despite Mark Twain, the Signal Corps has gone ahead and developed an electronic brain which spots high-altitude indications of oncoming storms and calculates the data almost instantly. The system (above) tracks weather balloons (radiosondes) to an altitude of 24 miles and as far as 200 miles. It can be set up in three hours.

Truck Weigher

Weight problems have been eased for the trucking industry by a new electronic scales system. "Weightronic" automatically records axle weight when a truck stops on a platform. The platform is hooked to weight-sensing electronic cells and connected to an automatic printer (below).



Bend a "Light Bulb"

A flexible "light bulb" that can be bent into various shapes as desired (above) has been developed by Westinghouse. The pliable lamp is actually an electroluminescent cell—phosphor coated on a panel treated to conduct electricity—which lights when power is applied. The company has found a way to apply the phosphor to plastic, nylon and steel mesh, and it is expected that in the future it will be possible to make drapes, shades and such to light a room, replacing bulbs.

WIRELESS MIKE for Short Distances

By JOHN HARRINGTON

HERE IS a subminiature transmitter that really packs a punch considering its size. It's portable and uses a small whip-type antenna. Tuning most of the broadcast band, this little job can be used for TV antenna orientation as well as party games and mind-reading tricks.

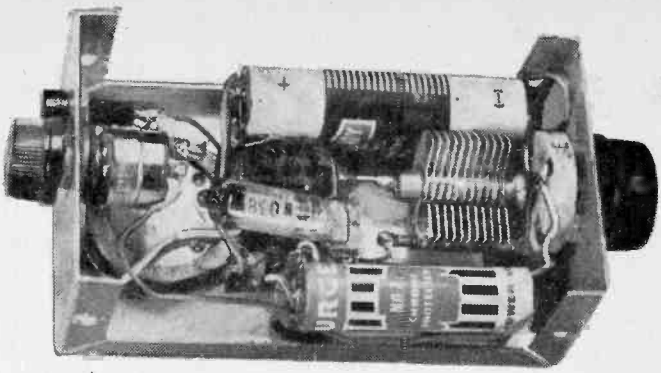
Ease of construction and simplicity of circuit make this an excellent "first project" for the beginner. It can be put together in one evening by a more experienced experimenter or hobbyist. Construction cost is small and can be kept below $7.00.

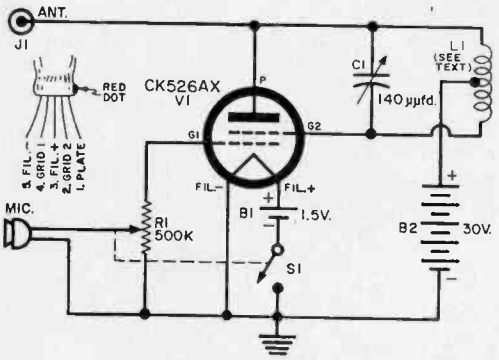
Tube *V1* is a subminiature hearing-aid type and requires a 5-pin in-line subminiature socket which is mounted on a small bracket. The crystal microphone and tube can be obtained from your parts jobber—mail-order house. Or you might pay a visit to a hearing-aid dealer who just might have defective or outdated aids which he accepted as trade-ins.

The transmitter can be housed in a plastic box, but a small aluminum box minimizes detuning due to hand capacitance and is more rugged.

Construction is started by drilling a series of 1/16" holes in concentric circles in the case. The largest circle of holes should be the same size as the outside circumference of the miniature microphone. This will allow sound waves to enter the case and strike the diaphragm of the microphone which is cemented inside the case behind the holes. Proper hole spacing will give your transmitter a neat appearance. Next,

When you mount the parts and wire this hand-held transmitter, note that the tuning capacitor and the antenna jack (see diagrams below) should be well insulated from the chassis. Battery leads can be soldered directly to terminal contacts. Clean the terminals with a file or emery cloth and solder as quickly as possible to avoid overheating.





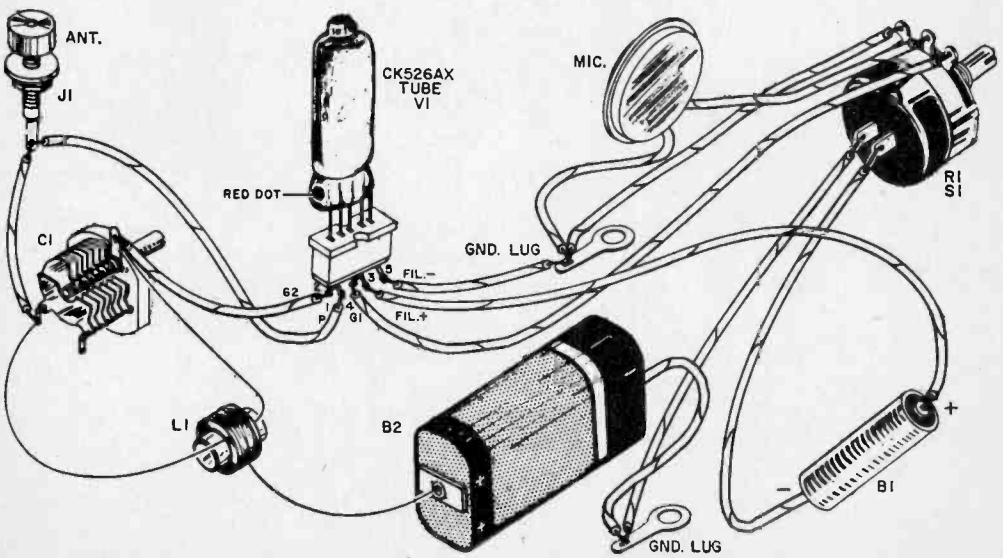
PARTS LIST

B1—1½-volt penlite cell
B2—30-volt B battery (Mallory RM-413R)
C1—6.7-140 μμfd. variable capacitor (Hammarlund APC-140)
J1—Insulated antenna jack
R1—500,000-ohm potentiometer with s.p.s.t. switch S1 (Lafayette VC-37)
L1—200 turns of No. 30 wire, center-tapped on ⅜" form
MIC.—Crystal microphone (Lafayette PA-27)
V1—CK522AX, CK533AX or CK526AX (Raytheon), or any hearing-aid output tube
1—4"x 2⅛" x 1⅝" case (Bud CU-2102)
Misc. #30 enameled wire, machine screws, etc.

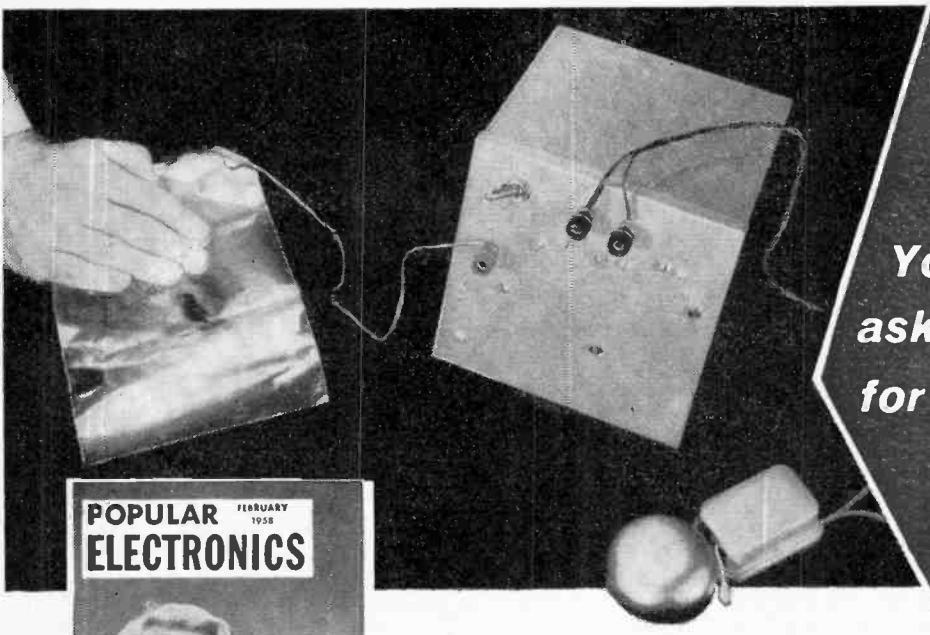
mount the 140-μμfd. variable tuning capacitor and the miniature volume control and switch.

Oscillator coil *L1* consists of 200 turns of enameled No. 30 wire, center-tapped and scramble-wound on a ⅜" form. It can be mounted on a small bracket. When you wire the transmitter, make all leads short and direct and be sure not to use too much heat when soldering, especially on the microphone. The A and B batteries can be soldered directly into the circuit or mounted in a standard battery holder. The whip antenna is a length of stiff wire about 30" long. A test-lead type plug is soldered at one end for insertion in the antenna jack.

It's easy to operate. Turn on the transmitter and advance volume control *R1* about three-quarters of the way. Tune a standard-band radio to a "dead" spot anywhere between 700 kc. and 1500 kc. and turn up its volume control. Then tune the transmitter until you hear a swishing noise from the radio. Speak distinctly into the microphone while making final adjustments, and you are on the air! —30—



BATTERY-OPERATED PROXIMITY RELAY



You asked for it!

Portable detector "senses" people approaching it

By RUFUS P. TURNER

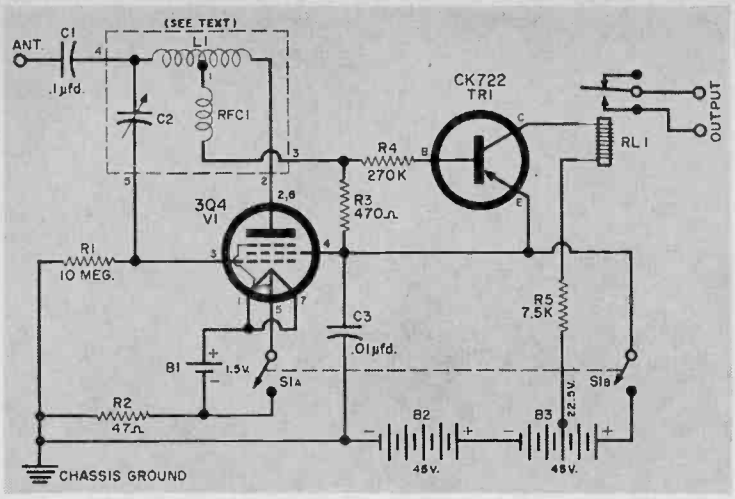
THE PROXIMITY RELAY is a capacitance-controlled relay that has been well known to gadgeteers and electronic hobbyists for a number of years. Place your hand or body near its "antenna," and the relay closes. Withdraw, and the relay opens.

In some applications, such as intrusion alarms, the proximity relay is sometimes preferred to photoelectric "eyes" because, unlike the photocell, no light source is needed which might betray its presence. Control of store-window moving displays, counting and safety control of heavy-duty machinery are other job opportunities for this device.

Proximity relays described in previous projects have been operated from the a.c. line. This is a definite handicap in portable or emergency applications when line power is not available. The battery-operated proximity relay is ready for instant operation, since no warm-up time is required. Completely battery-operated, our new circuit employs one tube and one transistor. It's self-contained in a metal box, weighs 6½ pounds, and will cost approximately $22.00.

Construction and Wiring. The proximity relay is built in a 6" x 6" x 6" aluminum chassis box (LMB No. 973). For convenience, all components are mounted in the top cover of the box and hang downward when the cover is fastened in position. Cut a clearance hole in the bottom cover directly over trimmer capacitor *C2* to permit insertion of an alignment tool for adjustment of *C2*.

Filament battery *B1* is held by clips



Schematic at left and pictorial below show simplicity of circuitry and wiring. The sensitivity of the relay (RL1) can be increased by adjustment of its pivot screw to loosen the armature spring.

HOW IT WORKS

Basically, this device consists of a r.f. oscillator employing a 3Q4, a transistor d.c. amplifier, and a sensitive d.c. relay. The oscillator has little tank capacitance and is sensitive to small capacitance changes such as are caused by approaching nearby objects.

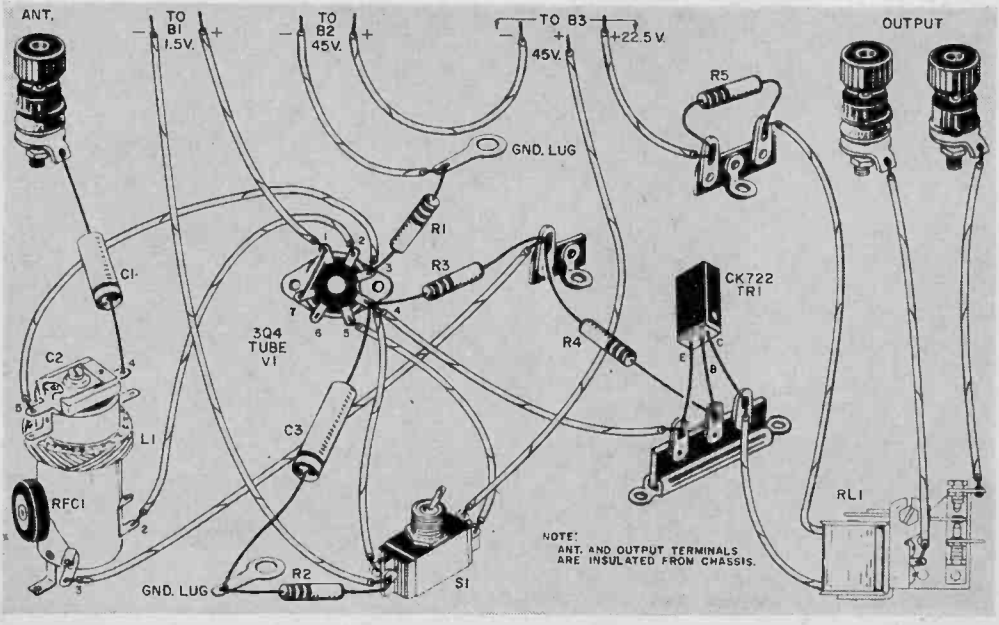
With the antenna connected to the circuit and trimmer capacitor *C2* adjusted to bring the circuit just into oscillation, the 3Q4 plate current voltage drop across *R3* is small.

When a hand or other conductive object is brought near the pickup antenna, the added capacitance throws the circuit out of oscillation, then the 3Q4 plate current and the voltage across *R3* increases. When this higher voltage is applied to the transistor through current-limiting resistor *R4*, it causes the collector current of the transistor to increase and close relay *RL1*.

When the hand is withdrawn, the circuit resumes oscillation, the voltage across *R3* decreases, the transistor collector current falls to a low value, and the relay opens.

PARTS LIST

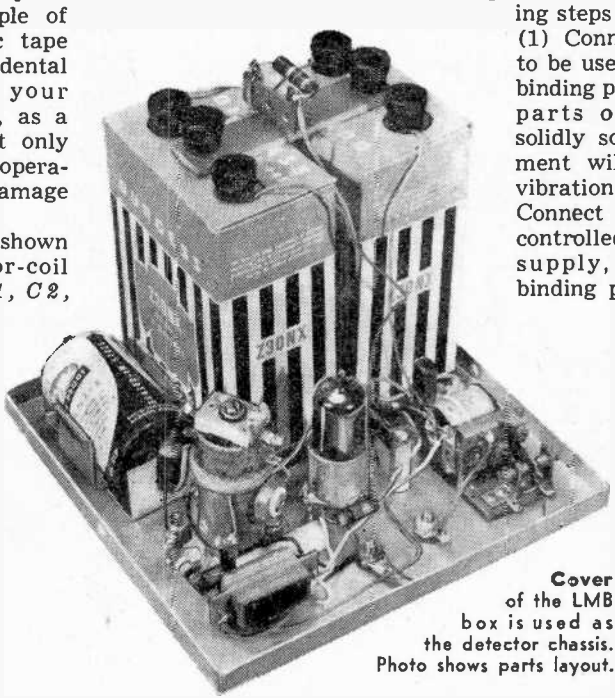
B1—1½-volt Size-D cell
B2, B3—45-volt B batteries tapped at 22½ volts (Burgess Z30NX)
C1—0.1-μfd., 200-volt metalized tubular capacitor
C2—Trimmer capacitor in L1 assembly
C3—0.01-μfd. mica capacitor
L1—Capacitor-oscillator coil assembly (Miller No. 695)
R1—10-megohm, ½-watt resistor
R2—47-ohm, ½-watt resistor
R3—470-ohm, ½-watt resistor
R4—270,000-ohm, ½-watt resistor
R5—7500-ohm, ½-watt resistor
RFC1—Radio-frequency choke in L1 assembly
RL1—8000-ohm d.c. relay (Sigma Type 4-F)
S1a/S1b—D.p.s.t. toggle switch
TR1—CK722 transistor
V1—3Q4 tube
1—6" x 6" x 6" aluminum chassis box (LMB No. 973)
Misc. 7-pin miniature tube socket, battery holder for single 1½-volt Size-D cell, insulated binding posts, terminal strips, etc.



mounted on the cover. Batteries *B2* and *B3* are held to the cover by fastening a Bakelite strip to their center (22½-volt) terminals and passing a long *6-32* threaded rod through the center of this strip, between the two batteries and through the cover. The rod is secured by a nut on each end.

Mount the tube socket on a pair of 1"-long screws to keep its contacts clear of the chassis. A couple of strips of plastic tape will prevent accidental shorts. Check your wiring carefully, as a mistake will not only prevent correct operation but may damage the components.

The numbers shown on the oscillator-coil assembly (*L1, C2, RFC1*) are those used by the coil manufacturer in designating the terminals and must be followed in the wiring. Note that terminal 1 of this coil is not connected externally to the circuit. The coil has a pair of right-angle mounting feet which are fastened to the cover with two *6-32* screws and nuts.



Cover of the LMB box is used as the detector chassis. Photo shows parts layout.

Checking the Unit. Fasten both covers of the box tightly and throw switch *S1* to its "on" position. Insert the alignment screwdriver through the hole in the bottom cover of the box and slowly adjust trimmer *C2*. At one extreme (*C2* at "open" or minimum capacitance), the relay armature should pull in. At the "closed" position of *C2*, the relay should release.

With the circuit oscillating at this setting, touch your finger tip momentarily to the insulated cap of the antenna binding post. The relay should close each time the post is touched and open when your finger is removed. If trimmer *C2* is set to the point at which the circuit just starts to oscillate (the relay just releases), you will find that the sensitivity of the device has increased to such an extent that you can close the relay by bringing your finger tip within a quarter inch of the antenna binding post.

Operation is Simple. Connect a "pick-up" antenna to the antenna binding post. The actual form, size and shape of the antenna will depend upon the particular use to which the capacitance relay is put and the amount of sensitivity desired. It may be a long wire or a metal plate or object connected by wire to the antenna post. In general, the larger the antenna, the higher the sensitivity.*

When making the installation, the following steps should be taken. (1) Connect the antenna to be used to the antenna binding post and fasten all parts of the antenna solidly so that no movement will be caused by vibration or jostling. (2) Connect the device to be controlled, and its power supply, to the output binding posts. (3) Throw switch *S1* to its "on" position. (4) Adjust trimmer *C2* as before until the relay closes. (5) Now, turn the trimmer screw in the opposite direction until the relay just opens. By minor adjustments, in one direction or the other, you should be able to set *C2* so that the relay closes when your hand is at the desired distance from the antenna.

Relay closure at six inches from the disc is average. Operation from greater distances may be obtained by more critical adjustment of *C2* to place the circuit just on the edge of oscillation. However, when the adjustment places the circuit too close to the non-oscillating condition, the relay may remain closed when the actuating object has been withdrawn. With proper care, an operator will be able to adjust for maximum sensitivity and still secure dependable relay response. Applications, of course, are limited only by your ingenuity and the environment in which you want to operate the proximity relay. -30-

* As a window display, for example, the best pickup device is a 6"-diameter disc of metal foil or thin sheet metal cemented to the inside surface of the glass. A spectator placing his hand on the outside of the window near the disc can cause lights to flash, electric trains to run, etc.

In burglar alarm applications, the antenna can consist of a length of insulated wire looped several times around the door frame or window frame, or it may be a metal plate or several loops of insulated wire on a window sill or the threshold of a door, or under a rug.

Sputnik's a Recording Star in Midwest

Another recording star has zoomed into the world's firmament. While it's not expected to outgross Elvis, Sputnik's signals have proved to be quite an attraction to a Mason City, Iowa, high school, as seen in the photo above.

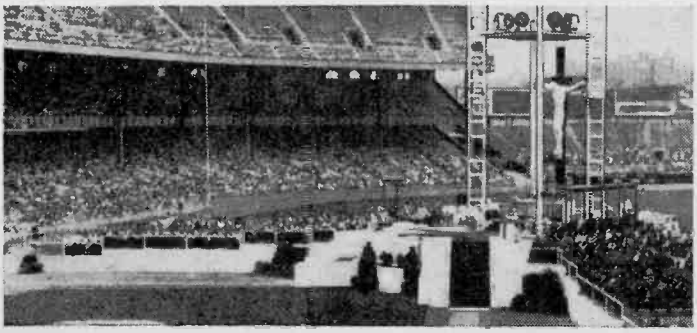
Two local high school teachers, in cooperation with a Bell & Howell tape recorder dealer, recorded the "beeps" of Sputnik I. Then, using a radio announcer as commentator, they incorporated all pertinent scientific data to produce an educational tape on one of the milestones of scientific achievement—including the "interview" with Sputnik itself. The tape has been made available to schools and colleges and other interested groups, and has been playing to capacity audiences at all sessions.

Hi-Fi "Do-It-Yourself" Recordings

A series of test records to help the audiophile determine what's wrong—if anything—with his hi-fi system has been issued by Components Corp., Denville, N. J. Priced at 89 cents each, the records consist of tests and instructions in layman's language on the following problems: wow and flutter; stylus wear; rumble; pickup resonance; vertical/lateral response; and location and cure of hum.

Ballpark Service Uses Sound Efficiently

An unusual high-quality public address system brought cathedral-like sound to 50,000 people attending a religious service at Yankee Stadium recently. Backbone of the system was an installation of 12 University WLC speakers in a square atop a special canopy 48 feet above the altar on the field at second base. Although capable of handling 30 watts each, the 12 speakers required a total of only 6½ watts to achieve complete sound coverage. Such a low-level sound installation is just the reverse of earlier systems at the Stadium, which used large amounts of power fed into a relatively small number of speakers. This had a tendency to cause echo effects, blasting and reverberations not present with the University system.



got the Shakes?

By HARVEY POLLACK

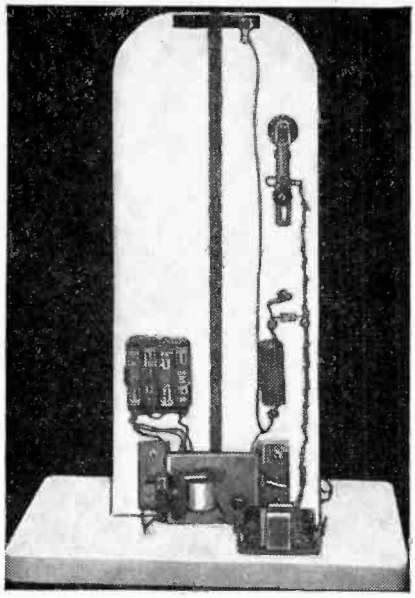
Build this transistorized gauge to test the steadiness of your hands and those of your friends

IN THE DAYS of the Golden West, Wild Bill Hiccup and Fearful Fosdick used to gauge their gun-hand steadiness by pouring a glass of whiskey through a knothole—at arm's length. Nowadays, we can do much the same thing, electronically. The gadget to be described here will save a lot of spilled liquid and is considerably more accurate. One like it is actually used to test "steadiness" by some police and accident prevention authorities.

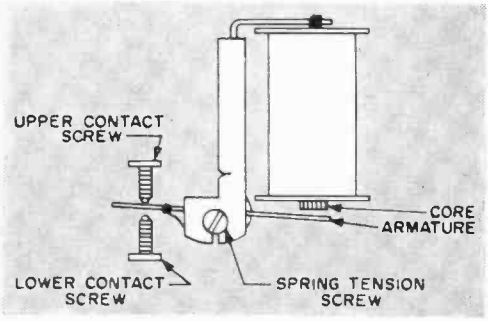
There's nothing to stop you from using this gadget at a party if you want to—as an "ice breaker." Your guests are sure to flock around to see who has those nerves of iron, so popular (and necessary) in the bygone days.

Test Yourself. After you turn on the switch, a short time delay occurs—adjustable from three to fifteen seconds. Then the indicator light will go on. To test yourself, sit in front of the panel with the prod in hand. Touch the tip of the prod to the *touch plate* at the top of the panel. The indicator light will click off and the timing interval of about eight seconds will begin. (Set timing control for this interval.)

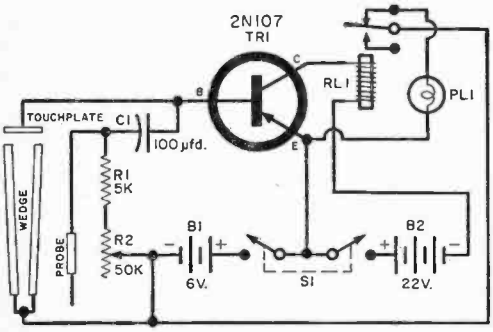
As quickly as your steadiness permits, move the prod tip down the middle of the wedge, trying not to touch the sides. The briefest contact will turn on the indicator light and it will remain glowing even if the contact is broken. If the sides of the wedge are not touched but more than the allowed time is used, the timing circuit will automatically trip the indicator light on. In



Rear view of tester shows subassemblies and the touch plate on back of wooden uprights.



Contact and tension screws of the relay, sketched above, will need some adjustment. See text.



Note wiring of wedge strips and touch plate in schematic. These are basic parts of the circuit.

either case, the score is determined by the numbers at the side of the track.

Construction Hints. When fastening the metal wedge strips in place, start the gap at about ⅜" at the top and let it narrow down to ⅛" at the bottom. The *touch plate* is insulated from the vertical wedge

SUM OF THREE TRIALS	RATING	SCORE
40-48	Excellent	A
30-39	Above average	B
20-29	Average	C
10-19	Below average	D
0-9	Poor	E

You can use this scoring system with the tester or, if you wish, you can develop your own system.

strips and fastened to the uprights by short wood screws with a solder lug under one of them. Drill two #26 holes near the lower edge of the wedge strips and mount them with long *6-32* machine screws. Add a solder lug to each.

The power switch (*S1*), the timing potentiometer (*R2*), and the transistor socket all require subchassis wiring. A small aluminum chassis can be constructed or a little shelf of wood will do as well. All three components and the relay (*RL1*) should be mounted with their connections easily available for soldering.

The two battery holders are secured to the wood members by small wood screws. Be *VERY CAREFUL* to observe correct polarity when inserting the batteries. Even *momentary* reversal of polarity may ruin the transistor.

