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Buy Hi-Fi

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July 1958

ELECTRONICS ILLUSTRATED

A Fawcett Publication

Vol. 1 No. 2

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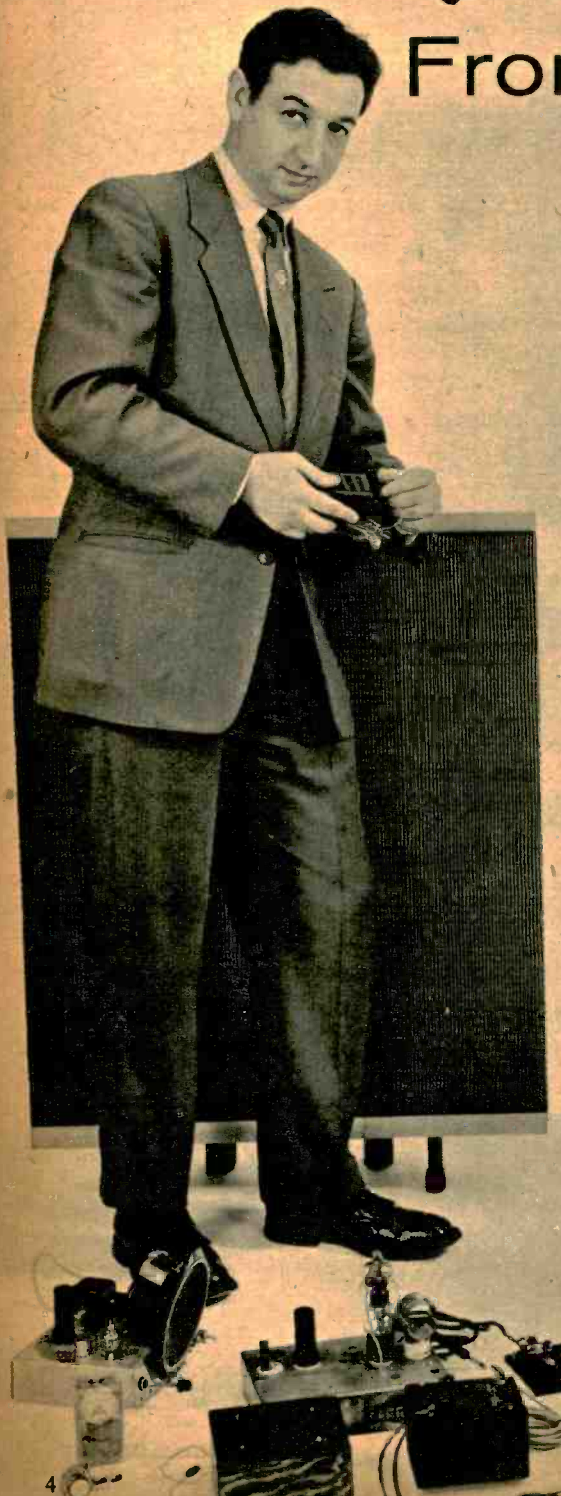
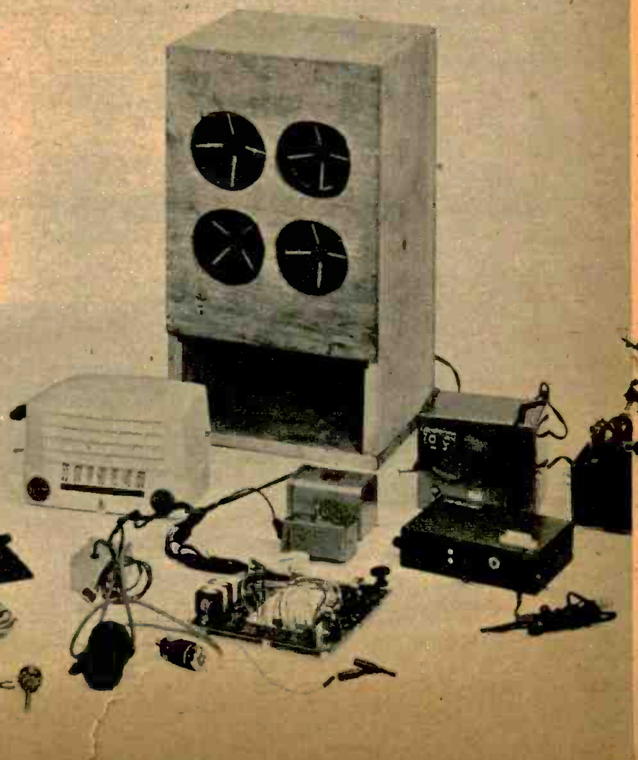
A *Message* From the Editor



ELECTRONICS ILLUSTRATED is on its way. The sale of the first issue has been excellent and we have received many congratulatory letters from readers. ". . . Thoroughly enjoyed your first issue, am looking forward to the next copy. . . Found many interesting items and I am sure that future issues will be even better. . . Congratulations on a great new magazine. . . I think that it is one of the best magazines published yet for people interested in electronics, there is something in it for everybody. . . Found the book so fascinating that I couldn't put it down. . ." and so they run. Thank you all for your very kind letters and encouragement. Our future issues will indeed be bigger and better. We've lots of "hot" ideas now in the works—things you'll want, and can build.

Talking about build-it-yourself items, you see a selection of them here. As

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promised in our first editorial, ELECTRONICS ILLUSTRATED is testing every construction item to make certain that it works and is easy to build. Most of the items shown on page 4 have already been tested successfully and either appeared in the first issue or are in this one. Some did not pass our tests and therefore the authors will get them back for additional work. We mean to stick to this principle in your favor.

This issue carries two new regular features: The Electronic Brain and the Hi-Fi Clinic. The operator of our Electronic Brain is Mr. Harvey Pollack, widely read author of electronics projects in popular magazines and science instructor in high school and college. Mr. Pollack has just been awarded first prize, for the second time, in a contest run by the National Science Teachers Association for his "New Laboratory Approach to High School Physics." We thought you'd like to know, because he'll be available to answer any questions you may have on electronics—radio—TV—amateur radio, etc. And if your interest is hi-fi, look through the Hi-Fi Clinic. Your questions may be answered there.

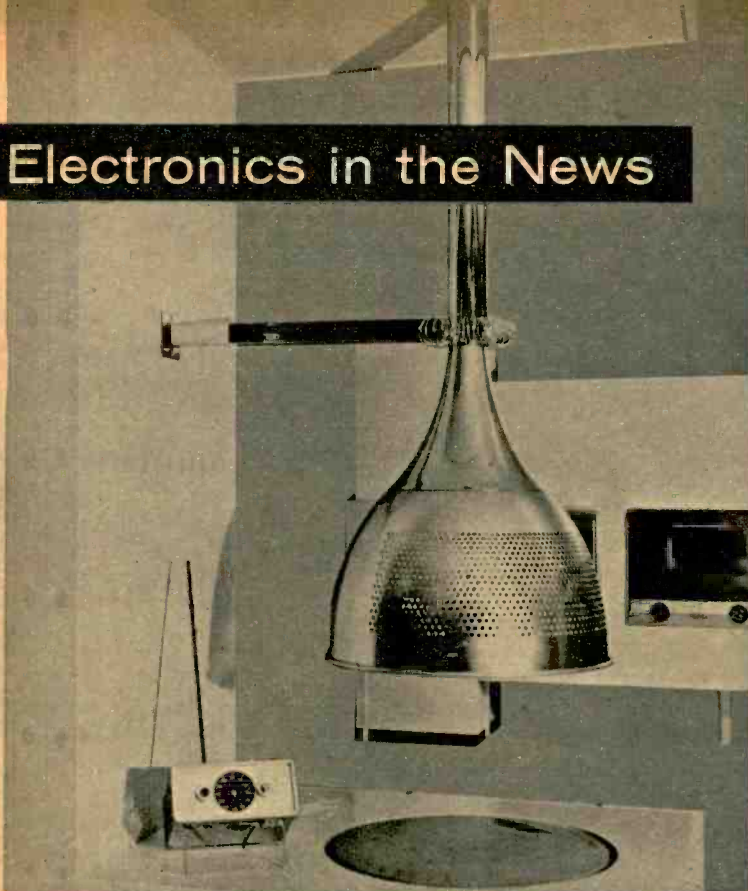
We've a factual interview in this issue with Len Chase, operator of the Electronic Workshop in New York City. Len is an expert salesman of hi-fi and his comments on "How To Buy Hi-Fi" should be of great interest and help to anyone now trying to make a choice between components and consoles, or among particular components.

There is so much to describe in this issue that I'd just as soon not keep you here, but encourage you to read through. In particular I'd like to call your attention to "How To Build A Safe Rocket" starting on page 28. This is an ideal project for father and son. We're hoping it will promote a measure of "togetherness" among the men in the family.

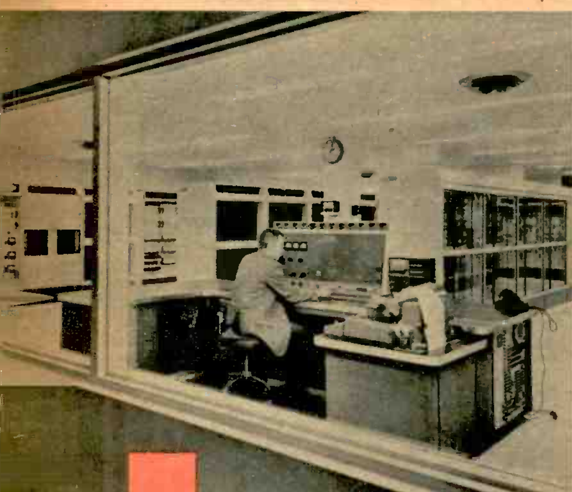
Our next issue will carry the rocket project toward the testing and firing stage, and in addition will bring you many build-it-yourself items designed to fit in with your warm-weather habits. Our theme will be electronics in the outdoors.

Charles Tepfer

Electronics in the News



We've been shown electronic ovens, now comes an electronic surface unit! The visible part consists of a Fiberglas disc on the countertop with a hood. Two controls turn the unit on or off and govern cooking time in minutes and seconds. As cooking begins the metal hood drops down over the food to distribute the microwaves evenly. This unit and the electronic oven behind it can be remotely controlled via a radio transmitter "from other side of town if needed," says Westinghouse.



Michigan Blue Cross-Blue Shield keeps track of 1,600,000 subscribers with this computer. Built by Minneapolis-Honeywell, the "1000" reads 627,000 names in Detroit phone-book in 11 minutes.

The new Lockheed WV-2E carries the world's biggest airborne antenna and most powerful aerial radar. This new super-snooper is expected to "see" half again as far as any current aircraft radar.

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Visitors to the Brussels World's Fair this summer will see the Sylvania "Sylouette" 21-inch television receiver on display as representative of U. S. advancement in the video art. Selected by the government for the exhibit, the TV is characterized by a cabinet depth of only 10 inches. The "Sylouette" was selected by a committee representing leading art and design associations in the U. S.

—o—

The nation-wide CONELRAD defense warning system is going to be used in the future to notify listeners of emergency storm and flood warnings as well. The FCC recently authorized this special use of the existing national defense alerting procedures in an attempt to reduce loss of life and property damage caused by sudden hurricanes, tornadoes, and flash floods.

—o—

It was bound to happen sooner or later—but a digital guidance computer is to be built along engineering designs provided by another electronic computer! Remington Rand's "Univac" was the brain behind the development of the "Athena," part of the ground-based guidance system for the Air Force's intercontinental ballistic missile, the "Titan."

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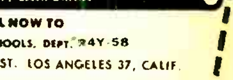

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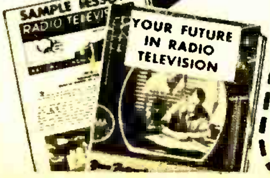

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The engineers of United Air Lines, working with Radio Specialists Company of Denver, have come up with a transistorized "Tiny Talky" which is being used by ramp supervisors to expedite the flow of passenger traffic on outgoing flights. The two-way portables weigh only 5½ pounds, have a maximum range of 4 miles, and operate on the 420-470 mc. band. Compactness is achieved through the use of transistors and small batteries. The radio is carried in a leather case attached to a Sam Brown belt. The small plastic earpiece and a hand microphone replace the telephone-type handset used with the predecessor models. The antenna, only 6 inches long, juts from a shoulder epaulet on the dispatcher's uniform.

—o—

Dirty dishes and greasy pots—the housewife's most dreaded spectacle—can now be cleaned silently and thoroughly with invisible sound waves. A new, noiseless, ultrasonic dishwashing machine that scours unscraped dishes, pots and pans in a fraction of the time now required by conventional machines will be available commercially, perhaps within the year, from Acoustica Associates, Inc., Culver City, California. Initial cost of the miraculous new machine will be about $500, a bit high, but you'll be a pioneer!

—o—

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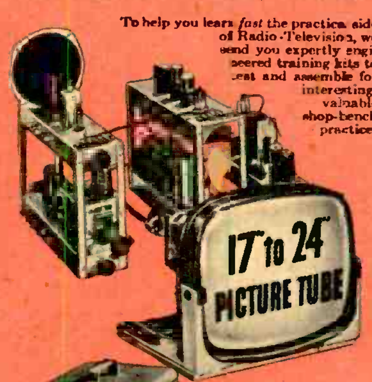

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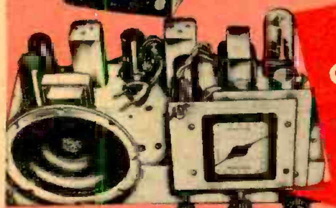

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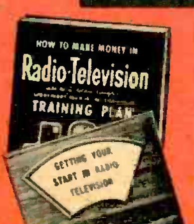

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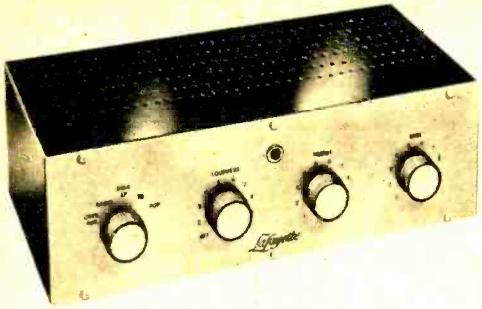
A magnetic head for tape recorders which records and plays four channels on a standard ¼-inch tape has been developed by Shure Brothers, Inc. of Evanston, Illinois. The unit has two in-line tracks that permit interlaced operation. The new tape head actually doubles the recording time of both monaural and stereophonic tapes. At the same time, it is completely compatible with present tapes.

Shure also recently unveiled a compatible stereo electromagnetic phono cartridge to sell for about $45.

—o—

An electronic outline of world history from 4 B.C. to the present will be a feature exhibit in the U. S. Pavilion at the Brussels World's Fair. Presented by IBM in cooperation with the U. S. Department of State, the automated history text is stored in ten languages, including Russian, in an IBM 305 "Ramac" computer. Any portion of the history may be located by the machine in less than two-thirds of a second and printed out in any one of the ten languages on a built-in IBM electric typewriter. Might not be a bad gadget for Junior's Christmas stocking next year—especially if he is pulling down C's in World History I.

—o—



New hi-fi listeners who are interested in obtaining a component system at minimum cost might investigate a new 12-watt amplifier available for $33.50 from Lafayette Radio, 165-08 Liberty Avenue, Jamaica 33, New York. This unit is known as the LA-22 and, according to the manufacturer, it possesses such features as frequency response of 30-20,000 cps + 1 db, less than 1½% intermodulation distortion, hum level 60-80 db below full output, 5 inputs including tape head and loudness control. The 4″ high cabinet is black and gold.

—o—

Most radio receivers are designed to minimize the effects of atmospheric noise, or static, as much as possible, but the Electronic Control Systems Division of Stromberg-Carlson is building a number of receivers with just the opposite goal in mind. These special instruments, called Atmospheric Noise Recorders, are being produced by Stromberg-Carlson, a division of General Dynamics Corporation, for the National Bureau of Standards. They will be used at widely-separated locations around the globe to receive, measure and record atmospheric radio noise. This scientific study program is being conducted in connection with the International Geophysical Year, but also will be continued through the next 11 years, in order to cover a complete sunspot cycle. In this way a multitude of studies will be drawn together in one overall evaluation, to provide the data for design of radio receivers having improved sensitivity and noise rejection characteristics for short wave listening as well as local reception.

—o—

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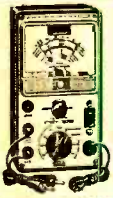

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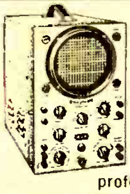

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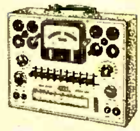

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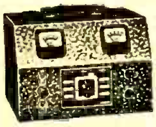

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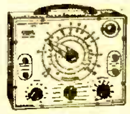

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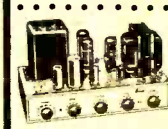

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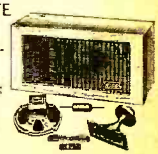


COMPLETE with FACTORY-BUILT CABINET: **2-WAY SPEAKER SYSTEM HFS1** $39.95

RCA has developed a new ultra-sensitive vidicon camera tube especially for broadcast, industrial, and military TV applications. When used in the new camera designs, the 7038 is capable of producing pictures of broadcast quality with as little as one foot-candle of highlight illumination on its faceplate because of an improved photoconductive surface.

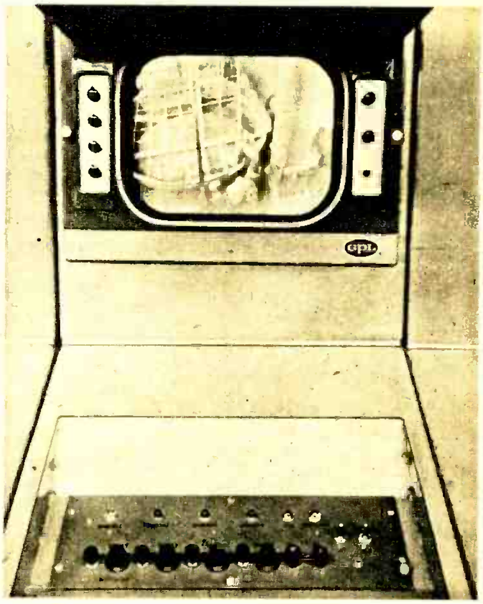
—o—

Power-line failures and the wild scramble for candles, flashlights, and Junior's ray gun may become a thing of the past. RCA has developed a new electronic "circuit sentry" which actuates circuit breakers and isolates the faulty high-voltage lines in a 12/1000th of a second. The fast-acting transistorized device uses a transmitted tone signal to set in motion a series of relays which do the actual work of guarding the equipment. Called the "Tru-Trip" unit, it can also transmit safety action signals for an entire system.

—o—

Motorola Inc. has developed a fully transistorized, battery-operated power megaphone that has an effective range up to ¾ths of a mile. Six ordinary flashlight cells drive the six-transistor amplifier to provide a full 15 watts of amplification. The whole unit weighs less than 8 pounds.

—o—



Western Electric Company is using closed-circuit television in its Kearny, N. J. cable plant to obtain maximum production efficiency and safety. Two General Precision Laboratory TV cameras, one focused on each of two 3000-gallon hydrapulper tanks, transmit a continuous picture of the process via coaxial cable to a 14" monitor which is viewed by an operator stationed at the central control panel on a different level in an adjacent building. Every step of this vast and potentially dangerous operation is monitored safely and surely by the "extra eyes" of the TV camera.

—o—

One answer to the growing problem of lack of TV channel space has been offered by Blonder-Tongue Laboratories, Inc. which has developed "Bi-Tran," a system of transmitting and receiving two different TV programs simultaneously on each TV channel. As envisioned by the company, the "A" program would consist of standard commercial fare as now provided and viewed on any TV set. The "B" signal would be assigned to pay-as-you-see TV, educational TV, etc. The "B" picture could be received privately, but only if the TV set were equipped with a special attachment.

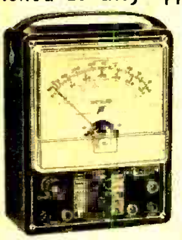
Shipped on... approval

SEND NO MONEY — NO C.O.D.

Try them for 10 days at no risk! Examine first, and then only if completely satisfied, pay lowest prices for highest quality units, in easy monthly installments.

SPEEDI-TUBE CHECKER, MODEL 301.

Only 2 settings needed. Checks over 99% of all TV and Radio tubes in use today, including 0Z4, series string, and magic eye. Checks for cathode-heater, cathode-grid, and cathode-plate shorts up to 1.5 megs. Uses large, D'Arsonval type meter with multi colored "reject-good" scale. New tube listings furnished as they appear. **By far, the lowest priced Tube Checker on the market today** . . . none finer at any price. Comes in handsome, hand-rubbed oak carrying case. **Model 301 (wired) $47.50 Net**



VOLOMETER, Model 104.
This 20,000 Ohms per volt instrument is the **lowest priced, domestic made, unit of its kind in today's market.** Uses large 4½" D'Arsonval, 50 microampere meter, accurate to 2%. Housed in polished, high impact, bakelite case . . . uses a durable, etched aluminum panel. 3 AC Current Ranges. Checks resistance accurately in 3 ranges to 20 megohms. 5 DC and AC Ranges to 3000 volts. 5 DB Ranges. **Model 104 (wired) $26.95 Net**

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Please send me for approval the units checked.
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Total Price $47.50
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within 10 days
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He who is fortunate enough to own the Garrard 301 Transcription Turntable and the Garrard TPA/10 Tone Arm can enjoy the unique pleasure of knowing that *his* is the finest . . . the handsomest . . . record-playing combination in the entire high fidelity galaxy.

A pair of great products . . . great because they reflect 35 years of skill and the standards of leadership. No gadgets . . . no compromises . . . only the time-proven features which guarantee continuing, undeviating excellence.

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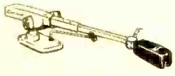
WORLD'S FINEST RECORD PLAYING EQUIPMENT

Model 301
PROFESSIONAL TRANSCRIPTION TURNTABLE

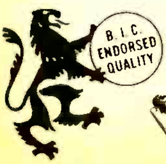
- Features continuously variable control of each speed . . . the record can be "tuned" to match a musical instrument
- Heavy-duty 4-pole shaded motor is entirely Garrard-built
- Cast aluminum turntable is a full 6½ lb. . . . dynamically-balanced
- Motor and connected levers are completely isolated from unit by an exclusive damping system of tension-compression springs
- Exclusive built-in pressure lubrication system
- Performance of each 301 is certified with a written individual test card **$89.00**



Model TPA/10
TRANSCRIPTION TONE ARM

- Built to insure professional quality performance, with traversing and vertical friction reduced to absolute minimum by special cone-type ball-bearing pivots, as in the finest chronometers
- Takes any cartridge
- Fits into more installations than any other professional tone arm, since it is adjustable in length and tracking angle . . . plays up to a full 16" record
- Simple to install, with specially designed templates **$24.50**

There's a Garrard for every high fidelity system



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4-Speed Super Auto-Manual Changer
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Model RC88
4-Speed Deluxe Auto-Manual Changer
$54.50

Model RC121/II
4-Speed Mixer Auto-Manual Changer
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For Information Write Dept. GG-438 **GARRARD SALES CORP., Port Washington, N. Y.**

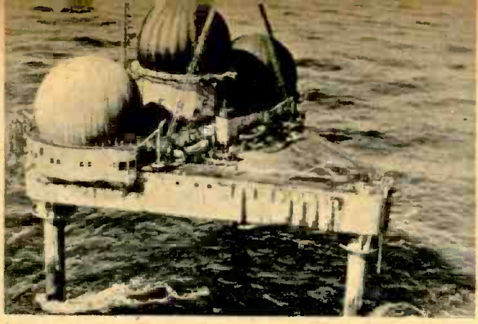
Nerve center of our anti-aircraft defense is this panel at NORAD HQ.

Blueprint for Defense

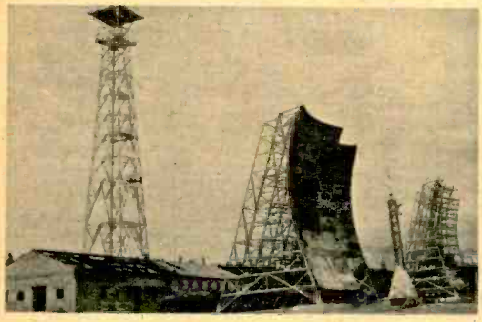
By Paul Beame

Can we beat an enemy air attack today? How and where does electronics fit in with missile warfare?

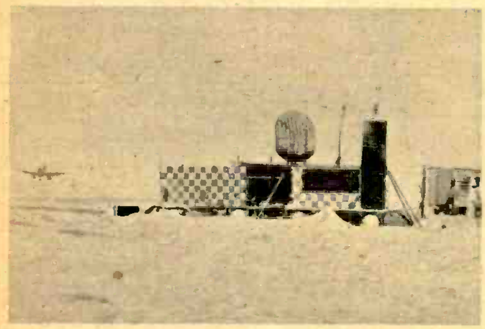
THE restless, probing finger of a radar beam pokes through the northern skies. The man hunched over the scope in the dimly lit room under the dome of a DEW Line installation, accustomed to seeing nothing but the sweep of the beam across the PPI screen, suddenly



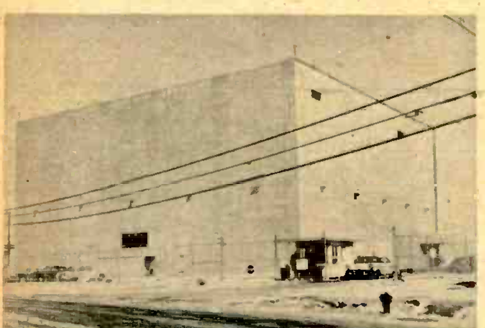
Three of these "Texas Towers" stand 100 miles off the Atlantic coast, extending radar curtain.



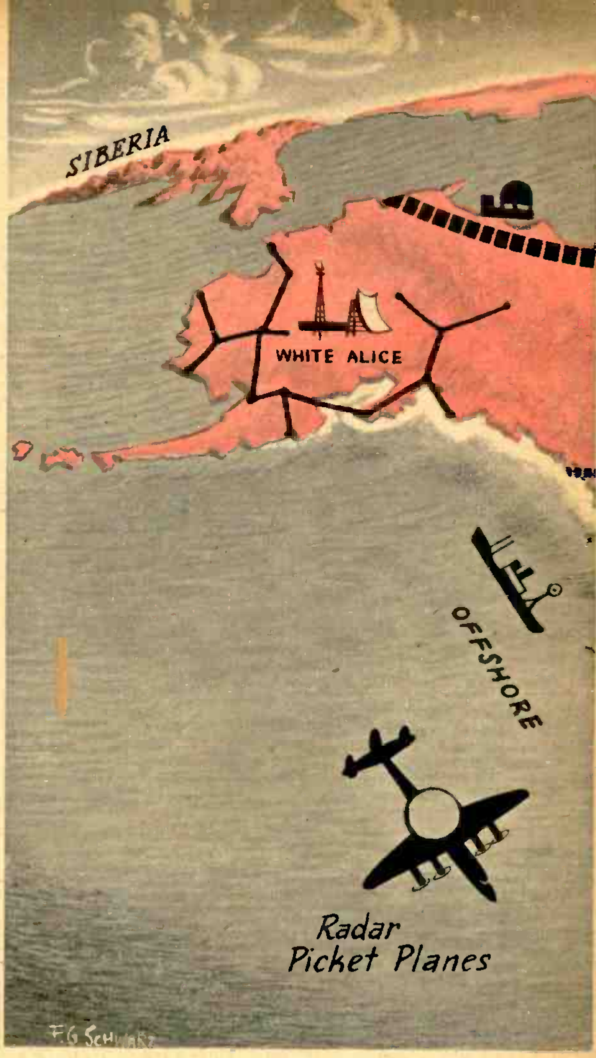
Huge "movie screen" antennas of "White Alice" send radar signals over the horizon.



Cargo plane, servicing the DEW Line, lands on snow covered strip, guided in by radar control.