Adjustment. After wiring is complete, rotate *R2* fully clockwise (shortest interval). At the instant power is applied, the indicator light should flash on briefly. Relay *RL1* must now be carefully adjusted by

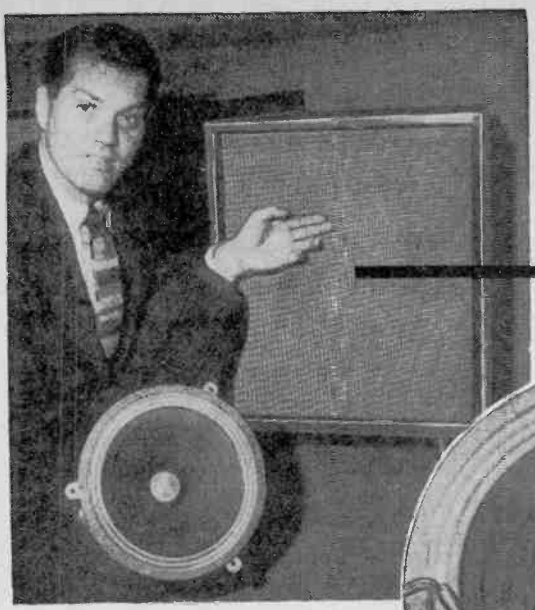
(*Continued on page* 126)

PARTS LIST

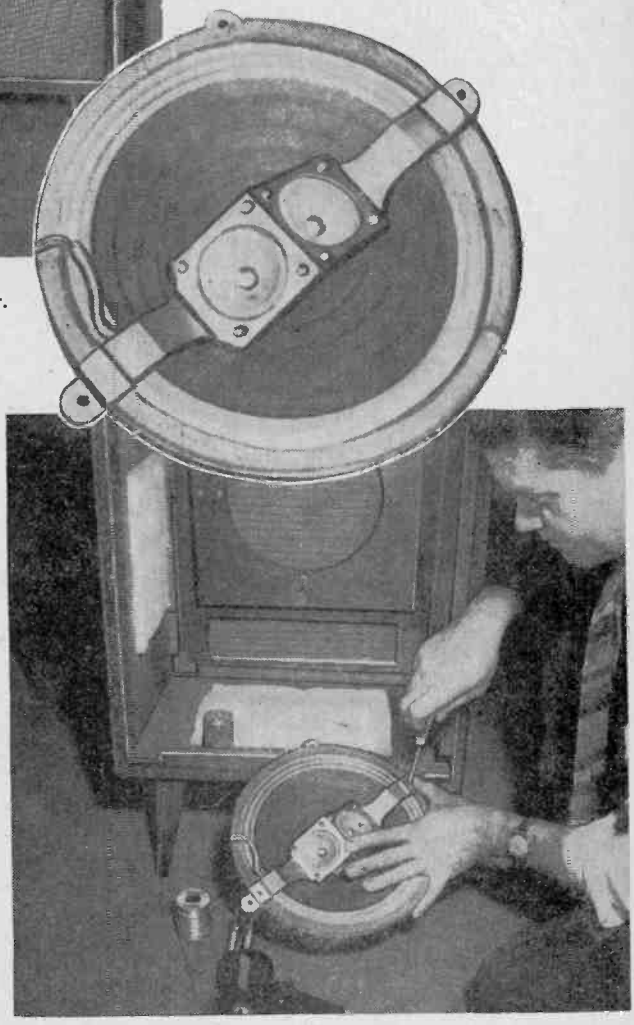
B1—Four 1.5-volt batteries (Burgess #7 or equivalent)
B2—22.5-volt miniature battery (RCA VS084)
C1—100-µfd., 25-volt capacitor (Mallory 250I or equivalent)
PL1—Pilot light assembly for #47 bulb
R1—5000-ohm, ½-watt resistor
R2—50,000-ohm potentiometer (Mallory U-34 or equivalent)
RL1—8000-ohm relay (Sigma 4F or equivalent)
S1—D.p.s.t. toggle switch
TR1—Type 2N107 transistor (General Electric)
1—Battery holder for VS084 (Lafayette MS177 or equivalent)
1—Battery holder for four #7 cells (Lafayette MS170)
1—Test probe and wire lead
1—2" metal-strap touch plate
2—Metal wedge strips (see text)
Cost of parts, approx. $11.00

THIS SPEAKER "GROWS UP"

Speaker cabinet courtesy of Electronic Workshop



"First installment" for this quality system is a full-range Wigo 12" speaker.



Later on, a dual tweeter array can be added across the basic speaker without the need for drilling additional mounting holes.

EXPANDING loudspeaker *systems* have become very popular. They let you add separate woofers and tweeters as your budget permits But here we have an add-a-part idea in which the *speaker* itself "grows up" from a one-way into a two-way model.

You start out with a Wigo Model ERD12B full-range loudspeaker that sells for $59.50. This precision-built speaker alone is a very good sound source. With its heavy magnet, cast aluminum frame, and soft cloth suspension, it is capable of high-quality performance in almost any type of baffle.

Later, to add that extra sparkle in the upper range you can buy a Wigo CX2 tweeter set that mounts across the basic speaker, making it in effect a coaxial model. That saves the drilling of extra holes in the baffle for the new tweeters. The only tool you need is a screwdriver. A matched crossover network comes with the tweeters, which take over at 4000 to 5000 cycles.

Use of cone tweeters provides the kind of treble preferred by many experienced listeners, and the offset angle of the tweeter array spreads out the sound over a wide sector. This makes the placement of the speaker less critical. -30-

THE OLD MAN in Ernest Hemingway's story *The Old Man and The Sea* lamented that his luck had run out in "following the fish." But modern science has eliminated the element of luck entirely in following fish—sonic-tagged ones, that is.

Through electronics, man has learned much about fish, and now he can even chart their underwater activity. In fact, a sonic-tagged fish can't make a move without a biologist of the U. S. Fish and Wildlife Service knowing it.

When the electronic tag is attached to a salmon, the fish becomes a sort of underwater, roving radio station. The tag is an aluminum capsule 2⅜" long and 0.86" in diameter. Inside the capsule are miniature components, including a 15-volt battery, a transistor and a resonating crystal.

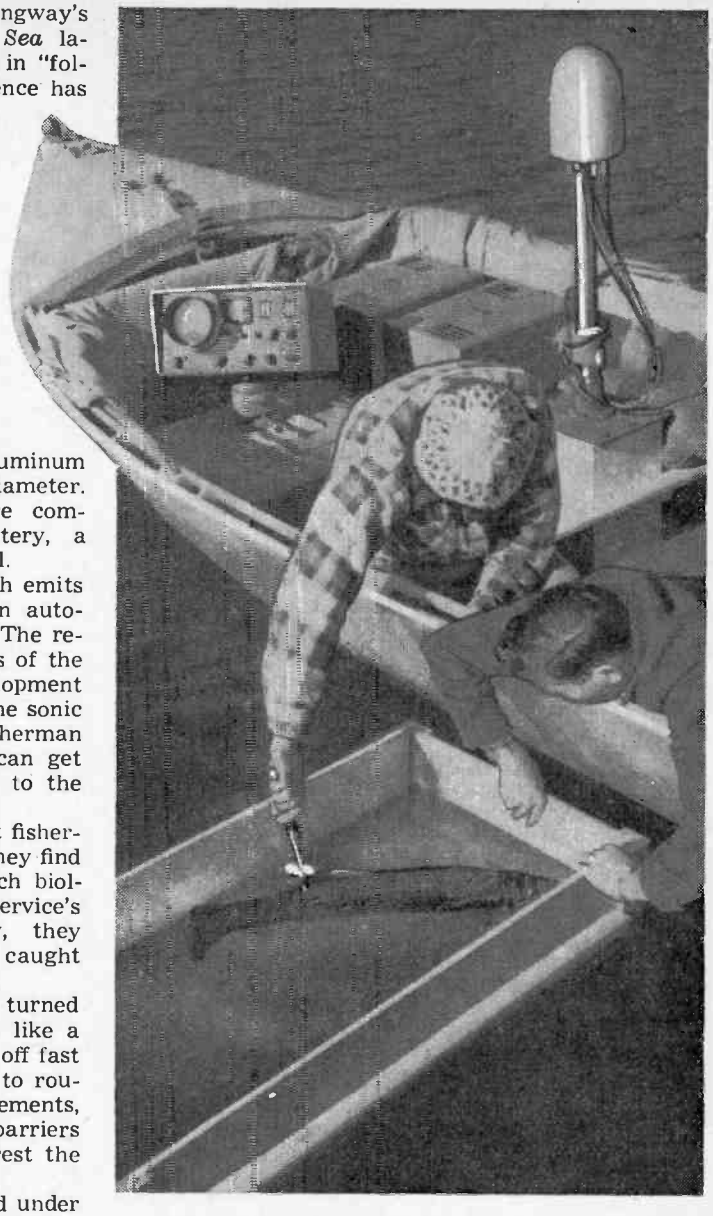
Equipped with this outfit, the fish emits signals which are picked up by an automatic tracking receiver in a boat. The receiver, for which Dr. Gerald Collins of the Fish and Wildlife Service gets development credit, seeks out and "homes" on the sonic tag attached to the fish. Any fisherman catching a fish with a sonic tag can get 50 cents back if he sends the tag to the Fish and Wildlife Service.

"The tag is so new, however, that fishermen are generally mystified when they find one on a fish," said fishery research biologist Thomas Duncan of the Service's Seattle headquarters. "Generally, they think it is a new kind of super lure caught on the fish."

Like a Loose Colt. When first turned loose, a sonic-tagged fish acts just like a colt freed from the halter. It bucks off fast in all directions, then settles down to routine movements. These routine movements, especially as applied to man-made barriers such as river dams, are what interest the biologists.

"The sonic equipment can be used under a variety of natural conditions to study the behavior of adult fish," explained biologist Parker S. Trefethen. "At dams, you can find out just how an adult salmon locates a fishway entrance. You can even measure the movements of a fish going through a fishway. You discover where the bottlenecks are . . . where the fish have trouble getting through.

"By tracking adult salmon as they make their exit from a fishway, you learn the relationship of their movements to spillways and powerhouse sections of a dam. Any changes in their behavior after they pass through a fishway can be determined."

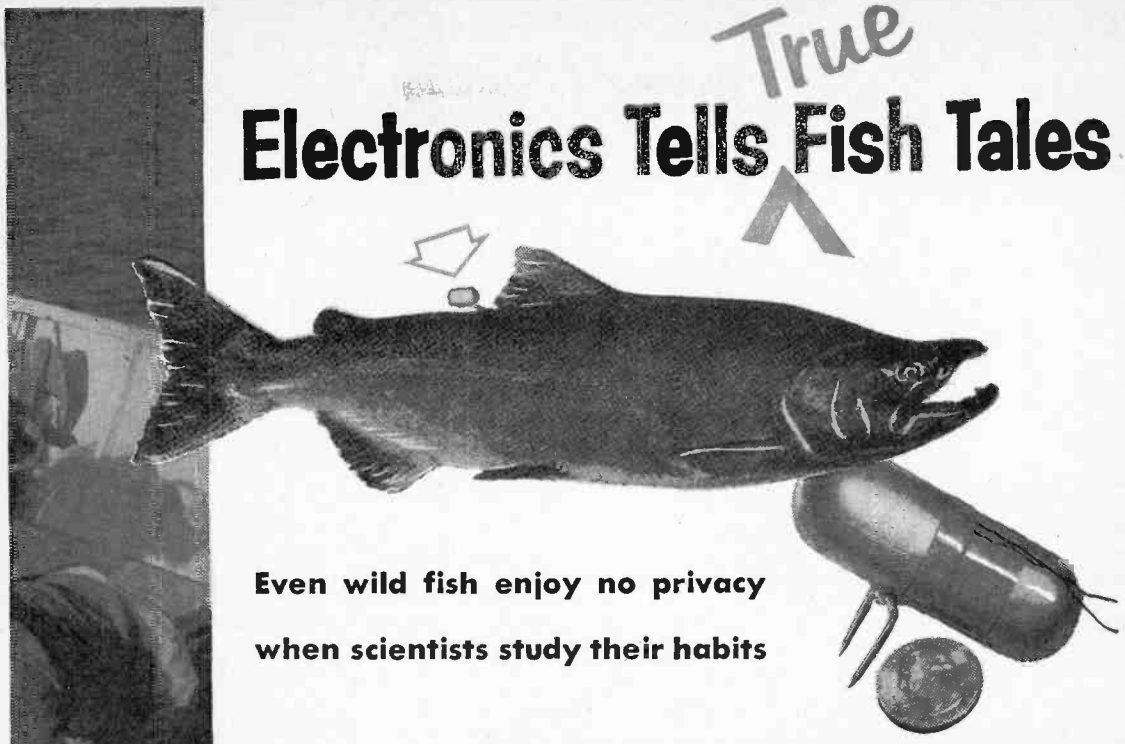


Trefethen added that the equipment also provides a method for studying the movements of adult salmon in a marine environment in relation to climatic conditions, shore lines and ocean currents.

Water Movements. While electronics shows the movements of the fish, it shows, too, the movements of the water in which the fish travel. Now being used by the biologists of the Fish and Wildlife Service is a water current meter that records the direction of the water and gives the velocity of the current at any depth.

(*Continued on page* 132)

True Electronics Tells Fish Tales



Even wild fish enjoy no privacy when scientists study their habits

Key to tracking of fish is the sonic "tab," shown at upper right compared in size with a quarter. This tiny sonic transmitter is attached behind the dorsal fin of the fish (see arrow above). Photo at left shows two Fish and Wildlife experts tagging a fish before releasing it. In the boat is an automatic tracking receiver which will follow the movements of the fish by "homing" on it. At right, center, is an electronic device for determining water flow through gravel and its oxygen content; this is important in increasing egg survival. The device shown in the bottom photo records the velocity of the current, enabling biologists to estimate which way the fish will swim.

By RAFE GIBBS

Transistor Topics

By LOU GARNER

WHILE there are a number of inexpensive transistors available, vacuum tubes still have a lower *average* cost than transistors capable of doing the same job. But the difference in relative prices is becoming less every day. Already, transistors have made inroads into about 10% of the vacuum-tube market, mostly in special-purpose, industrial, military, and computer applications. But their use in radios and other "entertainment" devices is increasing steadily.

That transistors should be more costly than vacuum tubes is rather surprising, for the transistor is, basically, much simpler as far as internal construction is concerned. Nor are the differences in cost due to the high cost of semiconductor materials. Take silicon, for example. Silicon transistors sell for $10.00 up to $90.00 *each*. Yet less than *10 cents worth* of silicon goes into the typical transistor, even though pure silicon sells for better than $250.00 a pound.

The comparatively higher price of transistors is due almost entirely to the difficulty in reproducing similar transistors in quantity. Completely automatic production, with a 100% "yield," has not yet been achieved. However, as current production methods are refined, we can expect prices to drop and quality to improve. The day may come when good-quality transistors can be purchased for only "two for a quarter."

One new fabrication process that shows great promise, especially in the subminiaturization of transistor circuitry, incorporates *photographic* methods in the production of semiconductor components. The technique, developed at the Diamond Ordnance Fuze Laboratory in Washington, is related to the process used to photo-etch printed-circuit boards, and, like the latter, involves photoresists, exposure to light, developing and etching steps.

In addition to new production methods, we can expect to see an increase in the *variety* of semiconductor materials. Today, all commercially available transistors use either silicon or germanium. Theoretically, any of the elements in the fourth column of the Periodic Table should make acceptable semiconductors, such as lead, tin or carbon. Carbon is of special interest as it has a very popular crystalline form—the *diamond*. Don't be too surprised if you read that a manufacturer is producing diamond transistors in the next few years!

Compounds of various elements also might be used. Silicon-carbide, for example, shows some promise as a semiconductor material which would be extremely

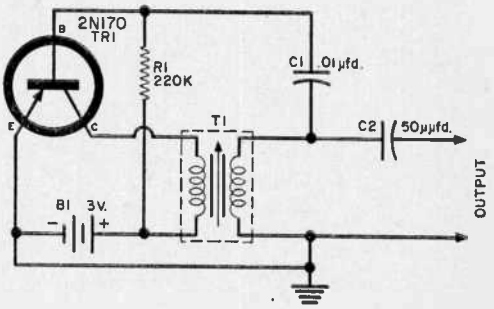


Fig. 2. The transistorized BFO circuit sent in by Bill Penrose is suitable for use with battery-operated portables or line-operated table and console receivers.

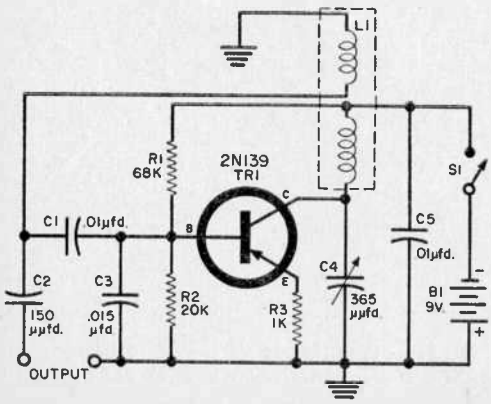


Fig. 1. Submitted by reader Stephen Vandivere, this simple r.f. signal generator circuit incorporates a p-n-p transistor in a modified tickler feedback oscillator arrangement.

resistant to high temperatures. And, as an historical note, old-timers may recall the day when *carborundum* crystals (a silicon-carbon compound) vied with *galena* (lead sulphide crystals) as "cat's-whiskers" detectors.

Readers' Circuits. This month we are featuring a pair of simple oscillator circuits. Each requires but a single transistor, but both make handy gadgets for the workshop.

R.F. Signal Generator. The circuit in Fig. 1 was submitted by Stephen Vandivere, 215 E. Jefferson St., Falls Church, Va. When assembled and calibrated, this simple instrument may be used for aligning receivers, checking out tuned circuits, or as an auxiliary r.f. signal source. It incorporates a *p-n-p* r.f. transistor in a modified tickler feedback oscillator arrangement. The common-emitter circuit configuration is employed, with operating power supplied by a single 9-volt battery (*B1*).

In operation, feedback necessary to start and sustain oscillation is supplied by the feedback winding of coil *L1*, with *C1* and *C3* serving as an impedance-matching r.f. voltage divider. Stabilized base bias is supplied by a resistor voltage divider, *R1/R2*, operating in conjunction with an unbypassed emitter resistor, *R3*. A tuned circuit, made up of the primary of *L1* and variable capacitor *C4*, serves as the collector load. Capacitor *C5* serves as a bypass across *B1* and the s.p.s.t. "on-off" switch, *S1*. The output signal is obtained through isolating capacitor *C2*.

Stephen suggests that a Meissner Type 14-1071 antenna coil be used for *L1* and an RCA Type VS300 battery for *B1*. *C4* can be any standard 365-$\mu\mu$fd. variable capacitor. The other capacitors may be ceramic, mica, or paper units. All resistors are ½-watt carbons.

You can assemble a similar oscillator in a small plastic or metal case, using a thin piece of Bakelite or plastic as a subchassis. Although circuit layout and wiring should be non-critical, you may have to experiment with the connections to the oscillator coil to obtain oscillation. If you have any trouble, try reversing *either* the primary or secondary connections.

Calibrate the unit by "zero-beating" the signal from the oscillator against the signal obtained from a known source, such as a standard r.f. signal generator or a broadcast station, using an ordinary receiver as your detector.

Beat-Frequency Oscillator. When a c.w. station is tuned in on a home short-wave receiver, the radiotelegraph signals will sound like a series of clicks or "shushes" instead of the *"didahdit"* tone signals. To convert

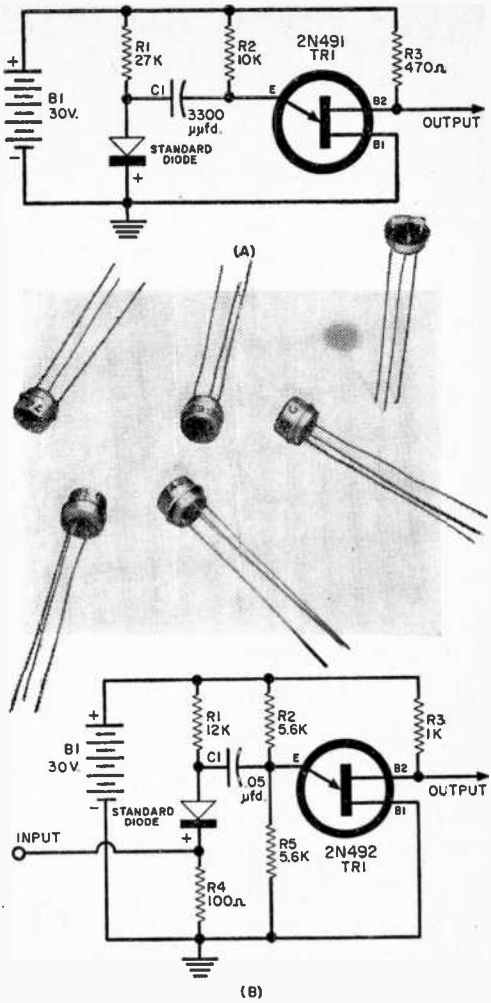


Fig. 3. Basic circuits utilizing one of General Electric's six new Unijunction transistors: (A) a free-running multivibrator, and (B) a "one-shot" multivibrator. See page 134 for complete details.

the "clicks" into an audio tone, a beat frequency oscillator (BFO) must be added to the receiver. The signal from the BFO "beats" against the receiver's i.f. signal, producing a difference frequency signal which falls within the audio range.

Reader Bill Penrose, 24 East 26th St., Hamilton, Ontario, Canada, sent in the transistorized BFO circuit shown in Fig. 2. Suitable for use with both battery-operated portable and line-operated table and console receivers, it has a 2N170 *n-p-n* transistor as a tickler feedback r.f. oscillator. Bill uses a common-emitter circuit arrangement to obtain maximum gain and to permit operation with a single, 3-volt battery (*B1*).

In operation, a 456-kc. i.f. transformer

(*Continued on page* 133)

I SHOULD HAVE KNOWN!

By Robin S. Lanier

Everyone gets out of bed from the wrong side occasionally. When it happens to a hi-fi fan on the day he installs a new rig, there's no end to the number of things that can go wrong. Not with the equipment itself—just with the installation. I wish they had told me about these things at the store where I bought the stuff. I should have known the few tricks that save all the trouble. So, since wise men learn from other people's mistakes, here's my tale of hi-fi woe—sparing no gruesome detail . . .

WHEN I walked out of the hi-fi shop, I was as proud as a beaver who had just thrown a dam across the Mississippi. Almost everything was brand-new: cartridge, amplifier, speaker and enclosure. I had kept only my old record changer, since it seemed to be running all right, and the tuner.

After I unpacked my new units and gloated over them like Scrooge with his cash box, I shoved the new amplifier into the cabinet in which the old one had been. Wonderful! It fitted exactly. All I needed was a new piece of plywood for the front panel, with holes for the controls to come through. I'm a lucky boy, I thought—my measurements had been just right. But "lucky" was not the right word, as it turned out.

I gave the old cartridge a pitying look as I chucked it into the wastebasket, and felt pretty good about the way the new one looked when it was installed in the arm of the changer.

The new enclosure went into the same place in the room as the old one: in the center of the wall facing a large glass-covered picture across the room. That spot was the only unoccupied wall space in my wife's latest furniture arrangement.

The great moment came sooner than I expected. I decided to let the tuner wait for a while, I was so eager to hear that brand-new hi-fi sound come pouring at last into *my own* living room, from *my own* rig. I turned on the amplifier, and very cautiously advanced the volume control. Immediately I heard the first sound from my new rig, even though no record was on the turntable.

It was hum. Lots of it. Enough to drown out music completely. *I should have known!* I had a far more sensitive amplifier, a speaker much stronger in the bass. Obviously the grounding arrangements with the old rig were not nearly good enough. Looking over the connections, I realized I probably not only had a "ground loop" in my shielding, but that the turntable motor was improperly connected, things I had never worried about before.

I turned off the outfit and in fifteen minutes had rearranged the input wiring. When I turned things on again, the volume control went nearly all the way up before I heard any hum at all. Hurrah!

Now was the moment. Onto the turntable went a new LP bought for the big day. The

. . . I gloated like Scrooge with his cash box . . .

changer lowered the stylus onto the turning record—oh, no! The music seemed to be going on and off regularly, like a flickering neon sign. Did I have an amplifier with a built-in shiver? What a crummy break, to be tripped up by a defective amplifier on the day of hope!

I was miserably watching the record

turn when it hit me. There seemed to be just a little more up and down movement in the arm than the record motion could account for. Of course! It was bouncing a small fraction of an inch, just enough to lose contact with the groove over and over. The new cartridge was far lighter than the old one, and the spring counterbalancing

. . . The amplifier chassis was all set to fry eggs . . .

the arm could almost lift it off the record. It needed just a little warp from the record to help it. *I should have known!*

I weighted down the arm with two pennies tacked on with Scotch tape so the stylus stayed in the groove. And the music came pouring out of the speaker with a power and clarity I had never heard in my living room before. This was what I had been waiting for.

BUT what was that heavy noise that took over whenever the music dropped below a fortissimo? Oh, misery! I probably had the worst turntable rumble in the history of high fidelity. A new cartridge, amplifier and speaker, all mighty and powerful in bass, were simply showing up my ancient changer—*I should have known!* With a groan I knew that as soon as the budget would stand it, I had to get a new, better turntable. What to do in the meantime?

Experimentally I backed down the bass tone control and was relieved when the rumble dropped out of hearing. But now the music sounded thin; I wanted the new, big bass I had spent all the dough for. Wasn't there a rumble filter on the new amplifier? Eureka! With the filter thrown in, I struck, for the time being, a workable compromise between rumble suppression and bass response. The rumble was low enough and the bass high enough to make the music exciting by any standards.

It was so exciting, in fact, that I spent the next half-hour just listening. Yet as my ear got used to the new fullness and clarity, I realized that the treble was too sharp and hard. Clicks, pops and hiss from the record surfaces all seemed very loud and obtrusive. I had expected the new tweeter in my coaxial to bring the highs way up, but not to make them shriek.

Using the treble tone control to roll the highs off reduced the over-sharpness, but now the music lost much of its sparkle. What was the trouble now? Speaker placement, of course. Facing the speaker across the short width of the room against the large glass area of the picture on the opposite wall was bouncing all the highs right back to where I was sitting. I needed the corner of the room for my enclosure, and I needed it badly. I would have to tackle the "Powers-That-Be" (Housewife Division).

I will spare you the details of my strategy. It was not based so much on frontal attack as on subtle propaganda combined with high-level bribery. In about 25 minutes, shaken but victorious, I had the enclosure in the corner and was sitting in the other end of the room.

This was it, all right—fullness *and* liveliness; clear, open sound with no hardness; no direct reflection; surface noises way, way down. I just wanted to sit there and take it all in.

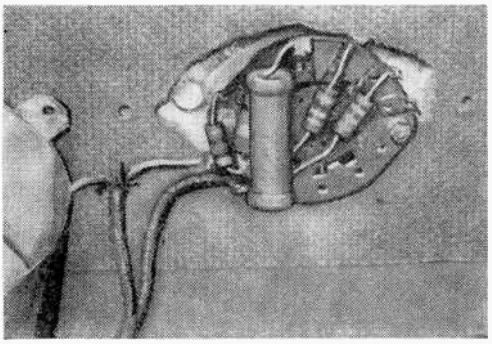
But suddenly I noticed a wisp of smoke.

(*Continued on page* 122)

...My neighbor was a big man....I got some beer...

Modification of the Heathkit AM Tuner

The popular Heathkit AM broadcast tuner Model BC-1 is a hi-fi wideband receiver. This characteristic, while fine for fidelity, may be responsible for interference

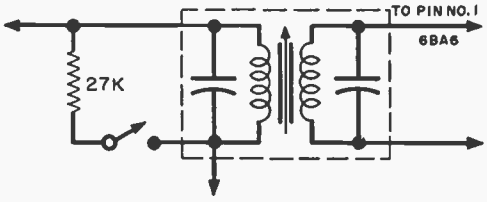


or crosstalk from some adjacent stations.