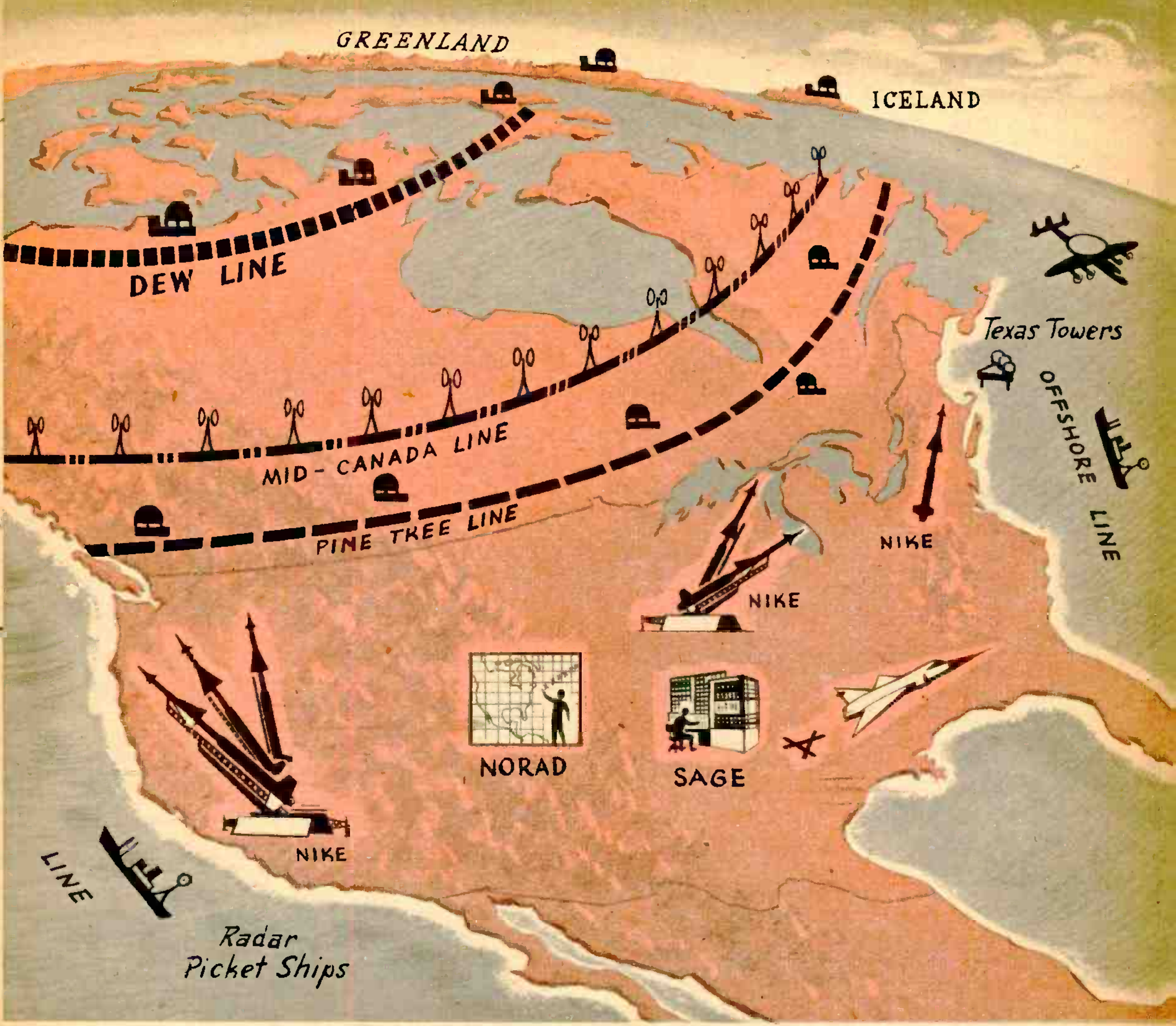
SAGE system computers, which keep track of flights over continent, are in blockhouses.



straightens up with a snap. A little "pip" of brightness has edged into view.

At this precise moment an IBM computer, one of the SAGE net linking district command headquarters across the United States and Canada, is muttering quietly to itself over the 30,000 scheduled flights daily that it keeps careful track of and labels with an "F" for Friendly.

At exactly this time an airman steps to the huge transparent plotting board that represents the continent of North America in NORAD (North American Air Defense) headquarters at Colorado Springs. The row of officers at the semi-circular row of control stations before the board watch him as they watched



These are the main elements in the defense network of the U.S. against enemy air attack.

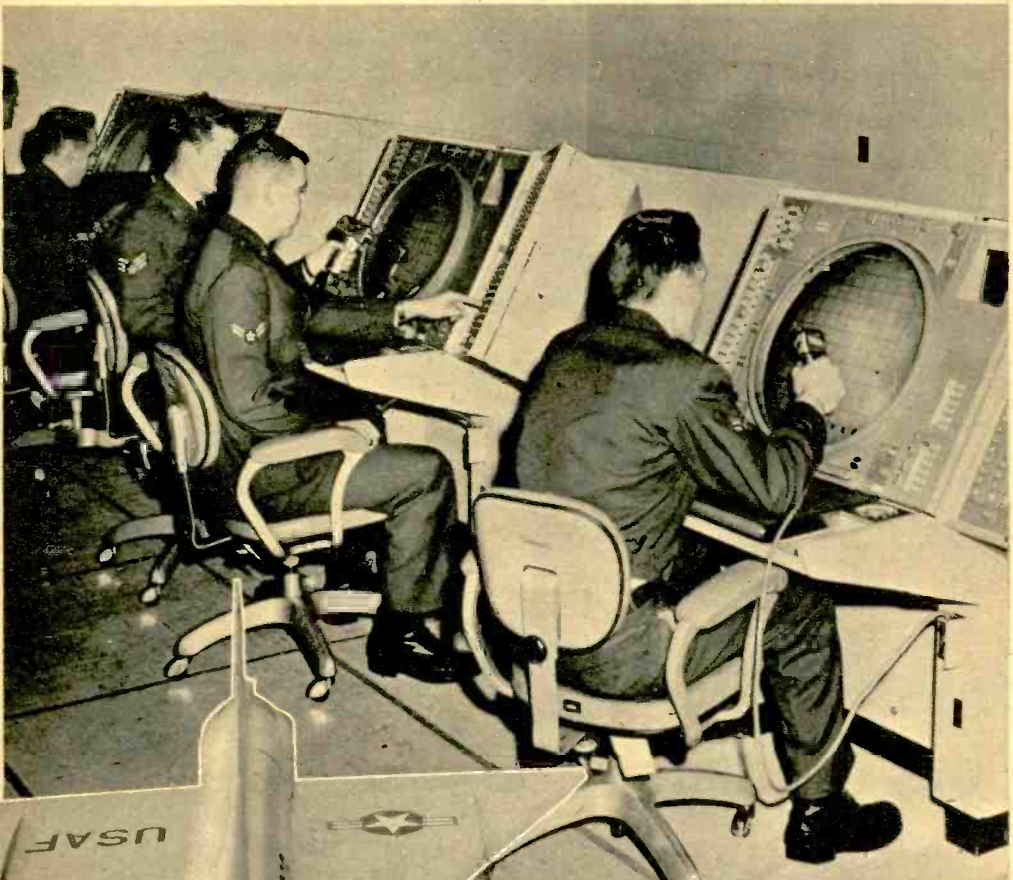
hundreds of times before. But this time they tense with an ominous alertness as he posts the dreaded indicator up near the roof of the world—"H" for Unknown and Presumed Hostile.

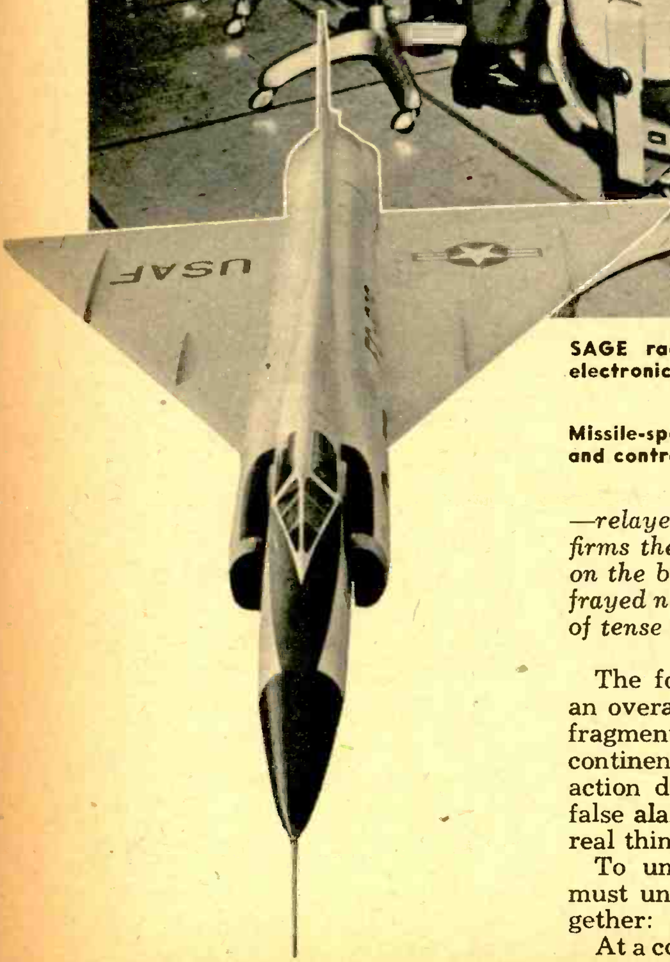
Back at SAGE headquarters and in all the SAGE headquarters across the continent the computers are alerted and the position and speed of the approaching "H" craft are fed into their spinning tape memories. These bits of information are filed and almost instantly compared to millions of other bits of information already in the tapes and auxiliary tapes. The computers reach a quick conclusion: They have no information regarding an aircraft in that position, but . . .

NORAD commander Gen. Partridge picks up the red "hot line" phone directly to the White House as his aides alert the Pentagon. From the President must come the final decision to order our Strategic Air Command to act against the homeland of the enemy and our fighters into the air to meet the presumed hostile plane.

. . . but, the computers add, there is a flight from Sweden expected over the Pole which may have been forced from its route. The computers continue to clack. Speed, they determine, is too slow for a jet. NORAD relaxes slightly, but remains alert.

Finally a radio report from the plane





SAGE radar operators pick up pips with electronic "guns," feed info to computer.

Missile-spouting "Delta Dagger" is sent aloft and controlled in air fight by SAGE computer.

—relayed by a DEW Line outpost—confirms the supposition. The designation on the big board is changed to "F" and frayed nerves calm to their normal state of tense readiness.

The foregoing is not the product of an overactive imagination. It is just a fragment of the overall picture of our continental defense system flashing into action during an alert. It was just a false alarm, but it could have been the real thing.

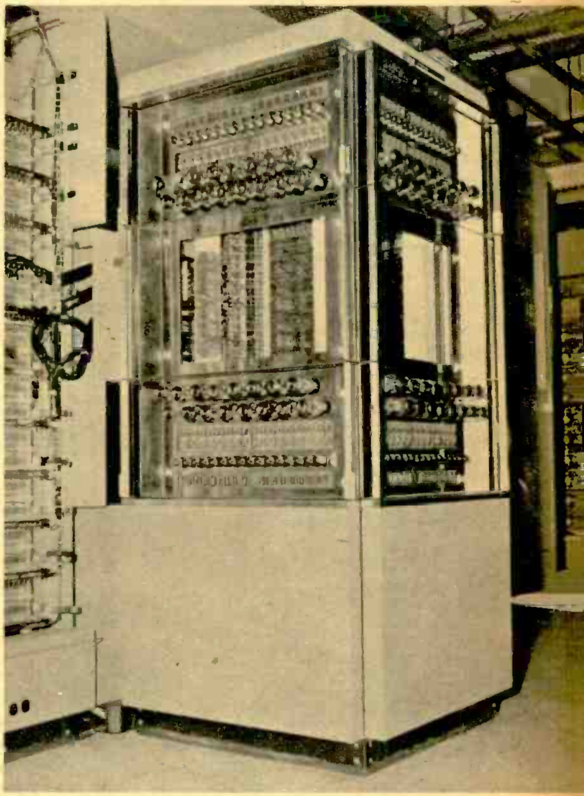
To understand the big picture, we must understand how the parts fit together:

At a cost of more than 8 billion dollars

we have constructed what we hoped would be an impenetrable warning screen around the top and sides of North America. Starting at the top, we built a chain of radar stations across the frozen, wind-swept tundra to probe the northern reaches. The range of these DEW (Distant Early Warning) Line stations is perhaps 200 miles, and forms an interconnecting fence with a reach of about 15 miles above the surface of the earth. These stations are semi-automatic, which means that automatic controls keep the electronic beams constantly on the alert, flashing a warning to the human occupants of the stations when they touch something with their fragile electronic fingers.

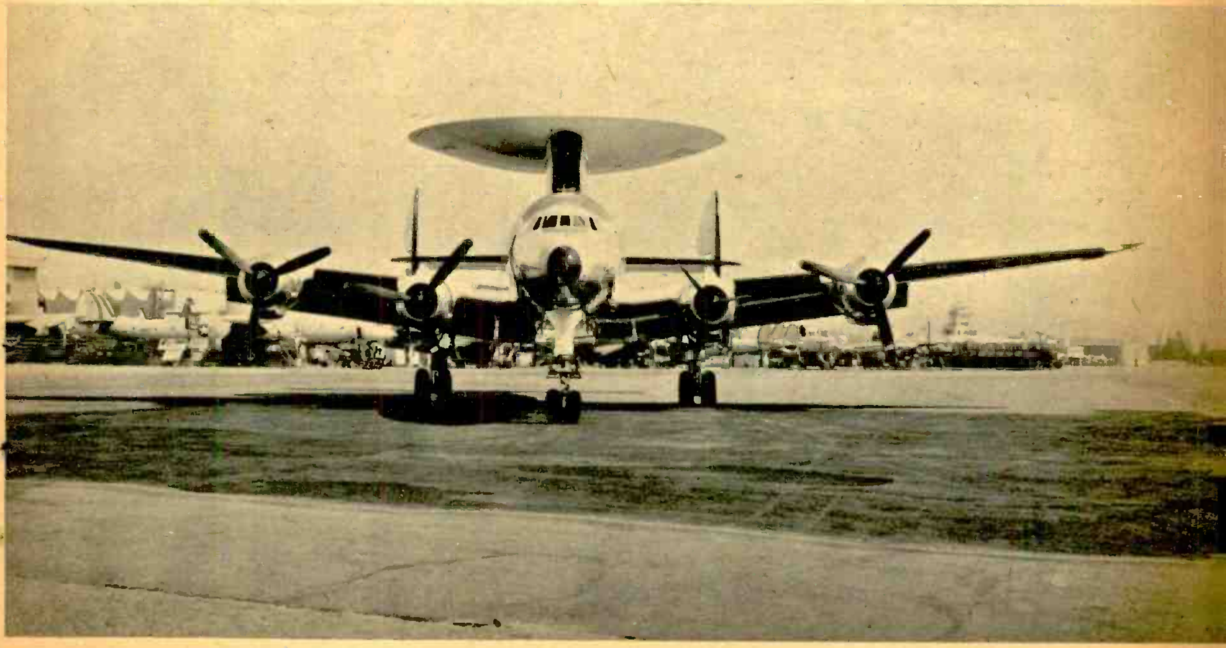
Until recently an alarm would have been relayed to NORAD by means of radio, which, due to atmospheric disturbance, might prove to be unreliable in a time of emergency. Therefore we constructed White Alice, a euphemism for a huge network of over-the-horizon, tropospheric propagation stations which give Alaska its first reliable, modern telephone connection to the United States. DEW Line communications are

[*Continued on page* 106]



Heart of the SAGE computer is this memory core that stores and recalls over 100,000 items.

A new type of radar antenna is atop this Navy plane which regularly patrols our coast line.

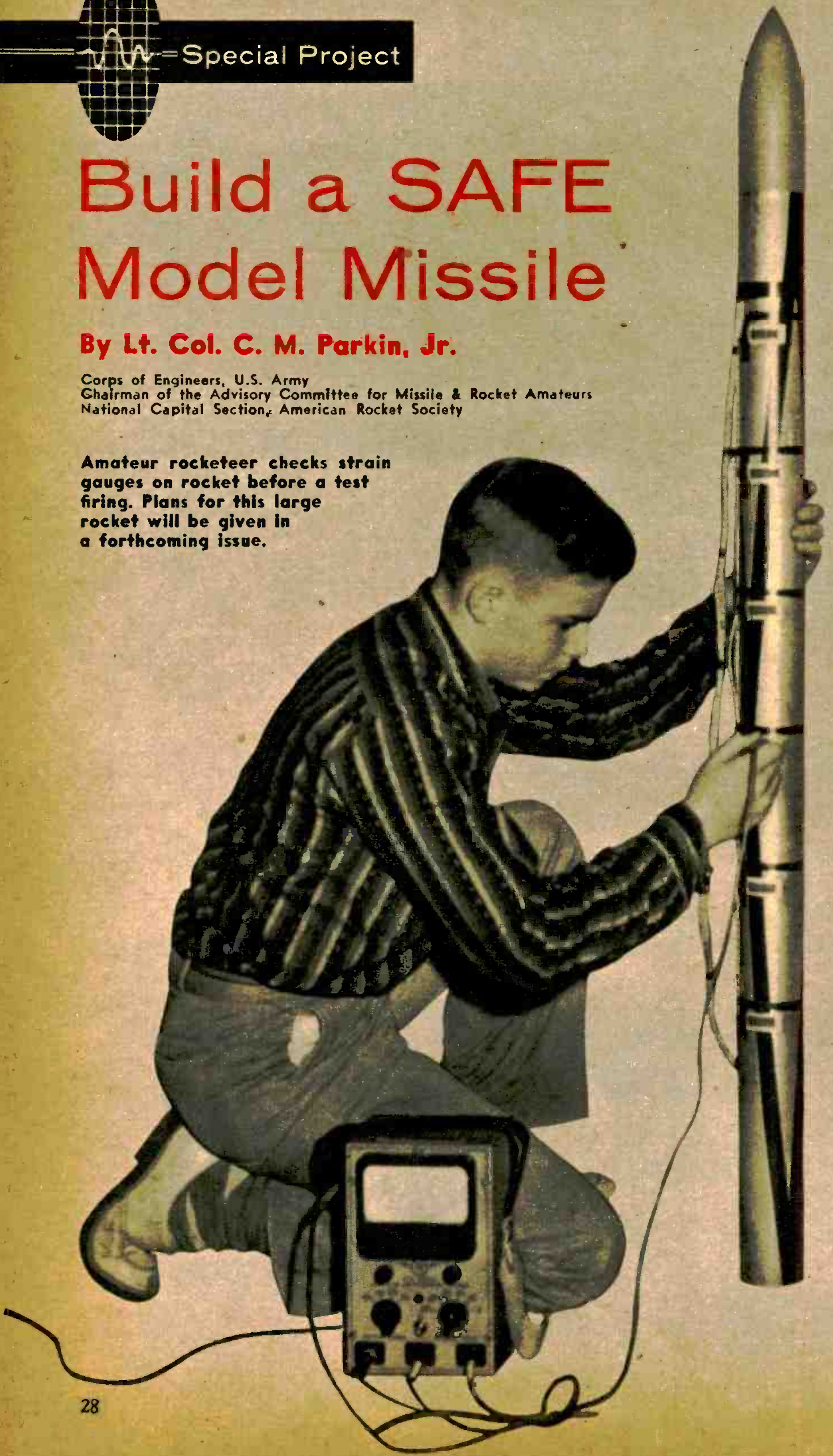


Special Project

Build a SAFE Model Missile

By Lt. Col. C. M. Parkin, Jr.

Corps of Engineers, U.S. Army
Chairman of the Advisory Committee for Missile & Rocket Amateurs
National Capital Section, American Rocket Society



Amateur rocketeer checks strain gauges on rocket before a test firing. Plans for this large rocket will be given in a forthcoming issue.

SEEN ON OUR COVER: James Blackmon, 19-year-old experimenter of Charlotte, North Carolina, and his 6-foot rocket which he built in his father's basement workshop. Jimmy figured that this rocket with its $5 lampshade nose cone, 6-inch combustion chamber and dry ice cooling system would go about one mile up. Liquid nitrogen, gasoline and liquid oxygen were stored in tanks equipped with valves and gauges. Unfortunately, when Army missile experts, headed by Dr. Wernher Von Braun, examined the rocket they found that it could not safely control the flow and mixing of fuel and therefore they grounded it. However they pronounced Jimmy's approach clever and admirable and invited him to work at the Redstone Arsenal when he finishes college which he is now attending, helped by a $1000 award from the Chrysler Corp. and the American Rocket Society.

Get into the exciting new hobby of rocketry, you may learn to become an electronics rocket expert.

THIS article and those that will follow will show the amateur rocket experimenter how to build the three major components that are essential to every rocket or missile operation: the rocket or missile itself, a test stand, and a launcher. The next step will be to equip the missile with some simple electronic equipment to measure flight characteristics, etc. This article includes a plan for a small simple rocket. The dimensions for this missile have been carefully chosen to conform to good engineering design. Specific information on how to build it will be given later in the article; first, some words about safety.

Paramount to the building of a simple rocket is your SAFETY and the safety of your friends and the public. SAFETY is first, last and always, and please do not forget it. There is no value in building a rocket if you will injure yourself or others in the process of building, testing or firing this rocket. Therefore I have outlined a few simple safety precautions which I urge you to pledge that you will support at all times.

Building the Rocket

The first rocket you build should be a small one, for you will soon see that you can learn as much from building and testing a small one as you can learn from building a large one, and it is a great deal less expensive. The plans given here are for a 17⅞″ aluminum rocket. *A full size blueprint for this rocket may be obtained by sending 50 cents along with your request to ELECTRONICS ILLUSTRATED, 67 West 44th Street, New York 36,*

This rocket, built by an amateur and loaded with a blasting cap, exploded upon firing, hurling forth dangerous shrapnel. For safety's sake, don't use blasting caps.

SAFETY RULES

1. Look up the rules, regulations and laws of your community—become familiar with them and OBEY them.

2. Find an organization such as a company who makes rockets, a rocket society of a high school or a science club. Go to them for help and if possible join a rocket society or science club. Remember, many heads are better than one.

3. If you are not an adult, always work under adult supervision. The reason for this is that most adults are more cautious and have more experience and common sense than youths.

4. Never work alone. The reasoning here is that you have someone to help you, someone to go for help and of course, two heads are always better than one.

5. Don't work in your basement or attic unless you have a good workshop—one that has good heating, good lighting and good ventilation. In addition there should be fire prevention measures at hand, a first aid kit and a telephone nearby.

6. Plan your work.

7. Develop check lists for the different phases of your work.

8. Be orderly and neat.

9. Never handle components of fuels near open flame or in the presence of oxidizers.

10. Never handle components of fuels unless you know ignition temperature or flash temperature of those compounds, both separately and combined.

11. Never mix fuels without some sure method of measuring temperature of the mixture.

12. Fuels should be mixed in small amounts.

13. Proper protective clothing should be worn when handling components of fuels. This includes face shield, gloves, etc.

14. Never load fuel into a container if the fuel will react with the container. Never pour fuel over or thru threaded sections without the use of a funnel.

15. Do not fuel your rocket until you are ready to test or fire it.

16. Do not fuel your rocket with explosives.

17. Do not fuel your rocket with blasting caps or black powder.

18. Don't use compounds that are sensitive to heat, shock or friction such as potassium chlorate, potassium perchlorate, compounds of the picrate, fulminate and iodate families.

19. Do not use matches to set off rockets.

20. Do not use time fuses to ignite the fuel of rockets.

21. Use only electrical means to set off rockets.

22. When the rocket is placed in the test stand or the launcher, only one person should be at the site and he should have the key to the firing device with him.

23. The size of rocket to be tested or fired, the type of test or launching stand and the type of blockhouse or bunker you build will determine how far you should be from the rocket to be tested or launched.

24. Be absolutely certain that all electrical wire firing leads are shorted (shunted) except when they are being connected for a test or a launching.

25. Rockets should always be fired first in a static test stand of a good design. Safety of the testers and of the surrounding public is the first and always overriding interest.

26. Every test stand or launching site should have some form of warning signal followed by a loud announcement over a speaker system.

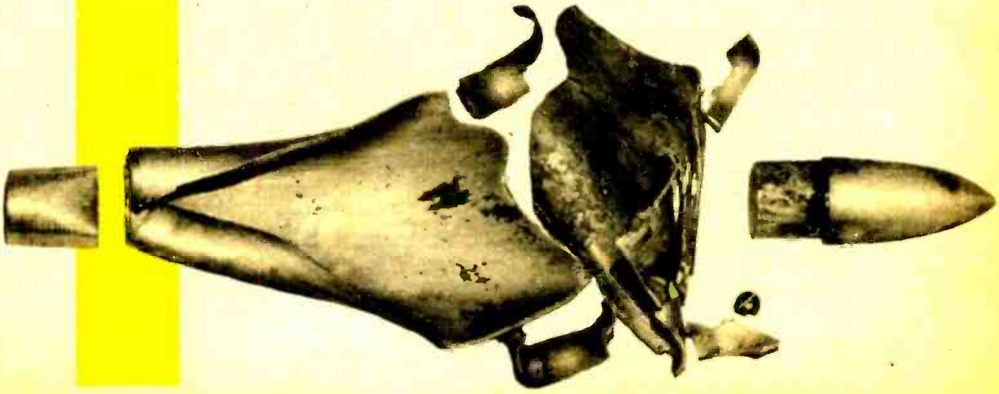
27. Remember this simple rule: two ounces of fuel are eight times as strong as one ounce, three ounces are 27 times as strong, four ounces are 64 times as strong and five ounces are 125 times as strong as one ounce. In short, for comparison purposes, the strength of the fuel increases as the cube of the weight.

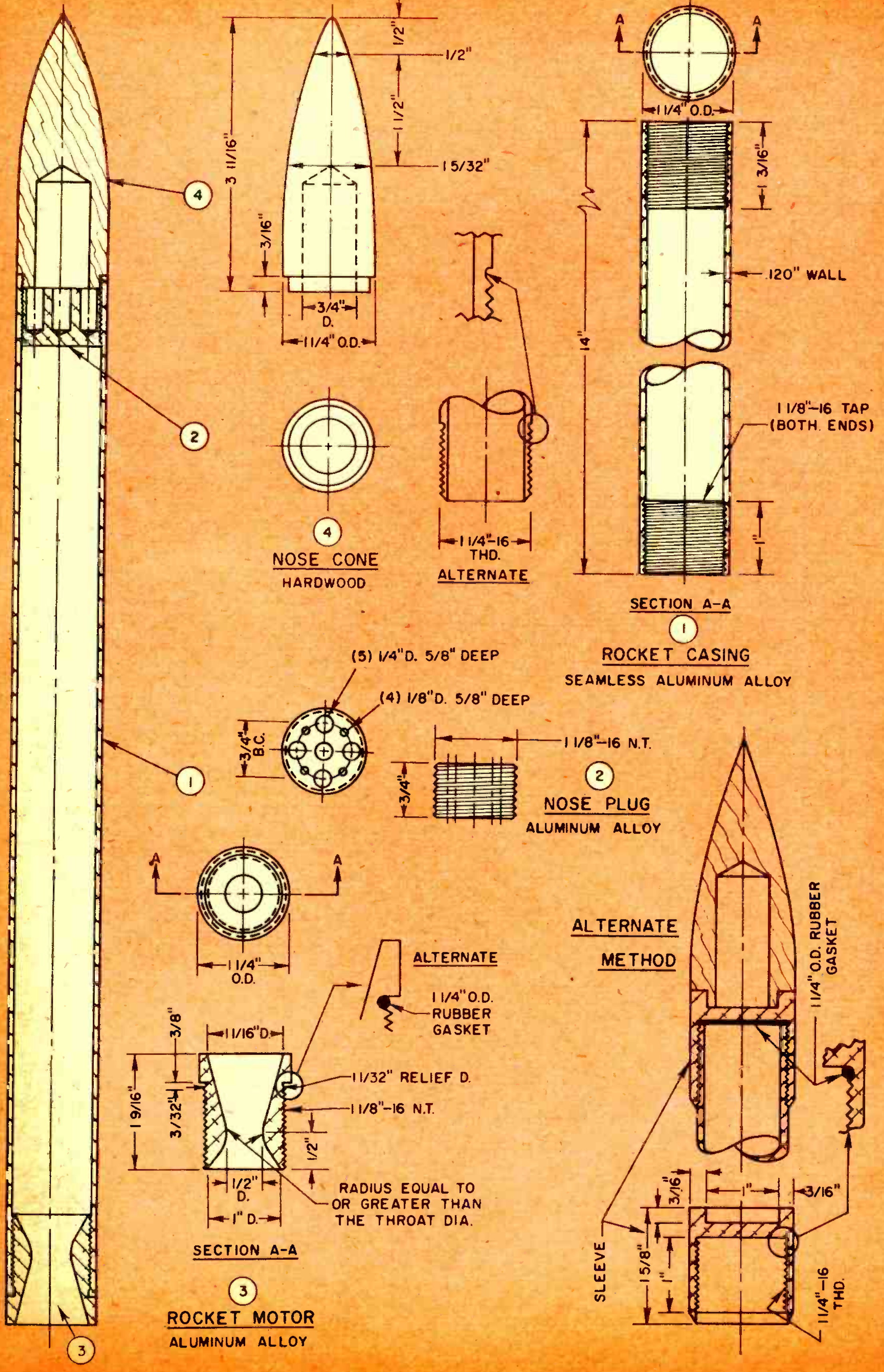
28. Matter in dust form is dangerous. Flour mills have been known to explode, so zinc dust and sulphur dust can be dangerous too. When pouring, keep the dust down, air itself can set off dust of some metals. Be extremely careful. Check for open flames, exposed electrical heaters, poor electrical fittings and switches and, of course, there should be NO SMOKING at anytime where building, fueling, testing or firing rockets.

29. Very little information can be observed with the naked eye when testing or firing by observing the test stand or the launcher, so don't take any chances, even for just one peek. If you must observe, use a periscope or observe thru heavy layers of safety glass.

30. Once the rocket or missile is fired from the launcher, it is a free flying projection. Therefore every effort should be made to secure adequate firing ranges. Most of these are under the jurisdiction of the Army, Navy or Air Force. It is advisable to make contact with a post, camp station or base of one of the Services far in advance of the desired firing date, and give them in writing all the information about yourself, your organization and your rockets (type of fuel, range, etc).

Black powder was the explosive used in this missile built by an experimenter. It never got off the ground. There are many safe fuels which do a much better job.





1/2"
1/2"
1 1/2"
3 11/16"
1 5/32"
3/16"
3/4"
D.
1 1/4" O.D.
4
NOSE CONE
HARDWOOD
1 1/4"-16
THD.
ALTERNATE
A
A
1 1/4" O.D.
1 3/16"
.120" WALL
14"
1 1/8"-16 TAP
(BOTH ENDS)
1"
SECTION A-A
1
ROCKET CASING
SEAMLESS ALUMINUM ALLOY
(5) 1/4"D. 5/8" DEEP
(4) 1/8"D. 5/8" DEEP
3/4" B.C.
1 1/8"-16 N.T.
3/4"
2
NOSE PLUG
ALUMINUM ALLOY
1
2
3
4
1 1/4"
O.D.
ALTERNATE
1 1/4" O.D.
RUBBER
GASKET
3/8"
1 1/16" D.
1 9/16"
3/32"
11/32" RELIEF D.
1 1/8"-16 N.T.
1/2"
1/2"
D.
1" D.
RADIUS EQUAL TO
OR GREATER THAN
THE THROAT DIA.
SECTION A-A
3
ROCKET MOTOR
ALUMINUM ALLOY
ALTERNATE
METHOD
1 1/4" O.D. RUBBER
GASKET
3/16"
1"
3/16"
1 5/8"
1"
SLEEVE
1 1/4"-16
THD.

N. Y. If you do not have a lathe you can probably get a small local machine shop, automotive parts fabricator, or boat repair shop to cut the necessary threads, etc., for you.

Use 3/32″ thick aluminum tubing, sometimes sold as .120 seamless aluminum alloy, for the rocket tube. This is a bit on the heavy side, but it will save a great deal of time since you will be able to thread both ends on the inside without weakening the strength of the walls of your rocket. If you wish, you could use $\frac{1}{16}$″ thick aluminum tubing, but you would then have to build up the inside thickness of the tube on both ends so that you could cut threads into the two ends to the proper depth.

The length of this aluminum tube should be 14 inches and it should have an outside diameter of 1¼ inches. This is the casing of the rocket.

The most difficult part of our project is the building of the rocket motor. Some call this the nozzle. In dealing with liquid rockets or missiles, it often is referred to as the lower part of the thrust unit. Now there are many factors that go to make up the design of this rocket motor. We will not go into them here, however, I suggest that you do some serious reading on this topic. At the same time, I do not want the more experienced amateur to think that this particular design is the best or the most efficient rocket motor for this particular length, diameter and casing thickness.

This rocket motor is a convergent-divergent type with the throat diameter of ½ inch. The angle on the convergent side is 29 to 31 degrees and the angle on the divergent side is 14 to 16 degrees. 1¼ inch diameter aluminum stock was used. First the stock is cut on the lathe so that the collar is left on the end nearest the head stock. Next the threads are machined. These are $\frac{1}{16}$″ standard. Then a hole, ½ inch in diameter, is drilled through the rocket motor after which the convergent section of the rocket motor is machined. The rocket motor is then reversed in the lathe and the divergent part is machined. A small rounded file can be used to smooth out the curve of the throat. Be careful when handling the threaded sections for the threads are razor sharp.

We now turn to the nose section of the rocket. For the nose plug, use 1⅛-inch stock and once the threads have been cut, drill out several holes of two

[*Continued on page* 109]

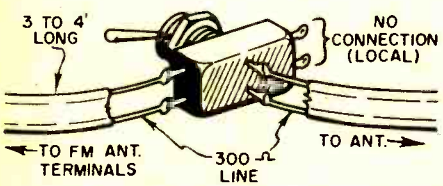
All of the parts for the safe, simple rocket are shown below prior to assembly. The dimensional drawings on the facing page give you all the information needed to build it.

Hi-Fi Clinic

Send us your questions on hi-fi—how to install, how to repair, how to listen; the clinic will answer you!

IN my search for the best in hi-fi I purchased the latest model super-sensitive FM tuner on the market. It does pull in more stations than the older tuner I had, but on the strongest stations it seems to have an odd kind of distortion that my older tuner never had. I have a good antenna hooked up to the tuner.

Arthur Devon, New York, N. Y.



From the description of your problem and your geographical location I would say that the distortion troubles are due to your having put up *too* good an antenna. It sounds like a case of overload due to the antenna delivering more signal than the new FM receiver can take without being driven into distortion. Try installing a "local-distant" double pole, single throw toggle switch on the antenna lead-in, three or four feet from the tuner. Wire the switch so that the major part of the antenna is disconnected from the set with the switch in the "local" position. The entire antenna length should be connected for "distant" reception.

The new 25-watt amplifier I bought to replace an obsolete 10-watt model has been giving me hum whenever I plug in the shielded cable from my FM tuner. This has me puzzled, since the tuner did not *hum when it was connected to the old amplifier. Where do I go from here?*

Charles Weiner, Toms River, New Jersey

Hum problems in new commercial hi-fi setups are usually due to some difficulty in the installation, rather than a defect in the equipment. From your description, it appears that the fault is probably due to AC being piped into the signal circuits by a difference of voltage potential between the chassis. Reverse the AC plugs in the wall outlet of each of the units—turntable, tuner, amplifier—until you hit the lucky hum-free combination. If the hum, at minimum, *still* overrides the signal, try modifying your connecting cable as follows. Unsolder or disconnect the shielding braid from the jack at the amplifier end of the FM tuner cable. Run a separate wire from the tuner chassis (close to its output jack) to the point on the amplifier chassis that results in the least hum. If needed, run another lead from the same spot to a good external ground.

A trouble has developed in my tape recorder that has me stumped. For the past three or four months there has been an increasing hiss on my tapes. I can cut it down by using the treble control on my amplifier, but that also kills my highs. What do you think my problem is?

Paul Mazer, El Paso, Texas

Hiss in tape recorder reproduction is both common and annoying. A logical approach to the problem demands first that the source of the noise be localized.

Play on your recorder a tape made on another machine. If the tape hisses on playback, this indicates that the hiss originates in the playback circuit. In that case, check your heads for magnetization and your playback preamp for noise. Tape head magnetization, if present, can be eliminated by using an inexpensive commercial demagnetizer.

If the hiss is present with your machine set for playback, but with *no* tape running by the heads, then the trouble is in the preamp section. Try several replacement preamp tubes, selecting the one that runs the quietest.

If tapes that you've recorded hiss when played back on your deck and another machine, check the bias current against the manufacturer's recommended setting. It may have to be reset because of component drift.

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

Robert Shearer, Waterville, Maine

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

George Wolfe, Latrobe, Pa.

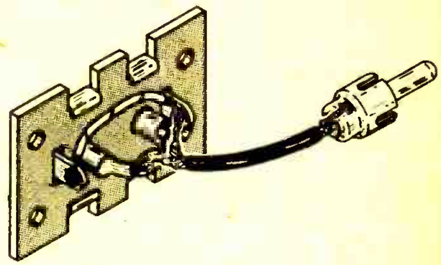
There's a lesson to be learned from the two questions above. When dealing with any equipment as sensitive as good hi-fi often is, don't assume any components can be added or replaced without proper adjustment, compensation, or matching. In the first case of the "hum pickup," I doubt that it is *hum*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

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

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

Gerald Armand, San Francisco, Calif.

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



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

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

Short Wave Listening Around The World

By Robert Hertzberg and Stewart West

Adventure! Knowledge! Hear foreign lands, listen to news as it's made—this and more awaits you.

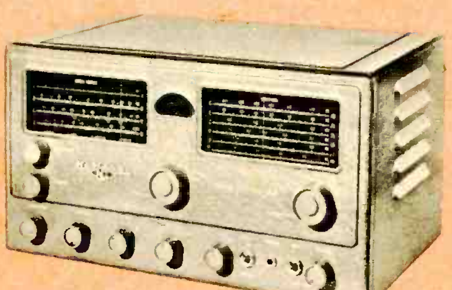
LISTENING to short-wave broadcasts from overseas gives you a fascinating opportunity to obtain the best entertainment of the whole world, to get first-hand accounts of current happenings from the very places where they are occurring, and to gain a better understanding of the people who live on the other side of the earth, by hearing the same music, drama, comedy and news commentary that they hear.

If you happen to be a student of foreign language, short-wave listening can give you the chance to hear that language on the air, spoken in conversational form with the native accent, a rare chance indeed.

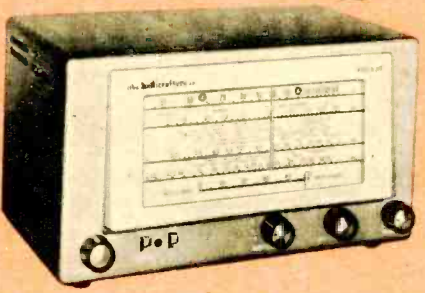
In addition, there's much enjoyment in store for the active hobbyist who goes in for short wave. By writing to many

Hammarlund HQ-140X advanced-type receiver for short-wave listener and ham.

National NC-98SW medium priced short-wave and ham set has great sensitivity.



Hallicrafters model SX99 medium priced set offers AM broadcast and 3 SW bands.



Hallicrafters S-38D low cost short-wave set with broadcast band and 5" speaker.

You too can tune in on the world, all you need is a sensitive receiver like the National NC-188.

of the stations you hear, you can collect a series of colorful, attractive cards which with the stations acknowledge their overseas listeners. And, if you like the feeling of being first-to-know, the on-the-spot news bulletins which you'll hear on your short-wave receiver will give you an advance on events not made generally available till the next day.

Short-wave stations exist on almost every spot on the globe. A good example of what you'll have to choose from is Radio Haiti, broadcasting from Port-au-Prince, Haiti. From this tiny country you can hear feature shows, popular Haitian music, and classical music programs announced in both French and English. Radio Haiti, transmitting on 1.325 megacycles (4VW), 6.200 mc (4 VHW) and 15.240 mc (4 VRW), likes to hear from listeners and will verify all correct, complete reception reports. Their address is Box 737, Port-au-Prince, Haiti. Incidentally, they'll be glad to play your requests on "Your Music Caravan," broadcast each Thursday at 2130 and 2230, and Sundays at 1800-1900. A complete listing of programs and times from stations throughout the world may be found on pages 38-39.

Short-wave listeners are fortunate in that there are quite a few excellent receivers available at all price levels. These are made by manufacturers who have specialized in such equipment for years. A complete rundown of short-wave receivers is given later, but first here are some tips to aid listening to the short-wave bands.

Short-wave broadcasting stations transmit between three and thirty megacycles generally within the bands designated for this radio service. There are six major international short-wave bands and four of lesser importance. The list on pages 38 and 39 will be helpful in finding these bands. Since most short-wave radios produced in the

BAND WAVELENGTHS	BAND FREQUENCY LIMITS	BAND WAVELENGTHS	BAND FREQUENCY LIMITS
11 m.b.	25.600-26.100 mc.	*31 m.b.	9.500- 9.775 mc.
*13 m.b.	21.450-21.750 mc.	41 m.b.	7.100- 7.300 mc.
*16 m.b.	17.700-17.900 mc.	*49 m.b.	5.950- 6.200 mc.
*19 m.b.	15.100-15.450 mc.	60 m.b.	4.750- 5.060 mc.
*25 m.b.	11.700-11.975 mc.	90 m.b.	3.200- 3.400 mc.

AROUND THE CLOCK

If you are an "Early Bird" and can listen before sunrise, stations in the Far East and Pacific areas will be heard on 19, 25, and 31 m.b. After dawn the stations in Europe, Africa, and South Asia will be found on 11, 13, and 16 m.b. Here are some stations heard in the early morning hours.

0200-0545 Radio New Zealand 9.540 mc. (ZL2) broadcasts a variety of programs in English. Sign off Sundays is 0500.

0230-0245 Radio Tahiti 6.135 mc. has English news and features.

0400-0430 The Call of the Orient, Manila, Philippines 21.515 mc. (DZ18), 17.805 mc. (DZ16), 15.300 mc. (DZH9), 11.855 mc. (DZHB), 9.730 mc. (DZH7), has English with news at 0400. This station will soon have a 50 Kw. short wave transmitter on the air.

0415-0445 Radio Demerara, British Guiana has a request program of Oriental music on 5.981 mc.

0530-0600 HLKA Seoul, Korea 9.640 mc. has English and music, often Oriental. At 0615 there is an English By Radio lesson.

0600-0700 The Voice of Indonesia, Djakarta 9.710 mc. has programs in English with news at 0615. This winter listeners could hear direct reports on the Civil War on these islands. Western listeners may also listen at 0930-1030.

0815-0900 Lisbon, Portugal 21.495 beams English programs to Goa.

0830-0845 Helsinki, Finland 15.190, 17.800 has a DX program in English the first Monday of each month. Also heard at 0630.

0900-1000 HCJB Quito, Ecuador 17.890, 15.115 is heard with "Morning in the Mountains".

0900-1315 B.B.C. London, England 21.660, 17.700, 17.810 in the North American Service heard daily. At this writing 17.700 is used until 1130 and 17.810 after 1115.

When there is time for "Daytime Dialing" the higher bands are the best for DX listening. As the hours pass during the afternoon, it will be noted that stations in Europe and Africa gradually come through on the 25 and 31 m.b., with 49 m.b. opening just before sunset. Here are some stations to look for during the day.

1000-1130 Radio Kabul, Afghanistan 18.637 mc. with news in English at 1045.

1120 Voice of M.T.D., New York has been heard Sundays with Maritime news on 19.850, 15.850, 15.700 mc.

1315-1330 Vatican Radio has English news and comments on 15.120, 11.685, 9.646, and 7.280 mc.

1530-1800 Voice of Tangiers 9.435 mc. carries English religious programs. Sign off Saturday and Sunday is 1815.

1600-1700 United Arab Broadcasting Service, Cairo, Egypt 11.990 mc. beams English programs to Europe. Mostly music with news at 1615.

1630-1730 The Voice of Zion, Jerusalem, Israel 9.008 mc. is now broadcasting English at this time, 30 minutes later than formerly broadcast.

1800-1900 Radio Japan, Tokyo 17.855 mc. (JOA24), 15.325 mc. (JOB21) beams to Eastern North America, in English for the first 50 minutes. Radio Japan News is an excellent monthly paper sent out to listeners.

During the hours of darkness the "Night Owls" find stations from most areas of the world. In the evening European and African stations beam programs to North America on 16, 19, 25, and 31 m.b. Latin America stations can be heard on all the bands they broadcast on, and stations in the Far East and Asia will be found in the 16, 19, and 25 m.b. In the later evening South Pacific stations will be located at good strength in 13, 16, and 19 m.b.; and stations broadcasting for listeners within Europe and Africa will sign on with their morning programs on 25, 31, 41, and 49 m.b. Here are a few that can be heard during the evening.

1930-1950 Rome, Italy 15.400, 11.905 has English to North America. This is repeated at 2205-2225 for West Coast listeners.

1930-2015 Radio Pakistan, Karachi 15.335, 11.885 is heard well in the U. S. and has English news at 2000. Oriental music is often played.

2030-2045 Voice of Free China, Formosa is now beaming to North America at this new time in English on 17.810 (BED63), 15.345 (BED57).

2045-2115 Radio Sweden, Stockholm 11.810 is heard well in the eastern U.S. There is a repeat for the West Coast at 2215-2245. On Mondays the last 10 minutes is Sweden Calling DXers.

2200-2230 Radio Peking, China has English to North America on 17.745 and 15.118 mc.

2215-2255 Voice of Spain, Madrid is back on 9.363 after trying 9.585 mc. in parallel with 6.130 to North America. This broadcast is repeated at 2315 and 0015.

2255 Baghdad, Iraq is heard signing on the new 100 Kw. transmitter on 6.190 mc. with 7.180 in parallel.

2329-0045 Radio Australia, Melbourne 21.680 mc. (VLA21) is usually strong in the African Service. At this same time 21.540 and 17.840 are heard beamed to Southeast Asia.

0000-0030 Radio Japan 17.855 mc. (JOA24), 15.325 mc. (JOB21) are heard with English to Western North America. They want reception report and verify with attractive QSL cards.

0000-0130 ELWA Monrovia, Liberia 11.986 mc. and 21.505 mc. is beamed for African listeners, but usually is strong in the U. S. At 0145 they continue with programs for West Africa including the B.B.C. news at 0200 on 4.771 and 21.505 mc.

0030-0045 HLKA Seoul, Korea 11.930 mc. has news in English.

I hope that these tips have been helpful, and I invite you to tune in during the Listener's Post mailbag program and hear the DXers' Corner, 10 minutes of the latest tips. This is heard on Radio 4VEH, Cap-Haitien, Haiti Saturdays at 0500 and 0930 over 11.850 and 9.635 mc. and Mondays at 2130 over 17.820 and 9.603 mc.

Times in this article are given in Eastern Standard Time using the 24 hour clock. To convert to other times do as follows:

For Atlantic Standard Time ADD 1 hour;
For Central Standard Time SUBTRACT 1 hour;
For Mountain Standard Time SUBTRACT 2 hours;
For Pacific Standard Time SUBTRACT 3 hours.

Then if your area is on Daylight Time ADD 1 hour.

Common ABBREVIATIONS used in this article.

mc. for megacycles m.b. for meter band(s) Kw. for kilowatt(s)

United States are marked in megacycles, the frequencies are listed here in megacycles. The wave lengths are in meter bands. Asterisks precede the major bands.

Buying a Receiver

You are lucky if you are in the market at the present time for a short-wave receiver, for listening to foreign and domestic stations. Sets covering a wide range of frequencies have reached a very advanced stage of development, and are available in a wide range of prices to suit any pocketbook.

What makes one set better or poorer than another? Probably the most important feature of a modern receiver, because of the crowded state of all the short-wave bands, is *selectivity;* that is, the ability to separate adjacent stations. Selectivity goes up with the number of tuning circuits and associated tubes, and obviously so does cost. Small sets with a minimum number of circuits suffer from a bad effect called "image response," wherein two stations of different frequencies often appear on the same spot on the dial.

Coupled with selectivity is smoothness of tuning. This is as much a mechanical as an electronic matter. Dial-drives vary from simple cord-and-pulley systems to complex spring-loaded gear boxes, the object in all cases being the elimination of backlash. In some receivers the main tuning dial is supplemented by an auxiliary "band spread" dial, by means of which all or certain portions of the scales can be stretched out to make tuning easier.

A third essential characteristic is *stability,* or the closeness with which a set holds its dial settings. An unstable receiver requires constant fiddling with the tuning controls, and is a nuisance rather than a source of enjoyment. Stability is achieved with the aid of rather complicated temperature-compensation devices and with heavy, rugged chassis construction. All sets wander a little after a cold start, but the good ones settle down to rock steadiness after about twenty minutes. One new receiver, designed for critical communications service, embodies an oscillator-compartment heater that is on all the time the line cord is plugged in, whether the set's switch is on or off.

Oddly enough, *sensitivity,* the ability to pick up weak signals, is not really as important, relatively, as selectivity and stability. Most short-wave receivers have more "gain" or amplification than can be used under ordinary circumstances. Turned up full, they are so sensitive that they respond to all sorts of random electronic agitation in space, sometimes thousands of miles away. This comes out of the loud speaker as a disturbing background noise, which often blankets desired radio signals. The endeavor of set manufacturers in recent years has been to devise means of improving the signal-to-noise ratio, not merely to increase the sensitivity alone.

You have a fine choice of fifteen dif-

Students of French benefit from news programs like this, on short-wave station Radio Haiti.

Popular Haitian music is just one of the many entertainment treats available on short-wave.

ferent receivers produced by four different firms.

A feature common to all these sets is the inclusion of the regular AM broadcast band. While this seems superfluous in a "short-wave" receiver, it actually is a convenience for picking up local news, weather and time broadcasts.

To assist you in making a selection, the sets are classified herewith by price, rather than by manufacturer.

Under $100:

Hallicrafters S-38D. Four bands, 540 kc. to 32 mc. Four tubes and rectifier. Built-in 5″ loudspeaker. $50.

National SW-54. Four bands, 540 kc. to 30 mc. Five tubes. Built-in 5″ loudspeaker. $60.

Hallicrafters S-53A. Five bands. 540 kc. to 54.5 mc. Eight tubes. Built-in 5″ loudspeaker. $90.

$100 to $200:

Hallicrafters S-85. Four bands. 540 kc. to 34 mc. Eight tubes. Built-in 5″ speaker. $120.

Hallicrafters SX-99. Four bands. 540 kc. to 34 mc. Seven tubes plus rectifier. No loudspeaker. $150.

(Beginning at this price level, receivers do not include loudspeakers, mainly because there is no longer room for them; the chassis are occupied by additional circuit elements. Matching loudspeakers are available, at prices from about $15 to $20. Any medium-size permanent magnet speaker in a small box can be used, at an appreciable saving.)

National NC-188. Four bands. 540 kc. to 40 mc. Nine tubes. No speaker. $160.

Hammarlund HQ-100. Four bands. 540 kc. to 30 mc. Nine tubes plus voltage regulator. No speaker. $169.

National NC-109. Four bands. 540 kc. to 40 mc. Ten tubes plus voltage regulator. No speaker. $200.

Above $200:

Hammarlund HQ-140XA. Six bands. 540 kc. to 31 mc. Ten tubes plus voltage regulator. No speaker. $250.

Hammarlund HQ-150. Six bands. 540 kc. to 31 mc. Eleven tubes plus voltage regulator. No speaker. $294.

Hallicrafters SX-62A. Six bands, including the FM broadcast band. 540 kc. to 109 mc. Fourteen tubes plus rectifier and voltage regulator. No speaker. $350.

Hammarlund HQ-160. Six bands. 540 kc. to 31 mc. Thirteen tubes. No speaker. $380.

National NC-183D. Five ranges. 540 kc. to 55 mc. Fifteen tubes plus rectifier and voltage regulator. No speaker. $450.

Technical Materiel Corp. GPR-90. Six bands. 540 kc. to 31 mc. Fifteen tubes plus voltage regulator. No speaker. $495.

National HRO-60. Only set with plug-in coils, covering 50 kc. to 54 mc. Fifteen tubes plus rectifier and voltage regulator. No speaker. $645.

Specifically excluded from the foregoing list is a group of six special receivers designed to cover *only* the amateur bands and nothing else. These are the Collins 75A-4, Hallicrafters SX-101, Hammarlund HQ-110, National NC-300, Harvey-Wells R-9, and RME/Electro-Voice 4350A.

The recognized ability of short-wave signals to bend around obstructions and to permeate seemingly enclosed places makes the use of elaborate antennas unnecessary. Almost any piece or length of wire serves the purpose. Theoretically, the aerial should be strung out in the open, as high and as clear as possible. A length between 50 and 100 feet is usually recommended.

With absolutely nothing connected to the antenna binding posts, most high-grade receivers pick up enough energy by themselves to give strong signals through a loudspeaker.

One of the greatest but least appreciated aids in short-wave DX hunting is a pair of earphones, popularly referred to as "cans." Earphones are fantastically sensitive, and with them you can often identify programs and stations that are just a smear of noise in the loud speaker. Every short-wave receiver has an earphone jack, connected so that the speaker is cut off when the phone plug in inserted.

Excellent phones can be bought for as little at $2.00, and the best grade crystal type cost about $13 or $14.

The best time to listen is when you have the time to do so.

Electronics in Medicine

By George Bay

Electronics is in the battle against heart disease, mental illness, and other ancient enemies of man.

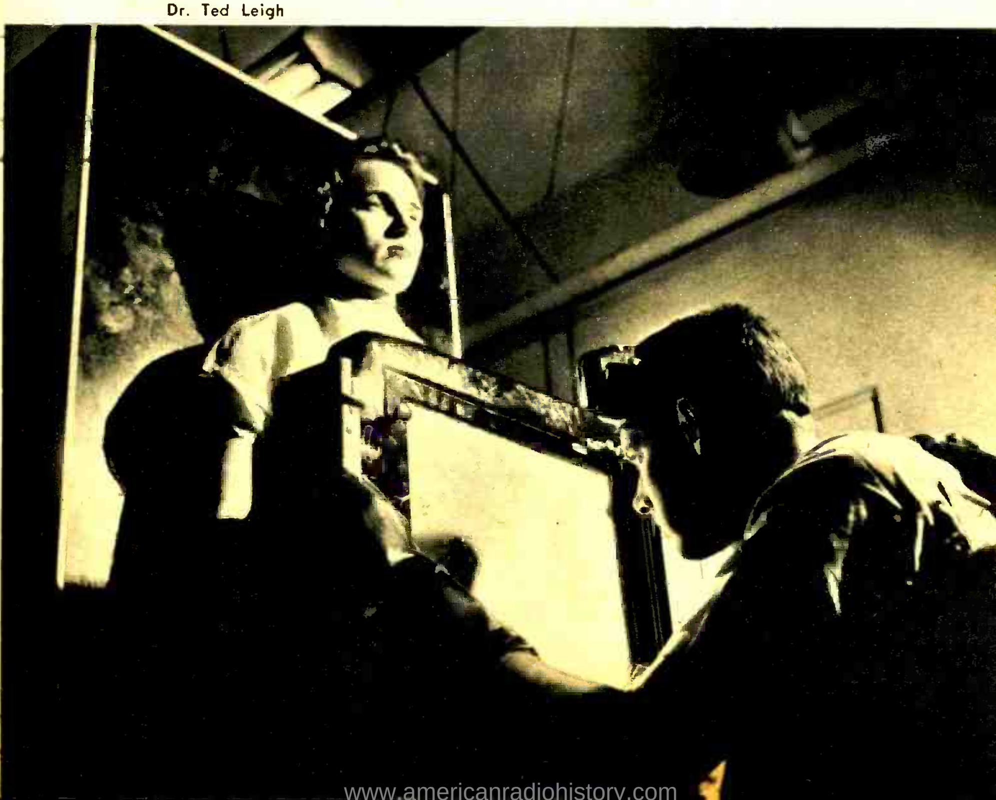
MEDICINE, the art of healing, is the oldest science, preceding even the study of the stars to the very dawn of human history. It is a curious fact that in our time this oldest science is becoming closely allied with the newest of sciences: electronics.

Yet this alliance of the seemingly dissimilar sciences of medicine and electronics is not as strange as it seems at first glance. After all, our knowledge of electricity was from the beginning related to biology. The twitching frog leg was the first indicator of electric current flow, long before the invention of other indicating instruments. The effect of electric currents on the living body has ever since been the subject of research.

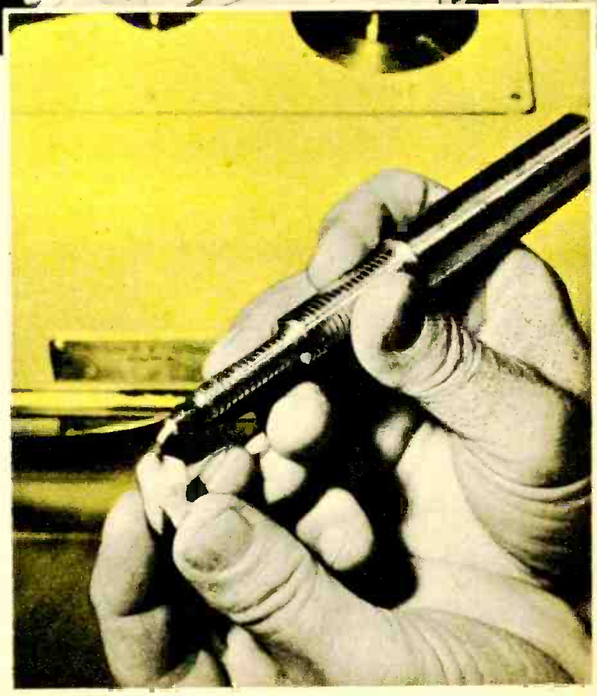
Nowhere are the inroads of electronics into modern medicine more evident than in the operating room. The surgical arena of a large, modern hospital equipped with the latest innovations, almost looks like the control room of an automated factory. Around the operating table, a whole array of electronic instruments keeps track of the patient's reactions during the progress of the operation.

Fluoroscope used to study motion in the abdomen for digestive disorders. This machine will also instantaneously make X-ray films of any findings.

Dr. Ted Leigh



Columbia Presbyterian Medical Center

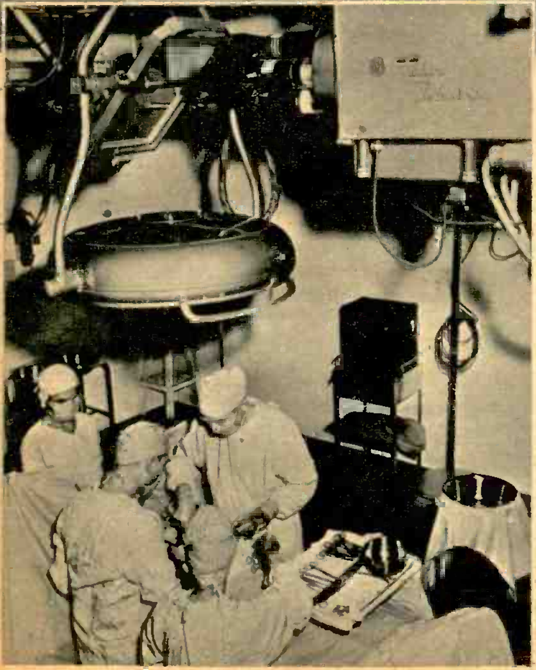


Instant display of many vital measures of heart and lung action of patient on table are shown on instrument above. This is used to help diagnose lung ailments and during heart operations. Right, new ultrasonic dentist drill uses agitated aluminum oxide solution for cutting, is said to be virtually painless.

Cavitron Equipment Corp.

U. S. Army Photo

The infrared microscope, shown above, is one of the latest electronic devices used by pathologists to study makeup of human tissue for diagnosis.



Color television camera above the operating table observes every step of surgeon, is great help to doctors in training. Films can also be made.

Walter Reed Army Medical Center; RCA

There are electronic blood pressure monitors which gage the force of the blood through special transducers operating on the principles of variable capacitance. They require only very little physical power to be exerted by the blood in the veins and arteries and hence even the smallest pressure variations can be picked up and amplified. Another new electronic aid to the surgeon and the anesthetist are the so-called pH-monitors, which keep track of the acidity of the patient's blood.

Lately a kind of computer has been devised which keeps watch over the patient while he is under anesthesia, gaging his vital functions, such as heartbeat, breathing rate, temperature, etc. From these data the computer then calculates the dosage of anesthetic necessary to maintain unconsciousness at the desired depth and administers this dosage through electronically activated automatic controls. Such a computer, equipped with all kinds of error-correcting safety devices, practically eliminates the element of human fallibility from the critical task of producing and maintaining anesthesia.