Since the Heathkit instruction manual states that you can reduce the bandwidth by connecting a 27,000-ohm resistor across the primary of the over-coupled input i.f. transformer, we should be able to make some sort of flexible adaptation. By installing a switch to cut the resistor in or out, we can either "live it up" with the full bandwidth or, when the QRM is bad, narrow it down a bit.

The terminals of the input i.f. transformer have room between them and the top panel for a slide switch. It would be best to mount the switch as close to the terminals as possible. Remove panel before the switch-mounting holes are made.

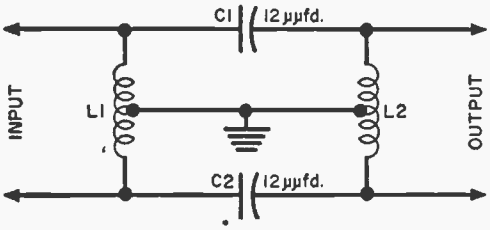
A more flexible arrangement is possible through the use of several different values of resistors mounted on a rotary switch (see photo). The bandwidth of the tuner can then be progressively changed by



switching in resistors of increasing value. A slight loss of sensitivity will be evident as the load across the coil increases. Try the following values for six steps of bandwidth: open, 500 ohms, 6800 ohms, 7200 ohms, 10,000 ohms, and 27,000 ohms. Use composition resistors. —*Wm. B. Rasmussen*

TV Interference — Its Cause and Cure

Can interference be eliminated from a TV receiver for less than half a dollar? Yes, if you install this TVR Hi-Pass Filter * at the antenna terminals of the set. Technically, it's a balanced constant-K high-pass filter, designed for 300-ohm line, which attenuates signals below 44 mc. and passes

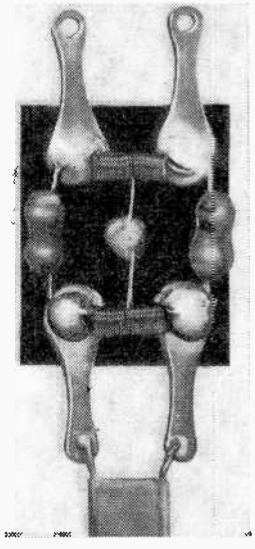


all higher frequencies. Most spurious signal overload problems can be cured with a single filter, but tough cases may require two in series.

The "chassis" is a 1" x 1¼" piece of insulating board. Drill five holes—four of which should be ½" in from each corner, the fifth at the exact center—for *4-40* brass screws and nuts, and assemble with soldering lugs under the screw heads. Solder the capacitors in place as shown in the photo.

Cut two 15" lengths of No. 30 enameled copper wire for the coils and fold each double. Now remove about 1" of insulation at the fold, solder the wires together, and bend the soldered portion at right angles. Measure out 6⅜" from the bend, cut the wire and tin ⅛" at the ends.

Wind the coil, starting at one end of the



wire, on a rod *exactly* ⅛" in diameter. Place the completed coil in position, trim the center tap until it just overlaps the center screw and solder in place. Then bend all coil end wires gently so they can be soldered to the corner screws, and the filter is complete. Keeping the coils so small that direct pickup is negligible eliminates the need for shielding.

* Originally described in the March-April, 1951, issue of "G-E Ham News."

BUILD THE COMMUTER'S PRIVATE EAR

By JOSEPH W. DOHERTY, K2SOO

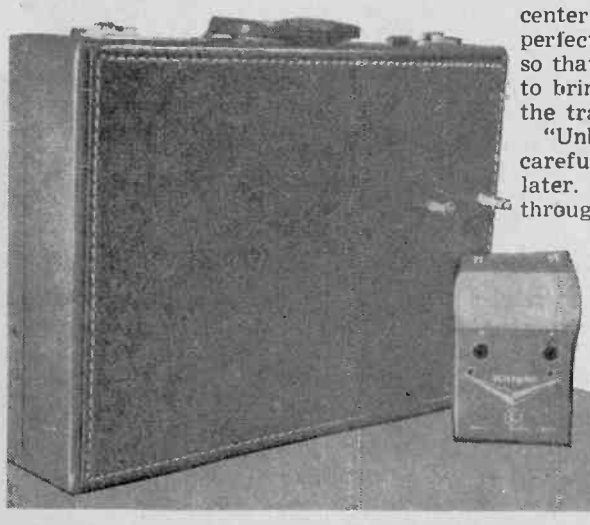
THE COMMUTER is a harried man. He gets up just in time to grab a shower, a cup of coffee and a quick kiss from his wife before he dashes to the station. On the 8:02 he opens his attache case and pores over his work. So when does friend commuter catch up on current events? Usually he doesn't. But the ideal solution is "The Commuter's Private Ear," which will allow him to tune in newscasts (or anything else) all the way in on the train.

It's uncomplicated, and inexpensive. You'll need an attache case ($4.95 in composition and plastic). In it mount a broadcast-band receiver, and you're all set. I used a two-transistor, germanium-diode reflex circuit. A Knight-Kit 83Y262 (Allied Radio) at $14.95 with printed-circuit chassis simplifies construction.

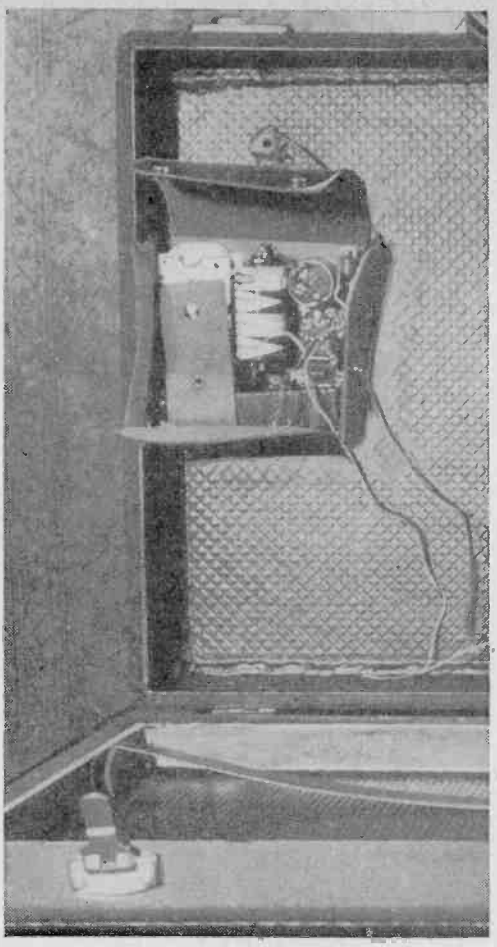
You'll have no trouble building the receiver if you follow the instructions to the letter. Complete it by attaching the ear plug leads. Then test the set. If it works properly, detach the leads and start on the attache case.

You can mount the receiver in the exact center of the case, which would give you perfect balance. I mounted it at one end, so that I could upend the case on my knee to bring the receiver up to the window of the train in difficult signal areas.

"Unbutton" the leatherette receiver case carefully, so the clips can be closed up later. Use a pointed tool and punch through for the mounting bolts. Then use



Moly bolts are in place, ready to mount the receiver in the attache case. Note mounting holes which are drilled below the control openings. See text for proper placement of the receiver.



these holes as templates on the attache case, and drill through both cases.

Mount the little case on the inside using two Moly bolts (¼" will do) pushed through from the outside of the attache case. Screw them tight; this will draw up the outer shields. Then remove the screws, clip away the shield overlaps and flatten them down completely if they are not already flat. Cover them with a piece of tape or other non-conductor.

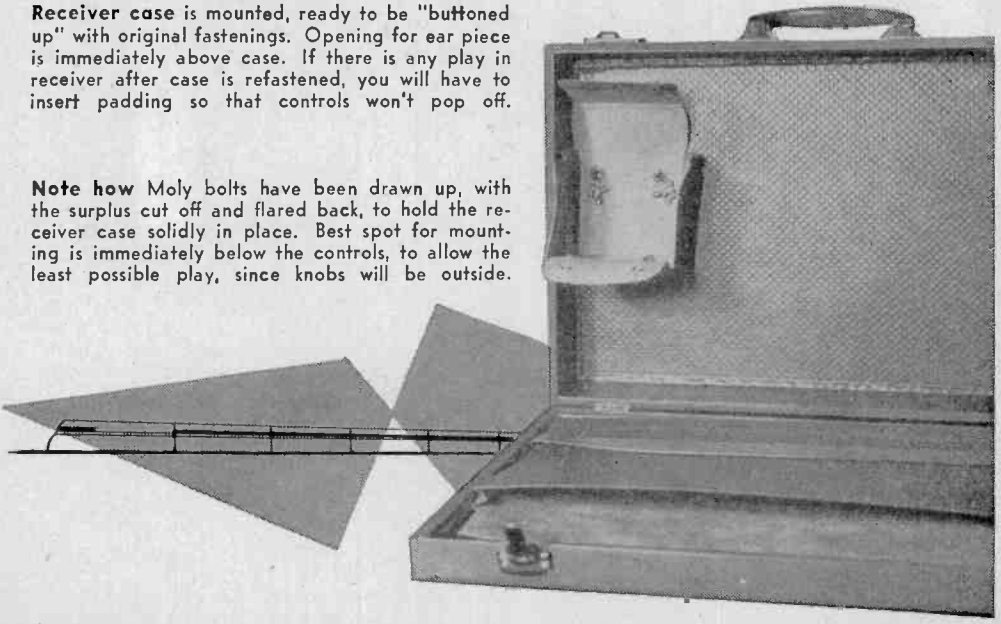
Next, drill through the control openings of the receiver case and through the attache case. You'll have to enlarge these openings carefully with a penknife until they accept the controls properly. Immediately above the small case, repeat this operation for the ear plug, until it fits snugly. Then solder the ear plug leads *after* you have put the wires through the hole from the *outside*.

Now mount the receiver and "button up" the receiver case. If you find there is "play" in the receiver after its case is closed, insert cardboard between it and the case, so that there will be no tendency for it to work off the control knobs.

When you use the receiver, you won't have to open the attache case. Simply pull out the ear plug and insert it in your ear, turn on the switch and tune in your station. You may have to "tune" the case by moving it about on your lap, but that's natural in this type of receiver. And you may have to upend it on your knee at times—that will depend on the construction of the train, the direction it's traveling in, and local conditions. —30—

Receiver case is mounted, ready to be "buttoned up" with original fastenings. Opening for ear piece is immediately above case. If there is any play in receiver after case is refastened, you will have to insert padding so that controls won't pop off.

Note how Moly bolts have been drawn up, with the surplus cut off and flared back, to hold the receiver case solidly in place. Best spot for mounting is immediately below the controls, to allow the least possible play, since knobs will be outside.



KIT BUILDER'S KORNER

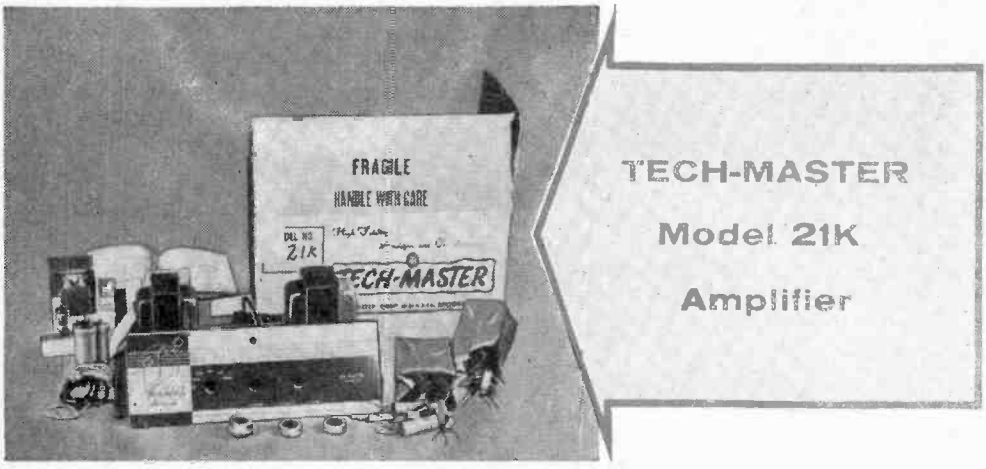
AN INTEGRATED AMPLIFIER is one that has *all* tubes and parts except input and speaker mounted on one chassis. It only requires connection to the pickup, microphone or tuner for input and the loudspeaker for output.

There are purists among high-fidelity fans who wouldn't touch an integrated amplifier with a ten-foot pole. They swear they can detect induced hum as long as the preamp is within a cable length of the basic amplifier, and nothing anyone can say or do will convince them otherwise. But for those whose ears are not quite so "sensitive," the integrated amplifier presents a considerable dollar saving, as well as a saving in time and trouble when constructing the kit. As a matter of fact, if it's put together with any amount of care at all, we ordinary mortals will find it impossible to detect hum where there shouldn't be any.

Tech-Master Corp. (75 Front St., Brooklyn 1, N. Y.) has come up with two integrated amplifier kits, a 25-watt unit and a 60-watt unit. Since the lower-powered job is probably closer to the needs of the average kit builder, we decided to construct that one.

Undistorted power output of the Model 21K is 25 watts from 20 to 20,000 cps. Intermodulation distortion is less than 1% at rated power and below 0.25% at all ordinary listening levels. Dimensions are neat, only 14" wide by 9" deep and 5" high, allowing it to fit in a fairly tight space. The basic price of the kit does not include the cabinet —only the face plate, which is finished in a handsome two-tone effect.

Putting It Together. One of the things you'll notice as you start to build the Model 21K is the fact that Tech-Master's instructions are brief and to the point. There are no wasted words. If you're used to being told the color code each time you wire a resistor, forget about that here. Tech-Master believes you should know the color code by heart—and you'd better, or you'll be jumping back and forth between the instruction sheet and the code.



Since this is an integrated chassis, the job of putting it together is far more complex than building a basic amplifier. This is especially so in the wiring of the controls, which requires extreme care and patience, and a constant check and recheck, not only for the proper parts but for positioning as well. Remember that wiring placement should conform as closely as possible to the wiring pictorial or you're liable to wind up with hum, and a rewiring job.

It's not difficult to follow the instructions closely, but here's a tip. Each time you're

Amplifier chassis at left is shown ready for check-out with a volt-ohm-milli-ammeter. Wiring is complex, and should be done with the utmost of care. The completed amplifier is shown without the cabinet, which is extra. Switch at the left of the front panel is the function control, on-off-volume switch is in the center, and the concentric tone controls are at the right.

told to cut a piece of wire of a specific length, check to see that it fits according to the diagram. Cut it to proper size, or you'll have wires running all over the place. You might, as you wire, use some rubber cement to hold the wires to the chassis.

Tech-Master has saved you trouble by attaching to the chassis beforehand some of the bigger, bulkier things like the output and power transformers as well as the tube sockets and the pilot light socket. This makes for less errors.

Special Features. The selector switch has only one equalization position—RIAA—which may be of interest for those who have old record collections. This should be borne in mind when buying the kit. On the same switch, in addition to the magnetic cartridge, are the positions for tuner, TV, magnetic tape or wire recorder, crystal and ceramic cartridge. The cathode-follower output jack on the amplifier allows signals from any of these sources to be fed into a tape recorder.

Magnetic-type pickups of any make can be matched to the Model 21K without soldering a new cartridge load resistor, by means of a small adjustable load resistance located in the rear of the chassis. The bass and treble controls are concentric and have a range of ± 15 db each.

Two types of a.c. power outlets are provided on the chassis. Record changers which can automatically disengage the drive wheel at the end of a cycle should be connected to the non-switched outlet marked "record player." Thus, when the amplifier is switched off in the middle of a record, the player will complete its cycle, preventing "flat" spots from developing on the changer's drive wheel which add to rumble. There is another outlet, to which the tuner can be connected. And taps for 4-, 8- and 16-ohm speakers are provided.

Comment. There is no great mystery about the Model 21K. Basically, the amplifier portion uses the well-known Dynakit arrangement, with a 6AN8 as the input tube of the power amplifier. It uses a screen-tapped or distributed-load output transformer and a pair of 6L6 tubes with fixed bias as output tubes.

Because of the complexity of the wiring job, it would be a good idea to set up some sort of standard procedure to follow as you wire. For instance, after each wiring step has been completed, you might read it over, then trace it out on the chassis again. You'll be amazed at how many errors you'll find that way, and how many headaches you'll save yourself.

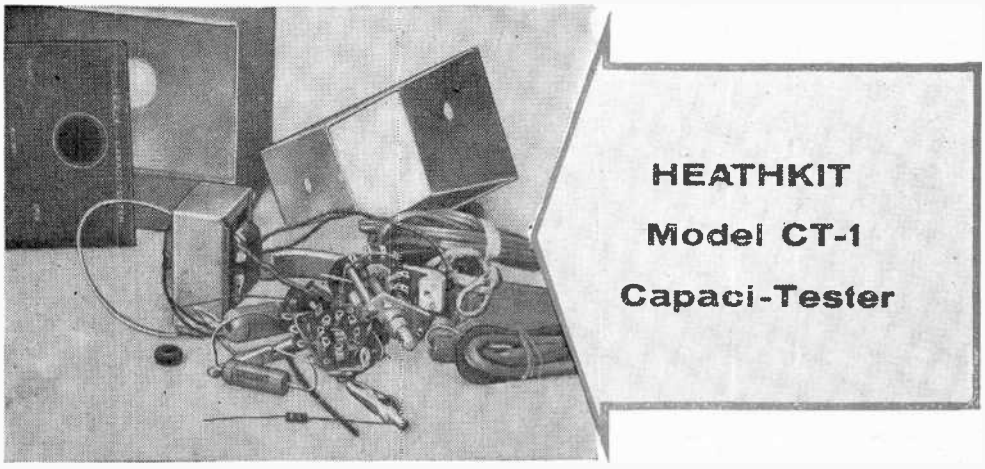
Unless you're an experienced solderer, it might be a wise idea to keep a VOM handy, and after each soldering job, use it to check for proper resistance—especially on switches and such where open connections might not be too obvious.

Properly constructed, the integrated amplifier will give you a good, workmanlike job which should satisfy all but those who insist on having separate chassis for preamp, power amplifier and power supplies.

"THIS could be it . . . the cathode voltage seems low. We'll clip out that capacitor and check it for a short . . . No, it's okay; solder it back. Hmm . . . it could be an open B+ bypass. We'll cut it out and see . . . Darn, that one's okay, too—solder it back. Could it be the screen bypass? . . ."

Clip it out—check it—solder it back; clip it out—check it . . . and so on into the night. Sound familiar? Well, the Heath Company (Benton Harbor, Mich.) has an answer to your problem. The Model CT-1 capacitor tester will check capacitors right in the circuit. There is no clipping, no cutting, no soldering.

You just connect the two Capaci-Tester leads across the suspected capacitor, move a switch once to the right and once to the left. Watch the "magic eye"—if it winks at you, the capacitor is okay. The component under test can be shunted by a resistance as low as 30 ohms (if capacity is 350 $\mu\mu$fd. or more), and a valid open-and-short check can still be made. Be sure the set being checked is turned off.



Putting It Together. In the construction of any kit, the old proverb "haste makes waste" is good sense. One wrong connection, because you've rushed, and you'll have two or three hours of trouble-shooting when your kit could have been complete and operating.

It's a good idea to have a "china-marking" pencil available as one of your tools when you assemble your Heathkit CT-1 (or any other kit). These crayons will write clearly on a metal chassis. When the assembly directions mention a terminal lug *F2*, a tube socket pin *XB-3* or grommet *D*, as they do here, the number or letter can be marked next to the connection. Kit manufacturers have found that many of the kit builder's mistakes are the result of his misnumbering terminal lugs or connections. If terminals are marked as you come to them, you'll run a constant cross-check on your wiring without any extra work.

Speaking of cross-checks, Heath has a new trick—every time one of the connections is to be soldered, there is a number printed next to the instructions indicating exactly how many wires go to that connection.

Special Features. The circuit of the checker is designed around only one tube, a 1629 electron-ray indicator. Its triode section is hooked up as a conventional Hartley oscillator tuned to about 19 megacycles.

Completed tester matches the Heath VTVM in size and general appearance. Information pertaining to interpretation of eye response is printed on front panel.

Another winding on the coil is coupled "tight" enough to cause the oscillator to quit oscillating. A good capacitor under

(*Continued on page* 132)

Short-Wave Report

By HANK BENNETT

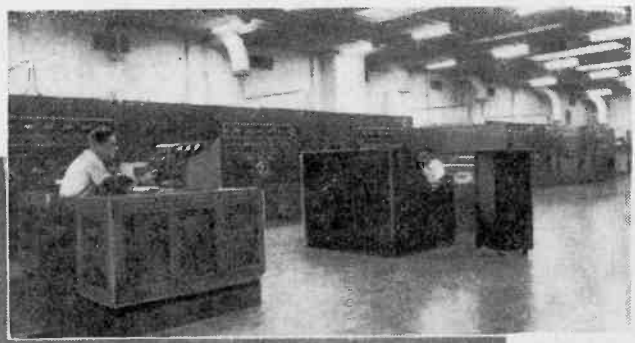
THE FIRST short-wave broadcast from Australia was made in September, 1927, when a 10-kw. transmitter owned and operated by Amalgamated Wireless Ltd. in Sydney, VK2ME, was used for a transmission to Europe. Two months later, in Melbourne, 3LO attempted a weekly service using VK3ME, a 2-kw. transmitter. This was unsuccessful, due mainly to the lack of ionospheric predictions and to the low power of the transmitter.

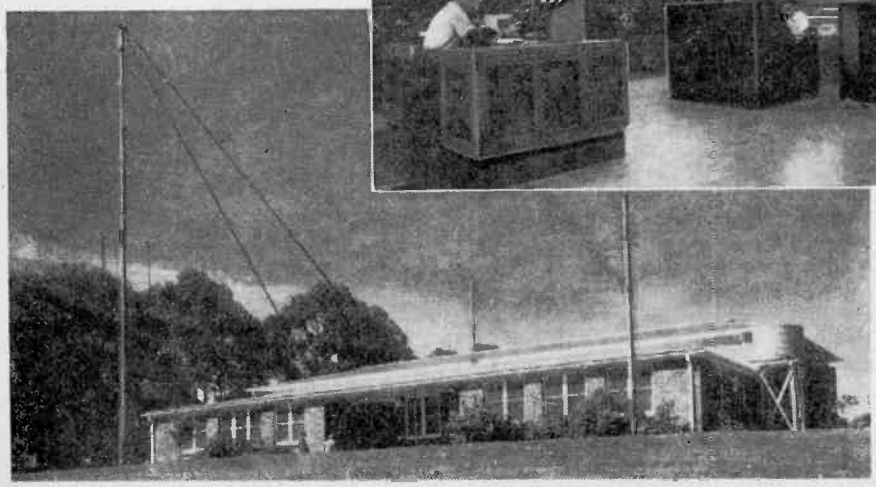
In 1936, 3LR, Melbourne, 2-kw. (later to be known as VLR, Lyndhurst), began a news service for listeners in New Caledonia and New Hebrides, with fairly good results. Signal strength was adequate over this relatively short distance. Later that year, using 3LR, the Australian Broadcasting Commission (A.B.C.) attempted unsuccessfully to rebroadcast to India and England a play-by-play description of the England vs. Australia test matches. It was the Second World War that finally brought about the establishment of official short-wave transmissions—the forerunner of today's service which operates 41½ program hours per day, using five languages, under A.B.C. control.

On December 5, 1939, the Australian Federal Government authorized the newly established Department of Information to set up an overseas broadcasting service. Fifteen days later the transmission officially began with a speech by the Prime Minister of the day, the Rt. Hon. R. G. Menzies. The BBC in London was able to pick up and rebroadcast this opening address to its listeners in the Home Service. Within a few weeks, seven transmissions were in operation to Europe, North America, South America, the Netherlands East Indies, Japan, the Philippines, and the Western Pacific areas.

There were certain geographical advantages when it came to developing audiences in Asia and the Pacific. Despite the low power of the transmitters, programs reached Southeast Asia and the Pacific Islands more clearly than those of any

(*Continued on page* 140)





Radio Australia's high-frequency station at Lyndhurst (near Melbourne) now houses VLG, a 10-kw. transmitter, and A.B.C.'s inland s.w. transmitters VLH and VLR. At right is the transmitter hall at Shepparton, Victoria.

Computers Get Jobs in Hotels Banks and Stores

THE COMPUTER, which had once been thought of as strictly a scientific tool, has been making steady inroads into the field of business and finance, as witness the examples on this page. For instance, the photo at right shows part of the nation's first fully automated department store data processing system, at Burdine's in Miami, Fla. The complete electronic system records a customer's transaction in as little as 10 seconds and computes daily totals at the rate of 24,000 additions a minute.

Banks are all prepared for automation. Photo at left shows an IBM system which scans paper checks, posts them to an electronic ledger, and automatically prepares customers' statements from the checks. The key to the system is magnetic ink, which allows the machine to "read" the checks as it would a tape.

The hotel industry's first automated electronic reservation service—Reservatron—has been put to work by the Sheraton hotel chain (below, left). It enables reservation operators to determine almost instantly what types of accommodations are available, up to a month in advance, at all Sheraton hotels. The heart of the system is an electronic "memory drum" which retains up-to-the-minute information on every guest room—there are some 24,000 in the chain's 45 hotels. The system can reveal in less time than it takes to dial a phone what rooms are available in four different classifications. —30—

Get the Best From Your FM Tuner

By ROBERT SAMPSON

CONSIDER cats, women, and FM tuners: if you treat them right, they purr, and if you treat them wrong, they squawk. If you keep your FM tuner in trim, and it purrs along just right, it makes mighty sweet music, for FM is the only truly hi-fi method of getting radio programs into your sound system.

But if you are mean to your FM tuner, it can sound as raucous as any cat with its tail in the door. Even if it seems to bring in the stations all right, you may still be mishandling it just enough to lop the top off the fidelity. Often FM owners don't know they are cheating themselves in this way! It's a shame when this happens, because it is quite simple to get full high fidelity out of any good FM tuner, if it is in proper operating condition.

Let's track the signal through an FM tuner to see where it might get battered and bruised, or just have its shine taken off, along the way.

What Is an FM Signal? At the antenna we have the carrier wave, a stream of electrical energy pulsating at very high frequency, which has hopped over from the FM transmitter at the speed of light. The music or speech rides on the carrier in the form of small swings up and down in the *frequency* of the carrier. These frequency swings keep step with the vibrations of the original sounds in the broadcast studio. The number of cycles off the channel center that the frequency swings up or down represents the *volume* of music or speech. (See Fig. 1 on p. 88.)

Suppose our carrier is 90 mc., or 90,000,000 cycles per second. For top volume, under American FM standards, this carrier frequency must change by 75 kc., or 75,000 cps, each side of the center frequency. Thus, a loud 100-cps tone, for instance, would get a ride by swinging the carrier up to 90,075,000, down to 89,925,000, and up again, 100 times each second. If we wanted half the volume, the swing would be 37,500 cps each way.

The I.F. Trap. Swinging and swaying to the music better than Sammy Kaye ever thought of doing, the carrier first gets selected and amplified in the r.f. stages of your tuner. Then it is converted to the intermediate frequency, for the main part of the amplification, just as in an ordinary AM superhet radio. In the i.f. stages, we come across one of the first booby traps that we must sidestep to keep the signal out of trouble.

We want the whole of each one of those frequency swings to come through without any change. But suppose the i.f. stages are tuned very sharply, with a peak in the middle of the channel. Then when the carrier swings far off center, the i.f. amplification will drop sharply. This will cause serious distortion. Therefore, the i.f. stages in an FM tuner are designed with a "flat-top" response.

But this adds an extra gimmick to the i.f. alignment. The responses of the two or three stages must be all lined up so that the "hoops" of response lie on top of each other, as in Fig. 2(B). Just getting them to overlap, so that the carrier can come strongly down the middle, as in Fig. 2(A), is not good enough.

Lopping Off Noise. After leaving the i.f. string, the signal comes to the limiter stage. Limiting is one of the smart tricks that gives FM its margin on quality. Figure 3 shows how it works.

A clean FM signal should vary in frequency only. But it arrives at the receiver

Radio can make a ruckus if you mistreat your hi-fi tuner—here's how to get smooth sound off the air

full of little bumps of amplitude changes. These amplitude bumps are static, noise and general interference. They must be stripped off the signal and kept out of the receiver.

The limiter does just that. It acts as a sort of bouncer that kicks out the undesirable elements — namely, the amplitude modulation mooching in on the FM signal. So, if a nasty, noisy amplitude bump comes riding in on the FM signal, the limiter just lops it off. In this way, it clears up all the hum, buzz and sputter rampaging in the atmosphere.

The limiter stage is designed to hold only a certain amount of signal. Feed it more, and it just spills over, running the excess literally into the ground. It's like pouring water into a glass until it runs over. You can get the water level to the top of the glass but no further. No matter how much more you pour in, it will just stay at the top—and the excess spills off.

This is how we get the velvet silence in back of the music that is one of the main joys of listening to FM. But if the signal is not strong enough to spill over, or "saturate" the limiter, the high sensitivity of an FM tuner brings in plenty of noise, and we get some distortion, too.

There is a fast way of telling whether your limiter is working right or not. You need no instruments for this test. Just spin your tuning knob and watch for the between-station noise. If the noise drops out over a wide gap as you come to a strong station on the dial, your limiting is all

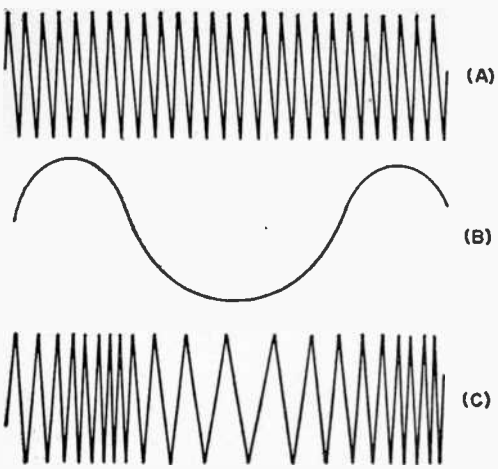


Fig. 1. The FM carrier (A) is modulated by the audio signal (B), resulting in frequency shift (C).

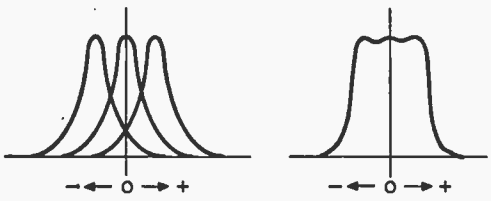


Fig. 2. If the tuning of the i.f. stages does not smoothly overlap (A), signal loss and distortion result. The humps should be aligned as in (B).

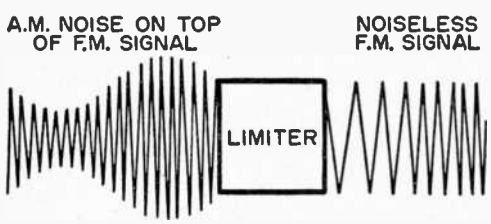


Fig. 3. Peaks of AM noise arriving with the signal are clipped off by the limiter, from which the FM signal emerges with uniform amplitude.

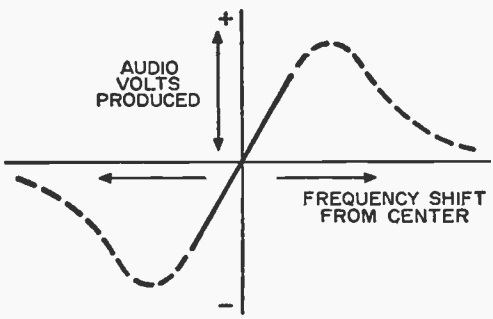


Fig. 4. A linear discriminator characteristic (solid diagonal section of curve) produces an audio signal proportional to the FM frequency shift.

right. If it takes hairline tuning even on strong stations to get rid of the rustle, or if it never entirely disappears, your limiter is on the blink.

Audio Uncovered. With all of its AM noise wrinkles smoothed out by the limiter, the signal arrives at the discriminator, which peels the r.f. wrap off the audio signal. This stage has two tuned detector circuits, so balanced against each other that when the carrier is steady on its center frequency nothing gets through. When a signal swings the carrier off the center frequency, the circuits become unbalanced, one to put out a positive voltage and the other a negative voltage. The more the frequency changes, the higher the voltage rises. In this way we get an audio voltage that can go through the amplifier and speaker to spell out the original music and speech.

If the tuned circuits in a discriminator are not perfectly balanced, you have a "crooked" detector. Like a crooked bookkeeper, it can cause you plenty of trouble. Any bend in the discriminator response curve (see Fig. 4) means harmonic distortion, intermodulation distortion, and several other bugaboos. We need linear discriminator response for distortionless FM performance. Luckily, in most cases, this is just a matter of having the discriminator circuits properly tuned.

Some FM tuners have a slightly different detector stage called a "ratio detector." This needs balanced adjustment just as a discriminator does. One main difference is that a ratio detector is somewhat less sensitive to AM noise, and so needs less stringent limiting ahead of it.

Now we can add up what we need to make an FM tuner sit up straight and do its hi-fi best: (1) the r.f. stages in good alignment, for selectivity and signal strength; (2) the i.f. stages adjusted with the response curves on top of each other; (3) enough signal at the limiter to spill over; and (4) a discriminator or ratio detector that is strictly on the straight and narrow path. Points 1, 2 and 4 all depend on alignment. Point 3 depends on getting enough signal to the limiter stage. How is this accomplished?

Getting Enough Signal. The first factor affecting signal strength is your distance from the FM transmitter. Next is the design of your antenna, which determines how much of the available signal is caught and piped into your receiver. FM antennas in order of increasing quality range from power line connection, up through the dipole in the cabinet, dipole in the attic, dipole on the roof, dipole with

(*Continued on page* 127)

LIGHT AMPLIFIERS

I've heard that light amplifiers will soon be revolutionizing the television industry. What are light amplifiers, how do they work, and is it true that they will soon bring about far-reaching changes in electronics and optics?

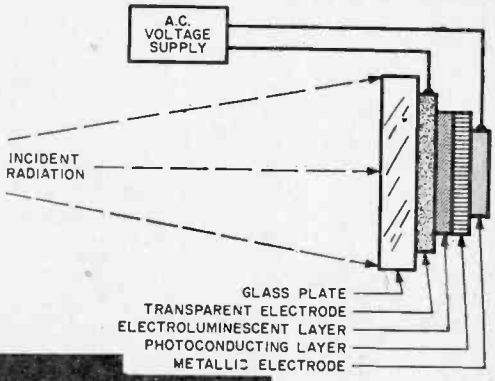
THE ANNOUNCEMENT of light-amplifying phosphors late in 1954 brought with it a flood of rumors. The "word" was that next year's television receiver would be as flat as the proverbial pancake, that you would be able to buy binoculars which would fit in your wallet, and that—the year *after* next—all big observatories would be equipped with electron light-amplifying telescopes to see clear around the nether end of Einstein's curved space!

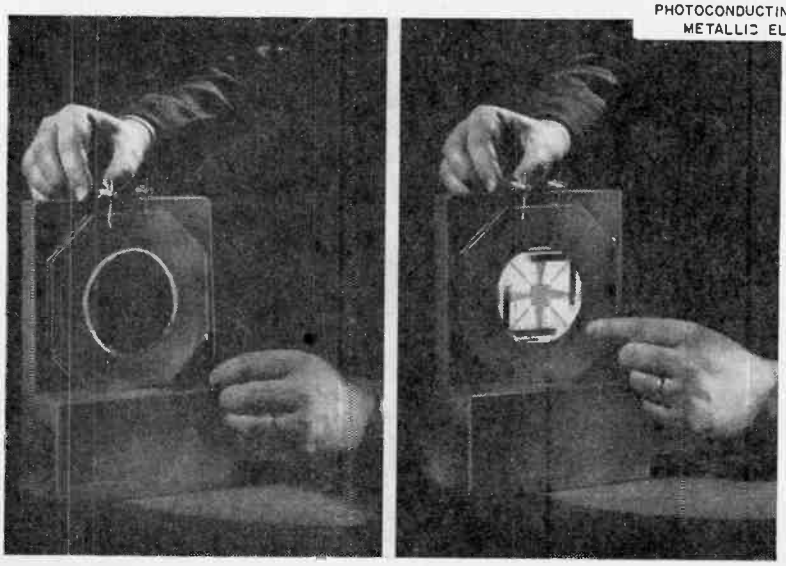
To be sure, phosphor screens with startling light amplifying properties have been built and tested. And research now in progress holds out fascinating promises for the future. But don't look for revolutions just yet! A little down-to-earth discussion on the theory of light amplifiers and their shortcomings will make clear that much work is yet to be done.

Combined Effects. The recently announced light amplifiers combine the effects of two well-known phenomena: *photoconductivity* and *electroluminescence*. Certain common chemical compounds such as cadmium sulfide (CdS) reduce their electrical resistance when exposed to ultraviolet or visible light, hence the name photo*conductivity*. It is this property that has made possible the tiny, sensitive CdS photocells. Electroluminescence, discovered about 20 years ago, is the emission of light from certain phosphor materials when an alternating voltage is applied.

(*Continued on page* 119)

Fig. 1. The light amplifier cell consists of several layers of materials.





Experimental G.E. light amplifier. The amplifying area is about 4" in diameter. An ordinary lantern slide projector is used to throw a dim ultraviolet image on the screen. As the d.c. voltage on the screen is increased, the picture becomes many times brighter, maintaining detail and contrast.

Among the Novice Hams

By **HERB S. BRIER,** W9EGQ

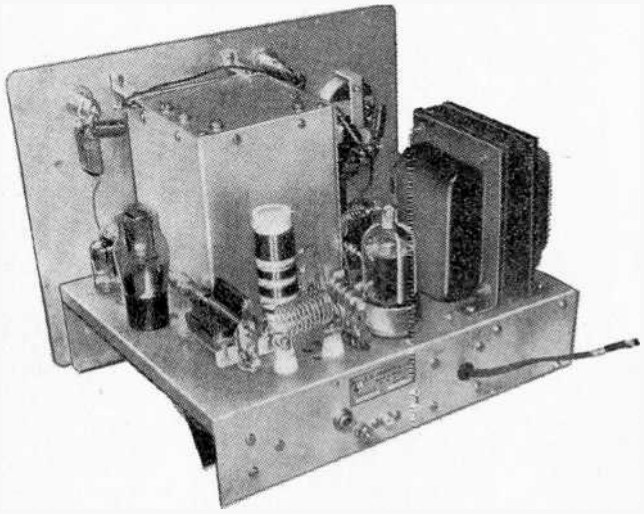
IN ADVANCE PUBLICITY, the new Johnson Navigator transmitter sounded so good that I felt sure you would like to have a complete report on it. I thereupon contacted the E. F. Johnson people, in Waseca, Minn., who were kind enough to send me one of the kits as soon as they started coming off the production line.

In its 13¼" x 10$\frac{1}{16}$" x 9⅛" aluminum cabinet, the Navigator weighs in at 22 pounds. It is a seven-band (1.8 to 30 mc.) c.w. transmitter, rated at 40 watts, which features optional, crystal or variable frequency control.

"Navigator" Design. The circuit is designed around a 6AU6 variable frequency oscillator which operates in the 1.75-mc. or 7-mc. range, depending on the desired output frequency. It drives a 6CL6 buffer/frequency multiplier stage, which becomes the crystal oscillator/frequency multiplier when crystal control is used.

A four-position panel switch selects either of two crystals, or the VFO, or permits "zero beating" a frequency without putting a signal on the air. One-hundred-sixty meter crystals are used for 160-meter output, 80-meter ones for 80 or 40 meters, and 40-meter ones for 40, 20, 15, and 10 meters.

The 6CL6 drives a 6146 as a straight r.f. power amplifier on all bands. The 6146 output tank circuit is a *pi*-network type, for matching into loads of 40 to 500 ohms.



Band selection is accomplished through a 7-position, 3-section rotary switch. It connects the proper values of inductance into the buffer and output circuits for operation on the different bands. In addition, it switches fixed capacitors across the 6146 plate-tuning capacitor on the 1.75- and 3.5-mc. bands to provide sufficient capacitance for good circuit *Q* and harmonic suppression, without using so large a variable capacitor that tuning on the higher frequency bands would become unduly critical.

The bandswitch varies the 6CL6 screen voltage as bands are changed, in order to insure proper grid excitation to the 6146 on all of them. The bandswitch knob also controls the VFO range switch through an ingenious ratchet system.

Final amplifier plate and grid currents are measured by a dual-range milliammeter controlled by a slide switch.

"Clickless" Keying. Straight cathode keying of the 6CL6 is employed when the Navigator is crystal-controlled. With VFO operation, grid-block keying of the VFO and the buffer is employed, with a 12AU7 dual triode functioning as the keyer tube.

When the key is pressed, the VFO comes on immediately, followed by the 6CL6 a split second later. Conversely, when the key is released, the 6CL6 cuts off first, followed by the VFO. In this manner, the advantages of oscillator keying (key down, transmitter on the air; key up, entire transmitter dead) for full "break-in" operation are obtained without the chirps and clicks which invariably accompany simple oscillator keying.

Actually, this system does not prevent the oscillator from clicking or chirping at the start and end of each character, although both are minimized by careful oscillator design. Instead, the keying sequence prevents them from reaching the antenna to be radiated.

A single power transformer provides all operating voltages for the Navigator. Plate potential is 350 volts supplied by a 5U4GB rectifier and choke-input filter. And a regulated 150 volts is supplied to the VFO and amplifier screen grids. A tap on the high-voltage transformer winding and a separate rectifier and filter furnish the negative voltages required to operate the keyer circuit and to cut off the 6146 plate current when the key is up.

The transmitter is fused against overloads, and power, key, and the external relay line are bypassed and filtered to prevent them from radiating spurious signals.

Assembling the Kit. Successful construction of any electronic instrument requires the ability to solder well and willingness to read and *follow* instructions carefully. Because of the complexity of the assembly, I would not recommend the Navigator kit as your first electronic construction project, at least not without supervision. However, anyone with a little experience who is willing to follow the instructions and study the illustrations furnished should be able to do the job.

How long the assembly will take will vary with different individuals, but 50 hours—more or less—spread over a couple of weeks would seem a fair estimate. Tools needed include only a couple of screwdrivers, pliers, knife, ruler, small-tipped soldering iron (or gun), and rosin core solder.

A feature of the kit that many constructors will appreciate is that all small parts and hardware of the same general type are packed in individual envelopes with a list of their contents printed on them. Consequently, when a specific size of screw, washer, fixed capacitor, etc., is called for, it is only necessary to choose the envelope containing that type of material and select the desired part from it.

SEE NEXT PAGE FOR
list of those who request help in obtaining their ham licenses

Testing the Transmitter. After calibrating the VFO of the completed Navigator with the aid of a 100-kc. crystal standard, and checking its power output—over 25 watts on all bands, I put it on the air. When used with the VFO, the stability of the emitted signal was excellent with very little warm-up drift, and the keying was as good as I have ever heard.

Upon switching to crystal control, the only difference in the signal was that the keying, although excellent for a keyed crystal oscillator, was not quite as "clean" as when the VFO was used. This was especially true on the higher-frequency bands.

Operating the Navigator above 14 mc. without a low-pass filter in the antenna output circuit resulted in a slight amount of interference to a television set in the same room tuned to Channel 2. With the

(*Continued on page* 136)

Rear view of the Navigator c.w. transmitter assembled by the author. It features optional crystal or variable frequency control. Aluminum box in center contains the variable-frequency oscillator.

Weighing in at 22 pounds, the Navigator is housed in a 13¼" x 10$^{1}/_{16}$" x 9⅛" aluminum cabinet. Selection of each of the seven bands it covers is accomplished through a 7-position, 3-section switch.

HELP US OBTAIN OUR HAM LICENSES

Prospective amateurs requesting help and encouragement in obtaining their licenses are listed here. To have your name listed, write to Herb S. Brier, W9EGQ, % POPULAR ELECTRONICS, 366 Madison Ave., New York 17, N. Y. Please print your name and address clearly. Names are grouped geographically by amateur call areas.

K1/W1 CALL AREA

Richard Bonin, 1 Star St., Pawtucket, R. I. Phone: PA 3-9834. (Code and theory)

David Perrin, 1096 Highland Ave., Needham Heights 94, Mass. (Code, theory and selection of equipment)

Richard Fell, Montana Drive, Holden, Mass. (Code, theory, regulations and selection of equipment)

Stanley Chapman, Jr., 50 Acton St., Maynard, Mass. (Code, theory, and selection of equipment)

Ralph Kelley, 47 Acton St., Maynard, Mass. (Code, theory and selection of equipment)

John Bradshaw, 257 Mechanic St., Marlboro, Mass. Phone: 3766-W. (Code and General Class theory)

K2/W2 CALL AREA

Wm. Walker, 14 Cooper St., Brooklyn 7, N. Y. (Code and theory)

A. M. Walker, 14 Cooper St., Brooklyn 7, N. Y. (Code and theory)

Paul F. Castorina, 1537 Mayflower Ave., Bronx 61, N. Y. (Code and theory)

Janet M. Stellato (23), 88-18 150 St., Jamaica, L. I., N. Y. (Code and theory)

William Cropanzano, 180 Bay 8th St., Brooklyn 28, N. Y. (Code and theory)

Robert McNichols, 222 East 87 St., New York 28, N. Y. (Theory)

Chuck Goodsole (14), 1402 E. Park Rd., Grand Island, N. Y. (Code and theory)

Lewis Lester, 2241 Creston Ave., Bronx 53, N. Y. (Code, theory and selection of equipment)

Leonard Katz (14), 316 Palsted Ave., Westfield, N. J. Phone: ADams 2-7678. (Code, theory and selection of equipment)

Francis O. Mayer, 95 Bond Ave., Malverne, N. Y. (Code and theory)

Steve Cohen, 1900 Quentin Rd., Brooklyn, N. Y. Phone: DE 9-8056. (Code, theory and selection of equipment)

K3/W3 CALL AREA

Glenn K. Metzler, R.D. #1, Manheim, Pa. (Theory and selection of equipment)

James Friedline, 2901 O'Donnell St., Baltimore 24, Md. (Code, theory and regulations)

Jerry L. Snellbaker (16), Manchester, Pa. Phone: 4521. (Code, theory and regulations)

Gale Whitton (12), R.D. #1, Tionesta, Pa. (Code and theory)

James Laux, Box 85, Ruffsdale, Pa. Phone: KI 7-4036. (Code, theory and selection of equipment)

David Guianen, 508 West 9th St., Erie, Pa.

Ronald J. Gilmore, 103 Hilltop Rd., Plymouth Valley, Norristown, Pa. Phone: BE 5-3571. (Code and theory)

Jack Quinn, 634 Main St., Apt. 21, Johnstown, Pa. (Code and theory)

Jack Winter, 7422 Perrysville Ave., Ben Avon, Pittsburgh, Pa. Phone: PO 1-5543.

K4/W4 CALL AREA

John V. Blake, SA Htg. Ellyson, Fld. Ecom. Dept., Pensacola, Fla. Phone: Ellyson EXT 259. (Theory, regulations, and selection of equipment)

John Cross, P.O. Box 156, Brantley, Ala. (Code and theory)

Tim Prather (14), 235 Jasper St., Somerset, Ky. (Code and theory)

Rembert T. Powell, P.O. Box 1343, Mtn. Home, Tenn. (Code and theory)

Sgt. James E. Camp, RA25530816, 120 Lee Ave., Colonial Heights, Va. (Code and theory)

Virgil Simmons, Route 4, Box 239, Oneonta, Ala. (Code and theory)

Kenny Houtz, 300 W. Church St., Elizabeth City, N. C. (Code and theory)

K5/W5 CALL AREA

Edward Baer, 519 Watson, Ft. Worth, Texas. Phone: JE 5-7643. (Code and theory)

Dewey Jones (17), 4323 Worth St., Dallas 10, Texas. Phone: TA 4-4742. (Theory and regulations)

Harvel C. Littlefield (18), Box 182, Lorenzo, Texas. (Theory)

K6/W6 CALL AREA

Tom J. Orzech, Box 813, 78th Supply Sqdr., Hamilton AFB, Calif. (Code and theory)

Fred B. Payton, Jr., 3341 Monroe St., Riverside, Calif. (Code, theory and regulations)

James Slosburg (13), 10619 Bradbury Rd., Los Angeles 64, Calif. (Code and theory)

K. W. Bridgman, 2116 Fairfield St., Montebello, Calif. (Code and theory)

Jameson Randolph Wood, 10657 Valerio, Sun Valley, Calif. (Code, theory and selection of equipment)

Randall Bemis (12), P.O. Box 57, Julian, Calif. (Code and theory)

Mike Colvin (13), 1001 E. Latham, Henret, Calif. Phone: OL 8-5027. (Code and selection of equipment)

K7/W7 CALL AREA

Joe Dixon, Box 116, Pomeroy, Wash. (Theory)

Bruce Mendenhall (15), 2223 E. McGraw St., Seattle 2, Wash. (Code and General Class theory)

K8/W8 CALL AREA

Bill Wolfe (15), Wakefield Rd., Hiram, Ohio. (Code and General Class theory)

Al Nowakowski, Jr., 907 Forest Ave., Toledo, Ohio. (Theory)

Ray Horn, Jr. (15), 1009 Minerva Ave., Columbus 24, Ohio. Phone: TU 5-1733. (Code and theory)

Michael Cheney (12), 3210 Norwood Dr., Flint 3, Mich. Phone: CE 5-4074. (Code, theory and selection of equipment)

Lindon Daniels, 2895 Jordan Rd., Woodland, Mich. (Code, theory and selection of equipment)

Walter Morawa, Jr., 6850 Stahelin, Detroit 28, Mich. Phone: LU 4-1099. (Code)

John Miller (15), Box 123, Richville, Mich. (General Class code and theory)

Bob Schuld (15), 3524 E. 114 St., Cleveland 5, Ohio. (Code and theory)

K9/W9 CALL AREA

William E. Daupert, R. R. #2, Lebanon, Ind. (Code)

John Hoerner (13), 1333 Sunview Lane, Winnetka, Ill. (Code and theory)

Ronnie McDaniels, 319 North 18th St., Terre Haute, Ind. (Code and theory)

David Greiner (13), 110 E. Holland St., Washington, Ill. Phone: 770. (Code and theory)

Larry L. Langreer (13), 1431 East Ave., Berwyn, Ill. Phone: GU 4-7605. (Code and theory)

Alex Box, Jr., 6125 S. Ellis, Chicago 37, Ill. Phone: FA 4-9878. (Code and theory)

KØ/WØ CALL AREA

Mark Anderson (14), Box 348, Crete, Nebr. (Code and theory)

George W. Schroeder, 2627 Armand Place, St. Louis, Mo. Phone: PR 3-6908. (Code)

VE AND OTHERS

Mike and George Papper, 94 Clark St., Port Colborne, Ont., Canada. (Code)

Michael Pupeza (15), 644 Bathurst St., Toronto, Ont., Canada. Phone: LE 5-4127. (Code, theory and regulations)

Dossue N. Paymaster, "Court View," 126 Queen's Rd., Bombay 1, India. (Code and theory)

To help prospective amateurs obtain their Novice licenses, the Electronic Industries Association (formerly RETMA) offers a set of code records (recorded at a speed of 33⅓ rpm) and a Novice Theory Course for $10.00, postpaid. The complete course or more information on it is available from EIA, 1721 DeSales St., N.W., Washington 6, D. C.

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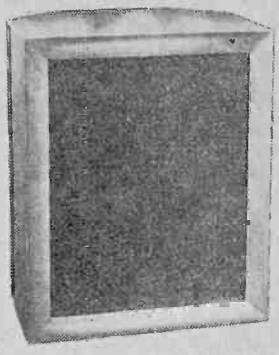
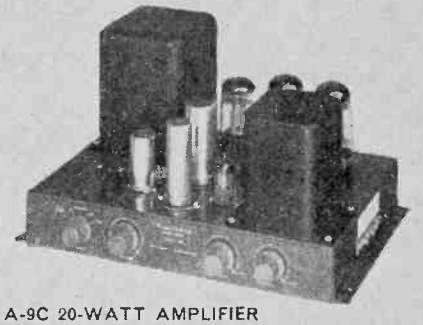
"BASIC" SPEAKER SYSTEM



RANGE EXTENDER



A-9C 20-WATT AMPLIFIER

HEATHKIT "BASIC RANGE" HIGH FIDELITY SPEAKER SYSTEM KIT

This amazing speaker system can fulfill your present needs and still provide for future expansion. Fine hi-fi performance the result of using high quality speakers in an enclosure especially designed for them. Features two Jensen speakers to cover 50 to 12,000 CPS within ± 5 db. Power rating is 25 watts, and impedance is 16 ohms. Enclosure constructed of veneer-surfaced plywood, ½" thick, and measures 11½" H x 23" W x 11¾" D. Precut and predrilled for quick assembly.

Model SS-1

Shpg. Wt. 30 Lbs. **$39.95**

HEATHKIT RANGE EXTENDING HIGH FIDELITY SPEAKER SYSTEM KIT

Designed especially for use with SS-1 "Basic" system. Contains 15" woofer and compression-type super tweeter. Extends basic unit to 35—16,000 CPS, ± 5 db. Impedance 16 ohms. Measures 29" H x 23" W x 17½" D, and is constructed of ¾" veneer-surfaced plywood.

Model SS-1B

Shpg. Wt. 80 lbs. **$99.95**

HEATHKIT A-9C HIGH FIDELITY AMPLIFIER KIT

This model incorporates its own power supply and preamplifier. Plenty of power with full 20 watt rating. Four separate inputs, selected by panel-mounted switch, and separate bass and treble controls. Ideal for home or PA applications. Output transformer tapped at 4, 8, 16 or 500 ohms. Response within ± 1 db from 20 to 20,000 CPS.

Model A-9C

Shpg. Wt. 23 lbs. **$35.50**

HEATHKIT HIGH FIDELITY FM TUNER KIT

Now you can have full-fidelity FM performance from 88 to 108 mc at reasonable cost. Features temperature-compensated oscillator—built in power supply, and beautiful cabinet. Components prealigned at factory!

Model FM-3A

Shpg. Wt. 8 lbs. **$25.95** *(with cabinet)*

HEATHKIT BROADBAND AM TUNER KIT

Tunes standard AM band from 550 to 1600 kc with fine sensitivity and broadband characteristics. Features include built-in power supply and low-distortion detector. All RF circuits prealigned for simplified construction.