In one of the most daring fields of surgery, operations on the heart, new electronic devices have sharply reduced the risk of death. Such equipment includes an electrocardiograph with both cathode-ray and pen-recorder displays, a heart-rate meter, in addition to a thermistor thermometer and an electronic blood pressure monitor. This enables the surgeon to keep posted on the condition of the heart during the operation and forestall trouble before it reaches a critical stage. Even if the heart should fail under the strain of surgery and cease beating, electronic devices such as the cardiac stimulator and defibrillator can call the patient back to life where formerly a fatal outcome would have been inevitable.

This remarkable device that can return life to a heart lapsed into standstill is basically a low-frequency pulse generator whose output is fed to the heart through rod electrodes inserted through the open chest. The waveform and sequence of the pulses follow the pattern of the natural heartbeat that was previously determined by means of the electrocardiograph. Many of these aids were sponsored by the National Research Council of Canada.

Chemist of the Warner-Lambert Pharmaceutical Co. uses spectrophotometer in research.

This unit measures heart and blood characteristics and is a heart stimulator in emergencies.

Photo by Mike Bonvinc

A "private ear" (wireless microphone) hides behind the mirror picking up threats of blackmailer. A radio and tape recorder are in another room.

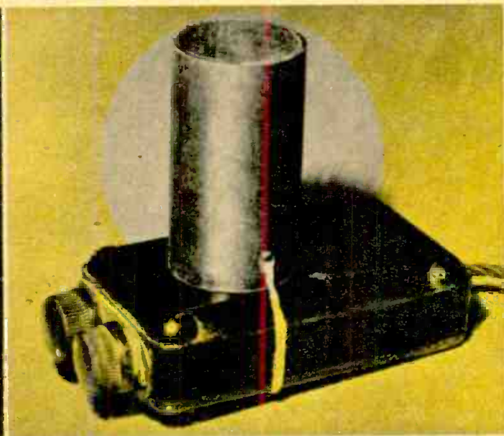
All About Bugging

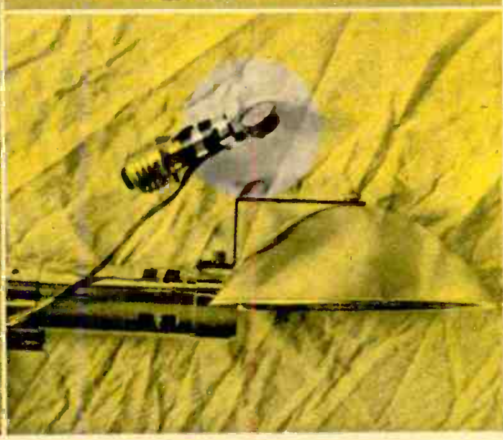
By James A. McRoberts

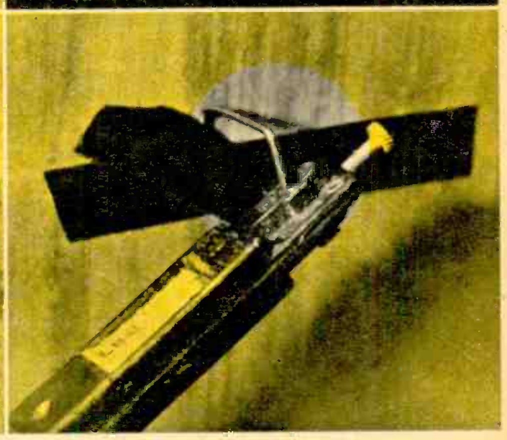
The story of hidden microphones—how and why they are used. Also, how to build a wireless mike.

HIDDEN microphones can provide much fun at parties. They provide a good basis for mind reading tricks and the like. More sinister though is the "bug" in the hands of a blackmailer. The papers have been full recently of the use of hidden microphones to pick up private conversations of labor leaders and government functionaries.

Think you are safe holding a secret conversation on the street? Well, maybe, but if you notice someone in your vicinity with a hearing aid showing, be careful, a fiber cylinder strapped to the







Cylinder on front of hearing aid (top) makes it directional for street conversation pickup.

Microphone taped to flashgun socket adapter is used with reflector for distant sound pickup.

Microphone "bug" on outside window pane (top) is hidden in shadows, can you see it?

Crystal phono pickup with bent wire stylus is taped to a door, converts vibrations to signal.

front of a hearing aid acts like a megaphone in reverse. It is simply pointed towards the talkers; with a sensitive pickup, conversations one block away can be recorded.

This is an example of a simple on-the-person "bug." Wired types are also widely used.

Nearly all varieties of microphones require some form of amplifier to boost their weak signal output to a usable level for recording or direct listening. The modern transistor saves space, weight, and battery power. About 4 transistors do the work of 3 tubes.

Almost any microphone can be used with nearly any amplifier if impedances are matched closely. For short runs, a high impedance microphone is generally used and no matching is required if the amplifier has a high impedance input connection or jack. For example, a standard tape recorder-type crystal mike is a high impedance job and plugs directly into the high impedance input of a tape recorder or other amplifier.

The same high impedance input can be used with a low or medium impedance type mike for long cable runs if the proper value of matching transformer is inserted between the mike and the input.

Unusual "Bugs"

Sometimes the stylus of an ordinary phono pickup is replaced with a bent

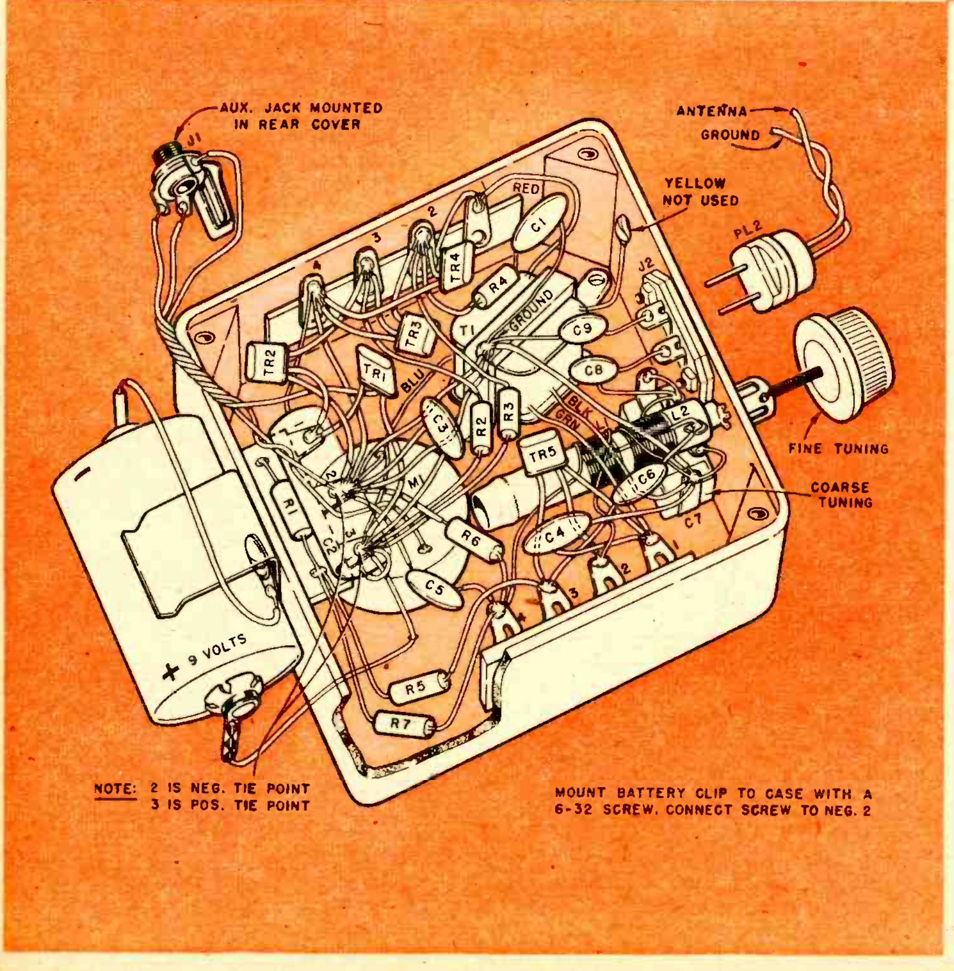
PARTS LIST

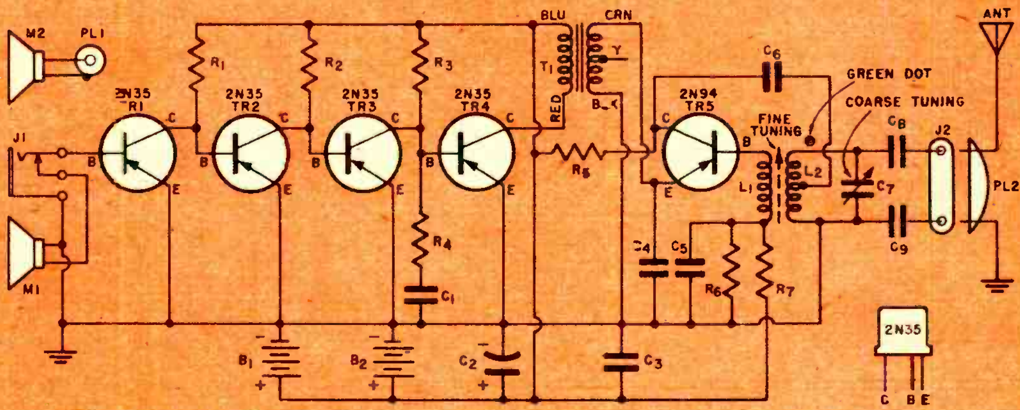
Capacitors:
- C1—.01 mfd. ceramic disc
- C2—50 mfd., 25 v. miniature electrolytic
- C3, C4, C5, C6—4700 mmfd. ceramic disc
- C7—45 to 380 mmfd. variable mica padder
- C8, C9—47 mmfd. ceramic disc

Resistors:
- R1, R2—47,000 ohm, 1/4 w.
- R3—33,000 ohm, 1/4 w.
- R4—3300 ohm, 1/4 w.
- R5—2200 ohm, 1/4 w.
- R6—10,000 ohm, 1/4 w.
- R7—470,000 ohm, 1/4 w.

Misc.:
- L1—14 or 15 turns of enamel or hookup wire wound on L2
- L2—Transistor tapped "Vari-loop" antenna coil, with tunable slug
- T1—Midget transistor transformer (Argonne model AR-103)
- TR1, 2, 3, 4—2N35 transistors
- TR5—2N94 transistor
- M1, M2—Midget reluctance microphone (Shure MC11 or MC20)
- B1, B2—9 volt transistor type batteries
- PL1, J1—Midget plug and jack
- TS1, TS2—4 lug terminal strips
- TS3—3 lug terminal strip
- Case—Miniature plastic case (Lafayette Radio MS315)
- 2 alligator clips
- 2 pairs of battery clips
- Coil of #24 plastic covered hookup wire
- 12" of spaghetti tubing
- Midget knob

A complete wireless broadcaster, small enough to fit in the palm of your hand, may be built by using the parts listed above and wiring them according to the guide shown below. The schematic for this unit is on the facing page. This device measures about 2 3/4" x 5 1/2" x 1 1/2" and uses five transistors. It will broadcast any sound it picks up to any ordinary radio in an adjoining room or farther. Parts are all easily obtained.



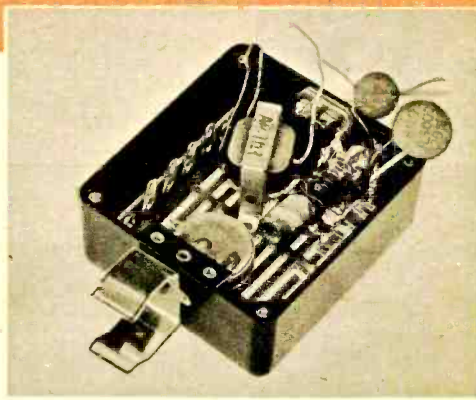


wire to pick up vibrations from a door panel or a window pane and convert these sound waves into electrical currents.

A very common "bug" in industrial plants and factories is the intercom system. Here the intercom is simply turned to "listen" and the conversation at the other end can be recorded.

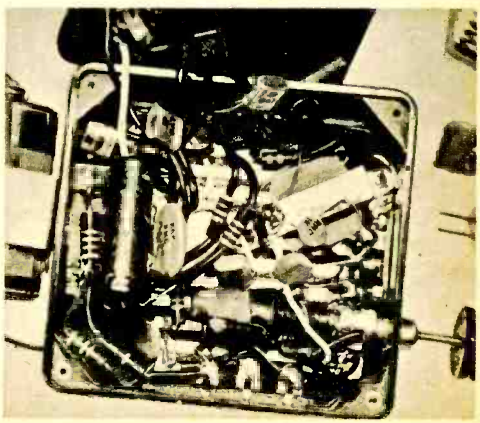
One clever ruse is to use a low impedance mike attached to the bayonet base adaptor of a photographer's flashgun. When inserted into the gun the microphone will be at the focal point of the flashgun's reflector. The reflector picks up sound waves and converges them on the microphone diaphragm which will face the reflector. Two taped wires carry the microphone current to the amplifier via a matching transformer. The recorder hides in a briefcase, etc.

In an interesting case not long ago a private detective was employed by a young lady to trap an extortionist who had attempted to blackmail her. They were to meet in a public park near the young lady's home. Mr. Detective posed as a weary free-lance photographer eating a delicatessen sandwich on a park bench just opposite the rendezvous. The meeting took place on schedule. The detective diddled the flashgun across his knees for best sound pickup



The first step in the construction is to glue the major parts into the box as shown above.

The completely wired "bug." Jack on cover is for remote mike. Padder, C7, is under coil.



which he monitored on his earphone. Also, the same sound was recorded on a spring-driven wire recorder. With this record, the detective's client escaped the clutches of the crook.

Wireless Microphone

Wired microphones can not always be employed to "bug" a particular spot. The wiring may be too evident or difficult to install. In such cases wireless microphones are used.

In these gadgets the sound is picked up by a mike, amplified, and transmitted on a standard broadcast-band frequency. The radio signals are picked up just like those of a broadcast station on a radio set nearby, say in an adjacent room.

A complete wireless microphone and broadcaster may be made by following the wiring guide and photos. A small plastic case houses the complete unit which includes five transistors. First glue down transformer *T1*, the microphone *M1* and two terminal strips *TS1* and *TS2*. Drill a hole in the top of the case for the tuning coil *L2* next to jack *J2* which comes on the case. Drill a hole on the bottom for the screw which secures the battery holder to the case.

Capacitor *C7* is soldered by doubled-up hookup wire to the black- and green-dot lugs on coil *L2*. The outer leaf of the capacitor connects to the black dot via its terminal lug. Capacitors *C8* and *C6* are soldered to the coil prior to mounting the coil in its $\frac{5}{16}''$ hole.

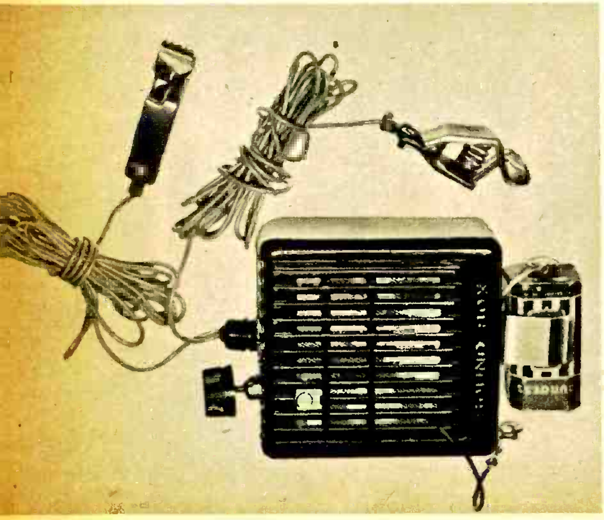
Coil *L1*, consisting of 14 or 15 turns of enamelled or hookup wire is wound on assembled coil *L2* prior to mounting. Leave leads long since these may have to be reversed if the oscillator does not work right off.

Enamel wire may be used to connect a second microphone, *M2*, to plug *PL1*. Thus one could put the "bug" near a radiator and run the mike wires under a carpet to the opposite side of the room. If excess hum is encountered reverse the leads to *M2*. Do this before actual use, in a shop tryout.

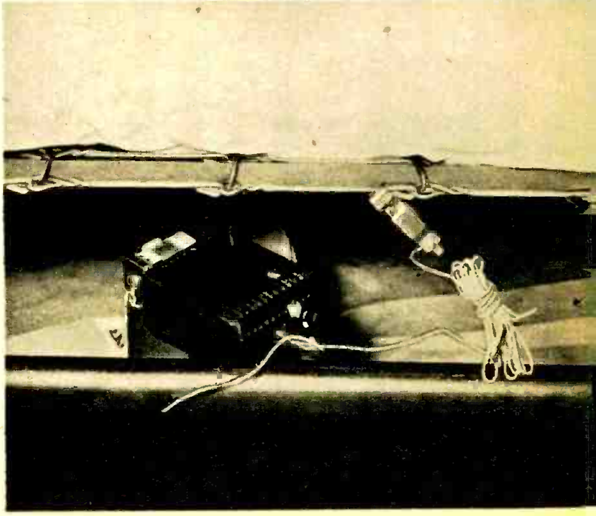
To operate the wireless microphone, snap the connectors onto a 9-volt battery and push it into the clip. Rotate the coarse adjusting screw on *C7* while listening to a radio tuned to a quiet spot in the middle of the broadcast band. With the "bug" within a few feet of the set a whistle should be heard. You may now use the fine tuning for tuning over about a third of the broadcast band. If a whistle is not heard, reverse connections to *L1*. If still no whistle, cut off battery and recheck connections.

[*Continued on page* 104]

Wireless microphone with ground and antenna wires. Screw on front is for coarse tuning.



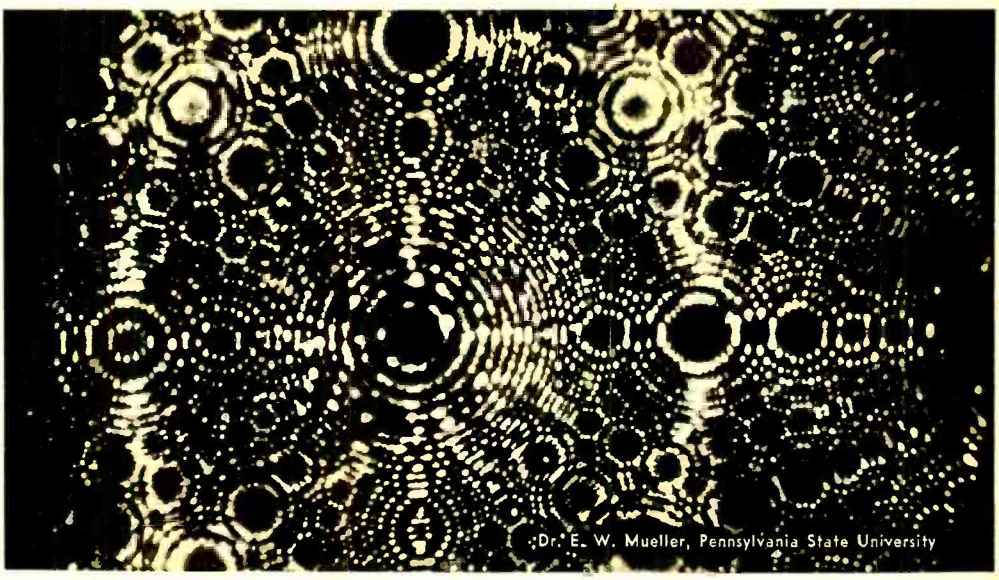
A bedspring is the antenna for a hidden mike, the other lead (ground) is merely strung out.



The ABC's of Electronics

By Donald Hoefler

Part 2 in this series explains the electron theory of matter and how electrons travel in a conductor.



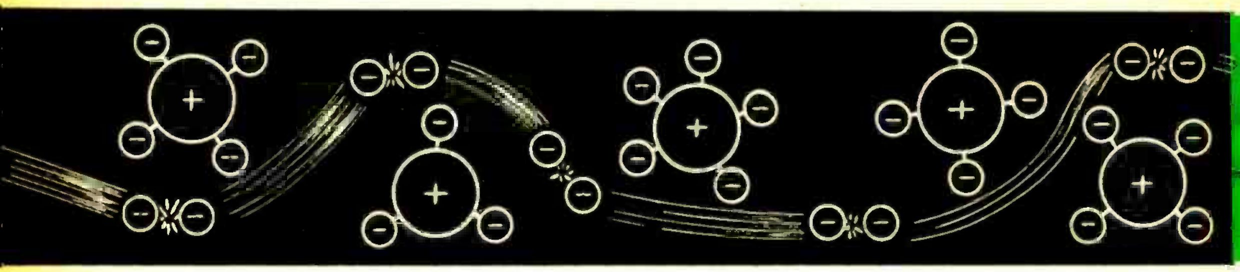
This photo taken with the newly developed ion miscroscope shows how atoms (white dots) of platinum combine in a crystaline-type molecule.

IT isn't surprising to learn that the science of electronics depends upon that tiniest particle called the *electron*. Not only that, but much of what we experience in life is explained by the *electron theory* of matter.

The scientist calls matter "anything which occupies space and has weight and dimensions." In a general way, then, we can see that matter is anything which can be detected by one or more of the five human senses.

Now any object of matter is thought to be made up of a huge number of tiny particles called *molecules* and each substance has its own particular molecular structure. Going even further, however, we find if we break apart a molecule, of water for example, it splits into two *atoms* of hydrogen and one atom of oxygen. From this we gather that while the molecule is the smallest possible particle of a compound, the atom is the very tiniest part of an element.

But suppose we go even beyond this and look inside the atom. There we will find that it is constructed somewhat like our own



Electricity flows through a conductor via the limited travel of millions of free electrons.

solar system, with a central sun (the nucleus) and a number of planets (the electrons) revolving around it in their orbits. The nucleus comprises a number of particles called *protons,* which are actually units of electricity, said to be positively charged.

Similarly, the planets revolving around the nucleus are called *electrons,* tiny particles of negative electricity. It should be understood that this explanation is somewhat simplified, for it is now known that there are sometimes electrons in the nucleus as well, and there are some other minor types of particles within the atom. As electronics workers, however, we will be primarily interested in the planetary electrons.

From this it is plain to see that all matter as we know it is basically composed of just two things, electrons and protons. Since all electrons and all protons are alike, the difference in characteristics of various substances, such as gold, silver, tobacco smoke or soda pop, is simply and entirely dependent on the number and position of the protons and electrons which make up each tiny atom.

Electrons and protons are called electric charges because of the manner in which they react to one another. Electrons tend to repel each other with relatively enormous forces, and protons react against other protons in the same way. But electrons have an equally strong attraction for protons, and protons feel the same way about electrons.

This fact provides us with one of the basic electronic laws: *Like charges repel and unlike charges attract.* If this were not so, atoms and molecules would be flying apart in all directions. It is only the attractive force between the positive charge of the nucleus and the negative charges of the planetary electrons which holds them together.

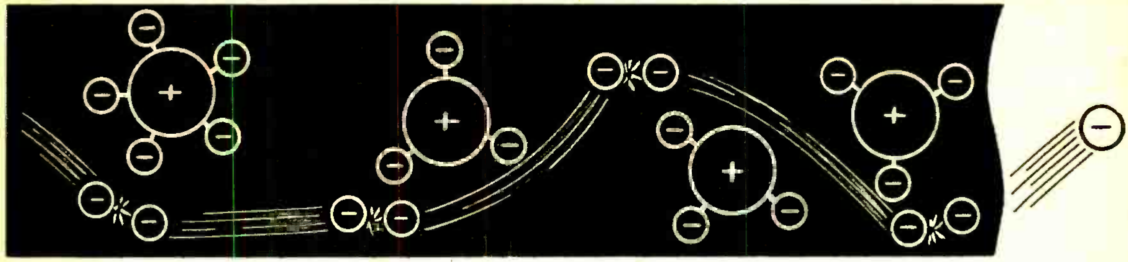
Often, however, this delicate balance between charges within the atom or molecule may be easily upset. The substance may readily lose a few electrons from the outermost orbit, or this same orbit may be constantly seeking to add a few more.

If either of these two events actually occur, the body itself is said to be charged. As an example, consider the old trick of running a comb briskly through the hair and then using it to pick up bits of paper by static attraction. In this case friction has caused the comb either to gain or lose some electrons, and thereby to become charged.

If the comb has lost electrons, the negative charges out in orbit no longer cancel the positive ones in the nucleus, and the substance is said to be positively charged. If on the other hand the comb has added extra electrons, their force now exceeds that in each nucleus, and the substance is negatively charged. This leads us to another fundamental electronic law: *A negative charge indicates an excess of electrons, while a positive charge results from an electron deficiency.*

When a body becomes charged, the condition we are discussing is actually one of static electricity. And at this point we should understand that man cannot generate electricity. We can cause electrons to move from place to place, yes, but whether we use friction to create the movement, or a dynamo or a solar battery, we are simply controlling electrons which are already there. A battery or generator no more creates electricity than a pump creates water.

There is another type of electron



movement within certain elements, wherein they are constantly shooting off protons and electrons. These elements are very unstable and their behaviour is called *radioactivity*. Their characteristics are constantly changing, but since they have such a large number of protons and electrons to begin with, the noticeable changes occur very slowly. Nevertheless, it is quite possible that in time a radioactive element will actually change into another element. Here in nature is a transmutation of the kind the ancient alchemists were attempting to perform by changing lead into gold.

Getting back to our hair-and-comb experiment, the charge developed between these two bodies can be easily discharged by the simple process of touching the comb to the hair without the earlier friction movement which set up the charge. But it is interesting to note that the bodies do not actually *have* to touch.

Suppose instead that one end of a copper wire touches the hair and the comb is touched to the other end. Now when we try to pick up the bits of paper with the comb, it won't work. The charge has been equalized. But how? Well, obviously electrons must have moved along that wire from the negatively-charged body to the positively-charged one. There must in fact have been a flow of *electron current*.

This current electricity is much more important to electronics men than simple static electricity. The flow of electrons is well known as electric current when it flows through a wire, which is known as a *conductor*. But in electronics we don't care at all about the state of that conductor.

Anything which will cause an electron flow through a conductor is called an *electromotive force*. This flow does not mean that each excess electron flows all the way through the conductor to the point of electron deficiency. It is more like the maneuver in croquet when you try to knock your opponent's ball out.

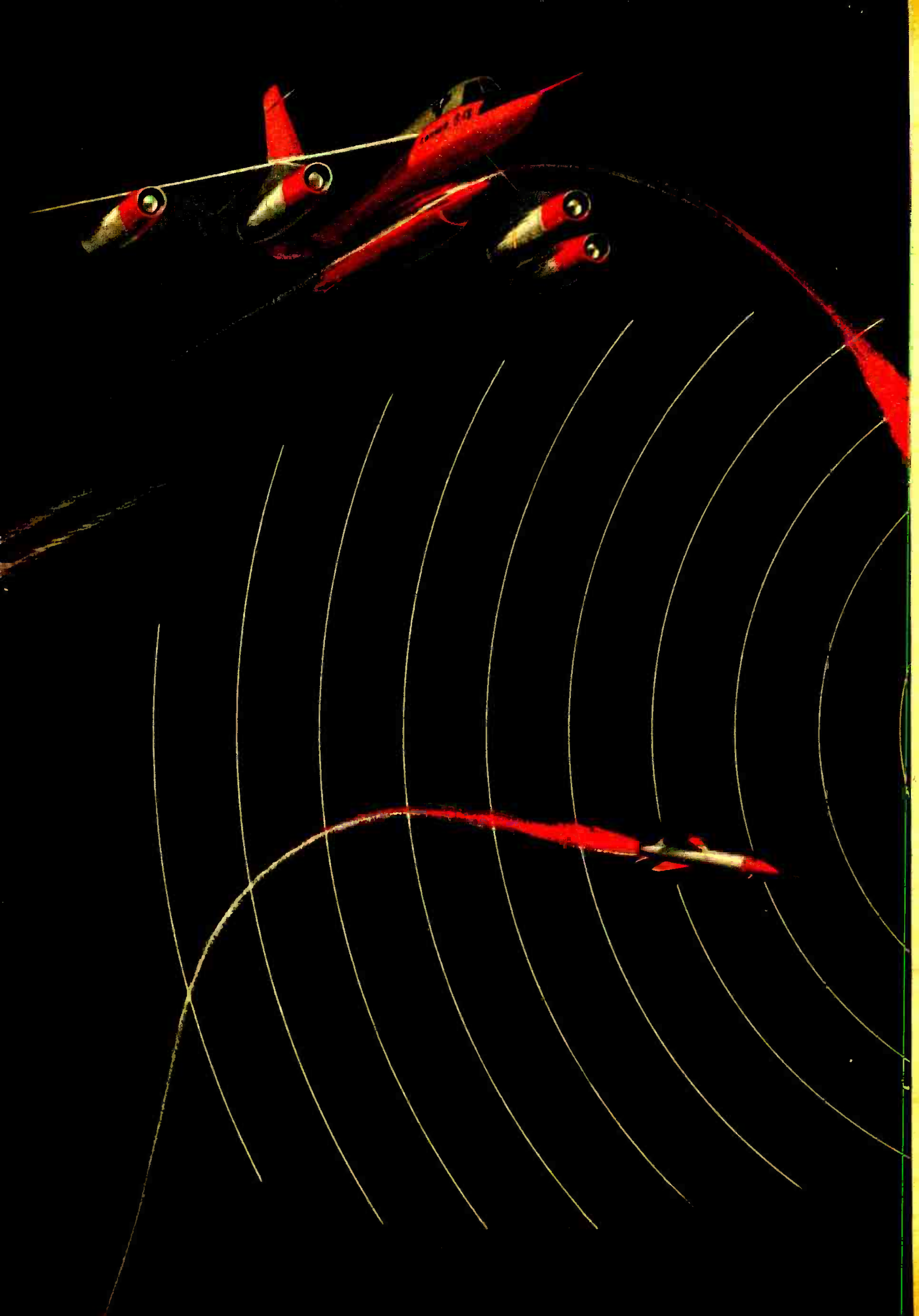
In this case you hold your foot on your own ball so it won't move. But when you smack it with the mallet, the opposing ball which was lying next to it goes flying. You could do the same thing with a whole string of croquet balls in line if you wanted to. Then you'd strike the blow at one end, but the ball at the other end of the line is the one which would take off.