Model BC-1A

Shpg. Wt. 8 lbs. **$25.95** *(with cabinet)*

HEATHKIT "MASTER CONTROL" HI-FI PREAMPLIFIER KIT

Provides extra amplification, selection of inputs, volume and tone controls, and turnover and rolloff controls, for Williamson-type amplifiers. Beautiful satin-gold enamel cabinet. Derives operating power from amplifier.

Model WA-P2

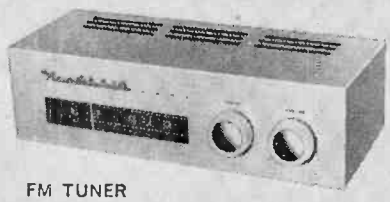
Shpg. Wt. 7 lbs. **$19.75** *(with cabinet)*

HEATHKIT 25-WATT HIGH FIDELITY AMPLIFIER KIT

Outstanding 25-watt Williamson-type amplifier employs KT66 tubes and Peerless output transformer, tapped at 4, 8, and 16 ohms. A fine amplifier for the "deluxe" system. WA-P2 preamplifier required for operation. Express only.

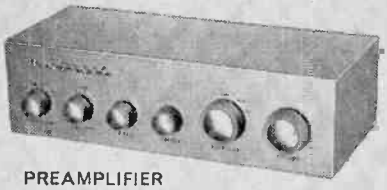
Model W-5M

Shpg. Wt. 31 lbs. **$59.75**



FM TUNER

AM TUNER



PREAMPLIFIER

W-5M 25-WATT AMPLIFIER

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HEATHKIT FUEL VAPOR DETECTOR KIT

The FD-1 is a safety device to detect fuel vapor in the engine compartment or other sections of your boat. The detector unit mounts in the area to be checked, and the indicating meter and controls mount on the control panel. Will operate intermittently or continuously, and indicates dangers of fire or explosion to protect your boat and its passengers. Models FD-1-6 (6 volts DC) and FD-1-12 (12 volts DC) operate from boat batteries. Kit even includes spare detector unit. Shpg. Wt. 4 lbs.

6-volt FD-1-6, 12-vt. FD-1-12

$35.95 each

HEATHKIT RF POWER METER KIT

This handy device measures the RF field in the vicinity of a transmitter, whether it be marine, mobile, fixed, etc. Requires no electricity, nor direct connection to the transmitter. Provides a continuing indication of transmitter operation. Merely place it in proximity to the transmitter antenna and it will produce a reading on its 200 ua panel meter when the transmitter is in use. Operates with any transmitter between 100 kc and 250 mc. Includes a sensitivity control for meter. Shpg. Wt. 2 lbs.

Model PM-1

$14.95

HEATHKIT TRANSISTOR RADIO DIRECTION-FINDER KIT

The Heathkit Transistor Radio Direction-Finder model DF-1 is a self-contained, self-powered, 6-transistor super heterodyne broadcast radio receiver incorporating a directional loop antenna, indicating meter, and integral speaker. It is designed to serve primarily as an aid to navigation when out of sight of familiar landmarks. It can be used not only aboard yachts, fishing craft, tugs, and other vessels which navigate either out of sight of land or at night, but also for the hunter, hiker, camper, fisherman, aviator, etc. It is powered by a 9-volt battery. (A spare battery is also included with the kit.) The frequency range covers the broadcast band from 540 to 1600 kc and will double as a portable radio. A directional high-Q ferrite antenna is incorporated which is rotated from the front panel to obtain a fix on a station and a 1 ma meter serves as the null and tuning indicator. The controls consist of: tuning, volume and power (on-off), sensitivity, heading indicator (compass rose) and bearing indicator (antenna index). Overall dimensions are 7½" W x 5⅞" H x 5⅜" D. Supplied with slip-in-place mounting brackets, which allow easy removal from ship bulkheads or other similar places. Shpg. Wt. 4 lbs.

Model DF-1

$49.95

(Available after November 15)

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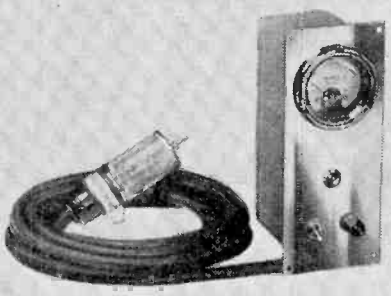
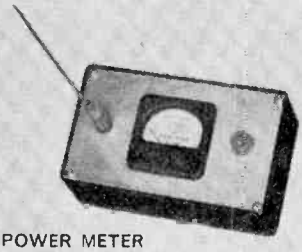
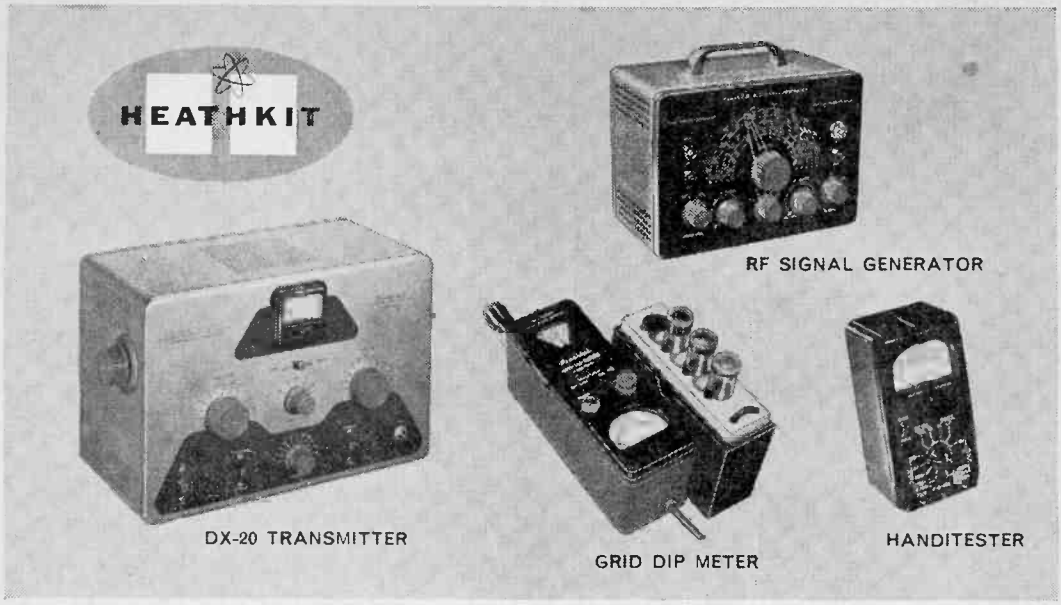


FUEL VAPOR DETECTOR



POWER METER

RADIO DIRECTION-FINDER



HEATHKIT DX-20 CW TRANSMITTER KIT

This Heathkit straight-CW transmitter is one of the most efficient rigs available today. It is ideal for the novice, and even for the advanced-class CW operator. It employs a 6DQ6A tube in the 50-watt final amplifier circuit, a 6CL6 oscillator and a 5U4GB rectifier. Single-knob band switching covers 80, 40, 20, 15, 11, and 10 meters. The DX-20 is designed for crystal excitation, but may be excited by an external VFO. Pi network output circuit is employed to match antenna impedances between 50 and 1000 ohms.

Model DX-20

Shpg. Wt. 18 lbs. **$35.95**

HEATHKIT GRID DIP METER KIT

An instrument of many uses for the ham, experimenter, or service technician. Useful in locating parasitics, neutralizing, determining resonant frequencies, etc. Covers 2 mc to 250 mc with prewound coils. Use to beat against unknown frequencies, or as absorption-type wave meter.

Model GD-1B

Shpg. Wt. 4 lbs. **$19.95**

HEATHKIT RF SIGNAL GENERATOR KIT

Produces rf signals from 160 kc to 110 mc on fundamentals on five bands, and covers 110 mc to 220 mc on calibrated harmonics. Output may be pure rf, rf modulated at 400 CPS, or audio at 400 CPS. Prealigned coils eliminate the need for calibration after completion.

Model SG-8

Shpg. Wt. 8 lbs. **$19.50**

HEATHKIT HANDITESTER KIT

Measures AC or DC voltage at 0—10, 30, 300, 1000 and 5000 volts. Direct current ranges are 0-10 ma and 0-100 ma. Ohmmeter ranges are 0-3000 and 0-300,000 ohms. Sensitivity is 1000 ohms/volt. Features small size and rugged construction in sleek black bakelite case.

Model M-1

Shpg. Wt. 3 lbs. **$14.50**

HEATHKIT ETCHED-CIRCUIT VTVM KIT

Sensitivity and reliability are combined in the V-7A. It features 1% precision resistors, large 4½" panel meter, and etched circuit board. AC (RMS) and DC voltage ranges are 0—1.5, 5, 15, 50, 150, 500, and 1500. Peak-to-peak AC ranges are 0—4, 14, 40, 140, 400, 1400 and 4000 volts. X1, X10, X100, X10k, X100k, and X1 megohm.

Model V-7A

Shpg. Wt. 7 lbs. **$24.50**

HEATHKIT ALL-BAND RADIO KIT

This receiver covers 550 kc to 30 mc in four bands, and is ideal for the short wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image projection. Amateur bands clearly marked on the illuminated dial scale. Employs transformer-type power supply—electrical band spread—antenna trimmer—separate rf and af gain controls—noise limiter and headphone jack. Built-in BFO for CW reception. Cabinet, as shown, available separately.

Model AR-3

Shpg. Wt. 12 lbs. **$29.95**

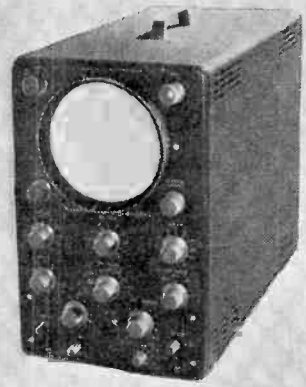
(less cabinet)

HEATHKIT "GENERAL PURPOSE" 5" OSCILLOSCOPE KIT

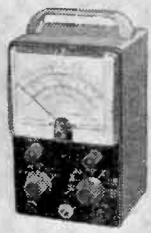
This oscilloscope sells for less than the previous model, yet incorporates features for improved performance. The OM-2 provides wider vertical frequency response, extended sweep generator coverage, and increased stability. Vertical channel is essentially flat to over 1 mc. Sweep generator functions from 20 CPS to over 150 kc. Amplifiers are push-pull, and modern etched circuits are employed in critical parts of the design. A 5BP1 cathode ray tube is used. The scope features external or internal sweep and sync, 1-volt peak-to-peak reference voltage, three-position step attenuated input, and many other "extras."

Model OM-2

Shpg. Wt. 21 lbs. **$42.50**



"GENERAL-PURPOSE" SCOPE



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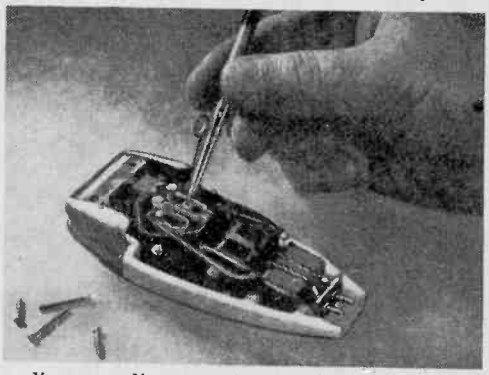
Some smaller mechanisms, such as the motor of an electric shaver, require only a tiny amount of oil. Too much can even stop the motor until it's cleaned away. An



ordinary ruling pen is excellent for applying the fraction of a drop of oil required as the oil will seep slowly from the pen instead of dropping in larger amounts from an oil can. —*K.M.*

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Here is an easy, inexpensive way to make your own QSL cards. The only materials you'll need are a sharp pencil, some plain two-cent post cards, and four alu-

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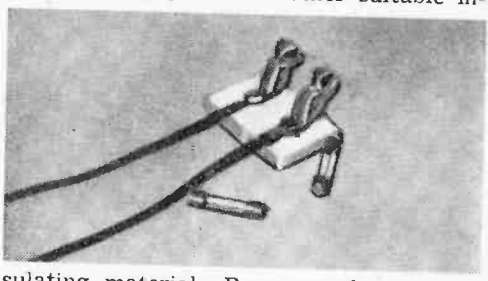
blank side of a post card, then trace around each one several times. Be sure to blow away the residue of pencil dust before you lift the letter from the card or you may leave a smudge. After the tracing is done, either type, print, or write your QTH, signal report, etc., in the proper places. —*R.A.B.*

TEST CLIPS MAKE FUSE HOLDER

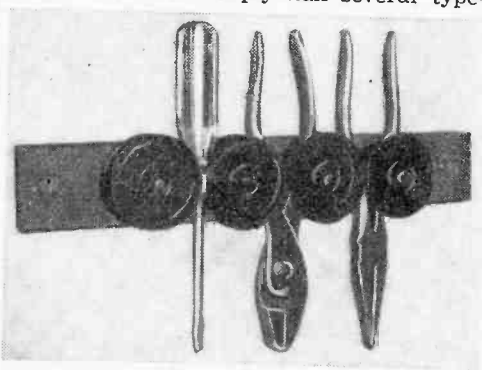
Need a fuse holder for experimental circuits or other applications? Make one to order simply by mounting two test clips on a base of plastic or other suitable in-



sulating material. Remove the screws from the clips, drill the holes larger, and secure the clips to the base with mounting screws. Connect wires to the screws and place the fuse in the jaws of the clips as shown. —*J.A.C.*

EASILY MADE TOOL RACK

Want a rack for your hand tools that's easy to make? Simply nail several type-



writer ribbon spools side by side to your bench or a piece of wood as shown in the photograph. Space the spools to hold the tools. The rack can be made to accommodate pliers, screwdrivers, nut drivers, files, and most other hand tools. —*J.A.C.*

DOUBLE-DECK TRANSISTOR CHASSIS

Using a perforated Bakelite circuit board or two and a few *6-32* screws and nuts, you can make up an experimental transistor chassis in a matter of minutes. Machine screws are used as legs and spacers and are held in place with a nut on each side of the circuit board. Since the boards

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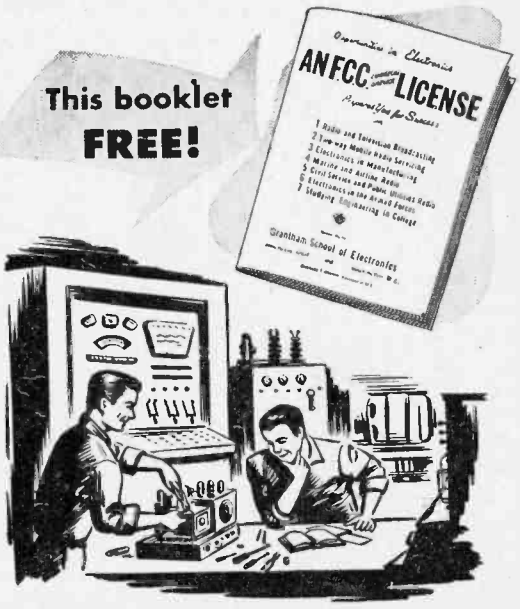

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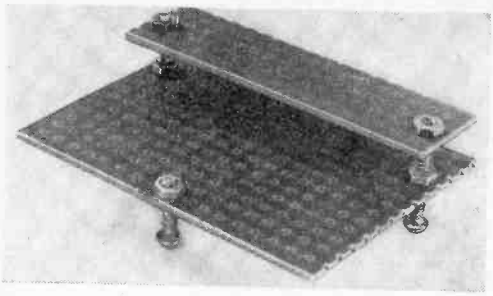
have small holes punched at 3/16" intervals, a leg or spacer can be accurately installed



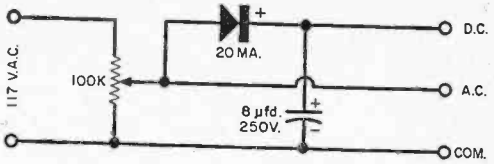
by using the punched holes as guides for your *6-32* drill.

A double-decker, as shown, or even a triple- or quadruple-decker may be stacked on lengths of *6-32* threaded brass rod. By running nuts up or down on the rod threads, you can space the boards at any distance necessary to obtain clearance for components. These boards are available in several sizes from Lafayette Radio.—*F.H.T.*

VOLTAGE CALIBRATION SOURCE

A convenient source of low-current test voltages for calibrating meters can be constructed for less than three dollars. Variable from near zero up to about 130 volts d.c. and line voltage on a.c., you will find frequent use for this little rig if kit building is your hobby. The usual precautions when dealing with direct-line-operated devices should be observed.

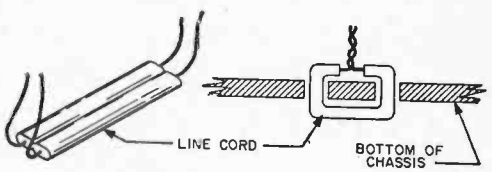
To use this unit, the meter whose calibration is to be checked is connected between "d.c." and "common" or "a.c." and "common" and a meter whose calibration



is known to be accurate is connected directly across the leads of the meter which is being tested. —*H.G.*

SIMPLE RUBBER CHASSIS FEET

Rubber feet for homemade chassis can be made from rubber lamp cord. Drill holes

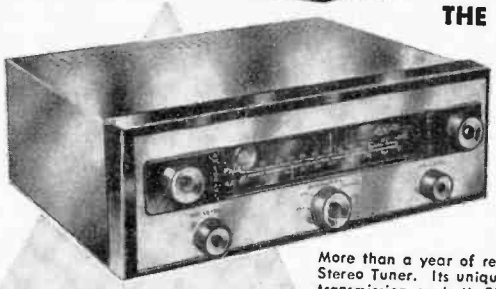


in the chassis bottom about an inch apart and pull the ends of the wire through. For

(*Continued on page* 108)

New! YEARS AHEAD! Lafayette STEREO TUNER KIT

THE MOST FLEXIBLE TUNER EVER DESIGNED



Use it as a Binaural-Stereophonic FM-AM tuner
Use it as a Dual-Monaural FM-AM tuner
Use it as a straight Monaural FM or AM tuner

- Separately Tuned FM and AM Sections
- Armstrong Circuit with FM/AFC and AFC Defeat
- 12 Tuned Circuits
- Dual Cathode Follower Output

KT-500 74.50 IN KIT FORM

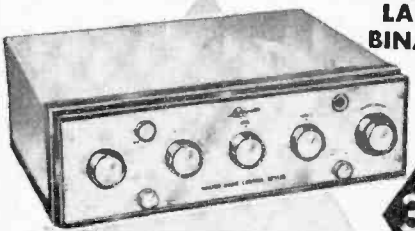
More than a year of research, planning and engineering went into the making of the Lafayette Stereo Tuner. Its unique flexibility permits the reception of binaural broadcasting (simultaneous transmission on both FM and AM), the independent operation of both the FM and AM sections at the same time, and the ordinary reception of either FM or AM. The AM and FM sections are separately tuned, each with a separate 3-gang tuning condenser, separate flywheel tuning and separate volume control for proper balancing when used for binaural programs. Simplified accurate knife-edge tuning is provided by magic eye which operates independently on FM and AM. Automatic frequency control "locks in" FM signal permanently. Aside from its unique flexibility, this is, above all else, a quality high-fidelity tuner incorporating features found exclusively in the highest priced tuners.

The 5 controls of the KT-500 are FM Volume, AM Volume, FM Tuning, AM Tuning and 5-position Function Selector Switch. Tastefully styled with gold-brass escutcheon having dark maroon background plus matching moroon knobs with gold inserts. The Lafayette Stereo Tuner was designed with the builder in mind. Two separate printed circuit boards moke construction and wiring simple, even for such a complex unit. Complete kit includes all parts and metal cover, a step-by-step instruction manual, schematic and pictorial diagrams. Size is 13¾" W x 10⅜" D x 4½" H. Shpg. wt., 18 lbs.

The new Lafayette Model KT-500 Stereo FM-AM Tuner is a companion piece to the Models KT-300 Audio Control Center Kit and KT-400 70-watt Basic Amplifier Kit and the "Triumvirate" of these 3 units form the heart of a top quality stereo hi-fi system.

KT-500.....Net **74.50**

LAFAYETTE MASTER AUDIO CONTROL CENTER with BINAURAL CHANNEL AND DUAL VOLUME CONTROL.



- Self-Powered • DC On All Filaments
- 24 Positions of Equalization
- Tape Head Input, High Impedance
- Dual Cathode Follower Output Stages

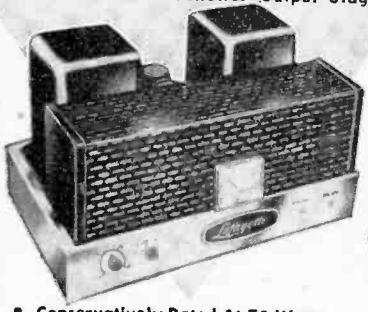
KT-300 39.50 IN KIT FORM

This is not only the finest hi-fi preamp charocterized by unmatched features, but it hos been functionolly designed to keep pace with the conversion of your present hi-fi system to binaural (Stereophonic) sound. Incorporates an extra channel and duol volume control for binaural reproduction. Features include DC on all tube filaments, negative feedback in every stage, dual cathode follower output stages and latest printed circuit construction. Less than 0.09% IM distortion and less than 0.07 harmonic distortion at 1V. Hum and noise level better than 80 db below 3V. Uniformly flat frequency response over entire audible spectrum. 7 inputs for every type of phono, tuner or tape. Tasteful styling, brilliantly executed. Size 12¾" x 9⅛" x 3¾". Shpg. wt., 10½ lbs.

KT-300—Lafayette Master Audio Control Kit Complete with cage and detailed assembly instructions. .....Net **39.50**

LT-30—Same as above completely wired and tested with cage and instruction manual. .....Net **59.50**

DELUXE 70 WATT BASIC AMPLIFIER



- Conservatively Rated At 70 Watts
- Metered Balance And Bias Adjust Controls
- Inverse Feedback • Variable Damping
- Available In Kit And Wired Form

KT-400 69.50 IN KIT FORM

Here's ultra-stability in a 70 watt basic power amplifier employing highest quality components conservatively rated to insure performance and long life. Features matched pair KT 88's and wide range linear Chicago output transformer, variable damping control, meter for bias and balance and gold finish chassis. Frequency response 10-100,000 cps ± 1db. Hum and noise 90db below full output. IM distortion less than 1½% at 70 watts, less than 0.3% below 30 watts. Harmonic distortion less than 2% at 70 watts from 20 to 20,000 cps ± 1db. Output impedance 4, 8 and 16 ohms. Handsome decorative cage perforated for proper ventilation. Size 14½ x 10 x 7⅜" including cage and knobs. Shpg. wt., 40 lbs.

KT-400—Lafayette 70 watt Deluxe Basic Amplifier Kit complete with cage and detailed assembly instructions. .....Net **69.50**

LA-70—Same as above completely wired and tested with cage and instruction manual. .....Net **94.50**

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Less case and battery

- **100% SUBMINIATURE PARTS—NO COMPROMISES!**
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Lafayette is proud to present its 6 Transistor Superhet Receiver Kit KT-119. This kit represents the optimum in sensitivity, selectivity and stability. You'll be amazed at its superior commercial quality! You'll be elated with its surprising performance! The circuit uses 3 high frequency RF Transistors, 3 dependable audio Transistors and Crystal Diode and features a specially matched set of 3 I.F.'s, Oscillator, High-Q Loop, Class B Push-Pull Audio Amplification, and Transformer Coupling in audio and output stages. Special care has been taken in the design for exact impedance matching throughout to effect maximum transfer of power. Has efficient 2¾" speaker, and earphone jack for private listening. Complete with all parts, transistors, pre-punched chassis, and easy-to follow step-by-step instructions. 6" x 3½" x 1½". Shpg. wt., 3 lbs.

KT-119—Complete Kit—Less Case and Battery ..... Net 29.95
MS-339—Sturdy, attractive brown leather case with carrying strap for KT-119 Shpg. wt., 1 lb. ..... Net 2.95
MS-279—Sensitive matching earphone ..... Net 2.39

3 TRANSISTOR SUPERHET POCKET RADIO KIT

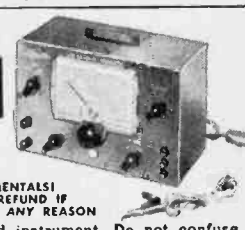
- A TRUE POCKET SUPERHET RECEIVER-NO EXTERNAL ANTENNA!
- NO EXTERNAL GROUND!

A remarkable sensitive, super-selective pocket superhet receiver with astonishing performance over the complete broadcast band. Uses 2 high-frequency and one audio transistor plus efficient diode detector and features 2 specially matched IF transformers for maximum power transfer. The components are housed in a professional looking beige plastic case. The receiver's appearance enhanced by attractive maroon and silver station dial. Sensitive built-in ferrite antenna eliminates need for external antenna. A designer's dream in a true pocket superhet receiver! Complete with all parts, transistors battery, case, dial and easy to follow step-by-step instructions. 4⅛" x 2⅝" x 1-1/16". Shpg. wt., 1 lb.

KT-116—Complete Kit, less earphone ..... Net 16.95
MS-260—Super Power Dynamic Earphone ..... Net 3.95

LAFAYETTE SIGNAL GENERATOR

COMPLETELY WIRED AND TESTED! ACCURACY AND QUALITY GUARANTEED!



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- FREQUENCY 120KC to 260MC!
- 120KC to 120MC ON FUNDAMENTALS!
- 30 DAY TRIAL PERIOD! FULL REFUND IF YOU ARE NOT SATISFIED FOR ANY REASON

Completely wired and tested instrument. Do not confuse with kits sold in the same price range. Has the quality and accuracy of instruments selling for 3 to 4 times as much. Six overlapping ranges — 120KC to 320KC, 320KC to 1000KC, 1MC to 3.2MC, 3.2MC to 11MC, 11MC to 38MC, 37MC to 130MC — all on fundamentals — calibrated harmonics from 120MC to 260MC. Switch between internal modulation at 400 cps or any external source at other frequencies. 400 cps signal can be used separately. Outputs are unmodulated RF, modulated RF and 400 cps audio. RF output is in excess of 100,000 micro volts. Jacks are provided for high or low RF output.

Highly stable special circuit design. Fine adjust RF control. AF output 2-3 volts, input 4 volts, across 1 megohm. 6 inch etched dial plate — protected by clear plastic bezel. Common AF terminals for EXT-MOD input and INT-AF output eliminates need for special connectors. Gray metal case — carrying handle — complete with leads, line cord and plug. For 105-126V, 60-60 cycle A.C. Shpg. wt., 8 lbs.

LSG-10 — Signal Generator 22.50

NEW POCKET AC-DC VOM MULTITESTER 2,000 ohm per Volt on AC & DC

- **Completely wired — Not a kit**

Accurate VOM with a sensitivity of 2000 ohms per volt on both AC and DC. Single selector switch. 3" 160 amp. meter. Scales: DC Volts: 0-10-50-500-1000; AC Volts: 0-10-50-500-1000; Ohms: 0-10K, 0-1 Meg; DC Current: 500 ua and 500 ma; Decibel: —20 to +22, +20 to 36; Capacity: 250 mmf to .2 mfd and .005 to 1 mfd. Heavy plastic panel, metal bottom. 4¼" x 3½" x 1⅝". With batteries and test leads. Shpg. wt. 4 lbs.