This same kind of chain reaction occurs in a conductor. An electron near one end strikes another, that in turn hits still another, and so on until the effect is felt all the way down the line. Thus no one electron moves very far, but the *effect* of the electron flow is felt at all points along the conductor.

Now if we connect the ends of a copper wire to the terminals of a battery, a fairly sizable electron current will flow. But if we connect a carbon rod to these same terminals, the current will be much less. Obviously some materials are better conductors than others. Why?

It appears that the better conductors are those whose atoms will fairly readily give up an electron from its outer shell or orbit. The atoms or molecules of some materials, on the other hand, hold on to their electrons so tightly that it is difficult to free any electrons and cause them to move along in a given direction. Depending upon how strongly the atoms hold on to their outer electrons, they are called *resistors* or *insulators*.

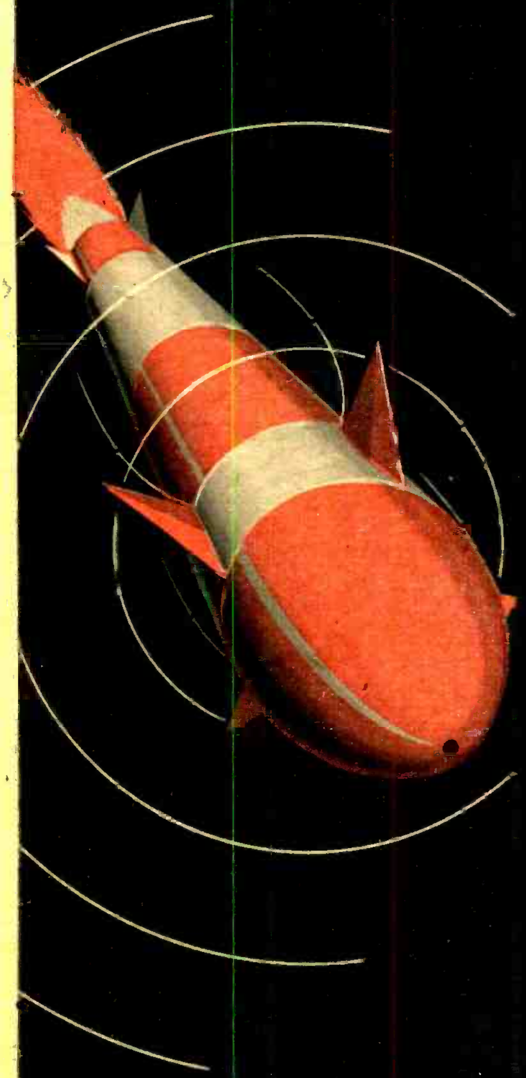
In our next discussion we shall learn the relationship between electromotive force, electron current and resistance.



Electronic Countermeasures

By Philip Julian

The fascinating story of how electronics makes the enemy think you are not where you really are.



Radio-transmitting decoy hurled from our bomber attracts enemy missile, saves bomber.

IN any future war, electronic countermeasures, the silent, highly secret weapons which employ electromagnetic radiation instead of explosives, will play a dominant, perhaps even a decisive role.

Electronic countermeasures, or ECM for short is a term applied to a variety of devices and techniques which can be employed to confuse and misdirect many types of guided missiles launched against our aircraft, ships, and other tactical and strategic targets. ECM also is employed to "blind" an enemy radar, confuse its operators, and disrupt the enemy's vital communications. Use of ECM frequently is called "electronic warfare."

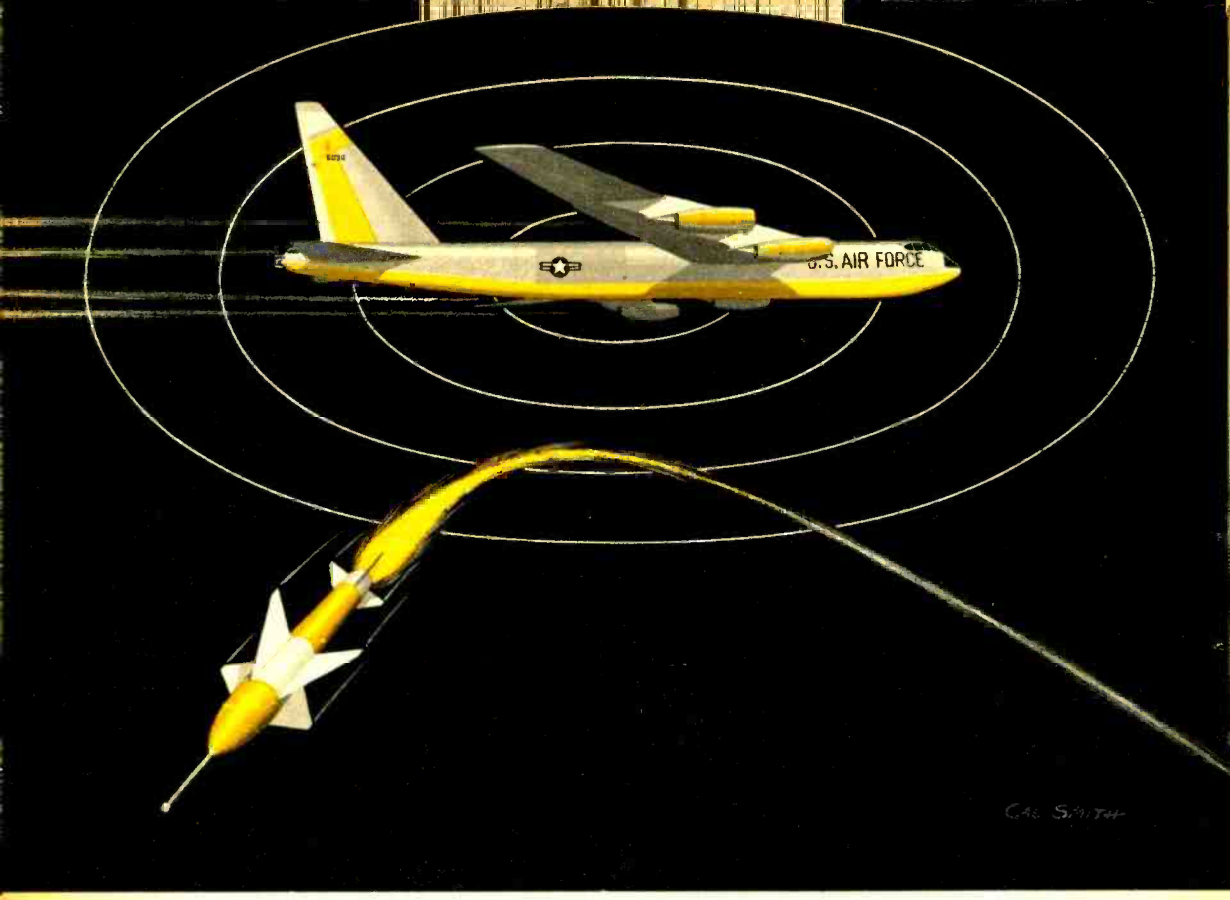
One indication of the vital importance of ECM is the fact that the Defense Department this year is expected to spend close to half a billion dollars for electronic countermeasures. This is nearly 10 percent of all Defense electronic purchases and more than the U. S. spent for ECM through nearly four years of active fighting in World War II.

Because electromagnetic radiation from enemy, and our own, radars and radio communications equipment, penetrates beyond national boundaries, limited electronic warfare is being waged today as both sides probe the other's electronic defenses.

Objective is to determine the location of radar and radio transmitters and to analyze their operating characteristics in order to develop ECM capable of jamming or confusing the enemy in event of a shooting war

This electronic probing, or reconnaissance, is carried out by aircraft, submarines and fixed installations

CAL SMITH



Bomber under attack has ECM equipment send out false range info to deflect enemy missile.

equipped with extremely sensitive radio-radar receivers and associated equipment designed to record and analyze the characteristics of the enemy signals.

Occasionally a probing airplane or submarine ventures too close and enemy guns blaze, producing a small international incident. But the probing goes on.

Passive ECM

One of the simplest types of electronic countermeasures, and one of the first types employed in World War II, is called "passive ECM." The term passive implies that the device or technique does not itself generate or transmit any electromagnetic radiation, but seeks to change the nature of radar echos or prevent their return to the radar.

Perhaps the best known example of passive ECM is called "chaff," or sometimes by its World War II code-name of "Window." Chaff consists of thousands of strips of tinfoil, dumped overboard from an airplane, which produce the effect of false targets on radar scopes by reflecting back some of the radar signal. By proper seeding, it is possible to lay down a sort of chaff smokescreen which obscures the attacking aircraft from air defense radars.

First recorded use of chaff in World War II was made by the British in July 1943 against the deadly effective German anti-aircraft radars. The results, to quote a U. S. Government report, were "spectacular." Royal Air Force losses were cut to a small fraction of those suffered in previous attacks. German radar operators were heard to exclaim: "The planes are doubling themselves!!"

The slow speed of World War II bombers resulted in a sufficiently small speed differential between airplane and drifting chaff to make it difficult to distinguish chaff echos from aircraft echos. Today, however, the 800 to 1,200 mph speed of modern bombers has made simple chaff less effective and led to the development of more sophisticated types of ECM.

It is possible to build devices which focus radar energy much as a polished parabolic reflector focuses light waves. One such device, called a corner reflector, consists merely of three flat metal plates, each mounted perpendicular to the other two, with a common corner.

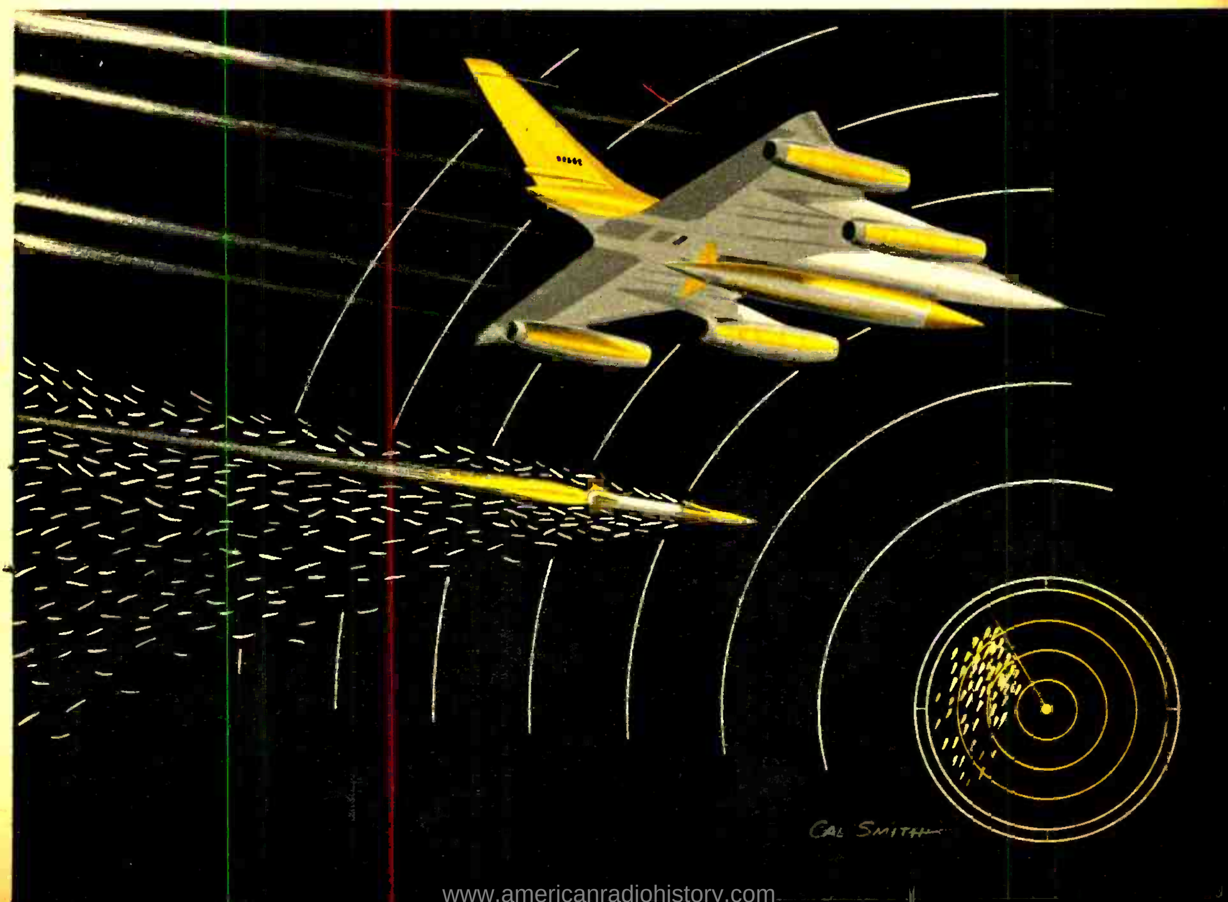
If one or more of these corner reflectors is mounted on a tiny rocket-missile or small drone airplane, it will reflect back a much stronger echo to the radar than normal for so small a vehicle. As a result the tiny missile or drone can appear to be a full-fledged bomber, misleading ground defense radars.

In the World War II Normandy invasion, the Allies outfitted a group of small motor launches with such corner reflectors which made them appear to be the size of a fleet of battleships on German radar scopes. These decoy boats made diversionary feints along the coast, fooling the enemy.

The dream of a perpetual motion machine, which occupied many amateur inventors a few decades ago, has been replaced by the dream of developing a "paint" which will make objects invisible to radar. Hardly a month goes by but what some inventor reports the discovery of such a technique, usually in the public press, but performance never comes up to claims.

Another approach to "blinding" radars is the use of destructive interference—similar to the anti-reflection coating used on camera lenses. Germans developed, and reportedly used, such radar camouflage on U-boats in World War II. Serious shortcoming of this technique is that it is very frequency sensitive. That is, it can conceal the object from radar reflections only for a relatively narrow band of radar frequencies.

Missile launched by our bomber spreads "chaff" at high speed, confusing enemy radar operators.



Active ECM

Major portion of Defense Department's ECM effort is being devoted to "active" electronic countermeasures—equipment which generates electromagnetic radiation that is intended to overpower the enemy's radio-radar signals, to irritate or confuse its radio-radar operators.

Most elementary form of active ECM is called "jamming," although this term also is loosely applied to all types of active ECM. One of the earliest, and simplest, forms of jamming used a simple spark gap to generate brief, jagged peaks of noise—not unlike that produced in home radios by an electric razor.

When this, or similar, types of jamming are employed against radio communications, considerable power may be required to overpower and disrupt the service. Other, more sophisticated techniques can be used which require less power but which can be more disconcerting, and hence effective, against an enemy radio operator. One, called "bagpipes," consists of transmitting a sequence of different audio tones over and over again, producing a sound in the radio operator's ear like the wail of bagpipes.

Because radar receivers must be designed to operate from extremely low level echos, the power output of a jamming transmitter can be only a few watts, or several hundred at most—compared to the far more powerful jamming transmitters needed to obliterate enemy radio communications.

Radar has two basic means for establishing the bearing and distance to its target. The direction in which the radar antenna is pointing when the echo is received establishes the bearing to the target, and the transit time for the radar pulse to travel from the antenna out to the target and back determines distance to the target.

One way to fool a radar is to design an ECM transmitter, for an airplane for example, so that it transmits a series of pulses each time it receives one pulse from the enemy's radar. (Naturally, the pulses transmitted by the ECM equipment must be identical to those sent out by the radar in terms of repetition frequency, duration, etc.).

The enemy radar will then receive a series of "echos" from the ECM-equipped airplane, each delayed slightly from the other. This will produce a series of target blips on the radar scope, each at a slightly different range and the radar operator can not tell which is the true target and which are false echos.

Enemy interceptor aircraft and missiles which employ radar for guidance to their targets must have accurate information on target range in order to determine where to aim. If, for example, a bomber under attack carries ECM equipment capable of creating false range information in the interceptor/missile radar, the latter will be misguided and the bomber can escape.

Our newest bombers, the Boeing B-52 and the supersonic Convair B-58, both will carry belly pods filled with a variety of ECM equipment, both active and passive types.

U. S. Air Force currently has at least several ECM missiles under development. One, called the Quail, is being developed by McDonnell Aircraft; another, known as the Goose, is being produced by Fairchild Aircraft. Mission of these ECM missiles has not been revealed, but it is possible to speculate.

One might be designed to be launched from a bomber under attack, to lure away the attacking interceptor or missile. Another might be intended to operate over enemy installations, jamming their radar and/or communications. Still others may be designed to spread a smokescreen of chaff.

Fundamentally, any missile which employs radio, radar or infrared for guidance can be jammed or fooled by ECM—and this represents the bulk of our missile inventory. Only the ballistic missiles and other long-range surface-to-surface types are immune, because they employ inertial guidance which is completely self-contained and does not involve any electro-magnetic radiation.

Growing emphasis on electronic countermeasures has spawned a concerted effort in what is called "counter-ECM"—an effort to make our own radar, radio and missile guidance less susceptible to enemy ECM.

Henry and Me

Electronic Handymen

How to Buy Hi-Fi

An exclusive EI interview with hi-fi experts yields the answers you need to buy the hi-fi best for you.

GENERALLY those people who know the most about any particular subject are also too busy to write about it. If their knowledge can help us either in what we buy or in what we think, we seldom get the benefit of their help unless we know them personally.

ELECTRONICS ILLUSTRATED thought about this situation long and hard and we think we have a way of extracting from the experts in a painless way such knowledge as would help our readers. Naturally, the method uses an electronic instrument—the tape recorder. We will interview for our readers experts in all fields of electronics—consumer as well as industrial and military. These interviews will be conducted by the Editor. The questions will be those that will bring out information of most use and interest for our readers. Your response to this feature will determine who we interview and how often.

For the first interview we chose Mr. Leonard Chase, partner and head salesman of the Electronic Workshop, a hi-fi sales salon in New York City and his service and installation man, Bob Tish. Mr. Chase has, himself, serviced and installed hi-fi, radio and television, and has a good knowledge of engineering practices. As a salesman he is very jealous of the reputation of his establishment. His methods are far from "high-pressure," he inspires confidence. The questions we asked started with the general and then became specific.

Q. How much should a hi-fi set cost?

A. As with any other item there is a wide variation in price depending on quality, number of units and furniture desired. Usually you get what you pay for. You can buy hi-fi for as low as $135 or as much as $2,000.

Q. Just how do you help someone who comes into your shop decide what is best for him to buy?

A. Well, I must discover what a customer needs and how much he has to spend, and this is a most difficult job for a salesman. If I show a customer a set that he likes, but is completely out of financial reach, he is kind of frustrated and may abandon the whole idea because he feels he can't afford good hi-fi. On the other hand, if I show him something too inexpensive he may feel that the shop doesn't have anything good enough for him. I think it's very important for the customer to know how much he wants to spend.

Q. Do you think they are afraid to admit how much they have to spend?

A. Yes they are. They seem to think that if they mention one figure they'll end up being high-pressured into paying a little bit more. That's really not true; if you know how much you have to spend and indicate that it's the limit and you'll stick to it, the salesman will respect that figure. Incidentally, the buyer need not be ashamed of mentioning a low price. There are many modest cost systems available that sound fine.

Q. What kind of information about the home and habits of the buyer do you need to know, to be able to recommend a suitable system for him?

A. Size of the room; amount of sound absorbent material in the room, such as drapes, upholstered furniture, rugs, etc., style of furniture, kind of musical tastes; whether the buyer will be listening to records only or whether he wants a radio tuner also; and where the system will be located within the room.

Q. How about whether a buyer wants a popular priced packaged set or a system made up of individual components—or has

In his showroom in New York City, Len Chase tries to determine which hi-fi components will best suit the needs of a prospective customer.

everyone who comes in here already decided that he wants components?

A. No, many people come in here for a package, but they usually end up by realizing that components are far superior.

Q. Why is that?

A. There have to be compromises made in popular priced package sets so that they can maintain their low price despite their costly cabinets. Also, everything is contained in one cabinet of a set furniture style. Component systems however, can be installed into any cabinet or set of cabinets, or on bookshelves, or anyplace else. They can be pulled out and re-installed at anytime. Most important though, when you buy, individually, every part of a component hi-fi system, you need make no compromises, you need have no weak links.

Q. How can a buyer be sure he is going to get the best set-up for his money?

A. He should definitely go to a reputable dealer who will take the time to determine his specific needs. If possible, he should talk to someone who owns the kind of equipment he is considering.

Q. Here's a question I know is important to our readers. Once a person has bought the components which you have helped him select, how does he go about installing them?

A. Actually, the equipment is very simple to install. Record changers come with all cables connected, amplifiers come complete, speakers are either sold in cabinets or can be screwed into the cabinet very easily. With a little common sense anyone can just plug one unit into another.

Q. Can the average buyer trust his own ears when listening to a hi-fi set?

A. Many people who go shopping from store to store get very confused after a while and all sets start to sound alike. One thing a buyer should be sure to do during his shopping period is to go to a live concert, then he will know what to listen for.

Q. I've noticed in your showroom this evening that during several customer demonstrations you encouraged the purchase of a transcription-type record player. Do you recommend a manual transcription-type player or a record changer for the buyer?

A. You know, when a couple comes in to buy, the woman almost

Size and quality of a speaker are major factors in a hi-fi system. Don't stint on this. Speaker needs heavy magnet, rigid frame, supple rim. Two or more speakers, for different ranges, are generally better than one. Solid, scientifically-planned enclosure is a must.

Record changer or manual turntable? She wants more convenience, he's out for less distortion. Len Chase moderates — they're both right!

always wants a record changer, "because you can just put your records on and forget about it." The men, too, are often swayed by this convenience, and it's a very real one, if your listening is mainly in the form of albums and background music. The transcription turntable on the other hand, represents the height of engineering design, and provides less inherent distortion.

Q. The current trend toward larger amplifiers has made me wonder, is there a minimum size amplifier that you would recommend?

A. I would definitely not advise anything below a 10 watt amplifier. Whether more than a 20 watt is needed depends largely upon the efficiency and size of the speaker, the number of speakers and extension speakers used, the size of the room and the amount of sound absorbing material, the type of music played, how loud the listener likes his music, and other factors. Actually even though most music at home is played at less than 5 watts, the larger the amplifier the less distortion there will be.

Q. How about tuners, when would you recommend an AM-FM tuner and when would you recommend an FM only?

A. I rarely recommend an AM-FM tuner for listeners in any large city where there are several FM stations. However, when people live in smaller towns where there may be no, or at most one FM station, or where they must depend on reception from a nearby city, an AM-FM tuner is obviously called for.

Q. Do you recommend the purchase of a tape recorder when someone is assembling his first hi-fi set?

A. Good tape recorders lend another dimension to any hi-fi installation. They can be used to record, off the air, music and other things not always available in records. There is a wide variety of pre-recorded tapes now available with a fidelity that is breathtaking. Of course, right now, tapes are the only widely available sources of stereo. Yes, I would recommend that anyone buying hi-fi seriously consider buying a tape recorder as one of the components.

Q. Now the $64 question—do you think the person who is interested in hi-fi should wait until stereo equipment comes down in price and stereo records are widely available?

A. No, I don't. There are thousands of records and types of music which don't necessarily need stereo for maximum effectiveness. And those people who primarily use [*Continued on page* 111]

Assembling an FM Tuner Kit

We built and lab tested the EICO HFT-90—is it easy to assemble? How good is it? Here's EI's report.

ELECTRONIC construction kits are now available for almost everything—from a $3 oscilloscope probe to a $1,000 analog computer. Engineers, radio-TV repairmen, hobbyists and home handymen have found in the electronic kit a way to equip their laboratory, test bench or workbench with accurate and reliable low-cost equipment. However, it is in the hi-fi field that the biggest impact has been felt.

Kit manufacturers whose initial interest was in the test equipment area are now channeling a major part of their production

The completed EICO model HFT-90. With cover the kit sells for $43.90. It is also sold for $69.90 factory wired.

Before starting to assemble the kit, check all the parts as you remove them from the box against the parts list.

into hi-fi. Amplifiers, tuners and speaker system kits are rolling off the assembly-packing line in ever-increasing numbers. But as the non-technical hi-fi buyer presents a growing market to the manufacturer, he also introduces new problems. Step-by-step instructions have to be simplified, refined and simplified again. Kit components must be identified so clearly that there will be no doubt in the novice's mind whether a particular item is a resistor, capacitor or "slug-tuned frammisnoid."

How successfully have the kit manufacturers met the challenge of the technically inexperienced? Can the average "handy with tools" individual put a kit together that will approximate the factory-wired model in performance?

This is the big question ELECTRONICS ILLUSTRATED has set out to answer for you. Each kit that we review will be assembled by a two-man team consisting of an engineer and a newcomer to electronics.

The novice will do the assembly and wiring, the expert will observe, taking notes and correcting any errors. The report will be written by the engineer on the basis of his notes and tests on the completed unit.

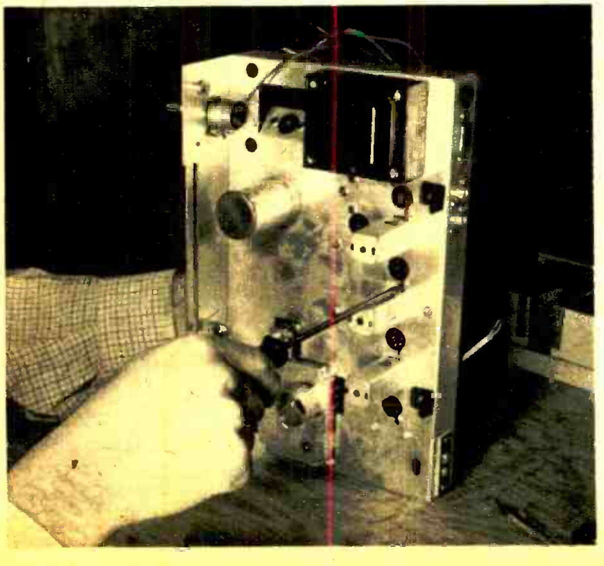
EI is going to pull no punches. We will print it as we see it. If the manufacturer wishes, his comments will be presented in conjunction with the EI report. By this approach we hope to render a genuine service to our readers. We will present honest reports, honestly done.

FM Tuner Kit

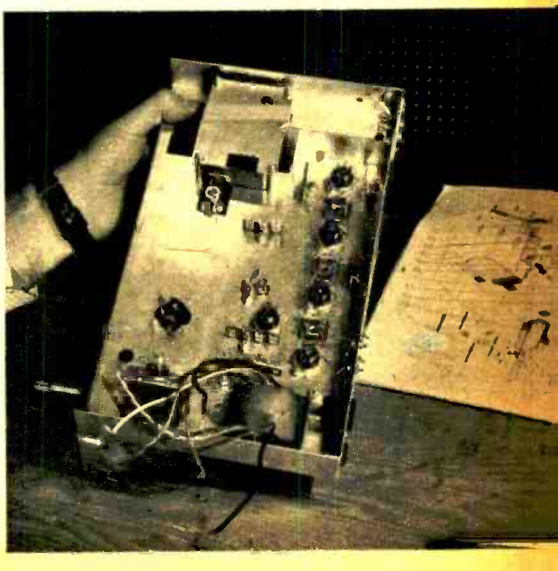
EICO (Electronic Instrument Co., Inc.) recently introduced an FM tuner kit, the model HFT-90 for $39.95 less cover. This we chose for our first hi-fi kit report. However, it should be pointed out that in an FM tuner poor wire placement, overlong resistor and capacitor leads, sloppy soldering, etc., can easily turn a well engineered product into a distorting, howling, humming monster. It is for this reason that a tuner kit is not recommended as a first hi-fi construction project. You can tackle it though if you've successfully completed other simpler kits.

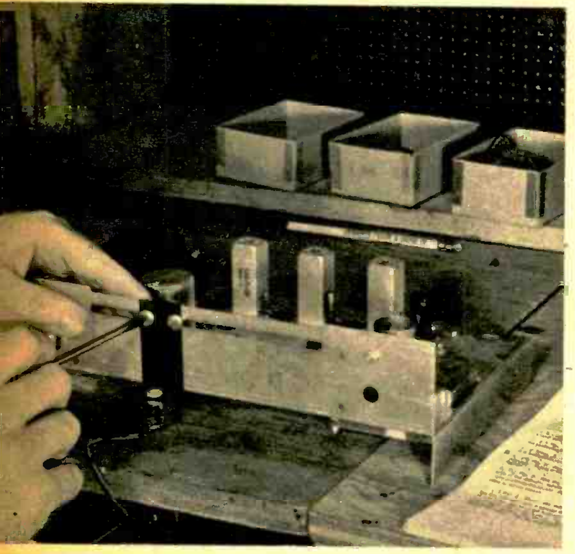
First, a few general suggestions. As each terminal strip, socket or part comes up in the text, mark its code (XV7, TB3, T3 etc.) adjacent to it on the chassis. A lot of time will be saved when cross checking and the chance of error will be minimized. Check and

Mounting the tube sockets onto the chassis. Make certain they are screwed down tightly.

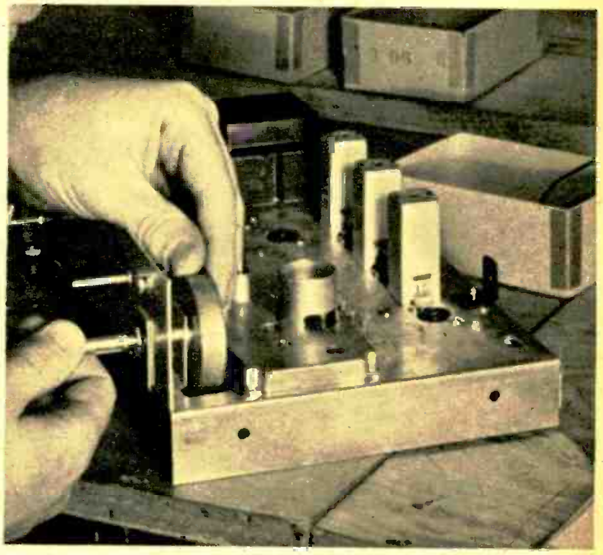


Bottom view of chassis with all major parts mounted and before the actual wiring is begun.





The tuning pointer is also the tuning eye, this is mounted on a special moving bracket.



The flywheel which gives the tuning knob a "solid" feel mounts in front of RF assembly.

double check the mounting positions of the tube sockets and the IF transformer terminals when you install the cans. If you later find you've made an error in the mounting of one of these, it *must* be repositioned correctly. Remember—*lead length is critical!*

Mechanical Assembly

Paul, who acted as the guinea pig for this report unpacked the kit as received from EICO. Using the tops and bottoms of the small cardboard parts boxes he checked and separated the hardware and components into separate small groups, read the general instructions and got to work.

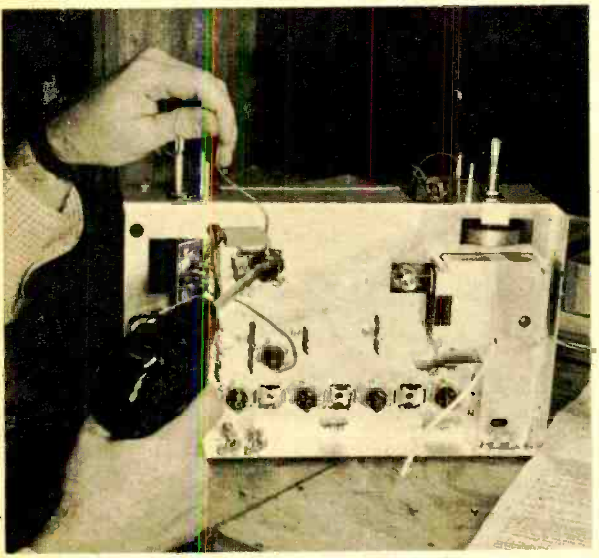
The 7-pin miniature sockets used throughout the tuner were found to mount easiest if first one screw, washer and nut were loosely put in place, then the other, and then both tightened. It is very important that the tube sockets be mechanically secure to the chassis, as part of the socket's metal rims are used as grounding lugs. Paul found that he could position all major components correctly if he studied *all* of the pictorial diagrams first. Confusion about the mounting position of the tuning drive bracket for example, was resolved by consulting a view of the assembly at the rear of the manual.

The heart of this tuner kit is the conveniently preassembled "front end," prealigned and completely shielded within its own case. This part screws onto the chassis and connections to it are made at external terminals; no room for error here.

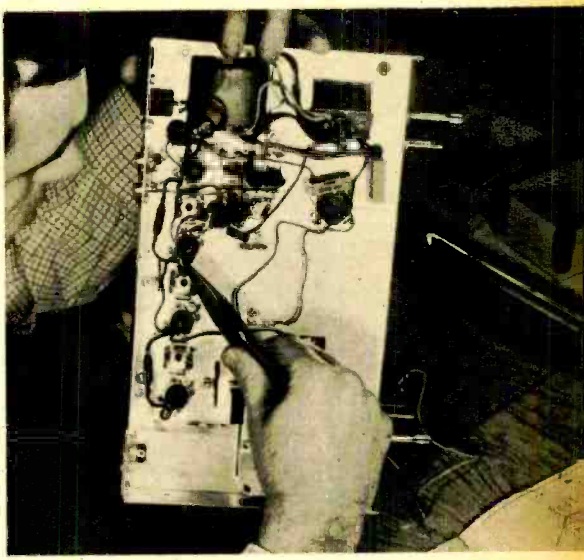
The instructions specify the length to which component leads should be cut. However, in several steps leads were too long by as much as ¾". In general, the pigtail leads from resistors, capacitors and choke coils should be no longer than is necessary to complete the connection without physically straining the component itself. Trouble arises from leads that are too long, not too short.

Occasionally, Paul came across a resistor whose color-coding agreed with the instructions, except for the omission or change of the last silver or gold color band. This was not important since none of the circuits for which these resistors were intended are particularly critical as to resistor accuracy (which is what the band signifies).

Paul brought up the matter of frequent use of "spaghetti" in the wiring. "Spaghetti" in electronics (as opposed to that which accompanies meatballs) is the thin insulating tubing used to



The power supply circuits are wired first, here a lead is soldered to filter capacitor.



Bending down tube socket tabs to prevent shorting to wires, a step often overlooked.

cover component pigtail leads. In general this sleeving should be placed over bare leads that cannot conveniently be shortened and hence might short out to chassis or adjacent components.

Paul found that wiring the 300-ohm flat twinlead to the antenna terminals of the RF assembly had to be done carefully, both to prevent overheating of the terminals and shorting the RF terminals to ground.

The dial cord assembly looked complicated, but went smoothly.

Two more points in the mechanical assembly needed clarifying. On first try, the bezel or front plate was mounted upside down. It should have been mounted with the control shaft holes closest to the top of the tuner. Also, though there are no instructions to that effect, the paper backing on the Plexiglas station frequency dial plate *must* be removed for the tuning eye station indicator to be visible.

As a final step, an ohmmeter was used to check out the power supply for possible short circuits. Everything tested fine. A 3-foot length of wire was connected to an antenna terminal and Paul, as the one who did all the work had the honor of clicking on the tuner. Nothing happened for a moment and then a little green exclamation point appeared, glowing through the dial scale. A twist of the station selector knob and the exclamation point contracted to the "on-tune" condition and beautiful hi-fi music filled the room.

Lab Report

Because of lack of accepted standards in the hi-fi industry, FM tuner sensitivity measurements are not particularly meaningful. One manufacturer's rating of 3 microvolt sensitivity frequently corresponds to another's 6 microvolts. For that reason EI checked this FM tuner by comparison with a "standard" (highly rated, factory wired) tuner for sensitivity, noise, audio quality, frequency response and drift.

How did the HFT-90 measure up? Several low-powered metropolitan broadcast stations (the unit was tested in Manhattan) which could be picked up cleanly with the "standard" tuner with no external antenna were received by the unaligned kit when a good external antenna was used. The strong stations were picked up well with only a short length of wire as an antenna. After the tuner alignment was "touched

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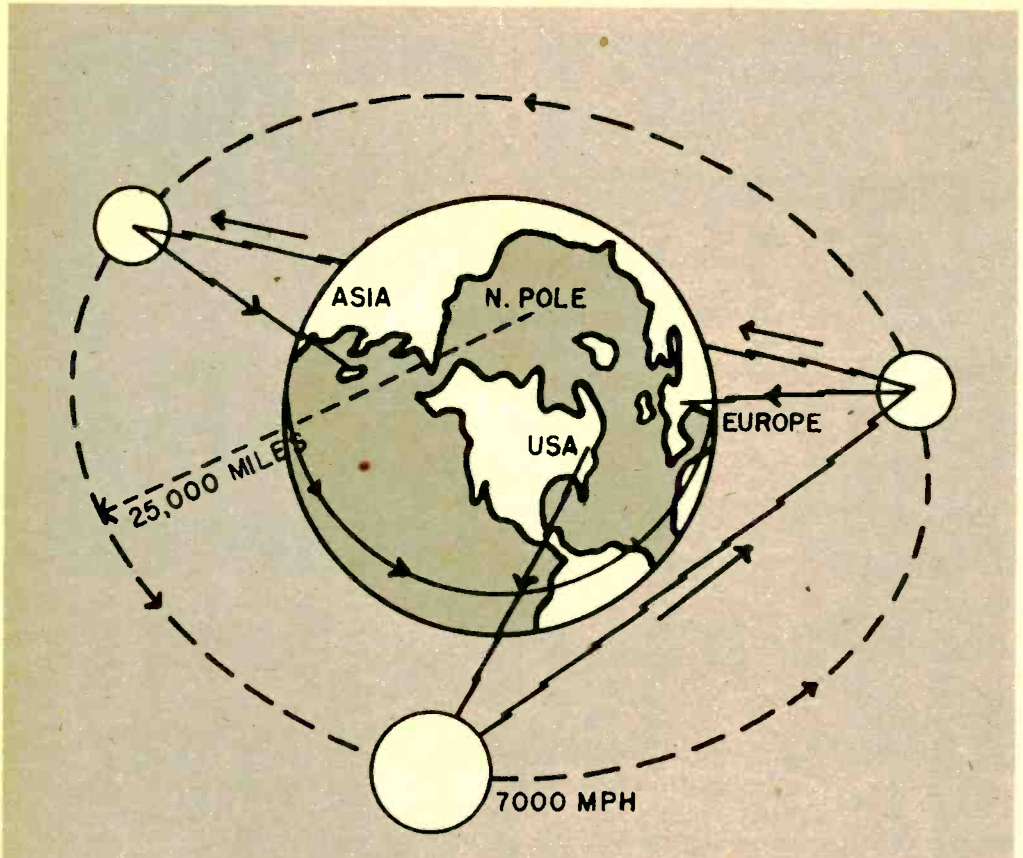


Three satellite relay stations will hover over Earth at fixed positions.

TV to Circle Globe

By Matt Johnson

Satellites now planned to orbit around Earth to make TV reception from Asia or Europe to U. S. a reality.

WITH a whole flock of satellites causing a traffic jam around the earth it may be well to pause a moment and ask: What good are the Sputniks and the Explorers and the Vanguards going to do us? We all realize, of course, that science is gaining tremendous knowledge, which in the final analysis will benefit every man, woman and child. But what about right now. What can we do with the satellites that will give us a return for the billions we—and the Russians—have invested in them?

The answer is in almost everyone's living room. Television. Television with a great big, capital T. World-wide video, reaching into every nook and cranny on the face of the globe. The best in entertainment, drama, ballet, music and education from the United States, Russia, England, France—literally from almost every country on earth, available on a worldwide network.

For years, television engineers and broadcasters have dreamed of being able to pick up Europe "live". The best they can get is fragmentary DX reception—hardly worth the effort.

Now, with the satellites, we can have global coverage, and probably within the next few years. Up to now long-distance reception of television signals was impossible because at the high frequencies employed for TV (50 to 1,000 mc) the transmissions penetrated the ionosphere like a hot knife through butter, and disappeared into space. So we have had to be satisfied with line-of-sight transmission, and have built the highest towers possible to get extra distance. But the satellites could give us towers 26,000 miles high, and global TV.

To make such a system operable, the satellite must contain a transmitter capable of sending a signal we could pick up on earth, and a receiver capable of receiving a signal from earth. All of the satellites have transmitted signals powerful enough to be heard by receivers here, some as little as 1 milliwatt. And it is believed that at least one of the satellites had receiving equipment, so that we could key it to transmit a message when we wanted it, instead of keeping the transmitter on continuously.

Some of the latest equipment just unveiled has a power of 500 milliwatts, weighs 3 ounces, and is no larger than the earlier satellite types, about four or five inches. Since equipment is no problem, let's see how global TV would work.

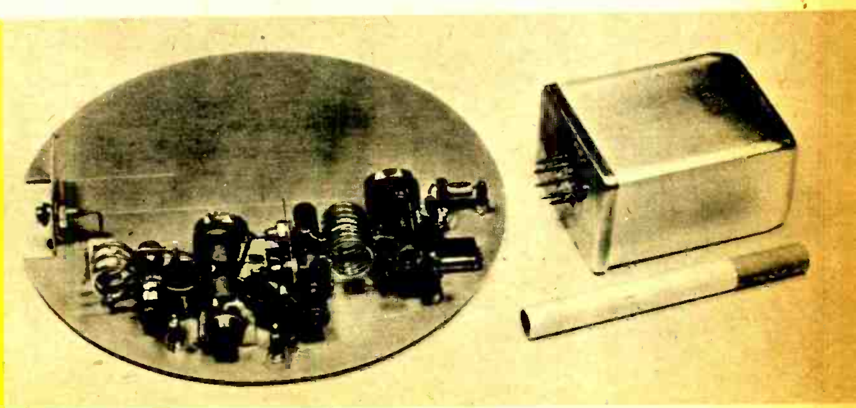
The satellite would act as a relay station. Sitting thousands of miles above the earth, it would pick up television signals beamed at it, and transmit them to earth thousands of miles from their origin. As long as the signal-to-noise ratio is sufficiently high, the receivers could amplify the signals and rebroadcast them to local viewers.

Actually, this is a simplification. You may ask, if the satellite is traveling at 18,000 or so miles an hour, how would we be able to beam a signal to it accurately enough so that it could be received and retransmitted? And even if we could, the satellite would be over the horizon in minutes, so we'd get very little reception.

The answer to that is, of course, to use a satellite that is *stationary* so that once we got a fix on its location, we'd be able to hold it continuously.

This may sound odd, but it's not impossible. It all depends on how we launch the satellite. If we shoot up a satellite and send it orbiting over the equator in an easterly direction at about 26,000 miles or so from the center of the earth, at a speed of a little less than 7,000 miles an hour, we will have achieved our purpose. For at this speed and height, the satellite would match the speed of the earth's rotation eastward, and would therefore stay directly over one spot on the surface. In other words, if it achieved this orbit over the western

Complete signal transmitter which develops ½ watt of power, is 3 oz. and uses transistors throughout.



hemisphere let's say, it would hover over Brazil—probably forever—subject only to possible perturbations caused by the sun and moon, with possibly a tiny shift due to the distribution of the mass of the earth.

Once in such an orbit, intercontinental transmission could be achieved. However, true world-wide transmission would still not be possible, since the far side of the globe would still be in a video "blackout", just as one side of the earth is always in darkness when the other receives the sun's light.

Ideally, therefore, if we could orbit several such satellites at strategic spots about the earth, we could then bounce signals from one to the other, as well as back to the earth's surface. In other words, if we sent aloft a sufficient number of "moons" so that each area of the earth we wished to cover were "visible" to at least one of them, we could achieve the global network.

One such system proposed would have three satellites, 120 degrees apart, one over South America, the second over Africa and the third over Southern Asia. A signal transmitted by a station in New York would be picked up by number one, which would bounce it to number two, over Africa, which would broadcast it to stations in Europe, and at the same time, relay it to number three, over Asia, which would rebroadcast it to Asian stations. The same relay system, of course, would work from the other satellites in returning European and Asian programs to the United States.

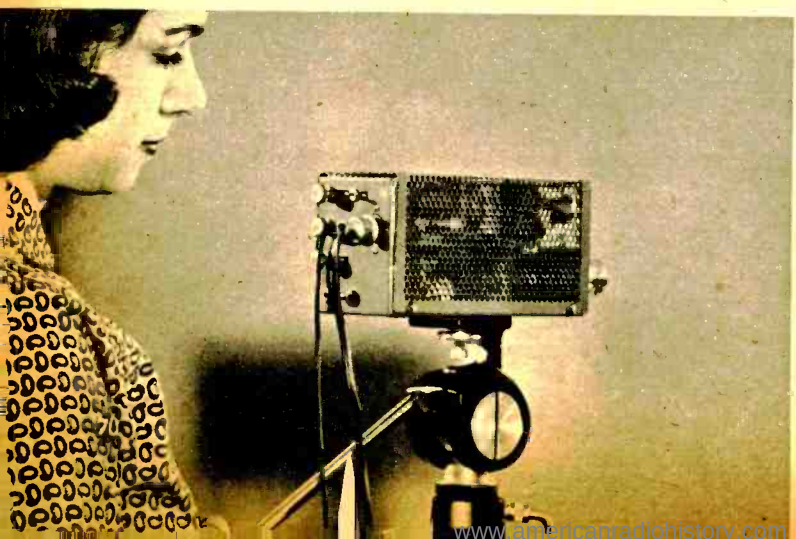
Such satellites would have to have enduring power. That rules out ordinary chemical batteries. The most likely source would be solar cells, which are currently being tested on Vanguard I. There is some suspicion that such photoelectric cells, exposed to raw sunlight in outer space, would be burned up in short order. Even if that should prove true, it should not be too difficult to devise a radiation-shielded window to cut down the strength of the sunlight.

Naturally, such equipment would be all transistorized, to eliminate the possibility of failure. But since there is always the slight chance of the unexpected happening, duplicate equipment most certainly would be carried, so if one receiver or transmitter failed, the second would automatically cut in.

We may have a very clear demonstration of the feasibility of television transmission from space soon. It is expected that one of our satellites to be launched during this International Geophysical Year will contain a small, rugged television camera.

One of the smallest such cameras under construction at this time, is being made by RCA. It is 3⅝" X 3⅛" X 7⅛", and weighs slightly less than four pounds. It used a ½-inch Vidicon tube, and 8mm movie camera lenses. It is a completely transistorized device, with all components contained in the package described above. If it survives the shock of launching, we may be receiving pictures of our own earth from hundreds of miles high and photos of the stars and moon without the interfering layers of atmosphere that distort them so.

When we do—and it's a pretty sure bet that we will—it will be but a short step before global TV.



Special rugged version of miniature TV camera like this one with very sensitive pickup tube and transistors may be used in a satellite to take pictures of Earth.

Ham License Requirements

By Robert Hertzberg

WANT to operate your own shortwave station at home, or in your car, and engage in thrilling long distance communication with other "hams" all over the world? The privilege is yours—if you first obtain an amateur radio license from the Federal Communications Commission (FCC). Learn the location of the nearest FCC office, from the phone book (look under "United States"), or from your local post office; or get the information from the main office, whose address is Washington 25, D. C.

There's no age limit for "hams." The license doesn't cost a cent. The document itself is mailed out from FCC headquarters, and it is a combination operator-license authorization.

CLASS—WHAT IT IS	HOW TO GET IT
NOVICE . . . Instituted to encourage the hobby of amateur radio. The exam is easy; lots of boys and girls of 12 pass it. Operating privileges limited to one "ham" phone channel and three radiotelegraph bands. License is good for one year and is not renewable. After a year the "novice" must either qualify for a higher license or go off the air.	Given *only* by mail. Get necessary papers from FCC, take test in presence of any holder of "general" or "amateur extra" class license, mail papers back to FCC. You must be able to copy dot-and-dash clear text code at 5 words per minute, and answer questions on elementary radio theory and regulations.
GENERAL . . . This is the best ticket to get as it allows unrestricted operating privileges in all fifteen assigned "ham" bands, runs for five years, and is renewable regularly for life of holder.	If you live within 75 miles of an FCC examining point, you must take test in person. First part is a five minute transmission of clear text and numbers in the dot-and-dash characters of the International Code, at the rate of 13 words per minute. Copy any one minute of the message correctly and you can go on to the written exam, which consists of 45 questions of the multiple choice type and the drawing of five diagrams. If you flunk the code, you don't take the written, but you can return in 30 days and try again. Regardless of where you live, you may take the "general" test at any FCC point where it is given.
CONDITIONAL . . . The same operating privileges and same term as the "general," but given by mail, in the same manner as the "novice," for persons living more than 75 miles from an FCC office or physically unable to travel.	The same code and written test as for the "general." Get necessary papers from the FCC, take test in presence of any holder of "general" or "amateur extra" class license, mail papers back to FCC. Doctor's certificate required to cover situation where you are unable to travel.
TECHNICIAN . . . Limited operating privileges; runs for 5 years and is renewable, but is hardly worth the bother. With just a little more code practice you might as well qualify for the "general/conditional."	By mail only, as with the "novice" class. Consists of the 5 w.p.m. code test of the "novice" and the more difficult written exam of the "general/conditional."
AMATEUR-EXTRA . . . A special prestige ticket, exactly the same operating privileges and term as the "general/conditional." Very few "hams" take the exam to obtain this ticket. The exam is waived entirely for persons who hold or can qualify for a "general" and can prove that they held "ham" licenses prior to May, 1917. For this reason it is known popularly as the "grandfather ticket."	Can be taken only by the holder of a "general/conditional" license with a minimum of 2 years experience. It involves passing a 20 w.p.m. code test in person and an advanced written test on theory and regulations.

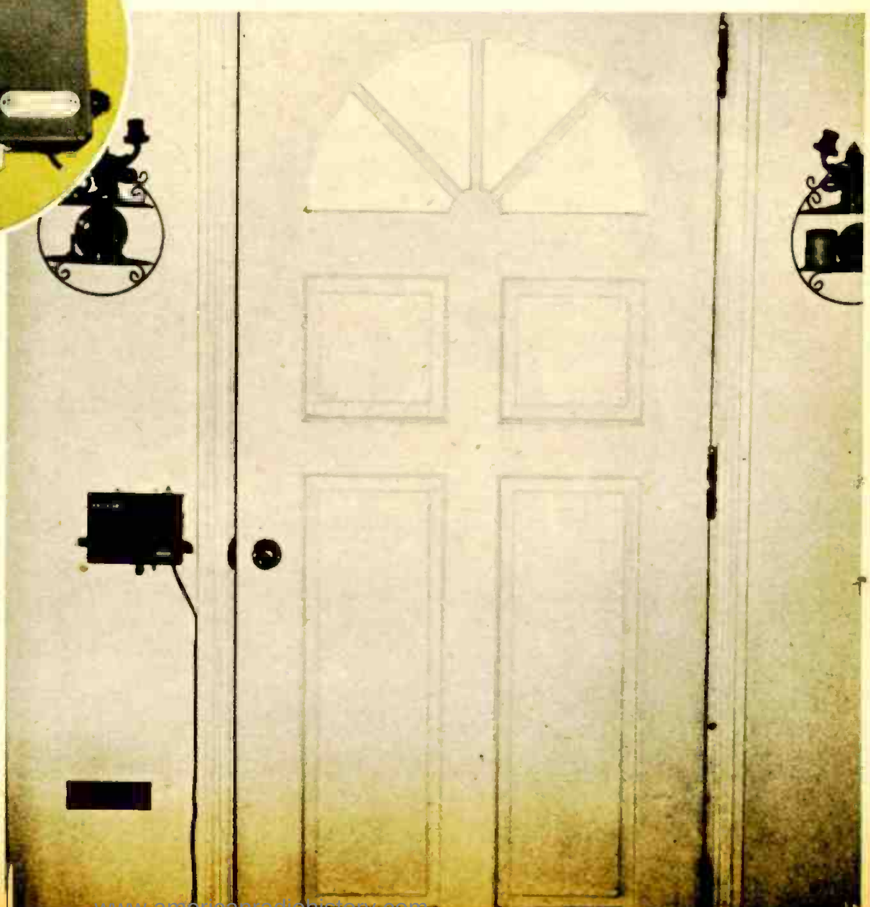
The Invisible Switch

By Harvey Pollack

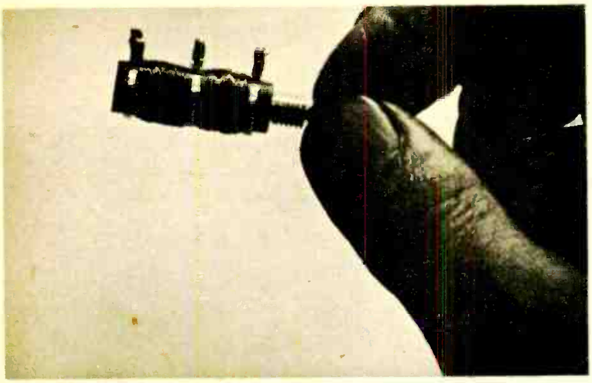
Use it as a burglar alarm, children alarm, proximity switch—1001 uses around the home, workshop, etc.

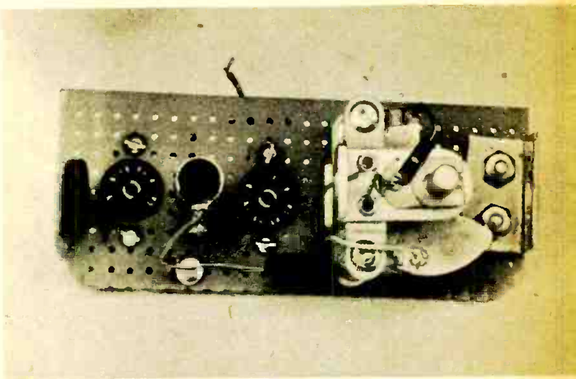
HERE is something you can find more uses for around the house than you can imagine. It will turn lights on or off as you enter a room; it will warn of children who come too close to your circular saw or other operating power tool; it will protect jewelry or other valuables against theft; or it will ring an alarm bell at the approach of an intruder to an outside door. And, there is no visible box or light beam to warn of its existence.

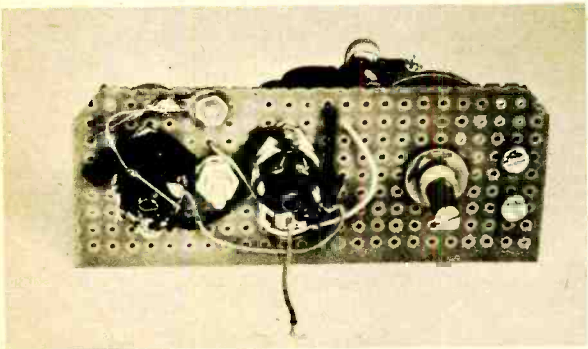
The applications of this proximity detector are limited only by your imagination. Since its action is based upon body capacitance, it requires no light beam as you would need for a photoelectric trigger system, or any other auxiliary equipment.

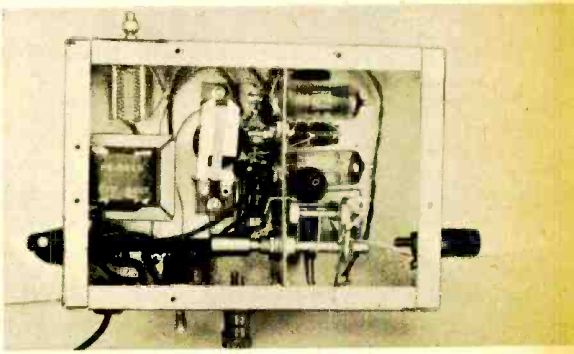


The heart of the invisible switch is the flat box at left. From it, a long thin wire is strung around the door; anyone coming within two feet of this wire sets off the alarm.









The oscillator coil (top) is wound on a commercially available form. Follow directions.

Top view of subchassis (top) shows position of tuning capacitor, coil and mounting bracket.

The two tube sockets are mounted to the bottom of board; fine tuning control at right.

Inside view of switch box shows all parts in place. Note extension on fine tuning shaft.

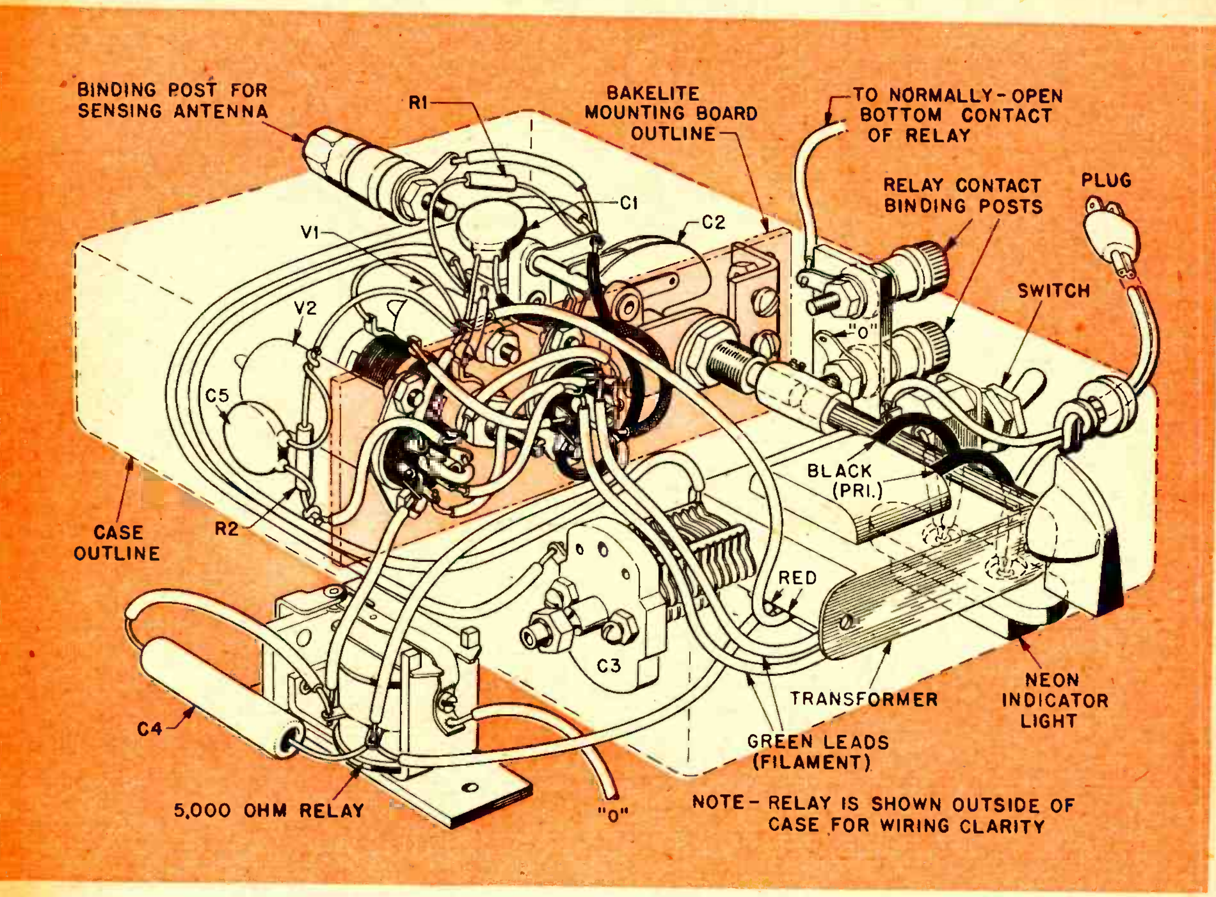
Design emphasis in this model was placed upon reliability, personal safety, ease of adjustment, and long trouble-free operation.