RW-27A 8.95

20,000 OHM PER VOLT MULTITESTER SEMI KIT

- 20,000 OHMS PER VOLT DC—5,000 OHMS PER VOLT AC
- 40 MICROAMPERE 3" D'ARSONVAL METER MOVEMENT
- HIGH INPUT RESISTANCE ON ALL DC AND AC RANGES

A new kind of kit—the difficult work is already done—you wire in only a few multipliers and mount the battery holder to complete the unit. A fine high sensitivity (20,000 ohms per volt DC —5000 ohms per volt AC) instrument employing a 3" 40 microamp movement. Has 4 DC voltage, 4 AC voltage, 2 DC current, 3 resistance and 2 db ranges. Complete with test leads and detailed instructions. Size 3⅜" x 4⅝" x 1⅝". Shpg. wt., 3 lbs.

TK-20—Kit ..... Net 11.95

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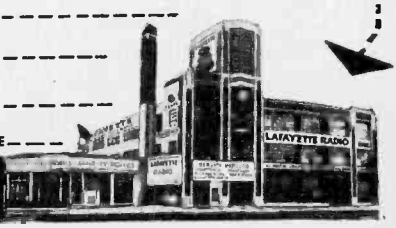


CUT OUT AND MAIL TODAY!

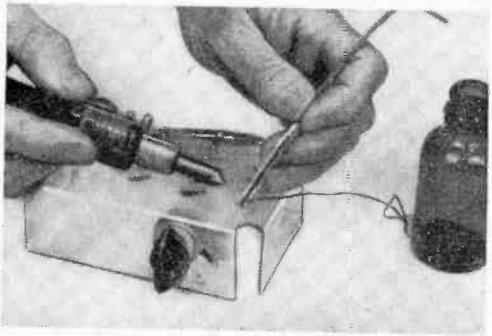
Tips

(*Continued from page* 104)

wooden bases, the wire may be fastened into a loop; for sheet metal, it may be soldered in place as shown. —*H.L.*

COOL IT WITH A PIPE CLEANER

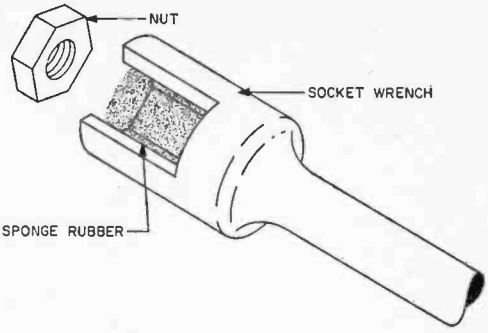
Keep one end of a pipe cleaner in a small bottle of water or carbon tetrachloride on



your test bench. The application of the wet end of the cleaner to newly soldered connections will minimize the possibility of heat damage to the components. You can follow up by using the dry end of the cleaner as a swab. —*I.C.C.*

IMPROVED SOCKET WRENCH

Starting nuts on bolts that point downward is difficult with some socket wrenches because the nut tends to slip too far down in the socket. A simple solution to the problem is to insert bits of sponge rubber in the



socket to keep the nut near the edge. The soft material can be easily removed when necessary. —*H.L.*

TOOL SHOP ON CLOSET WALL

Many of the pegboards sold at variety and hardware stores will accommodate sturdy hooks that come in an assortment of sizes. By spacing these hooks to support your most frequently used hand tools, a compact "shop" can be installed in any free wall space. Soldering irons, cutters, test probes, screwdrivers, etc., will all rest safely and out of the way. —*P.H.*

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(FAMOUS KIT KING® DOLLARBUYS IN NEW "POLY-PAKS")

AT THIS SPECIAL INTRODUCTORY PRICE

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4 OUTPUT TRANSFORMERS, 50L6, etc. 2 lbs.
15-PC. TWIST DRILL SET. Wt. ½ lb.
WORLD'S SMALLEST RADIO KIT
50 TERMINAL STRIPS AND POSTS. Wt. 1 lb.
60 COILS & CHOKES. Wt. 2 lbs.
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30 MOLDED CONDENSERS. Wt. 1 lb.
125 CARBON RESISTORS. Wt. 2 lbs.
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7 25-FT. ROLLS HOOKUP WIRE. 1 lb.
70 INSULATED RESISTORS. Wt. 1 lb.
2 SUB-MINIATURE 12V SOLENOIDS.
60 TUBULAR CONDENSERS. Wt. 2 lbs.
30 TUBE SOCKETS. Wt. 1 lb.
40 SUBMINIATURE RESISTORS.
8-PC. NUTDRIVER SET. Wt. 1 lb.
40 PRECISION RESISTORS.
100 RADIO PARTS, ASSTD. 1 lb.
30 DISC CONDENSERS.
50 PLUGS AND RECEPTACLES. 1 lb.
70 MICA CONDENSERS. Wt. 1 lb.
30 POWER RESISTORS. Wt. 2 lbs.
15 VOLUME CONTROLS. Wt. 1 lb.
10 "POLY" BOXES.
50 ASSTD. KNOBS. Wt. 2 lbs.
10 ELECTROLYTICS. Wt. 2 lbs.
15 ROTARY SWITCHES. Wt. 3 lbs.
100 CERAMIC CONDENSERS. 2 lbs.
115VAC 60 CYCLE FAN MOTOR.
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SIGMA 10000-OHM RELAY—SPDT.
2 MIKE TRANSFORMERS.
15 ASSTD. NEON BULBS.
5 PILOT LITE ASSEMBLIES.
PIC TUBE BRITENER—parallel/series.
6 TRANSISTOR SOCKETS w/ mtg. plate.
7 SCREWDRIVERS W/RACK.
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WIRE STRIPPER & CUTTER.
MINIMETER—0-6 amp. AC, 1¼" dia.
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6AT6	.45	12AT7	.77
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6AV6	.45	12AV7	.79
6AX4	.72	12AX7	.69
6BA6	.59	12BA6	.54
6BC5	.59	12BE6	.55
6BE6	.57	12BH7	.72
6BG6	1.49	12SA7	.69
6BK7	.87	12SK7	.59
6BQ6	1.13	12SQ7	.59
6BQ7A	.98	25BQ6	1.10
6C4	.39	25L6	.55
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Battery 94¢ extra.

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Fully wired. Reg. $5. Sep. vol., tone controls. Lowest price ever! **$2.99**
Tubes $1.91 extra.

HI-FI TWEETER

Metal cased, cone. Freq. response, 3000 to 16000 cps. Max. rating 20W. 2⅞ x 2½" w/flat surface mtg. bracket. Elsewhere $5.95 to $12. Two types: 8 ohm or 16 ohm imp. .....Each **$3.99**

HEARING-AID PHONES with cords

Crystal $1.39
Dynamic (5,000 ohm) 1.69

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Scoop! Lightweight, controlled heat for transistor and printed circuit work... **$4.99**

12" HI-FI PM SPEAKER

50 to 10,000 cps. Use with tweeter as nifty co-ax. 3-4 ohm v.c. Only... **$4.44**

POCKET MULTI-TESTER

3½ x 2 x 1½" bakelite case. 100 ohms/V. Zero adj. 0/15/150/1000 AC & DC V; 0/150 ma; 0/100,000 ohms. W/test leads & battery . . . in orig. pack. $13 value!. **$6.99**

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60 to 10,000 cps. Sleek, lightwt. aluminum; 4⅝ x 1¼" dia. ON-OFF sw., cable, conn. Ship. wt. 2 lbs. Reg. $14.95.... **$4.88**

SUPER-SENSITIVE RELAY

Needs only 100,500 microamps. 0.5 VDC. Adj. SPDT contacts. 4000 ohm coil. Reg. $10.....Only **$2.98**

3-SPEED PICKUP

With turnover cartridge, 2 sapphire needles. High output. HI-FI type. Reg. $8. Only **$2.99**

New! ¼" Electric Drill

115 VAC 60 cycles, w/cord & plug. Wt. 3 lbs. Reg. $17 ..... **$9.99**

TRANSISTOR PORTABLE RADIO KIT with speaker

No experience necessary! Famous make, with powerful HI-Q ferrite antenna, diode det., 2 transistor ampl. stages, 4" spkr. 7½ x 5 x 2½" styrene case. For broadcast band. Instructions, diagrams, pictorials, all parts **$12.94**
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Generates greater energy than famed B2M. 2½ x 1¾ x ½" plug-in type; in handy case **$2.88**

FAMOUS MANSFIELD 8mm. MOVIE PROJECTOR

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WITH INDEX STAND. 1/16 to ½" by 64ths. Full standard length. Save $25! Wt. 4 lbs. **$5.99**

FREE! 12-PAGE BARGAIN FLYER!

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ORDER BY 'BLACK TYPE' HEADLINES i.e. "one HI-FI TWEETER, 8 ohm, $3.99"

State price with each item. Send check or MO, including sufficient postage; excess returned. C.O.D. orders, 25% down. Rated, net 30 days. (Canada postage: 45¢ 1st lb.; 28¢ ea. addl. lb.)
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LEKTRON

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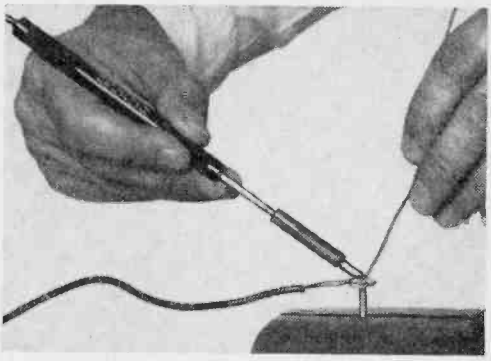
TOOLS and GADGETS

HIGH-TEMPERATURE SOLDERING IRON

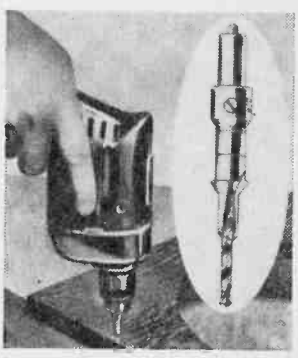
Need a light soldering iron for "hot" work? The Oryx Model 25 weighs less than one ounce, yet generates enough heat to



solder heavy copper wire to a galvanized nail despite heat dissipation through vise. (Imported from England by *Oryx Company*, 9015 Wilshire Blvd., Beverly Hills, Calif.)

HANDY "SCREW-DRILL"

Quick, accurate screwdriving is a cinch with an Arco "Screw-Drill." All in one operation, one of these handy accessories drills: pilot hole for screw threads, shank clearance of screw, countersink for screw head, and counterbore for plastic wood or plugs. The ¼" shank will fit electric drills, drill presses, etc.



These "screw-drills" come in a set of four sizes for wood screws Nos. 6, 8, 10 and 12. Price, $3.69, postpaid. (*Arrow Metal Products Co.*, 421 W. 203 St., New York, N. Y.)

TUBE AND CONTINUITY CHECKER

All radio and TV tubes can be simply checked for burned-out filament elements with the "TEST-A-TUBE" checker—even the picture tube. If the lamp goes on when you insert the tube in the checker, the filament is good; if the lamp does not go on, the filament is bad and the tube should be

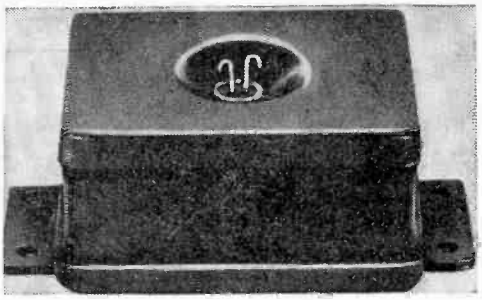
replaced. Battery power makes this unit safe to use. Test lamp and battery are built in. Detailed instructions are furnished. List price, $5.95. (*Rue Products,* 1628 Venice Blvd., Venice, Calif.)

SHORTENED TEST-POINT JACKS

There are now two shortened versions of the SKT-10 test-point jack for shallow assemblies. Types SKT-2BC and SKT-5BC take 0.080"-and 0.090"-diameter pins or plugs respectively. Machined contact members provide a firm grip for the inserted pin or plug in each case, while the Teflon body provides good insulation. Both types are available in a choice of the eight RETMA code colors. (*Sealectro Corporation,* 610 Fayette Ave., Mamaroneck, N. Y.)

WATERTIGHT BUZZERS

For use under severe exposure to the elements, the new Auth watertight buzzers are totally enclosed units and can also be supplied hermetically sealed. They are available in a contact-type mechanism for 6 to 48 volts a.c. or d.c.; in a contactless model for a.c. service in the 8 to 48 volt range. Since the mechanism is totally



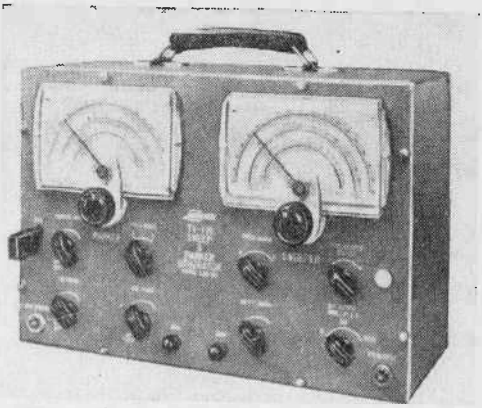
enclosed, pitch is non-adjustable. These buzzers measure 3¼" x 2⅛" x 1 5/16". External solder-type terminals are provided for wiring connections. (*Auth Electric Company, Inc.,* 34-20 45th St., Long Island City 1, N. Y.)

MARKER-SWEEP SIGNAL GENERATOR

An all-purpose signal generator for alignment of TV and FM receivers, the Model LSG-50 provides a range of *sweep* frequencies of 3 mc. to 260 mc. in two bands and marker frequencies of 3 mc. to 225 mc. in four overlapping bands. The highly linear

and shielded electromagnetic sweep system provides a continuously variable sweep width up to more than 12 mc. with built-in variable retrace blanking.

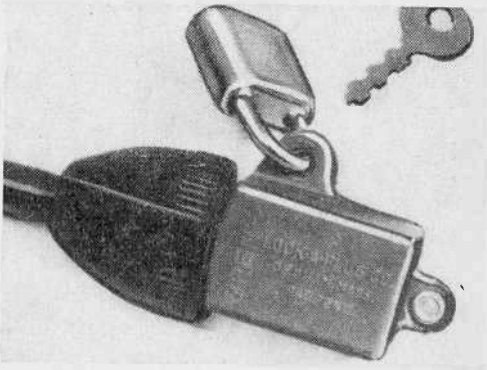
The LSG-50 is supplied with a 75-ohm



output cable, external marker input cable, and a 4.5-mc. crystal. Its 9" x 13½" x 6" metal cabinet is finished in gray wrinkle, and has a convenient carrying handle. Net, $79.50. (*Lafayette Radio,* 165-08 Liberty Ave., Jamaica 33, N. Y.)

"PLUG GUARD"

"Plug Guard" is a small plastic box which snaps securely over the electric plug on your appliance cord. Held closed by a miniature padlock, this little device makes it



impossible for unauthorized people to operate your appliance without your knowledge and permission. Price, $1.00 postpaid. (*Lock-A-Plug Company,* Box 85, Dept. J-9, Dedham, Mass.)

TRIPLE-PURPOSE CONVERTER

If you have a power failure, the MASCO CV-612 converter attached to any 6- or 12-volt storage battery will operate electric lights or radio receivers. In addition, it will convert any straight a.c. amplifier with a power output up to 25 watts into a mobile job. It connects directly to the amplifier or similar equipment, and is capable of main-

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taining a constant 117-volt, 130-watt output, or 150 watts intermittently.

Weighing 18 pounds, the CV-612 measures 7"x8½"x8½". It is completely portable and equipped with carrying handle. List price, $105.00—add 5% west of the Rockies. (*Mark Simpson Mfg. Co., Inc.*, 32-28 49th St., Long Island City 3, N. Y.)

SPEAKER AND ANTENNA SELECTORS

Two three-way switches now available are the Model DS77 HI-3 speaker selector and the Model DA88 three-way antenna selector, each of which comes in a compact all-metal case. Designed for temporary or permanent speaker coupling and comparison checks, the speaker selector can be used in connection with any audio output for switching to as many as three speakers at remote points.

The antenna selector is for use where more than one and up to three individual antennas are to be coupled to one receiver Up to three lead-in wires (either 300 or 75 ohms) can be connected to the selector, then one set of leads from the selector to the TV, FM, short-wave or any multi-band receiver. (*Dynamic Electronics-New York, Inc.*, 73-39 Woodhaven Blvd., Forest Hills, Long Island, N. Y.) —30—

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Conelrad Your Home

(*Continued from page* 58)

and twisting the wire at the spot where it leaves the form to make a tap. Rewind the wire on the coil after the tap has been made. Remove the insulation from the tap.

The electronic part of the unit consists of the tuned circuit and the two transistors. The antenna is connected through an isolation capacitor, value of which is not critical. A value of 0.001 μfd. was used by the author with a ten-foot length of wire. A longer antenna will be required if the nearest station is distant. As with any antenna, the main thing is to locate it in a position so that it will pick up maximum r.f. signal for the job.

Use a CK722 for the detector transistor. Or, if more sensitivity is desired, use a CK768. Both are of the *p-n-p* type. The collector of this transistor is connected directly to the base of the second transistor, a 2N170 *n-p-n* type.

The relay is a Sigma 1000-ohm type with single-pole double-throw contacts. Only the back contacts, which are normally closed, are used in this hookup. The spring tension is adjusted so that a current of about 6 ma. will pull in the armature and open these contacts.

Any interruption of the current will

HOW IT WORKS

The tuned circuit, *L1/C2*, is set to an AM broadcast station whose radio-frequency carrier is strong enough to change the bias on *TR2*. Current is drawn through relay *RL1* and keeps the armature pulled in to open the relay contacts. When the broadcast carrier is interrupted, the contacts close, completing the circuit through the buzzer.

allow the contacts to return to the normally closed position. When this happens, the battery furnishes power to the buzzer and it warns that the pre-tuned broadcast carrier wave is off the air.

The buzzer can be made from another relay, by connecting its back contacts in a circuit that makes and breaks when power is supplied. During testing of this alarm, it was noted that, in addition to the noise produced by the buzzer itself, there was enough static radiated from the buzzer to make a noise in a nearby receiver. Of course, this happens only when the alarm is sounding and not during the standby period. This noise, caused by the contacts of the buzzer, would be helpful if the operator were wearing headphones while using his receiver.

Installation. After the unit is wired and ready for operation, connect it to an antenna ten or more feet long and a good ground. Leave the buzzer disconnected. Plug in earphones and adjust the slug in coil *L1* to the loudest local station. If the signal is sufficiently strong, the relay armature should pull in. Remove the phone plug and insert in its place a plug having both terminals connected together by a piece of wire. The buzzer can now be connected, and the setup is complete. To test, disconnect the antenna and see if the buzzer operates.

Opening of the battery circuit to both the buzzer and the transistors is taken care of by removing the shorting plug from *J1*. Just leave the plug out when the unit is not in use. —30—

EDITOR'S NOTE: The current of 6 ma. reported by the author of the above article amazed us. Upon investigation, however, we concluded that his location must be fairly close to the broadcast station, perhaps within a mile of the antenna. One of our editors built a duplicate alarm unit and tried it out at his home about 35 miles from the high-power stations around New York City. None of these stations provided enough signal strength to operate the relay specified. An 8000-ohm relay was substituted with no better results. Using this more sensitive relay, however, gave promise of proper operation from a 250-watt station ten miles away. Using an antenna length of 150 feet, the alarm worked perfectly. We suggest plugging in a 0-5 ma. meter, if one is available, to determine whether the current output is sufficient at your location and with your antenna to actuate the relay properly.

Oscilloscope Traces

(*Continued from page* 61)

cathode, a pattern will be developed as shown in Fig. 3. The amount of dots indicates the ratio of the high-frequency signal to the lower one. For example, 25 dots would mean that the high frequency is 25 times the lower frequency.

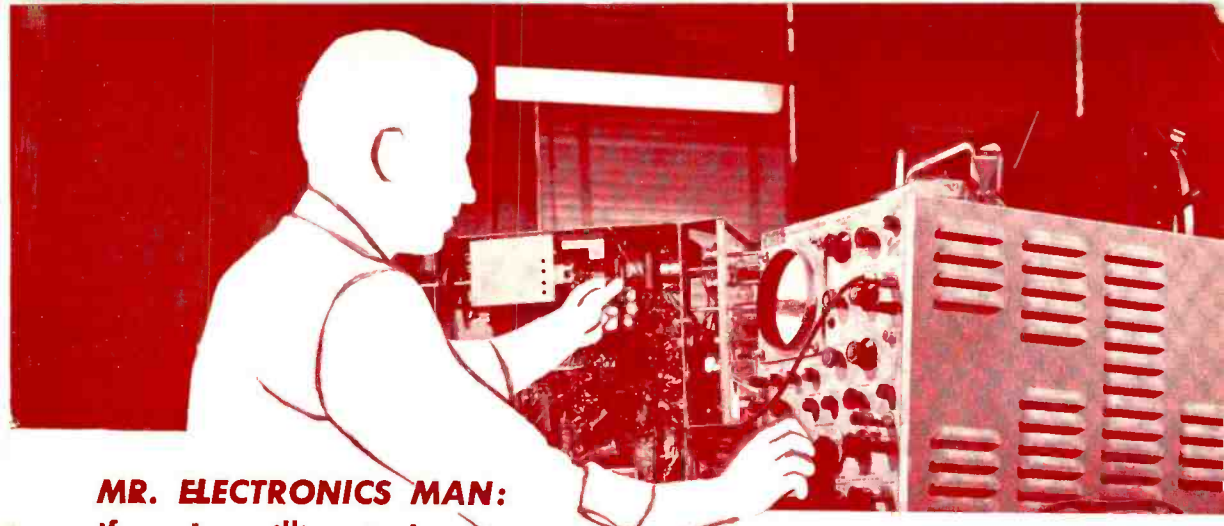
An interesting hookup is shown in Fig. 4. In this arrangement, the low frequency is again fed to the horizontal and vertical inputs to give a circle as before. The high frequency is again put on the cathode but, in addition, a small sample of it is fed into the vertical input.

When the intensity modulation is reduced by control *A*, control *B* can be adjusted to give the pattern shown in Fig. 5. Then by adjusting control *A*, part of the pattern will fade out, leaving only the peaks of each cycle. This hookup eliminates any possibility of "double-trace" errors.

Riding the Waves. Another interesting application of intensity modulation is in waveform analysis. The waveshape to be examined is applied to the vertical input as in a normal setup, and the internal sweep is adjusted to give a trace consisting of one or two complete cycles across the screen. The distribution of voltage in the waveform under analysis can be checked by placing markers by intensity modulation at known points and comparing the voltage at these points with those of a sine wave. Marker placement is achieved by multiplying the number of desired check or marker points by the frequency being examined. For instance, eight check points on a 100-cycle wave would require intensity modulation at a frequency of 800 cycles. The markers would be spaced 45° apart.

The experimenter should be able to find many uses for the Z axis method in measuring time intervals between recurring pulses or switching operations such as ignition firing and the like. If the circular sweep is formed by a known frequency and the unknown high-speed pulses are fed to the Z input, the time between pulses will be the known time of one sweep cycle divided by the number of dots in the circle. As an example, a circle formed by a 10-kc. signal would require 0.0001 second per sweep. If the unknown signal applied to the cathode gave 10 dots around the circle, the time between the unknown pulses would be 0.00001 second.

If you are not already using intensity modulation, give the "Z" jack on your oscilloscope a workout when you have some spare moments. Try a few experimental circuits of your own—you'll be surprised at the uses that suggest themselves. —30—



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(*Continued from page* 89)

Figure 1 indicates schematically how a light amplifier cell is fabricated. In its simplest form, a photoconductor layer and an electroluminescent layer are sandwiched between two electrodes, one of them transparent. When no illumination is present, the impedance of the photoconductor cadmium sulfide layer is substantially higher than that of the electroluminescent layer of zinc sulfide. Thus, in the dark, the voltage applied across the electrodes is almost completely across the photoconductor part of the cell (see Fig. 2). With virtually no voltage across the electroluminescent layer, no light is emitted.

Glowing Response. Now imagine that a spot of light shines on the photoconductor through the transparent layer. The resistance of the photoconductor will immediately diminish so that a large portion of the applied voltage is now across the electroluminescent layer. A glowing area develops, reproducing the size and shape of the initiating spot of light.

In this simple case, the action is adequate to yield an image. But what characteristics are required to produce a *brighter* image of a more complex picture containing many light and dark tones?

To develop such an image, the activating illumination must act as more than just a switch to turn on the electroluminescence. The cell should be designed so that increasing the intensity of the light applied will result in an increase of the light emitted. Neither image reproduction nor any degree of amplification could be realized without this property.

High Fidelity. Light amplification in the cell must be *linear,* to insure that the relation between the light and dark tones of the image, or *contrast,* will remain the same as that of the original regardless of the degree of amplification. This is quite

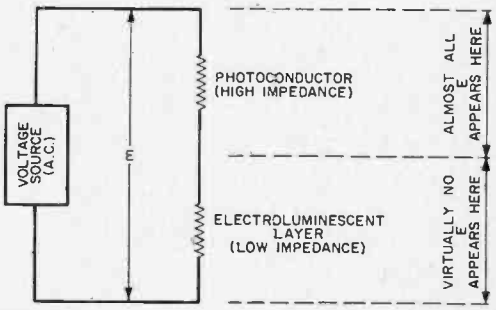


Fig. 2. Equivalent circuit of photoconductor and electroluminescent layer under dark conditions. As in any voltage divider, the large voltage appears across circuit element having the larger impedance.

important, of course, for faithful reproduction of picture quality.

Unfortunately, the light emission of this particular type of amplifier requires a definite time to adjust itself to sudden changes in applied light intensity. The time needed for the output to "catch up" may range from about 1/100 of a second to more than a full second.

This time lag in response is the chief shortcoming of the light amplifier. The long time constants of the present-day amplifiers make it impossible to use them in television applications. Even a slowly moving figure on a TV screen will change the incident light pattern much too suddenly for the electroluminescent phosphor to follow. The resulting afterglow and time-lag would jumble the picture to the point where it would become unreadable.

Latest Improvements. Quite recently an improved design of panel light amplifier has been described. In this arrangement, amplifications better than 100 to 1 have been achieved. Figure 3 shows the construction of this design.

Grooving the relatively thick photoconductor has the effect of increasing the area available to the incident radiation; the current diffusing layer spreads the photocurrents slightly so that more of the phosphor layer is utilized, thus stepping up the efficiency. The opaque layer prevents feedback of output light that would tend to produce multiple images. These are of the nature of mechanical improvements.

From the electrical standpoint, another substantial improvement has been made. It has been found that when d.c. rather than a.c. is applied to the photoconductor its effectiveness increases many times over. Unfortunately, however, the electroluminescent layer will not work unless it is energized by a.c.

A.C. and D.C. Figure 4 shows one method that has been used successfully to overcome this stumbling block. Experimental evidence indicates that amplifications of *better than 100 times* are easily obtained by this system. In Fig. 4 (A) note that each wedge-shaped photoconductive element or "line" is electrically insulated

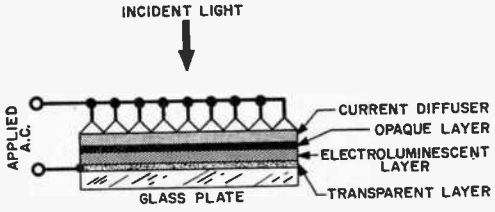


Fig. 3. The structure of a light amplifier cell which has recently been developed. Amplifications of over 100 times have been achieved with this cell.

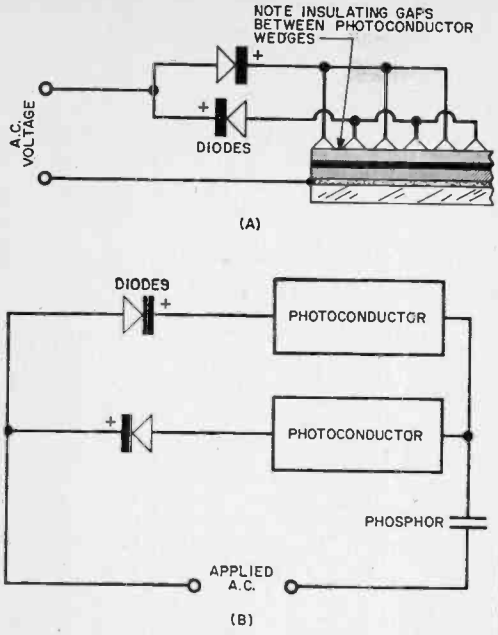


Fig. 4. Method of obtaining d.c. for photoconductors and a.c. for phosphor layer (A) and how photoconductors are connected (B) to remainder of circuit.

from its neighbor and that the alternate wedges are connected in parallel. This arrangement provides two separate interlaced photoconductive surfaces. Figure 4(B) illustrates how the elements are connected to the remainder of the circuit.

In series with each photoconductor wedge is a rectifier diode. With the application of the activating a.c., a half-wave voltage of opposite polarity and phase is fed to the two photoconductors in alternate sequence. The potential that appears across the phosphor, however, is still a.c. because the two diodes acting together pass along both halves of the a.c. cycle to the electroluminescent layer. Hence, the photoconductor's d.c. requirement and the phosphor's a.c. requirement are both satisfied.

At the moment, certain restricted but important applications for light amplifiers are under serious investigation. One of these is in the field of intensified fluoroscopic screens for x-ray examination. The fluoroscopic screen used in x-ray absorbs the x-ray photons and emits a dim light which—when sent through a light amplifier—enables a much brighter and easier-to-interpret picture to be obtained.

The Future. Use of light amplifiers for television belongs in the more distant future. Much more development is necessary. And as for binoculars and telescopes—they won't be in any of the department stores this summer—or the one after. —30—

I Should Have Known!

(*Continued from page 77*)

curl up from the back of the amplifier. I dashed to the power switch and turned everything off. Then I slid the amplifier out of its nice, tight box, and when I started to put my hand on the chassis to lift it down, a wave of heat warned me just in time. The chassis was all set to fry eggs, boil water, and perform other feats that would look fine on a stove, but *not* on an amplifier. *I should have known!* I had put some large, hot output tubes in a tight little box with no air circulation—no way for cool air to drive the hot air out. Enter my claim for champion dunce.

AS THE chassis cooled, I inspected it and found no parts visibly charred or connections burnt. Maybe I had caught it in time. Another five minutes and a capacitor might have been cooked or a transformer shorted, and all hell would have broken loose.

After a further cooling-off period, I used my multimeter to see if there was a short from the high voltage to ground. The needle jumped way over as the capacitors charged—good—and then settled back to a normal high resistance. So I put the amplifier in the open, on a small table next to the changer, and turned on the power again.

I kept my finger on the switch for quick action in case there were any sparks or red-hot tubes, but glory be, everything held tight. And the wonderful sound that came pouring out of the speaker told me that this time I really *was* lucky. Surely nothing more can happen, I thought, as I turned up the volume to send a Brahms symphony crashing into the room.

I was wrong. There was a loud pounding on my door as the horns and trombones let go for a chorale. My downstairs neighbor had come up, sputtering in my face. He was a big man.

"I never heard anything so loud in my life! Are you crazy? My walls are coming down," he shouted.

Maybe I was inspired, but I didn't crack for a second. I turned the volume way down and invited him in. I told him I had just installed my new hi-fi rig, and it sounded fine. I went to the kitchen for two bottles of beer.

"Hi-fi, eh," he muttered. "I've been hearing about that all over the place. Never knew what it was." He listened for a few minutes. "Turn it up a little so I can see what it sounds like." I gave him

a medium volume. Again he listened for a while.

"Say, that's really something. Ought to be a little louder, though." I happily accommodated him, and Brahms again took over the room as we rode the fortissimos like ocean surf. All my troubles were over!

There was a loud pounding at my door. I opened it to find my *upstairs* neighbor sputtering in my face.

"Are you crazy? I can't even think up there!"

I should have known! —30—

How We Listen to Stars . . .

(*Continued from page* 44)

One of the largest interferometers is near Sydney, Australia. This consists of an array of dipoles 1500 feet long.

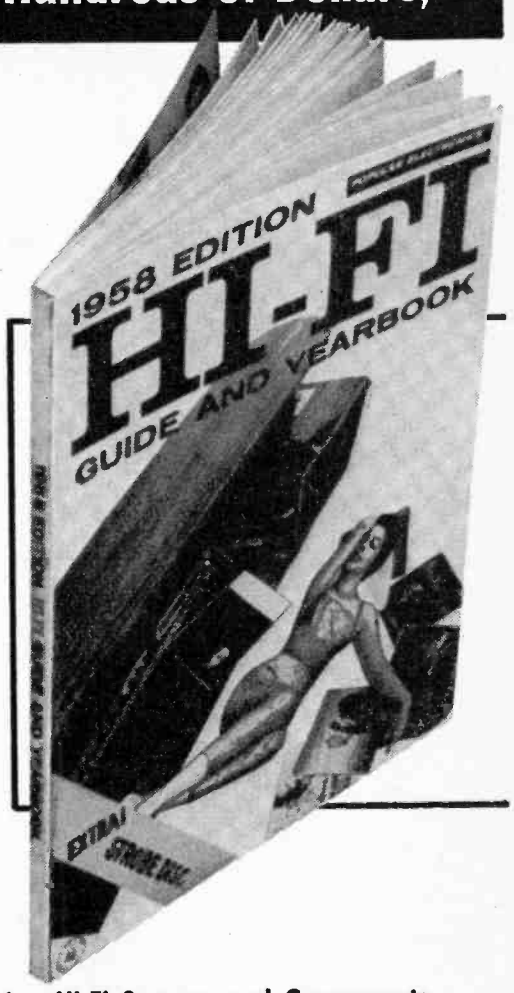
Essentially, the job of the radiotelescope is to focus the radio waves it receives and feed them into a sensitive receiver. This is analogous to the action of the optical telescope. The parabolic dish, either solid or made of wire screen or mesh, reflects incoming radio waves to a focal point, where they are picked up by a rod or dipole and fed to a receiver. The signal is amplified, then sent to a mechanical recorder, usually a pen tracing the signal on graph paper.

The interferometer, on the other hand, works in a different manner. The typical telescope of this sort consists of a flat array of dipoles. When they face directly toward the emission source, the wavefront reaches all the dipoles at the same time. This is shown as a signal of maximum strength. When the signal comes in at a slight angle, it reaches one dipole earlier than the next, and the interference of the out-of-phase waves cuts the signal strength. To improve resolution, interferometers are built with a second array of dipoles arranged at right angles to the first array. Where the two signals of maximum strength intersect, they produce a "pencil" beam which has the resolution of a huge parabolic antenna.

Diffuse Definition. Radio waves from space are relatively unaffected by daylight, cloud or fog, which is a tremendous advantage over light waves for observation, but their long wavelength compared to light makes it difficult to gain good resolution. The beam width depends on the ratio of the wavelength to the diameter of the telescope. Therefore, in order to gain the resolution of even a small optical telescope, the antenna of a radioscope would have to be thousands of miles long. For that reason, radioscopes are able to define a radio source only diffusely, causing the observers to con-

(*Continued on page* 126)

Now—See How to Save Hundreds of Dollars,



Many thousands of hi-fi fans knew a good thing when they saw the first edition of the *Hi-Fi Guide and Yearbook*. Newsstands were cleaned out in a matter of days and the book became a collector's item.

The *new 1958 Edition* of the *Hi-Fi Guide and Yearbook* will go on sale soon. It contains completely new material on every facet of high fidelity . . . from an advance report on 16⅔ rpm ("The Fourth Speed"), to guidance on adding stereophonic sound to your present set-up.

This new *Hi-Fi Guide and Yearbook* will return many times the $1 you pay for it . . . by showing how to shop wisely for equipment, how to save on repairs, which records are best, and money-saving techniques and ideas available nowhere else.

It will be a continually entertaining companion . . . providing you with fascinating, useful lore, showing you how to get more pleasure out of hi-fi, helping you explore the different worlds of high fidelity and music.

Reserve your copy today. This new edition will sell fast! A word to your newsdealer now will assure you of your copy of this handsome, practical book.

Latest Ideas for Buying, Improving, Using Hi-Fi Systems and Components Ways to Make Monaural and Stereo Tapes ☆ Best Records of the Year Rolloff and Turnover Settings ☆ Complete Hi-Fi Glossary ☆ FM Stations and Programs ☆ Hi-Fi Shows in '58 ☆ Where to get Free Hi-Fi Literature How to Use Demonstration and Sampler Records ☆ Record and Tape Clubs New Inventions and Improvements in Speakers, Amplifiers, Preamps, Tuners, Crossovers, Tape, Stereo, Controls, Turntables, Heads ☆ Free Strobe Test Disc ☆ 164 Pages ☆ Hundreds of Pictures ☆ A Storehouse of Exciting and Practical Information Compiled by the Editors of *Popular Electronics*

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centrate on the shorter wavelength. But as the larger scopes are built, they will be able to push their studies up into the longer wavelengths. There is no doubt that even more and possibly greater surprises are awaiting them in this region.

With the earth trembling on the threshold of space, it would not be out of place to predict that man may one day soon construct even larger radiotelescopes between orbiting space stations, or even on the moon itself. It is impossible to guess what tremendous discoveries there will be, but one thing is certain—radio astronomy will some day rank with optical astronomy as one of the most important of sciences. Indeed, it may even outgrow its older brother in unlocking the secrets of the universe. It won't be long now! -30-

Got the Shakes?

(*Continued from page* 70)

manipulating the contact and spring tension screws. If the light remains on, it means that relay spring tension is too great. Turn the adjusting screw slightly counterclockwise.

Before turning power on, always touch the prod tip to the *touch plate* to discharge *C1*. Repeat the above procedure until the light flashes every time the power switch is operated.

With *RL1* working dependably, allow the timing circuit to operate. After five or ten seconds, the indicator light should flash on automatically. If too long a period passes, or it does not flash, give the lower contact screw a very tiny clockwise adjustment—no more than 1/20 of a turn.

Test the control that *R2* exercises over the circuit. The range should be from three seconds at one end of rotation to about 15 seconds at the other end. Careful adjustment of the relay contact screws takes care of the timing range. -30-

HOW IT WORKS

The collector current of a transistor depends upon the base current, among other things. When power is applied, a small charging current flows into the timing capacitor (*C1*) through the base circuit, making the collector current large enough to hold relay *RL1* in. As the capacitor charges, the base current—and consequently the collector current—decreases slowly until it can no longer hold in the relay armature. The time required for the capacitor to charge is controlled by the resistance of the timing potentiometer (*R2*) in series with it.

When the probe touches the *touch plate*, capacitor *C1* is short-circuited and a new timing period starts. If the wedge strips are touched by the probe during this interval, the timing resistors (*R1, R2*) are short-circuited, charging the capacitor almost instantaneously. The base current drops to zero, the collector current diminishes to its lowest value, and the relay armature is released again.

Get the Best from Your Tuner

(*Continued from page* 88)

reflector, and Yagi. The last is the best for coaxing the signal into your set.

The third factor is the inherent sensitivity of the tuner (which varies according to its design), or the amount of amplification between antenna and limiter. We assume the tuner is properly aligned.

In the last couple of years, some FM tuners of extremely high sensitivity have come on the market. This is evidenced by such specifications as "1 to 3 microvolts signal for full limiting." Five to ten microvolts for full limiting would be medium sensitivity. Anything over that is low.

But don't compare the specs for two tuners closely with each other, because somewhat different methods of measurement are used by different manufacturers. If you are located within about 20 miles of the transmitter, any medium-to-high sensitivity tuner will pass on plenty of signal to the limiter, usually with a simple indoor antenna.

Further out, say 20 to 75 miles from the transmitter, we find a great variety of situations, depending on elevation, surrounding obstructions, etc. FM reception in this area is usually excellent too, but

it takes more stuff to get it. Only full trial at your location will determine just how good a tuner, and how high an antenna, you need for full limiting.

It is in this area that a lot of disappointment with FM has been caused because users didn't realize they were not getting enough signal into the limiter stage. Changing to a high-sensitivity tuner has changed FM listening from misery to joy for many people.

Beyond 75 miles, you will probably need a very sensitive tuner plus a very hot antenna. Beyond about 100 miles, FM reception becomes unreliable.

The Last Line-Up. Now let's talk about aligning. It is obvious that top quality in FM depends heavily on proper adjustment of the tuned circuits. Every FM tuner should be lined up at least once a year by a skilled technician who has the test equipment to do the job. If your tuner has been in use a year or more, and you have it lined up, the odds are that you will get the bang of your life. Such snap, clarity, and brilliance! You didn't know you had lost all that fidelity, because it crept away a little at a time.

Finally, in using your tuner, *do* use the tuning indicator to make sure you are parked right in the middle of the channel before you sit down to listen. Only when the signal is swinging equally to each side of the "center" will the distortion drop to a minimum. It's a good idea when tuning to turn off the a.f.c., if your tuner has it, because it is hard to find the center of the channel with the a.f.c. on.

If you do give your tuner the kind of good home treatment suggested in this article, and you tune in a live program from a well-run FM studio, you will be getting one of the top thrills in high fidelity. The fullness, power, brilliance of a good piano heard this way, for instance, will repay you many times over for your attentions to your FM tuner. —30—

German Radios

(*Continued from page* 57)

ment, assembled from separate components. The console sets lack magnetic phonograph cartridges, a choice of record equalization settings, FM tuners with automatic frequency control, and amplifiers with heavy output transformers. The very fact that the loudspeakers are contained in the same cabinet with the rest of the equipment is contrary to the principles of hi-fi design.

In other words, neither the German table model radios nor the console sets come anywhere near the top in hi-fi. Separate hi-fi

components, chosen by careful comparison, are still the only way to attain the best musical quality.

Yet, the Germans barely scratched the surface in the field of separate hi-fi components. Their major contributions here are not electronic, but lie in the field of precision mechanics. German turntables and changers like the Miraphon and Miracord, and German loudspeakers like the Wigo, are fast winning friends among American hi-fi'ers by offering good quality at a fair price. And the German Telefunken microphone has established its standing among technically fastidious recording and broadcast engineers.

In the field of portable radio design, Germany has made a real contribution by offering all-wave models with FM, bass and treble controls. No American manufacturer offers anything comparable. The A batteries in some of these sets automatically recharge themselves when the radio is plugged into regular power lines, and the sound is amazingly good for the size and weight of these portables. But again the claim of hi-fi, made by one importer, seems rather far-fetched.

Servicing. Chassis are quite elaborate and wiring layout differs from American practices. Some parts are not interchangeable with our components; replacements have to be ordered from the importer. The schematics provided by the manufacturer often bristle with strange symbols.

These problems have become less serious since the more important foreign manufacturers started wide-spread service organizations in the U. S. Often they team up with an established American firm to handle local distribution and servicing.

Appearance. The beautifully grained wood and the hand-rubbed finish add greatly to the outward attractiveness of German radios. The styling is often elegant and elaborate, with rounded corners and gold trim. Other models with clean, straight lines mark the graceful simplicity of contemporary design trends. Aside from good looks, these well-crafted wood cabinets also provide good sound.

The German imports must be judged for what they are, not for what they are not. They are *not* specialized short-wave receivers and they are *not* hi-fi systems. But they *are* remarkably versatile, well-made all-wave radios capable of exceptionally good sound, attractively housed. With this combination of useful design factors, they fill a definite need for a sizable section of the American public, and the value they offer comes at a fair price. -30-

Can You Spare the Time?

(*Continued from page* 50)

vals of precisely one second to allow him to adjust to within one part in 100,000,000. Whether his instruments can be adjusted so finely is another matter, but WWV's accuracy is that great.

A research laboratory has to measure a certain frequency to the greatest possible accuracy. It tunes to WWV on one of its six radio frequencies—2.5, 5, 10, 15, 20 and 25 mc.—and electronically converts to the frequency it needs.

The State Department has to know whether it will be able to send radio messages without interruption to Paris or London. It will listen to WWV, which broadcasts radio propagation forecasts twice each hour in code. These forecasts tell the condition of the ionosphere at the time of broadcast and the expected propagation conditions over the North Atlantic for the next six hours or so. They are based on data obtained from a world-wide network of observatories.

The busy WWV hour goes as follows: 12 voice announcements of Eastern Standard Time; 12 code signals of Universal (Greenwich) Time; six periods of 600 cycles and five of 440 cycles; two predictions of short-wave propagation conditions; and one four-minute period of silence. All through the hour (except during the silence), ticks mark off the seconds. To indicate the end of a minute, the 59th tick is omitted, and there is a very rapid double tick at 60 seconds. The silence, incidentally, is extremely useful for measurement of atmospheric noise, since these frequencies are not used by any other American broadcaster.

Similar services are broadcast by WWVH in Hawaii, whose radio propagation forecasts concern the Pacific area. WWVH broadcasts on 5, 10 and 15 mc. only. —30—

Trap Those Unwanted Stations

(*Continued from page* 54)

to one-half the electrical wavelength of that frequency, and is called a half-wave shorted stub (Fig. 8).

Since both the quarter-wave open stub and the half-wave shorted stub act as series-resonant circuits, *either* may be used as a series-resonant wave trap. Such a wave trap is connected directly across the receiver's antenna terminals, in parallel with the antenna transmission line.

Determining Lengths. To determine the approximate length of a quarter-wave stub in inches, divide 2800 by the frequency in megacycles. The transmission line would

be cut slightly longer than this, then trimmed to exact length after the stub is connected to the receiver. Ordinary 300-ohm two-conductor twin-lead can be used.

For example, suppose the frequency of an interfering signal is 200 mc. Then a quarter-wave open stub which could be used as a wave trap at this frequency would be 2800/200, or 14" long. A shorted half-wave stub would be twice this length, or about 28". In practice, you'd cut a piece of line of about 15" (or 30"), connect it to the receiver, then cut off a little at a time—checking the performance of the receiver each time—until maximum attenuation of the undesired signal is obtained.

Since a half-wave stub must be shorted at its far end each time its length is adjusted, and since it is twice as long as a quarter-wave stub, the open quarter-wave stub is preferred as a wave trap. However, an adjustable half-wave stub may be made by tightly wrapping a 2" to 4" length of aluminum foil around a length of transmission line (Fig. 9). The aluminum foil introduces a capacitance between the two conductors of the line which acts, for practical purposes, like an electrical "short." Since the wrapped foil can be slid back and forth along the length of the line, it serves as an "adjustable short." —30—

Kit Builder's Korner

(*Continued from page 83*)

test will detune this tightly coupled secondary enough to allow oscillation. The oscillation, in turn, develops bias which causes the cathode-ray section of the tube to deflect.

Comment. "Wall-size" diagrams are included, as is usual with Heathkits, and will be particularly useful in the switch wiring. Total assembly time shouldn't run much over three hours.

After assembly—for your own satisfaction—shunt a paper capacitor with a couple of hundred ohms and check it out. If you did a good job, the eye will wink. —30—

Electronics Tells Fish Tales

(*Continued from page 72*)

As biologist Duncan put it: "The checked streams are like a well-scouted football team. We know when to expect a run through center—or around end."

But still the probing goes on—right down into the gravel of the stream bed. Another electronic device has been developed for measuring the flow of water through the gravel—also for checking the oxygen.

"To keep the fish coming for the fishermen, we must find ways to improve the survival rate from the eggs laid in the gravel," explained Duncan. "We found in our Alaska studies, for instance, that a salmon may lay 2000 eggs, but the survival rate is only about 12%."

To expedite and add efficiency to the studies, huge indoor laboratories have been built at such sites as Bonneville Dam on the Columbia River in Washington. Another is under construction at Seattle. In these laboratories, all sorts of stream conditions are simulated—with real water and real fish.

They Act Human. One interesting thing the fishery biologists at Seattle have learned in their electronic studies of the behavior of fish is that fish will stake out a claim like a prospector, and then fight to keep it with the zeal of one.

The biologists put three salmon in a

ELECTRONICS AS A CAREER?

Cleveland Institute of Radio Electronics has opened two new offices, in Norfolk, Va., and Seattle, Wash., which will provide training counseling service to all those interested in electronics as a career. In Norfolk, the address is 906-908 Royster Bldg., Granby Ave. at City Hall Ave.; in Seattle, it is Room 711, Jones Bldg., 1331 Third Ave. Other CIRE offices are located in San Diego, Long Beach and San Francisco, Calif.

partitioned tank, one to each partition. The partitions had openings, but the salmon showed no disposition to stray—they all seemed well content with their own claims, and stayed put. When two claim-jumping salmon were added to the tank, however, the fighting began. Furiously, the fish with the staked claims fought off the intruders. Showing frustration, the claim-jumpers swerved to corners, flicking fins, quivering and shaking.

Salmon, it was also discovered, can be bullies. A tough one finds himself a choice spot, then drives off the others. When a block of wood was placed on the water of a tank, all the salmon in the tank went for this shelter. But there was a tough bruiser among the lot. He drove off the others, and kept the shelter for himself.

With the use of electronic equipment such as that employing the sonic tag, the biologists expect to find out much more about the lives of fish. They may even discover that fish "are darn near human."

"There will always be fish in the sea" is an old saying. New scientific equipment and the U.S. Fish and Wildlife Service will help keep it a true one. —30—

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Transistor Topics

(*Continued from page* 75)

(*T1*) serves as the oscillator coil. The feedback signal necessary to start and sustain oscillation is obtained from *T1*'s secondary winding and coupled back through d.c. blocking capacitor *C1* to the transistor's base electrode. Base bias current is supplied through *R1*. The output signal is obtained through a small (50-$\mu\mu$fd.) isolating capacitor (*C2*).

You can assemble the BFO on a small plastic or metal chassis, which may be mounted in an out-of-the-way location on your receiver. A BFO on-off switch may be added by connecting a s.p.s.t. switch in series with *either* battery lead. Use any standard 456-kc. transistor i.f. transformer for *T1* (Argonne No. AR-60 or Miller No. 2031). Battery *B1* can be two penlite cells in series.

Although lead dress and circuit layout should not be critical, you may have to experiment with the connections to *T1* to obtain oscillation. As in other circuits of this type, if you can't get oscillation try reversing either the primary or secondary connections.

The ground lead of the BFO connects to receiver circuit ground (usually the set's chassis), the "hot" lead to the input of the diode detector. Some slight realignment of

the receiver's last i.f. stage may be required. If you prefer, somewhat greater gain can be obtained if the "hot" lead from the BFO is connected to the grid (or base) of the last i.f. stage. In this case, add a 5- or 10-$\mu\mu$fd. capacitor *in series* with *C2* to reduce the loading on the i.f. stage and to minimize any detuning effects.

With the BFO operating and the receiver tuned to a short-wave code station, adjust *T1* until a clear audio note is heard. You can adjust for the tone (pitch) you prefer.

The only component which might cause difficulty is the i.f. transformer. If you find that the primary winding is tapped, follow the manufacturer's instructions for using the component in a conventional i.f. stage—except that the secondary should be connected back to the stage's "input."

TRANSISTOR PARTS CATALOG

Argonne Electronics Mfg. Corp. (165-11 South Rd., Jamaica 33, N. Y.), has announced the release of its first catalog, which should be useful to every transistor experimenter. Included within its twelve pages are specifications and descriptive data on transistor i.f. transformers, the famous Poly-Vari-Con subminiature tuning capacitors, various types of transistor antenna, r.f. and oscillator coils, subminiature volume controls, miniature electrolytic capacitors, and miniature earphones. There is also a complete listing of the 77 different Argonne audio transformers; interesting additions to the line are heavy-duty transformers designed for use in power transistor circuits—a driver and a 6-watt output transformer. And aside from subminiature and transistor components, the catalog includes a listing of microphones, multitesters, hi-fi and general-purpose tone arms and phono cartridges. For your free copy, check with your local Argonne distributor, or write direct to the manufacturer.

Unijunction Transistors. The General Electric Company (Syracuse, N. Y.) has announced the manufacture and availability of six new Unijunction transistors, carrying JETEC type numbers 2N489 through 2N494.

Originally called a double-base diode, the Unijunction transistor was invented by Dr. I. A. Lesk of the G.E. Advanced Semiconductor Laboratory, and has been under development for over five years. Physically, it looks much like any other transistor. Internally, however, it consists of a single crystal "*n*-type" silicon bar with ohmic contacts at each end, and with an aluminum wire attached to the bar at a point between the end contacts. The entire assembly is mounted in a hermetically sealed enclosure.

Electrically, the Unijunction transistor is the nearest solid-state equivalent of a small controlled-grid thyratron tube. The two ohmic contacts to the silicon bar are called

base 1 (B_1) and *base 2* (B_2), while the central wire contact becomes the *emitter*. The aluminum wire forms a *p-n* junction at its point of contact.

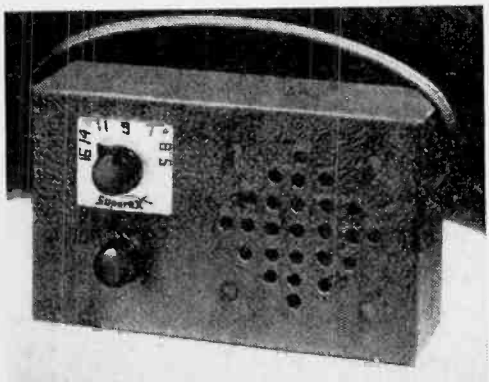
In operation, the B_1 to B_2 resistance is very high, and relatively little current will flow if a voltage is applied to these two terminals, *unless* a voltage is applied to the emitter electrode. If sufficient voltage is applied to the emitter, the B_1 to B_2 resistance drops sharply, and an appreciable current can flow between these two electrodes. This action is very similar to that encountered in a thyratron tube, where the plate-to-cathode resistance is very high until a control voltage is applied to the grid, causing the tube to "fire" and the plate-cathode resistance to drop to a low value.

A Unijunction transistor can be used in relaxation oscillator, switching and pulse-forming circuits. Two typical circuits are shown in Fig. 3, a *multivibrator* at (A) and a *"one-shot" multivibrator* at (B). The first multivibrator is a free-running oscillator and delivers a rectangularly shaped signal. The one-shot circuit must be driven by an external positive-going pulse (applied to the "input" terminal), and delivers a rectangular negative-going pulse.