A thin, unobtrusive piece of wire from 1 to 10 feet long is used as a "sensor" antenna and is placed near the object to be protected. As a person or animal comes close to the sensor, the additional electrical capacitance to ground provided by the conductivity of the body upsets a sensitive circuit which then pulls in a relay. The relay, as will be explained, may be arranged to open as soon as the intruder passes by or to remain closed or "latched in" once it is energized to serve as a self-maintained alarm system.

This model was designed to lie flat against a wall without tubes or other parts protruding from it. The parts layout shown here need not be followed too closely since the wiring is not particularly critical. Standard chassis construction may be employed, or you can build the entire device in a cigar box if you wish.

The wall-hugging, professional appearance obtained in the model illustrated here was achieved by building everything on the inside of a small aluminum chassis measuring 5"x7"x2". Only control shafts and terminals appear outside the enclosure; these are located out-of-the-way at the sides of the chassis where they will not be disturbed inadvertently by passers-by. This fundamental design also permits the proximity relay to serve as a lamp base; bringing your hand close to the base turns on the light.

A small perforated bakelite subchas-



sis is fitted across the 5″ dimension of the chassis about 3″ from one end. The subchassis carries most of the electrical parts; the isolation transformer, on-off switch, relay, relay capacitor, and coarse "tuning" control are mounted on the chassis. The inside of the main chassis should be marked off for mounting holes by placing these parts in their respective positions and using them as templates. Be careful to allow enough space between parts for free movement (variable capacitor must be able to unmesh fully and the relay armature must be clear of obstructions). Don't make your work too difficult by crowding the parts so that you have no room to get in with a soldering iron.

Here are some other things to watch out for when placing the larger parts in position:

The coarse tuning control (*C3*) has a slotted shaft for screwdriver adjustment; this protrudes from the side of the chassis through a 3/8″ hole and must not be allowed to touch the metal of the case.

Leave room for mounting insulated binding posts, two for external connection to the relay contacts and one for the sensor connection.

Plan on a 3″ length of 1/4″ bakelite or plastic rod which couples the shaft of the fine tuning control to its control knob on the outside of the chassis. The rod, which couples to the shaft by means of a 1/4″ to 1/4″ brass coupler, must have unobstructed passage to the outside of the chassis. It's so easy to forget this while positioning the components!

Finally, when placing the little bakelite subchassis in position, remember to allow room for the bottoms of the tube sockets and the wires that go to their lugs.

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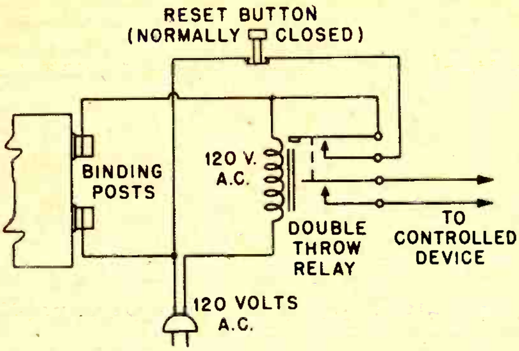
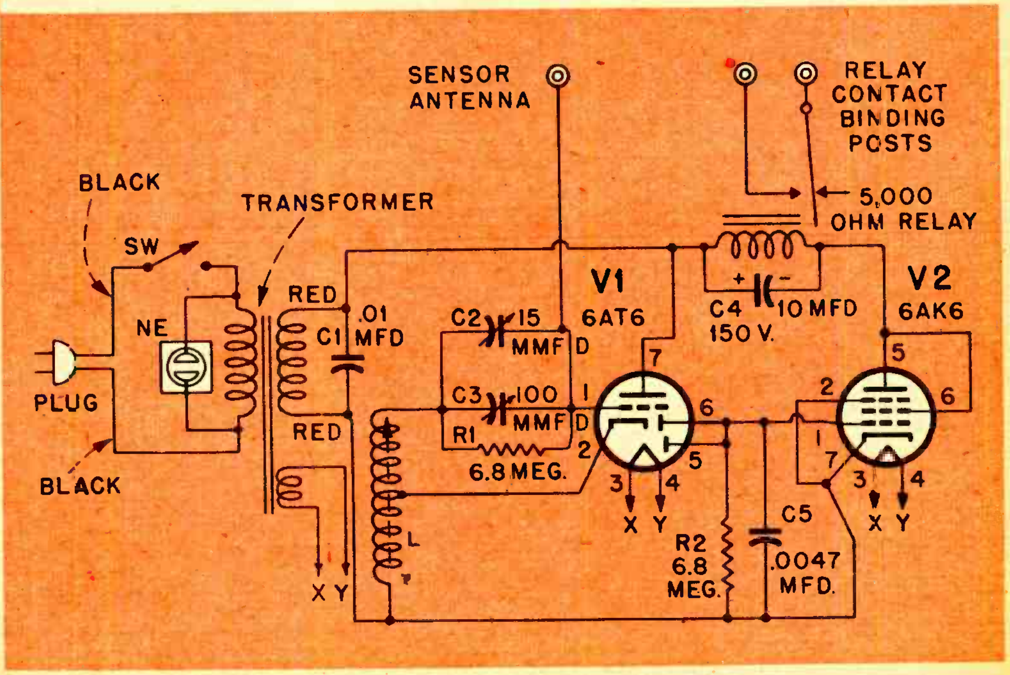


If you want the invisible switch to activate a control that stays on after the switch is tripped, a "latch-in" circuit is required, as shown here. A double-throw relay is connected to the binding posts of the switch box via a spring-return button; press to open relay.

PARTS LIST

C1—.01 mfd, 1000 v., disc type (Centralab MD-103)
C2—Variable, 15 mmfd, maximum capacitance, with 1/4" shaft
C3—Variable, 100 mmfd, maximum capacitance, slotted shaft for screwdriver adjustment. Must have insulated mounting provisions
C4—10 mfd, 150 v., electrolytic (Mallory TC-42)
C5—.0047 mfd, 1000 v., disc type (Centralab MD-472)
R1, R2—6.8 megohms, 1/2 v., fixed carbon resistors
L—Coil, 200 turns of #32 wire, center-tapped, 3/8" long for each half-winding, wound on a 1 1/8" x 3/8" coil form, phenolic base with tuning core (Cambridge LS3)
Ne—Neon on-off indicator, 120 volt with built in series resistor, flush-mounting type. (Drake type 110 Flushlite)
P1—Line cord and plug, standard 120 volt type
RY—Relay, SPDT, 5000 ohm coil, 5 amp. contacts (Potter and Brumfield LB5)
SW—SPST toggle switch
TRANS.—Transformer, isolation and heater, primary 117 volts 60 cycles, secondaries: 125 volts at 15 ma., 6.3 volts at 0.6 amps. (Stancor PS-8415)
V1—6AT6 tube
V2—6AK6 tube
Chassis—Aluminum, 5" x 7" x 2"
Subchassis—Perforated bakelite cut to 4 7/8" x 1 7/8"
Binding posts—Three needed, insulated 5-way type (Smith PJ-21)
Bakelite rod—Four-inch length, 1/4" diameter, to serve as shaft extender for fine tuning control
Shaft coupler—Brass, 1/4" to 1/4" coupler
Sockets—Two required, 7-pin miniature, bakelite
Knob—Pointer type, for fine tuning control extension

The wiring guide for the invisible switch is shown on the facing page. The schematic diagram is shown below, the parts list is above. The unit need not be as compact as shown here, but don't deviate from the parts specified if you want foolproof results.



Convert Your Old Radio to an Intercom

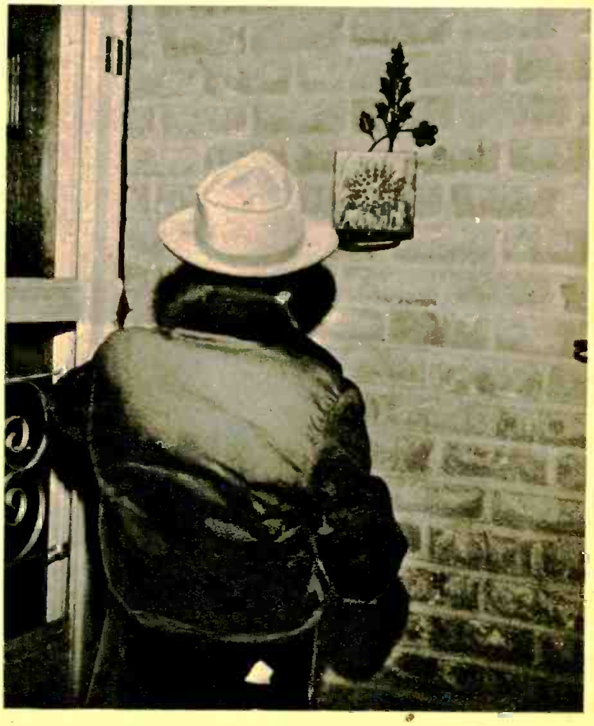
By Paul Hertzberg

Make this baby sitter, garage-to-kitchen intercom, or front-door answerer from any table model radio.

HOW many times have you or your wife wished you didn't have to answer the front door bell or talk to a salesman at the door? An intercom will help you dispose of these distasteful and time wasting tasks, but why buy one when you practically have one already in your home? Almost everyone has a small table model radio—with the addition of a few inexpensive parts, this radio can be made to serve as an intercom also.

The first step is to remove the power cord of the radio from the wall outlet. This will eliminate any danger of shock while working within the chassis. The knobs can be removed from 90% of all sets by simply pulling them off. Some may be held

To answer the front door, merely hold the "Listen-Talk" switch at the Talk position after flicking the bottom switch to "Intercom." The remote speaker on the outside also acts as a microphone for the caller. Total cost is $5.50.



on by small set screws. The chassis can be taken out of the cabinet by removing two or more small screws on the bottom or possibly at the back of the case.

Three parts are added to the radio: a toggle switch, a rotary switch, and a small transformer. Examine the radio's combination volume control and on-off switch. Notice that one terminal of the three on the *side* of the volume control is connected to the metal chassis. The center terminal usually has a paper capacitor (about .005 mfd.) between it and pin number 1 of the first audio amplifier-detector tube (12AV6, 12AT6 or 12SQ7). The wire at the third terminal has to be unsoldered and connected to terminal "B" of the added "Radio-Intercom" toggle switch. Connect a wire from the now-empty volume control terminal to connection "A" (common) of the switch.

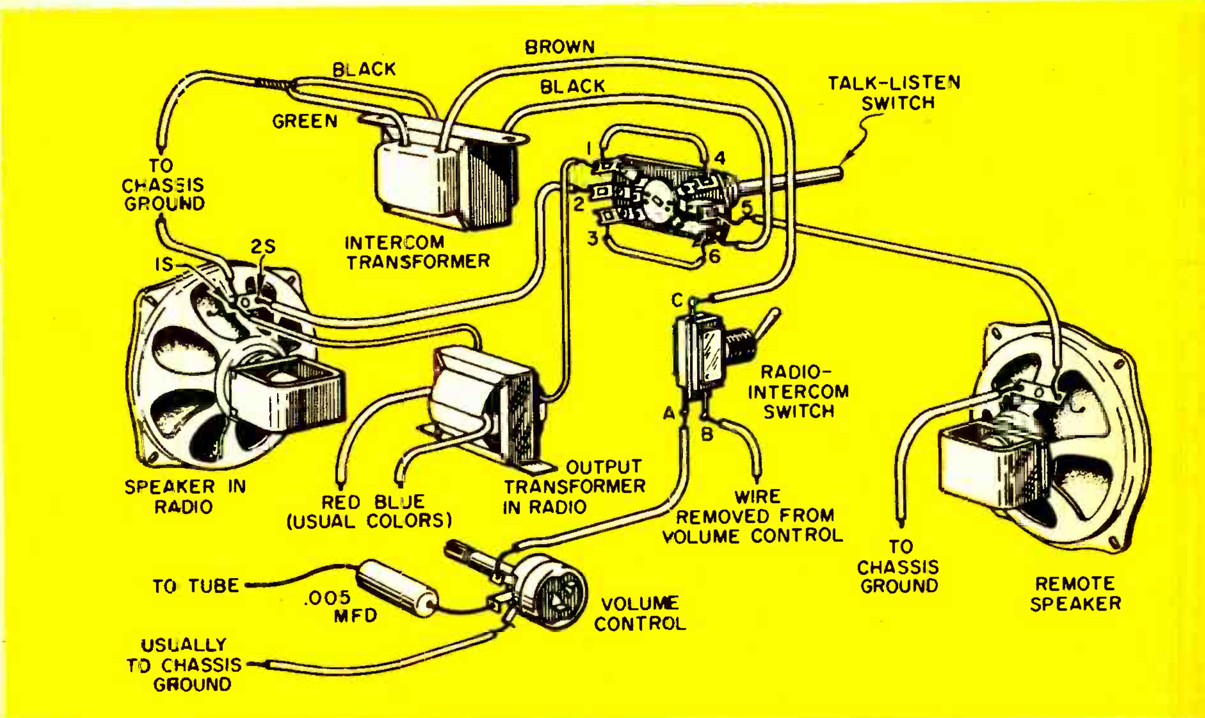
Locate the two leads to the radio loudspeaker. Many times one of these leads is grounded to the metal frame. The other lead comes from the output transformer; it must be disconnected at the speaker and extended to reach terminal "1" of the new "Talk-Listen" rotary switch. Run a wire from the "2" terminal of the switch to the empty speaker connection (2S). If one of the speaker leads is not grounded to the chassis, simply run a short length of wire from the speaker connection "1S" to any convenient spot on the metal chassis. Make the connections from "1" to "4" and "3" to "6" on the "Talk-Listen" switch with short lengths of hookup wire.

The intercom transformer that is added has color-coded leads and it is

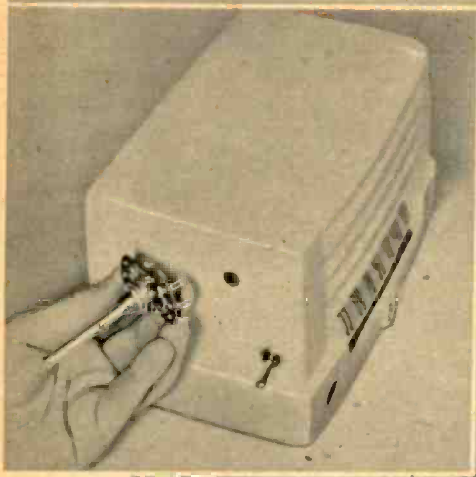
PARTS LIST

Intercom transformer—Stancor A-4744
Toggle switch, single-pole double-throw
Intercom switch—Centralab 1464
Loudspeaker—permanent magnet type, 4" to 6", 4 ohm
About 4' of insulated hookup wire
Intercom wire, as needed
Pointer, lever or round knob for "Talk-Listen" switch

Wiring guide shows how to connect few new parts into radio. Location depends on cabinet.

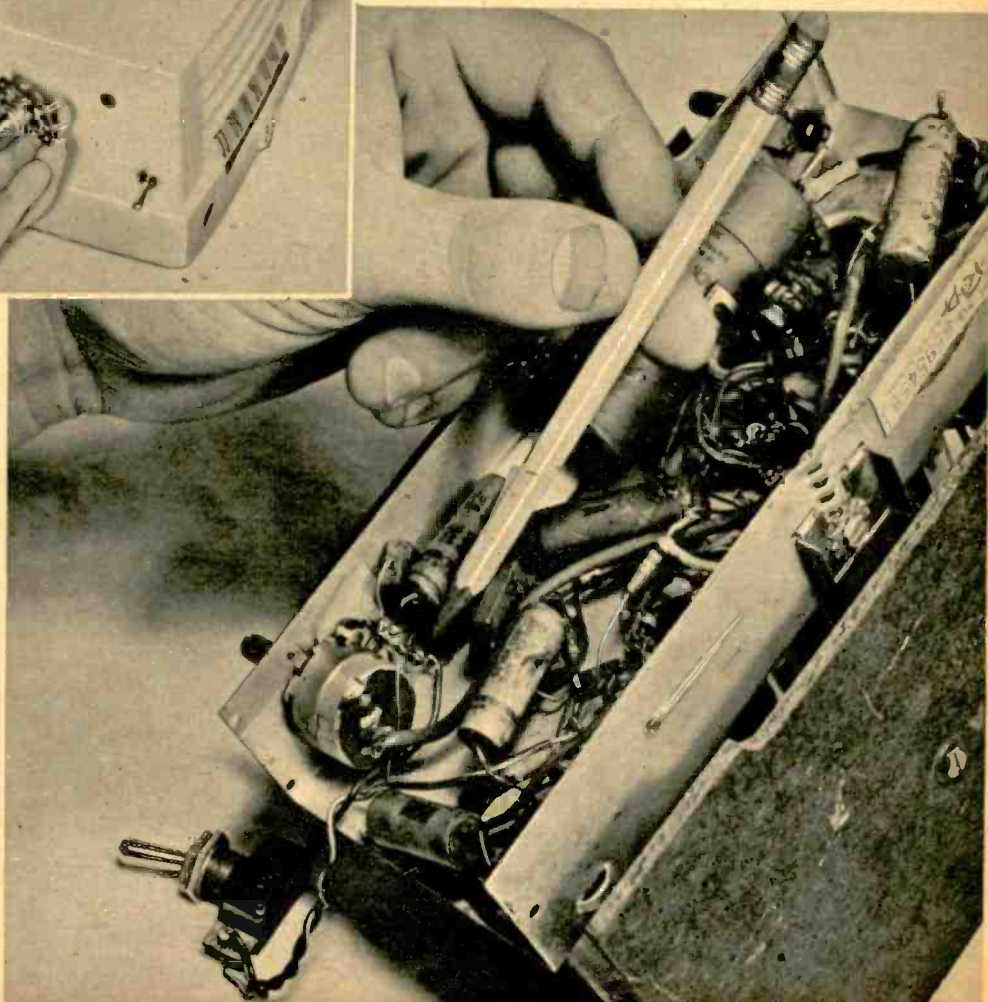


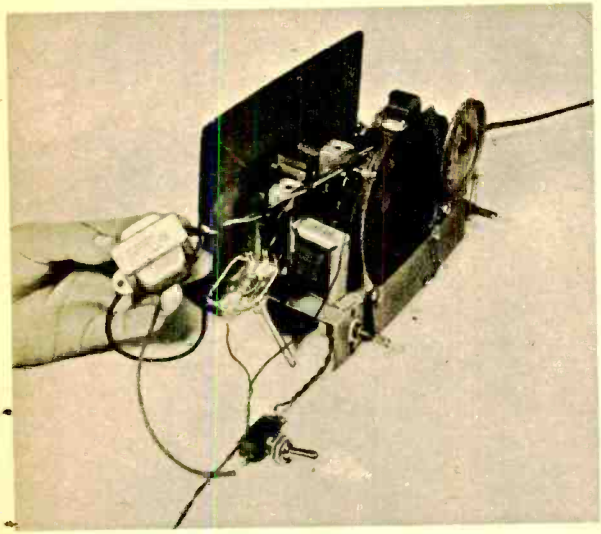
All of the parts needed to convert the radio to an intercom (including the table-model radio) are shown at the left. Wire is missing.



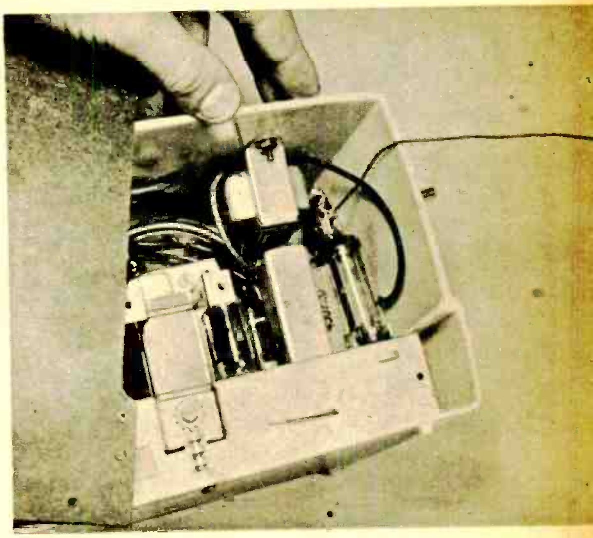
Two holes are drilled in the side of the radio cabinet for the "Listen-Talk" and the "Intercom-Radio" switches as shown at lower left.

One lead of the "Intercom-Radio" switch is connected to the lug on the radio's volume control indicated below. Do not touch the on-off switch part on the back of the control.





After all new parts are wired into the radio, the chassis is ready to go into its cabinet.



The intercom transformer is bolted to the top of the radio cabinet in a clear spot as shown.

necessary to ground one black lead and the green lead to the chassis. The brown lead is soldered to "C" of the "Radio-Intercom" switch and the remaining black lead to lug "6" of the "Talk-Listen" switch.

Intercom or ordinary lamp cord is used to connect the remote speaker to the radio. Connect one wire from the remote speaker to lug "5" on the "Talk-Listen" switch and the other to a chassis ground on the radio.

The physical placement of the two switches and the transformer depends upon available room on the chassis and in the radio cabinet. In my case, I simply drilled two holes in the plastic cabinet for the switches. The transformer was hung by one nut and bolt from the inside top of the cabinet. If you find insufficient room inside the radio cabinet, the parts may be mounted on a separate outside bracket or in a small box.

The remote speaker is mounted in a small box of wood or plastic. This box measures 5¾"x5¾"x3". If plywood is used, an outdoor grade is recommended. Merely drill a number of ¼" holes in the front of the box in any design that suits you. Varnish the box using a good grade of outdoor varnish and mount the speaker in the box, facing front. The wire from the radio may be connected directly to the lugs on the speaker or to two fahnestock clips, mounted in the box, which are connected to the speaker.

How can the speaker also be a microphone? Instead of sending a small electric current into the speaker and having it produce sound waves, you send sound from your voice into the speaker and have it produce a small electric current.

This small current passes through the transformer which matches the speaker to the first audio amplifier tube (usually a 12AV6, 12AT6 or 12SQ7). The tube amplifies the small current and passes it to a power amplifier tube (50C5 or 50L6) which drives the other speaker. The "Talk-Listen" switch merely selects which speaker acts as the mike.

In the majority of AC-DC table model radios made today you will not receive a shock if you touch the chassis. If one lead of the power cord coming into the radio from the wall outlet does *not* connect directly to the metal chassis, the chassis is not "hot."

In the case where the chassis is "hot," the best thing to do is provide adequately insulated wire to the remote speaker and cover any exposed terminals with electrical tape.

Warmup time for the intercom is the same as for the radio.

the Commuter Travalarm

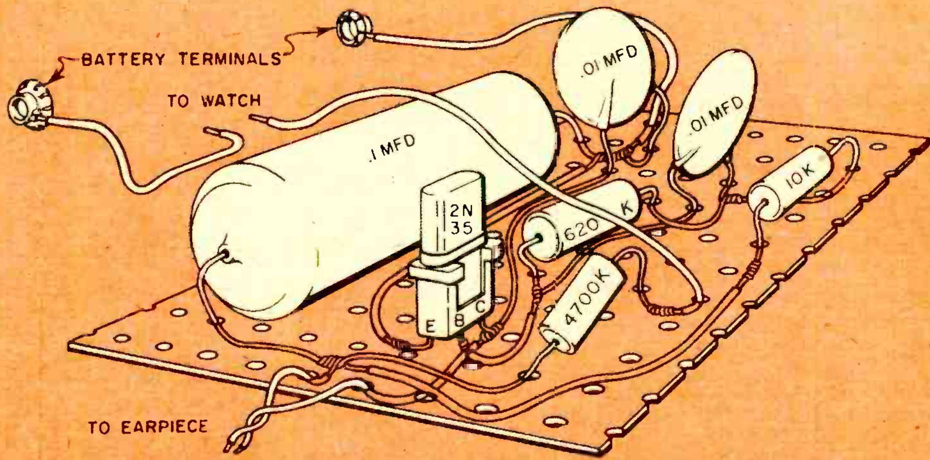
By Jonathan Paul

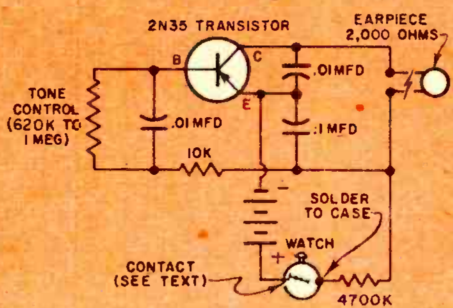
Sleep peacefully on your train or bus—this small unobtrusive alarm will wake you in time to get off!

ONE of the greatest disasters that can befall the commuter is falling asleep. As he sinks back wearily in his train seat after a hard day at the office, he struggles manfully to keep his bleary eyes open. He is successful for most of the forty minute trip—until the last five or ten minutes, that is. Then, blissfully unaware, he pulls into his station, snoring softly, and, still deep in the arms of sleep, he pulls out, as his wife fumes and frets, waiting for him to telephone from a station up the line.

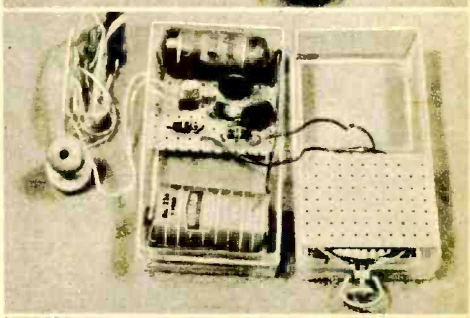
Mulling over the situation as a matter of self defense (I am a sleep-inclined commuter), it occurred to me that an alarm of some sort would be the answer. Set it and forget it. However

The blissfully asleep commuter at left need never worry about passing his station and getting home late. The inexpensive transistorized Travalarm, in his pocket, will wake him with a high frequency tone in the earphone on time.





The wiring guide above shows you how to put this very simple gadget together on the base.



To change the tone of the Travalarm, a potentiometer may be substituted for the 620 K resistor, as shown on the right. Adjust the pot. for the most pleasing tone, measure its resistance, and substitute a fixed resistor of that value. Note how the watch is held in the plastic case by perforated Bakelite at right center.

the cheapest clockwork alarm I could find was more than $7, and when I tested it, the buzz it emitted was barely audible when I was wide awake. The obvious answer was an oscillator attached to a timer, using a dynamic earphone to fit inconspicuously in the ear.

The perfect timer to use is a pocket watch of the inexpensive imported type. The watch used here cost only $1.90 plus tax in a New York City variety store and, most important, had no jewels, which simplifies connections. Mail order houses carry similar items.

All told, then, the "Travalarm" should cost between $5.50 and $7 depending upon how many of the parts you have. [*Continued on page* 110]

The Electronic Brain

Do you have a question regarding anything electronic? Send it to us and we will query our ELECTRONIC BRAIN who will come up with an answer. This will either be sent directly to you or printed in a future issue of *Electronics Illustrated* if we feel it may interest many of our readers.

I often see broad white flashes on the picture tube of my TV set accompanied by crackling sounds from the loudspeaker. The odd part is that these effects come and go, being much more annoying during the daylight and late evening hours than they are around sundown. Can you help me locate the trouble?

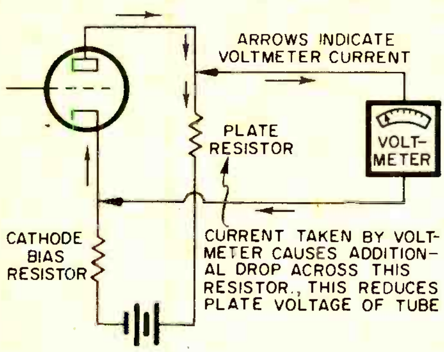
It isn't often easy to diagnose TV troubles by correspondence, but this one appears to be quite easy to answer. The clue lies in the intermittent nature of the difficulty and the particular times the trouble is most likely to occur. Broad white flashes accompanied by "static-like" sounds are usually a sign of antenna trouble. Connections to the roof-top dipoles may be bad or there may be intermittent breaks in the feeder cable. The symptoms are related to winds; since the writer of this letter lives in a seacoast city, he has strong seabreezes during the day and landbreezes in the late evening hours causing his antenna to whip around. At sundown, he normally gets a calm spell so that the intermittent breaks are not in evidence. The cure is to replace the antenna and feeder wires. Repairs of existing antenna parts seldom help.

How can I receive signals from the artificial satellites now circling the Earth and those yet to come?

At the time of writing, the radios of both Russian Sputniks and the U. S. Explorer I are no longer transmitting. However, the Vanguard satellite is sending out frequency modulated radio signals on a frequency of 108.3 mc. If you have a sensitive FM receiver, you should be able to hear the emission from the satellite just above the highest FM broadcast station you can hear. Any receiver having sufficient sensitivity at 108 mc. will do, however. For example, you might build a superregenerative receiver using either tubes or one of the new high-frequency drift transistors with which to listen to satellite transmissions. We want to call an important fact to your attention, though: the next Explorer will not be broadcasting continuously because it was found that much of the valuable data sent to earth by Explorer I was lost over the oceans where there were no stations to receive the signals. Rather, the meteorological and atmospheric information will be recorded on tape and the data re-transmitted only when the satellite is over a receiving station. The station itself will trigger the transmitter by radio control.