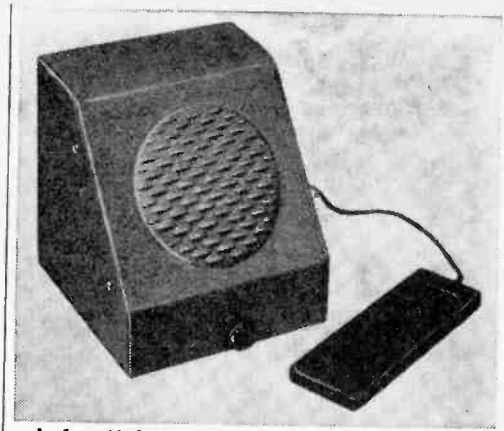
Basic electrical specifications for the new Unijunction transistors are as follows: r.m.s. power dissipation—250 mw.; r.m.s. emitter current—50 ma.; emitter reverse voltage—60 volts; peak emitter current—2 amperes.

Product News. Superex Electronics Corporation (4-6 Radford Place, Yonkers, N. Y.), has announced its newest transistor radio kit, Model TR4-K. This kit features four transistors, a diode, and a new flat transistor Loopstick. Other features include a prepunched circuit board, a 2½" loudspeaker and an earphone jack.

A new four-transistor telephone pickup amplifier kit has been added to Lafayette



Superex's four-transistor radio kit, Model TR4-K, features a new flat transistor Loopstick.



Lafayette's new four-transistor telephone pick-up amplifier kit, KT-131, permits group listening.

Radio's line (165-08 Liberty Ave., Jamaica 33, N. Y.). This unit permits group listening to telephone conversations and features a sensitive amplifier with Class B push-pull output. The kit comes complete with all parts, including an attractive ripple-finished metal cabinet, a pre-cut chassis, wire and solder—but less battery and pickup coil. Catalog number is KT-131; advertised price, $17.95 plus postage.

Philco has developed a new class of transistors, some of which are usable at frequencies up to 1000 mc. Still in the laboratory stage, chances are these units won't be available till later in the year.

That's all for now, fellows. See you next month.

Lou

Among the Novice Hams

(*Continued from page* 91)

low-pass filter, there was no trace of interference to any channel from any band.

Conclusions. The Johnson Navigator transmitter performs as the manufacturer said it would. It is recommended to any amateur who takes pride in emitting a really fine signal under his call letters. As a transmitter for a Novice, its built-in VFO, special keying system, and seven-band frequency coverage are not immediately usable. However, the first investment the average Novice makes after obtaining his General license is a VFO. Then he starts band-hopping. With a Navigator, the VFO is available at the turn of a switch.

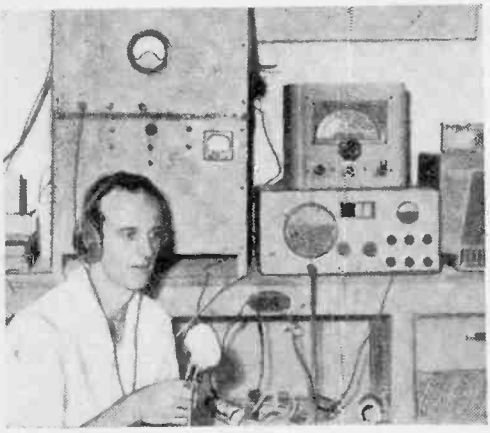
Not only is this unit an excellent low-power transmitter in itself, but it will also serve as an exciter for one of the higher-power amplifiers offered by the Johnson Co. and other manufacturers. Therefore, it

is a good long-term investment. Selling for $149.50 as a kit and $199.50 in ready-to-go form, it is available from any authorized distributor of E. F. Johnson equipment.

News and Views

Ralph, WN2RZJ, has just replaced the transmitter he used since getting on the air last July with a new Heathkit DX-40, and has added five states to his total in a few days—giving him 22 states worked on 40 meters only. He receives with a National NC-57 and uses a long-wire antenna. Ralph says that *Among The Novice Hams* helps him understand hard theory the easy way. He will sked anyone looking for a New Jersey contact . . . . . **"Rip," K9DSR,** was bitten by the amateur radio bug at the age of 66, got his Novice license after a few weeks of study and his General a few months later. He thinks that learning the code at 66+ might be a trifle more difficult than at the age of 14, but that learning the theory is probably easier. Rip is constantly amazed at the uniform friendliness and helpfulness of hams. He classes himself as "an old guy having a lot of fun at ham radio." His main interest is rag-chewing, and he has no idea of how many states he has worked!

Chris, KN8ICE, knows how many states he has worked. In a week and a half on the air, he has made 21 contacts in six states. He runs 75 watts to a WRL Globe Chief transmitter feeding a 140′ antenna and receives on a National NC-98 receiver. Most of his work has been on 80 meters, but Chris has an eye on some 15-meter DX . . . . . Does it do any good to have your name listed in "Help Us Obtain Our Ham Licenses?" **Bobby Copella,** Box 25, Byrnedale, Pa., says it does. Dick, K9GDF, Saul, W3WHK, and Lester Sade of California answered his call for help; and Ron, W3JEH, Charles, W3IYL, and Gary, W3FIM, all three from St. Marys, Pa., visited him and gave him much-needed encouragement. Bobby's Novice license was on the way when he wrote us . . . . . **Rob, KN1DEY** also gives thanks for the help he received as a result of his name being listed in the "Help" column. After three weeks of operation on



Julio Pena, YV3BS, is shown operating his efficient ham station which is located in Venezuela.

KN9IXD prefers to be called "Butch" rather than Doris. If you have worked KN9IXD on the air, you may want to revise your mental picture of what this particular "Butch" looks like. (Photo by W9EJW)

40 meters, his Globe Chief transmitter running 75 watts, 40-meter folded dipole antenna 50′ high, and NC-98 receiver have worked 13 states. Rob offers to help anyone get a ham ticket and to sked any ham.

Julio, YV3BS, Barquisimeto, Venezuela, has been on the air for about nine months and has made over 700 contacts throughout the world on 20-meter phone. Running 400 watts and having a "DX" call of his own helps in raising the rare ones. Julio is building a 35-watt transmitter so he can work 40, 15, and 10 meters; watch for him. He is the president of the LARA Radio Club and will be glad to answer questions about amateur radio in Venezuela . . . . . **Gordon, VE5KV,** has been on the air in Saskatchewan for six months. With his recently obtained Johnson Ranger transmitter and Hallicrafters S-77A receiver, he works all bands from 80 through 10 meters. He has worked 10 countries and has 20 states confirmed. His most unusual contact was a recent one on 10 meters, when he received an RST-599 report from Atlanta, Georgia, while using a 10-meter doublet antenna hung up in his basement shack.

Another Gordon in another country (England) is **Gordon, G3LEQ.** He runs 25 watts on phone and 50 watts on c.w., feeding a 100′ end-fed antenna on all bands, from 160 through 10 meters, and he receives on a Hallicrafters receiver, type not mentioned. He has worked around the world on both phone and c.w., including Australia and New Zealand (VK and ZL), which are as far away from England as you can get. G3LEQ frequently operates on 15 meters and works "cross band" to stations on 11 meters. He also is looking for "cross-band" contacts with 6-meter stations, which should interest Technician licensees. Gordon is not quite 20 and has been a ham for a year and a half . . . . . The next time a Korean ham (call letters beginning with HL) calls you, don't ignore him. The FCC reports that it is no longer forbidden for U.S. amateurs to work Korean amateurs . . . . . **"Butch," KN9IXD,** operates on the 80-meter Novice band. She has been scheduling W9BDG and W9SNQ to handle third-party messages in order to improve her code ability, with excellent results. She uses a Ranger

transmitter feeding a folded dipole antenna and receives on a Hallicrafters SX-88. She shares the receiver with her husband, W9SWD, but the Ranger is hers.

Gary, KNØLUZ, has worked 21 states and Canada in 15 days on the air. Most of his contacts are made on 40 and 15 meters. He uses a Heathkit DX-20 transmitter running 50 watts to excite a Windom antenna, and he receives on a modified Heathkit AR-2. Contact him if you need an Iowa QSL card . . . . . **Bob, KN1CVH, (13),** has been on the air since last summer and has 35 states worked, 20 confirmed. He operates on 40 and 15 meters, using a Globe Chief transmitter, a Hammarlund HQ-100 receiver. His ionosphere bombarder is a 40-meter doublet, fed with RG-59/U coaxial cable. Bob's pet peeve is hams who call CQ a hundred times or more before signing their call letters. When you read this, he will be "sweating out" the arrival of his General Class license . . . . . **Bob, K4RIU/KN4RIU,** (Novice and Technician licenses) has worked 36 states and six countries in 240 contacts in two months on the air. His best DX is Australia and Greenland. Bob's Globe Chief runs 75 watts to excite a 15-meter dipole, 30' high. He receives on a Hallicrafters S-38D. Bob would like to arrange schedules with Vermont, Montana, and Nevada on 15 meters and will sked anyone who wants to work Florida. He QSL's 100% and gets almost 100% returns from his cards.

Klaus Buchwald, Berlin — Tempelhof Siegertweg 22, Germany, is a German short-wave

listener who would like to exchange information with USA hams and SWL's. He promises to answer all letters received.

Contributors to News and Views: **Ralph, WN2RZJ**, 2-19 27th St., Fair Lawn, N. J.; **R. I. "Rip" Parker, K9DSR**, P.O. Box 60, Hinsdale, Ill.; **Chris Schauer, KN8ICE**, 648 Elizabeth St., Kalamazoo, Mich.; **Robert J. Riseman, KN1DEY**, 145 Pond Brook Rd., Chestnut Hill 67, Mass.; **Julio Peña, YV3BS**, Avenida 20 No. 27-95, Barquisimeto, Venezuela; **Gordon Gwillim, VE5KV**, Duval, Sask., Canada; **Gordon L. Adams, G3LEQ**, 5 Byng Road, Turnbridge Wells, Kent, England; **Doris "Butch" Singer, KN9IXD**, 7070 East 21st St., Indianapolis, Ind.; **Gary Letchford, KNØLUZ**, Box 333, Jesup, Iowa; **Bob Ogren, KN1CVH**, 931 Pleasant St., New Bedford, Mass.; **Bob Webb, K4RIU/KN4RIU**, 1104 East DeSoto, Pensacola, Florida.

Your news and views—and *your* picture—would look good in our column. Just address them to Herb Brier, W9EGQ, C/O POPULAR ELECTRONICS, 366 Madison Ave., New York 17, N. Y. Until next month, 73,

Herb, W9EGQ

Short-Wave Report

(*Continued from page* 84)

other allied country. The British and American transmitters lay to the east and west of the Asian Pacific area; their signals ran across the earth's magnetic field. The Australian signal, beamed from the south northwards, ran parallel with it.

During the war years, several changes in the administration of the Australian Short-Wave Service took place. In 1942, overseas broadcasting was transferred to the A.B.C. In 1944, control passed back to the Department of Information and *Radio Australia* became the "Short-Wave Division" of that Department. In 1950, it became the "Overseas Service of the Australian Broadcasting Commission."

Australia regards its short-wave service as a means of enabling friends and neighbors to gain a better understanding of the nation's affairs and as a way of promoting the cause of peace. The aims of *Radio Australia* are to give accurate information about the country, foster good will and promote trade and commerce with other countries, encourage the flow of migrants, and stimulate the tourist trade.

Next month we'll give you a resume of the transmitters and antennas used by *Radio Australia,* and a brief insight on some of the programing.

Current Station Reports

The following is a resume of the current reports. All times shown are EST and the 24-hour system is used. Reports are correct at time of compilation but stations may change

frequency or time with little or no advance notice.

Afghanistan — YAK, Kabul, 18,640 kc., is being widely reported. The latest schedule reads: s/on 0955, native music to 1020, news in Pushtu to 1035, English news around 1040, folk music after 1048A. Clock chimes, English and Pushtu ID signify s/off at 1130. *(61, 166, 313, 336)*

Angola—*Radio Diamang,* Dondo, 9340 kc., carries an Eng. program at 1330-1430 and is well heard in Eastern USA. *(11)*

Argentina—The Eng. period from LRA, *Radio Nacional,* Buenos Aires, 9690 kc., seems to have been changed. In addition to the one at 2230, they now have Eng. at 2300-2305 and 2355-0000, Monday through Friday. *(AN)*

Austria—OEI38, *Radio Osterreichische,* Vienna, has been noted on 25,615 kc. in a language xmsn from 0200 after ID in German. This runs to 0400 and signals are usually good. *(61)*

OEI30, 5985 kc., is also noted well around 0230. Although not confirmed, this may be parallel to the 25,615-kc. channel. *(166)*

Azores—CSA93, Ponta Delgada, has moved from 4865 to 4848 kc. and is heard at strong level in the east around 1730. Most programs are in Portuguese. *(166)*

Belgian Congo—OTM2, Leopoldville, has been noted Sundays *only* on 9385 kc. (9380 kc. weekdays) and closes at 1700 (1600 weekdays). This may be a special frequency for Sunday only. *(AN, 59)*

Ceylon—The Commercial Service of *Radio Ceylon,* Colombo, 15,265 kc., is being heard at 2030-2130 in English with news at 2100. Informal talks, pop music and commercial ads make up the remainder of the program. *(BP, RM, 329)*

China—Pekin is noted on 17,745 kc. at 2200-2229 with news to 2210, commentary to 2217, talks to 2228, s/off at 2229. This is dual to 15,115 kc. Another Eng. period is noted from 1900. *(WD, RH, 39)*

Another xmsn from Peking is reported on

WITH THE RADIO CLUBS

Here is a resume on the three largest radio clubs. Sample bulletins and application blanks can be obtained by writing to the addresses given.

Newark News Radio Club (215 Market St., Newark 1, N. J.)—The dues are $4.00 yearly and entitle members to receive the monthly bulletin featuring the latest news on the short-wave broadcast, ham, FM, TV and short-wave commercial bands. There is also a listing from time to time of those who are interested in swapping SWL cards.

Universal Radio DX Club (21446 Birch St., Hayward, Calif.)—The dues are $3.00. Members receive 19 bulletins per year covering the short-wave broadcast and ham bands.

International Short-Wave Club (100 Adams Gardens Estates, London, SE 16, England)—This club issues a monthly 4-page printed bulletin mainly covering the short-wave broadcast and ham bands. For complete dues information, write to the address given and please enclose an International Reply Coupon.

15,096 kc. with Eng. news to 1010, talks to 1030, and dictation-speed news until 1115 fade-out. *(59)*

The 9460-kc. outlet is noted in Germany at 0030-0100 and also at 0230-0300 with Eng. xmsns. *(GJ)*

Czechoslovakia—Prague broadcasts to N.A. at 1930-2000, 2200-2300, and 0000-0030 on 7250, 9510, 9550, 11,830, and 11,930 kc., and at 0330-0430 on 15,180, 17,810, and 21,450 kc. Xmsns in Spanish to Latin America are at 1800-1830, 1900-1930, 2130-2200, and 2330-0000 on 9550, 11,935, 15,145, and 15,285 kc. *(OS, 152, 176, 282, 313)*

Denmark—*The Voice of Denmark*, Copenhagen, operates to N.A. at 2030-2130 and 2200-2300 on 9520 kc. The first half hour is in Danish and the remainder in English. "Mailbag" session is noted Saturdays at 2100 and 2230. There is no Eng. broadcast on Sundays. *(312, 329)*

Another xmsn at 0000-0030 to England can be heard on 15,180 kc. *(CH)*

Dutch Guiana (Surinam)—AVROS, 15,406 kc., Paramaribo, broadcasts in Eng. on Mondays only at 2000-2010 with news. *(104)*

Egypt — *Cairo Calling* (Arabic — *Huna El Kahira)* is noted on 17,915 kc. at 0800-0900, all Arabic except for Eng. news; Eng. at 1500-1520 with news at 1500. The IS is camel bells. *(CA, 298)*

El Salvador—YSUA, San Salvador, is fine around 2345 on 6188 kc. Most of the other L.A. stations near this channel have s/off and there is little QRM. *(AN)*

French Equatorial Africa—*Radio Brazzaville* is noted on 11,970 and 9620 kc. with Eng. news to the Pacific Coast and the Far East at 2145-2155. S/off is 2159. *(CL, 44, 321)*

Guatemala—*R. Nacional*, TGQA, Guatemala City, is definitely using 6112 kc. and has been heard around 2230 with ID and American recordings. *(AN)*

Haiti—*R. Haiti*, Port-au-Prince, 6200 kc., has changed time for "Your Hit Parade." It is now heard at 1915 in Eng., and may be noted on Sundays and Thursdays. The 15,430-kc. outlet is being used for daytime service and is tuned around 1500-1530 with pop records and announcements in French. *(AN)*

The Evangelistic Voice of the West Indies, 4VE, Cap Haitien, is a low-powered station (50 watts) on 6100 kc. It is noted around 0500 s/on with regular programs. *(281)*

Honduras—*R. Montserrat*, Tegucigalpa, has moved from 6020 kc. to 6025 kc. and has Spanish news at 2245. This one is often smeared by QRM. *(AN)*

Hong Kong—*R. Hong Kong*, 3940 kc., is noted in Western states at 0815-0830, all Chinese, with news at 0830. Signals are good until 0845, then lose out to QRM. *(61)*

Hungary—*R. Budapest* has deleted 11,910 kc. and added 6195 kc. for the seasonal outlet. This is heard well around 2300. *(AN)*

India—*All-India Radio*, New Delhi, has a widely reported xmsn to England at 1445-1545 on 11,710 kc. This is dual to 15,105, 15,290, and 17,860 kc. but the 11-mc. channel seems to be best heard. *(KK, MM, 281, 298)*

Netherlands—The latest information from *Radio Nederland*, Hilversum, is as follows:

to Europe and N.A. on 17,810, 17,800, or 17,775 kc., and 15,445, 15,425, or 15,220 kc. (in each case, the channel used depends on conditions) at 1615-1655; and to N.A. on 6025 and 9590 kc. at 2130-2210. *(176, 313)*

Nicaragua—YNRM, *R. Musun*, Matagalpa, 7602 kc., was noted at 1830-1930. YNMS, *Radio Philips*, Leon, 7660 kc., is heard at 1900-1930. Both stations feature L.A. music, commercial ads, and all-Spanish anmt. *(61)*

Panama (Republic)—HOU31, *Voz del Baru*, David, 6045 kc., is currently good at 2130 and closes at 2200 through the week. *(AN)*

Pakistan—The following Eng. sessions are noted from Karachi: to Turkey at 1815-1900 and to England at 1915-2000 on 11,674 and 9705 kc. Another English period is noted at 1415-1500 with news at 1430 on 11,674 and 15,240 kc. *(MM, 298)*

A xmsn to Southeast Asia is well heard on 15,335 kc. (best) and 17,750 kc. at 1930-2015 with native music and announcements in Urdu. Announcements at the open and close comprise the only Eng. noted here. *(61, 128)*

Poland—Warsaw has been found on 9728 kc. at 2145 in Eng., but this seems to be more of a variation than a complete move. Language is heard at 2200. *(AN, 59)*

Sao Tome—*Radio Sao Tome* (off Western French Equatorial African Coast) is a rare catch but can be noted occasionally on 17,667 kc. around 0730 in Portuguese. While not confirmed, it is thought that this station operates Sundays only. *(61)*

South Africa—Johannesburg has been found on 11,780 kc. with a test program at 1050-1115. English news is heard at 1100, stock market reports from 1105. Music beginning about 1112 is often abruptly cut off at 1115 s/off. *(RP)*

SHORT-WAVE ABBREVIATIONS

A—Approximate frequency
anmt.—Announcement(s)
Eng.—English
ID—Identity, identification
IS—Interval signal
kc.—Kilocycles
L.A.—Latin America(n)
mc.—Megacycles
N.A.—North America(n)
QRM—Station interference
R.—Radio
s/off—Sign-off
s/on—Sign-on
xmsn—Transmission from station
xmtr—Transmitter used by station

St. Vincent—*Radio St. Vincent* (British West Indies), 3305 kc., has been noted in British Guiana on Sundays only at 1700. This has not been heard in the United States as yet. *(281, Editor)*

Switzerland—Berne operates to N. A. at 2030-2215 (East Coast) and 2315-0000 (West Coast) on 9535, 9665, and 11,865 kc. In addition, 6165 kc. is also used to the East Coast. The "Mailbag" is broadcast at 2145 on the last Sunday of the month, and the DX program on the first Thursday. *(BB, CF, SM, DP, 152, 176, 276, 298, 316)*

Tangier—WTAN, Tangier, was noted on 9430 kc. around 1700, and on another day on 9412 kc. Another report places it on 9324 kc. The ID is *The Voice of Tangier*. This one

moves around fairly frequently. *(AN, 59)*

Turkey—*Radio Ankara*, 15,160 kc., has Eng. to Western Europe at 1600-1645 with news and classical music. The signal is usually strong along the East Coast, becoming weaker in the Mid-West. *(CH, DS, 318)*

USSR—*Radio Moscow* has a new xmsn called "The Moscow Mailbag" on Saturdays at 1700 and 2200 on the regular N. A. program. *(CF)*

A listener in N. J. reports hearing Moscow on 1850 kc. at 2200-2230 with fair-to-good signals and the regular N. A. program.

Vatican City—New xmsn schedule is Monday, Thursday, Saturday at 1350 with news; Monday, Wednesday, Saturday at 1045 with news and comment in Latin; Tuesdays, Wednesdays, & Fridays at 1515. The ID is "Laudatur Jesus Christus" and the IS is the opening bars of "Christus Vincit." Frequencies are 6190, 7250, 7270, 7280, 9550, 9646, and 9660 kc. *(316)*

SHORT-WAVE CONTRIBUTORS

Charles R. Allen, Jr. *(CA)*, Gastonia, N. C.
Bill Beckett *(BB)*, New Lexington, Ohio
William Davis *(WD)*, Chicago, Ill.
Creed Freeman, Jr. *(CF)*, Fayetteville, N. C.
Clayton Hallmark *(CH)*, Shelby, Ohio
Richard Heil *(RH)*, Lodi, Calif.
Donald Jensen *(DJ)*, Racine, Wis.
Gerd Janzen *(GJ)*, Ulm/Do, Germany
Ken Kudon *(KK)*, Albany, N. Y.
Craig Lewis *(CL)*, Lake Bluff, Ill.
Michael Mattes *(MM)*, East Williston, N. Y.
Robert Mitchell *(RM)*, Tweed, Ontario
Steve Meyer *(SM)*, Sargent, Nebr.
Al Niblack *(AN)*, Vincennes, Ind.
Bob Partridge *(BP)*, Camden, N. J.
Dick Parsons *(DP)*, Ascension Island
Robert Palmer *(RP)*, Spokane, Wash.
Dan Stock *(DS)*, St. Louis, Mo.
Omar Sanchez *(OS)*, Cienfuegos, Cuba
Chuck Maxant *(11)*, Baldwin, N. Y.
Ross Brownell *(39)*, Vancouver, B. C.
Anson Boice *(44)*, New Britain, Conn.
Grady Ferguson *(59)*, Charlotte, N. C.
John Beaver *(61)*, Canon City, Colo.
Bill Hutchinson *(76)*, Baltimore, Md.
Ed Kowalski *(104)*, Philadelphia, Pa.
Tibor Gasparik *(128)*, Cleveland, Ohio
Roy Bugden *(152)*, Fort Lauderdale, Fla.
George Cox *(166)*, New Castle, Del.
Eugene Simpson *(176)*, Arlington, Mass.
Fjalar Hemming *(276)*, Helsingfors, Finland
Ronald W. Kenyon *(281)*, Ashland, Ky.
Bob Kapsch *(282)*, Roselle Park, N. J.
Robert Miller *(298)*, Philadelphia, Pa.
Ed Leibfarth *(312)*, Swedesboro, N. J.
Denny Avers *(313)*, Keyser, W. Va.
Stanley Schwartz *(316)*, Forest Hills, N. Y.
Kenneth McCartney *(318)*, Toledo, Ohio
Gary Sikorski *(321)*, Chicopee, Mass.
Russell Brown *(329)*, Hinsdale, Ill.
James Bannister *(336)*, Brampton, Ont.

Windward Islands—Grenada has moved to 5010 kc. from 4760 kc. and runs to 1730, when it changes over to 3363 kc. *(166)*

Yemen—According to a Middle-East magazine, *Radio Sanaa* has been authorized to study the possibility of providing afternoon as well as evening programs, the addition of a 25-minute Eng. program, moving to the 25-meter (11-mc.) band, and tape-recording and rebroadcasting the entire daily broadcast to Europe and America later at night. *(DJ)*

Clandestine—*Radio Espana Independiente* has been found on about 8025 kc. from 1730 to 1800 s/off in Spanish with some political talks. *(76)*

-30-

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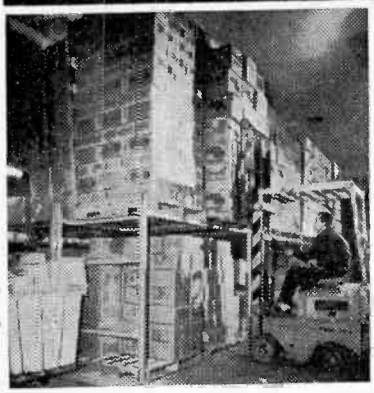

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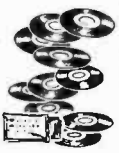

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- Handy reset button.
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- Included at no extra charge — U.S. Atomic Energy Commission booklet titled "Prospecting with a Counter."

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The Model WF-12A combines the laboratory and field counter in one rugged instrument. The use of an external probe permits the operator to investigate holes and fissures where an internal type of probe cannot reach. The use of phones and a visible lamp permits the operator greater freedom of operation as he no longer has to keep his eyes on a relatively small indicator.

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SPECIFICATIONS

Three counting ranges are available:

0-100 counts per minute—used in cosmic ray and extremely low activity determinations.

0-1,000 counts per minute—used for average activity and normal work.

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High accuracy is assured by the handy *reset button*, located on the front panel, which permits compensation for variations of battery voltages and background count.

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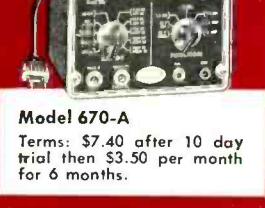

Model TV-40

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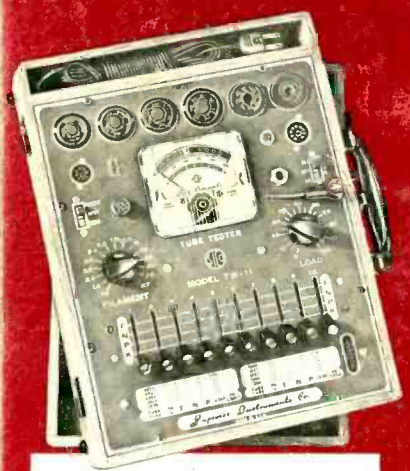

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Superior's New Model TD-55

TUBE TESTER

EMISSION TYPE

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The busy TV Service Organization, which needs extra Testers for its field men.

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The Model TD-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum.

Checks for shorts and leakages between all elements
The Model TD-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals.

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The 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

Complete with carrying case **$26.95 Net**

Superior's New Model TW-11

STANDARD PROFESSIONAL TUBE TESTER

- Tests all tubes, including 4, 5, 6, 7, Octal, Lockin, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Subminars, Proximity Fuse Types, etc.
- Uses the new self-cleaning Lever Action Switches for individual element testing. **All elements are numbered according to pin-number in the RMA base numbering system.** Model TW-11 does not use combination type sockets. Instead individual sockets are used for each type of tube. Thus it is **impossible to damage a tube by inserting it in the wrong socket.**
- Free-moving built-in roll chart provides complete data for all tubes. Printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose internal connections.

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Housed in hand-rubbed oak cabinet **$47.50 Net**

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