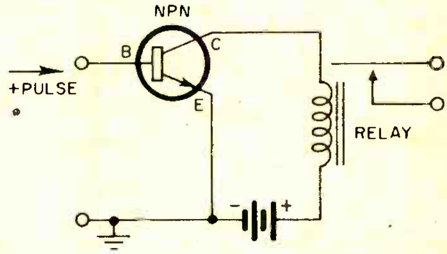
I have often noticed that authors of technical articles when referring to recommended voltage measurements state that the readings must be taken with a vacuum-tube voltmeter. Don't all voltmeters measure voltage? How does a VTVM differ from others?

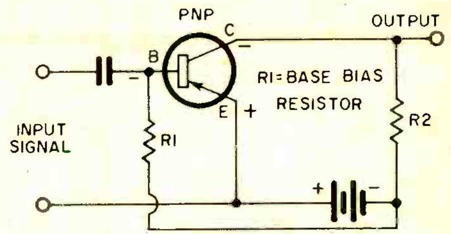
A device intended to measure any electrical "event" in a circuit must be so designed that it will not have any appreciable effect upon the operation of the circuit. In short, we don't want the circuit to behave differently as a result of the connection of the measuring instrument. An ordinary voltmeter in certain connections acts like a shunt or load on the circuit being measured; the current required to deflect the meter affects the circuit under test so that it no longer performs as it did before the addition of the meter. A VTVM, on the other hand, has an extremely high input resistance, hence it takes a negligible current to operate it. The VTVM's resistance is so high that, in effect, even after connecting it across the potential to be measured, it still behaves as an open circuit. As an example, consider the measurement shown here. We want to know the plate voltage of the tube so we connect an ordinary voltmeter between the plate and the cathode. The

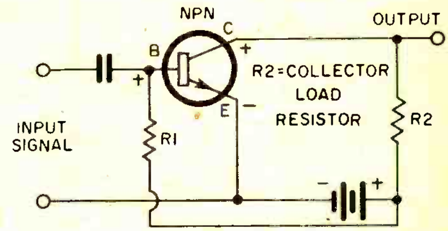


resistor in series with the plate may be very large in value so that even a small current flowing through it to satisfy the needs of the meter movement will cause a voltage drop that lowers the plate voltage. A VTVM needs so little current that this drop is inconsequential; thus the reading on the meter scale will actually be the tube's plate voltage.

What is the difference between a PNP and NPN transistor? When do you use the PNP type; when the NPN unit?







The difference between PNP and NPN transistors is largely a matter of the order of arrangement of the semiconductor materials in the body of the transistor. In equivalent circuits, their performance is identical. From the circuit standpoint, however, NPN and PNP transistors demand opposite battery polarities as shown in the drawings.

The collector current of PNP transistor increases when the base is made more negative while that of an NPN type increases when the base is made more positive. In DC amplifier circuits, for instance, where the current through a relay must increase as a result of a pulse of positive voltage applied to the base, an NPN transistor would be required. If the base is to go negative as a result of an incoming DC signal (as from certain photocells), a PNP unit would be called for. Except for such unique cases, however, either unit will serve as an amplifier or oscillator if battery polarity is correct.

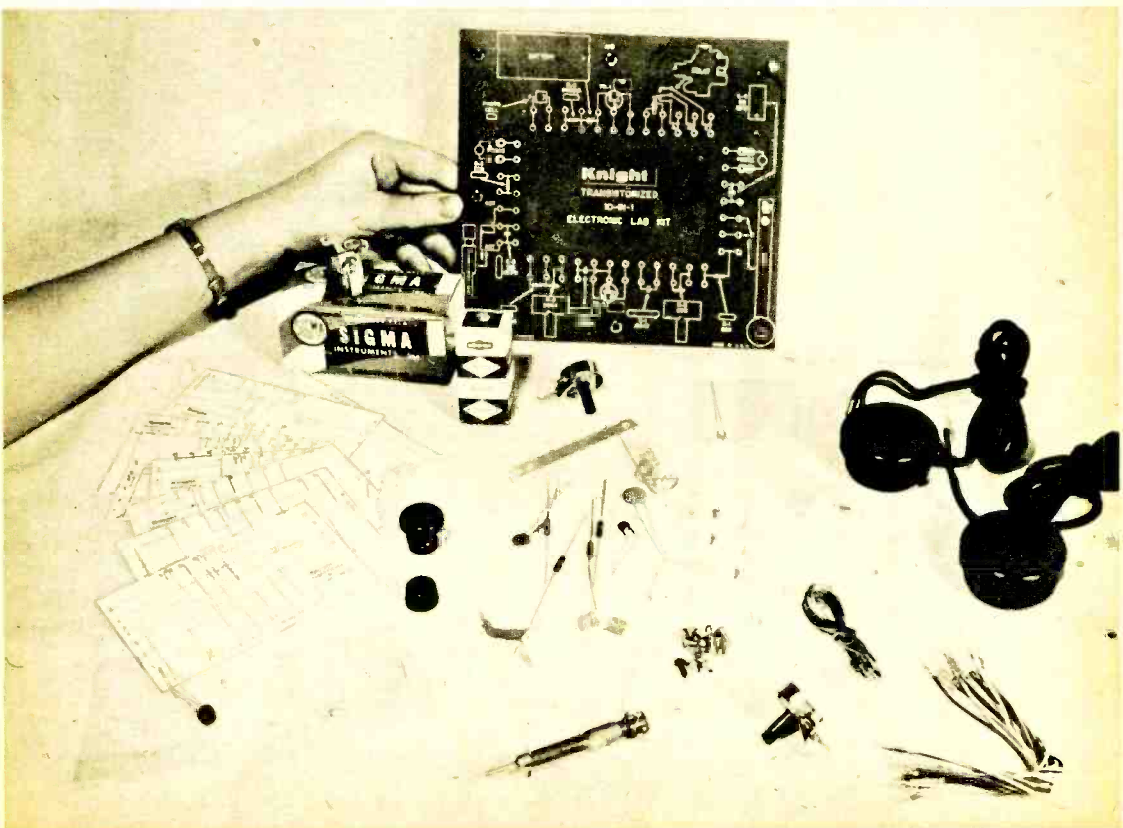
Transistor Workshop

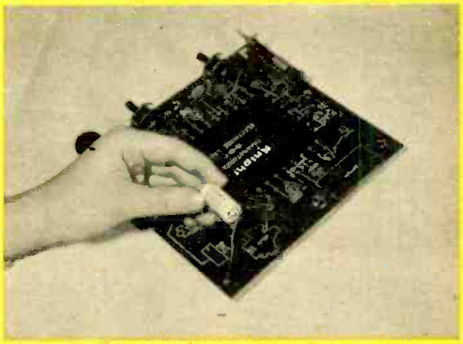
By Paul Hertzberg

Here's an ideal educational and useful kit for anyone, young or old, who wants to learn about transistors.

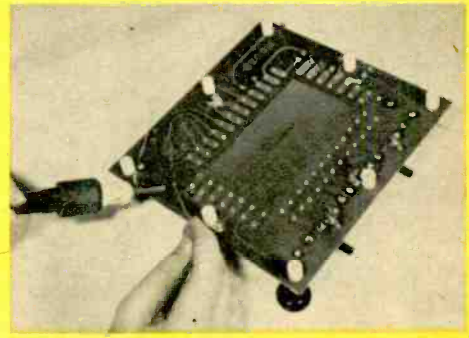
TRANSISTORS are used everywhere today, in computers, radios, ham equipment, control equipment and in experimental TV sets also. Now that transistors are readily available at low prices, about $1 or so, there's no reason why experimenters and hobbyists should not take advantage of their unlimited life and low current characteristics in more and more of their projects. However, to use transistors you should know something about them. One excellent way to learn how to use these little marvels is to assemble an equipment kit using transistors. One particular kit which uses transistors for ten different circuits is

The complete lab kit includes earphones, printed-wiring board, components and precut wire for ten different useable items from a radio to a timer.



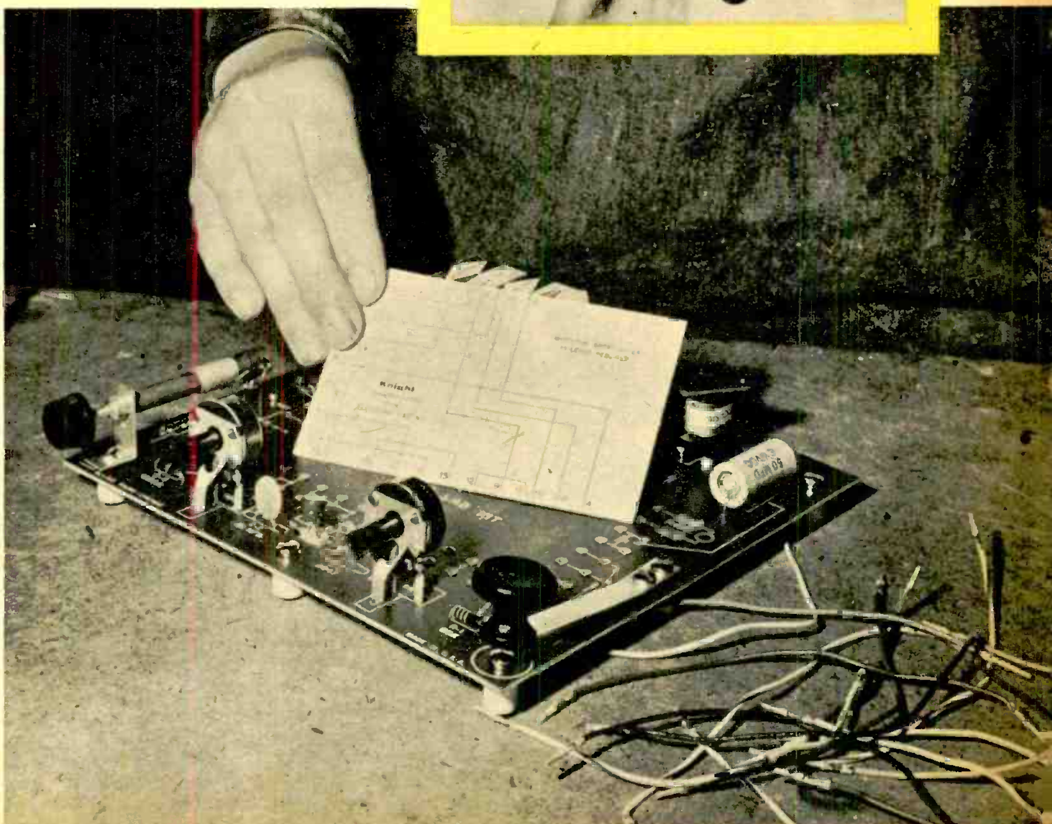


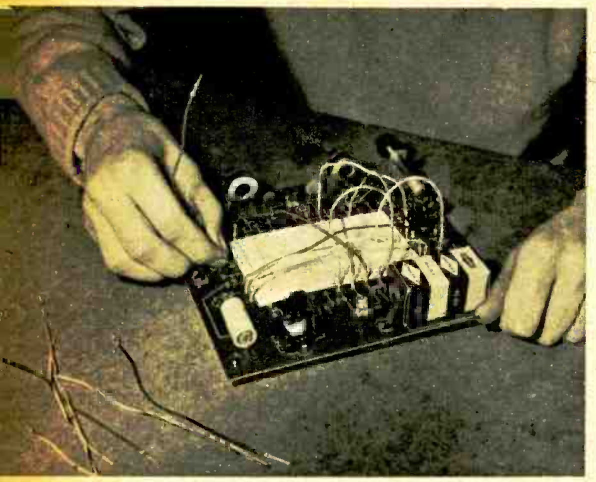
Connection of parts is very simple, the leads of the parts are inserted in holes on board. Below part is symbol and number.



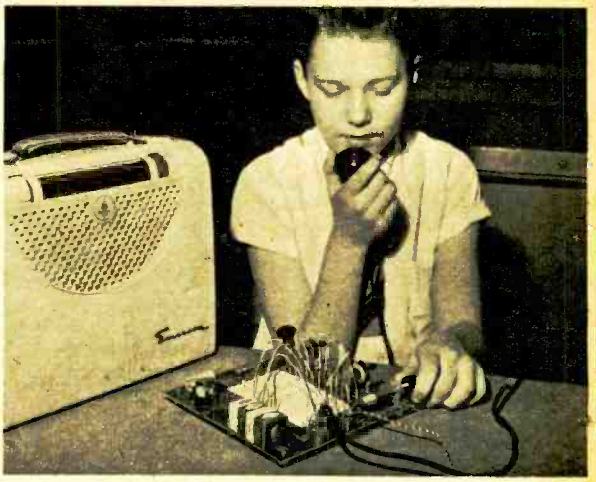
After scraping the printed wiring to remove dirt or grease, the leads are carefully soldered to wiring with low heat.

A separate card is supplied for each of the 10 circuits showing how to connect the components using the prepared leads.





Here, the wiring for a code practice oscillator is almost complete. Leads are plugged in.



An earphone is used as a mike for the broadcaster, signal is picked up by nearby radio.

the Allied Radio "Electronic Lab Kit."

The kit comes complete with relay, earphones, battery, transistors, resistors and capacitors, mounting hardware and wire. The parts are mounted in special eyelets in a base of insulating material. The leads of these parts are soldered to printed silver lines on the underside of the board. The secret of easy soldering here is to scrape away the thin layer of oxides that form on the silver.

One of the last steps in the mechanical construction is to insert the transistors into their sockets. It is at this point that extra caution must be observed with the fragile leads. The placement of the correct lead in the proper hole is a must. The top surface of the board is silk screened to show the placement of the various parts. A schematic symbol appears next to the part.

The instruction booklet, included with the kit, gives a schematic diagram, pictorial diagram and detailed explanation for each of the ten projects.

The ten circuits that can be made are:

1 A two stage broadcast band radio receiver using earphones. A length of wire is needed as an antenna.

2 An audio amplifier using one earphone as a microphone, the other to listen.

3 A code practice oscillator with a mounted key and variable tone output to the earphones.

4 A wireless broadcaster which makes it possible to send your voice through a regular radio. Although the output is measured in thousandths of a watt, it will transmit many feet. One earphone acts as a mike.

5 A photoelectric relay which can be used to control lights or buzzers when a beam of light is directed at it.

6 A capacity-operated relay setup which lets you control many electrical devices with a wave of your hand.

7 A voice-operated relay which can make gadgets turn on or off.

8 An electronic switch.

9 A timer circuit which can be used for timing photographic exposures.

10 A flasher for controlling lights.

All of the circuits use both transistors. Once the parts are soldered to the printed wiring board they are not moved. In order to change from one circuit to the next, you merely select the proper wiring layout on a small card. By plugging in all or just a few of 15 leads, the circuits can be changed.

The transistor lab is entirely safe because it uses only a small 6 volt battery as a source of power.

Additional circuits using one or both of the transistors are limited only by the imagination of the experimenter. The "Electronic Lab Kit" sells for $15.45, Allied Radio Corp., 100 N. Western Ave., Chicago, Ill.

Careers in Astronautics

By Lloyd Mallan

Why be earthbound? Here's a field that will need electronics specialists as space frontiers recede.

Electronics technician works on laboratory model of an ionic propulsion missile engine.

How can we control flow of fuel and liquids in space flights? Electronics may hold key.

WHEN the first American spaceship takes off for a voyage around the moon, sometime within the next fifteen years, it will carry a crew of five. You may be one of them.

The fact that you are reading this magazine means that you are interested in electronics. One crew member on every space voyage must be an electronics specialist. More accurately, he must be an *astronautical* electronics specialist. At the moment of this writing, there are no such specialists. If you are now between the ages of 15 and 30, the future can be yours in an exciting, vitally important new branch of electronics. It is called astrionics—spaceflight electronics.

Without scientists, engineers and technicians fully specialized in astrionics, there can be no spaceflight. Not only will navigation and communications systems in space depend on the astrionics specialist, but the very achievement of a workable space-going craft capable of transporting human crews safely through the void will depend largely upon the new field of space-electronics for the success of its design. Unique electronic test instruments and devices not yet conceived will aid in "proving out" the components of future spaceships. Exotic fuels and metals, control systems for advanced rocket engines, sensing devices, warning systems, automatic guidance systems and automation of spacecraft in general will all be tested for reliability, either directly or indirectly, by astrionic gadgets. In fact, the majority of the spaceship components will be electronic in nature. Even certain types of rocket engines will some day (not too far off) be propelled electronically. A perfect example is the ion-drive rocket, which ejects charged particles for propulsion (EI—May, 1958). Two great organizations are already engaged in serious research to develop a usable ion-drive rocket engine. They are the Rocketdyne Division of North American Aviation, a privately owned corporation, and the National Advisory Committee for Aeronautics, a Government-subsidized Civil Service agency.

So it is hardly too early right now to specialize in astrionics. Those who begin to acquire the proper background now will not only catch up with the future—but will be instrumental in creating that future.

How does one go about becoming an astrionics specialist? Here are a few basic suggestions.

1. Write to all the firms listed with this article requesting information about job openings and training programs in the field of electronics.

From the answers you will receive (and these companies will all answer your query, since they are intensely anxious to train promising people for the future), choose those branches of electronics that appeal most to you. A great many of these branches will be based upon missile technology. For example, you will find job and training opportunities listed for missile guidance and navigation systems; digital or analog computers and control systems; electronic instrumentation and test equipment; telemetering; data reduction and data handling; radar; magnetic amplifier and transistor applications; antennas and microwave components—the list is quite long for engineers and technicians. On the other hand, you will probably be amazed by the current demand for creative scientists in the fields of applied research and analysis, pure research in solid state, infrared and microwave physics as well as in ex-

Dir. of Scien. & Engineering Pers.
Aerojet-General Corporation
Box 296, Azusa, Cal.
(Or Box 1947, Sacramento, Cal.)

Personnel Director
Aeronutronic Systems, Inc.
Division of Ford Motor Co.
Glendale, Cal.

Director of Information Services
Office of Information Services
Headquarters Air Research
& Devel. Command, USAF
Andrews Air Force Base, Md.

Personnel Director
Applied Physics Laboratory
Johns Hopkins University
Silver Spring, Md.

Mr. Charles S. Fernow
Administrator of Technical Education
ARMA Div. of American Bosch Corp.
Roosevelt Field
Garden City, Long Island, N. Y.

Personnel Manager
Autonetics Division
North American Aviation
Downey, Cal.

Personnel Director
Crosley Division
AVCO Manufacturing Corp.
Cincinnati 25, Ohio

Mr. R. S. Drum
Personnel Manager
Batelle Institute
505 King Ave., Columbus 1, Ohio

Personnel Director
Bendix Guided Missile Section
Bendix Products Division
410 Bendix Drive., Mishawaka, Ind.

Manager, Engineering Personnel
Department K-S
Weapon Systems Division
Bell Aircraft Corporation
P.O. Box 1, Buffalo 5, N. Y.

Personnel Director
Bulova Research & Devel. Labs.
62-10 Woodside Ave.
Woodside 77, N. Y.

Personnel Director
The Jet Propulsion Laboratory
Cal. Institute of Technology
Pasadena, Cal.

Personnel Department
Chrysler Corp.—Missile Operations
P.O. Box 2628, Detroit 31, Mich.

Mr. Greg McMillan
Placement Director
Convair-Astronautics
Dept. 706-B, San Diego, Cal.

Mr. E. C. Kaliher
Missiles Engineering Personnel Mgr.
P.O. Box 620-RM
Douglas Aircraft Company
3000 Ocean Park Blvd.
Santa Monica, Cal.

Mr. G. Moison
Personnel Director
Cornell Aeronautical Lab., Inc.
4455 Genesee St.
Buffalo 2, N. Y.

Mr. Philip F. McCaffrey
Ford Instrument Company
Div. of Sperry Rand Corp.
31-10 Thomson Ave.
Long Island City 1, N. Y.

citation mechanisms, and basic electronic research as it applies to aeronautics generally. Some of the companies which have already established openings in the science of astrionics itself, are Convair-Astronautics, The Ramo-Wooldridge Corporation and the Autonetics Division of North American Aviation.

2. On the basis of your choice, apply for a job—if you have the necessary background. If not, then acquire that background by reading everything you can find and understand which is related to missile-electronics. Many scholarships are now being offered to students by these companies. If you are either a high school or college student, apply for a scholarship—even if you will not be in a position to take advantage of it until after you complete your current curriculum. The important thing is to show your interest to a personnel director. He will not forget it. His company depends on such interest for growth in this age of space. In your letter of application express your inter-

Tracing a printed circuit is a first step in preparing a transmitter to be used in a satellite.

Personnel Director
Guided Missile Division
Firestone Tire and Rubber Co.
2525 Firestone Blvd.
Los Angeles 54, Cal.

Personnel Director
Grand Central Rocket Co.
P.O. Box 111, Redlands, Cal.

Personnel Director
Lear, Inc.
3171 South Bundy Drive
Santa Monica, Cal.

Personnel Manager
Lockheed Missile Systems Div.
Palo Alto, Cal.

Mr. J. J. Holley
The Martin Company
Baltimore 3, Md.

Mr. Emmett E. Hearn
P.O. Box 179
The Martin Company
Denver 1, Col.

Mr. R. F. Kaletta
Technical Placement Supervisor
McDonnell Aircraft Corp.
Box 516, St. Louis 3, Mo.

Personnel Information
National Adv. Comm. for Aeronautics
1512 "H" Street, N.W.
Washington, D. C.

Personnel Information
Naval Research Laboratory
Washington 25, D. C.

Office of Scientific Research, USAF
Attention: Mr. Mel White
Chief Info. Services Officer
Washington 25, D. C.

Mr. E. A. Anderson
Employment Superintendent
Pan American World Airlines, Inc,
Guided Missiles Range Div.
Patrick Air Force Base, Fla.

Mr. D. L. Pyke
The Ramo-Wooldridge Corp.
5730 Arbor Vitae Street
Los Angeles 45, Cal.

Mr. G. P. O'Neil
Raytheon Manufacturing Co.
Missile Systems Div.
Bedford, Mass.

Mr. A. W. Jamieson
Engineering Personnel
Rocketdyne Division
North American Aviation, Inc.
6633 Canoga Ave., Canoga Park, Cal.

Personnel Department
Rohm & Haas Company
Redstone Arsenal Research Div.
Huntsville, Ala.

Personnel Manager
Systems Laboratories Corp.
15016 Ventura Blvd.
Sherman Oaks, Cal.

Mr. William R. Whittaker, Pres.
Telecomputing Corp.
915 North Citrus Ave.
Los Angeles 38, Cal.

Airman Information
United States Air Force
Box 7608, Washington 4, D. C.

Commander of Recruiting, USAF
Wright-Patterson Air Force Base, Ohio

est in terms of action. Ask advice about where to obtain source-material—books, pamphlets, technical reports—related to your chosen branch of astrionics (or missile-electronics). Request that your name be placed upon the company's mailing list to receive all their news releases, their annual report and other literature. It boils down to this: *show* the company your interest, rather than tell them of it. If you are not a student but generally earn a living in electronics, you can use the same approach profitably even though you may not be eligible for a scholarship. There is always on-the-job training as well.

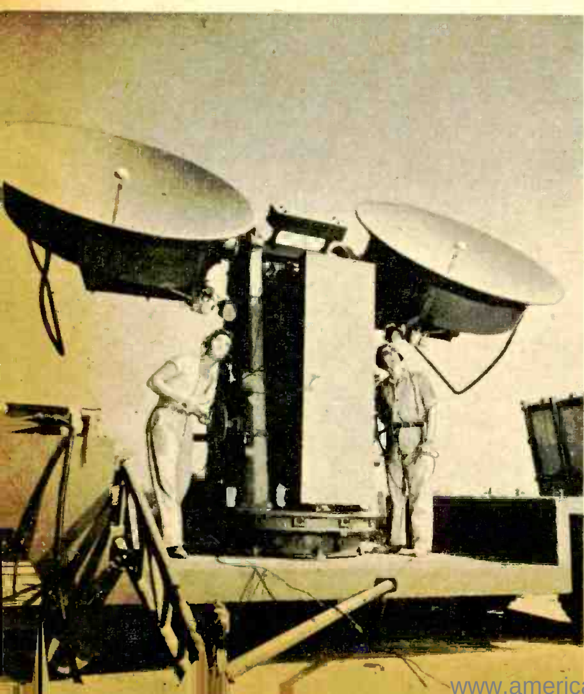
3. Steep yourself in all—repeat ALL—aspects of spaceflight. Start with basic works in layman's language (unless you are an engineer or physicist) which explain the theory and function of rocket engines and airframes; the biological and physiological (often called the "human factors") aspects; the theories of wave propagation; the physics of the upper atmosphere; the physics of the macrocosmos (a fancy phrase for astronomy and radio astronomy); the science of cybernetics, or automation; the function and purpose of computers; electronic miniaturization; and all the modern theories of nuclear physics.

This last item might seem like quite an order—but it's not at all as tough as it sounds. You can start with illustrated books intended for young teen agers, if need be, regardless of your age. There is no reason to be ashamed of this. It's a way to start acquiring a background in modern science. One thing will soon lead to another and before long you'll find yourself reading works with ease that had previously seemed like so much Greek to you. Your basic interest in and knowledge of electronics generally will be a surprising help in the process. By now it should be obvious, however, that to be a creative and valuable specialist in the future field of astrionics you must have a grasp of the meaning of all of science.

It's mighty well worth the effort. The salary range for astrionic specialists will undoubtedly run from $10,000 through $50,000 annually for the top jobs and from $5,500 to $7,500 yearly for lesser positions. The man or woman (yes, astrionics is a career in which women with the necessary background can participate with little or no prejudice) who combines the creative insights and abstract knowledge of a physicist with the practical knowhow of

[*Continued on page* 98]

Two civilian radar operators track a guided missile using a Doppler velocity-type radar.



Magnetic field measurements in the ionosphere are carried out with this instrument in rocket.

Play It Safe

Danger from electric shocks is eliminated by the proper grounding of your appliances.

Robert Hertzberg

Attachment plug at left is hard-to-get two-prong polarized type. Finger points to the wider of the two prongs; this is the "ground" side of the circuit. Polarized plug can go into circuit only one way. Center plug is ordinary type, can be inserted two ways. At right is the new type three-prong polarized safety plug. The one longer, thinner prong is for ground.

Diagram below shows basic power wiring of old-style radio set. Note ground location.

Somewhat improved arrangement of power circuit, chassis ground is away from switch.

FIG. 1A

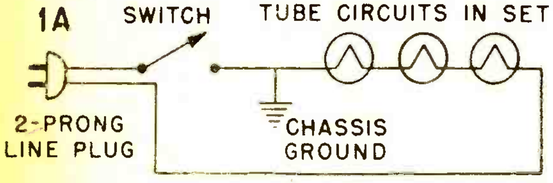
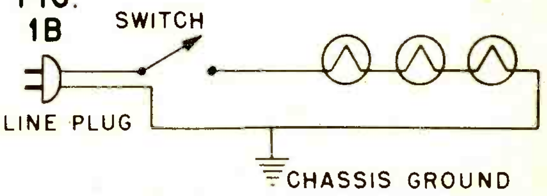


FIG. 1B



THERE is a general impression that "grounding" the frames or cases of electronic equipment and household appliances renders them harmless from the shock standpoint. Sometimes it does, but with certain radio and television receivers this treatment can just as readily start a display of fireworks.

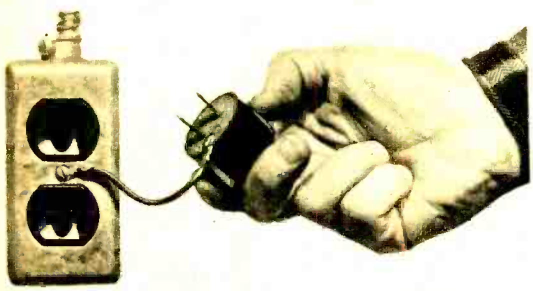
Without question, the worst offenders are transformerless radio and TV sets of the AC/DC "hot chassis" type, which have been sold by the million.

The basic power circuit of the AC/DC set looks like either Fig. 1A or 1B. In Fig. 1A, note carefully that the "chassis ground" goes to one side of the switch and one end of the tube circuits; in Fig. 1B, the chassis ground is connected to the other end of the tube circuits and one side of the line plug.

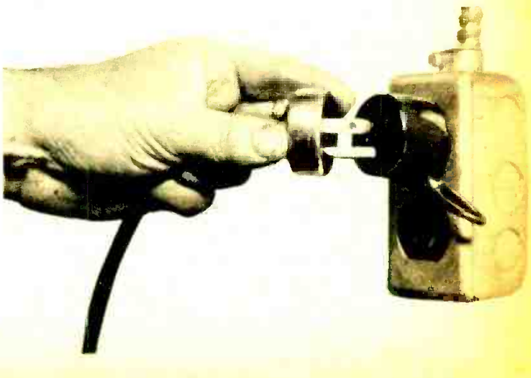
Now consider what can happen if you decide to replace the present two-prong line plug with one of those new "safety" three-prong plugs. These work with an adapter that fits existing two-prong outlets, or they go directly into new-type outlets especially made for them. You add a third wire to the line cord, and fasten one end under a chassis screw on the radio or TV receiver and the other to the round, protruding "ground" prong on the new plug.

Since the two existing wires of the line cord look exactly alike, you connect them to the two flat prongs of the plug without regard for their actual identity. This means that two combinations of plug connections are possible. Suppose that the first combination looks like that of Fig. 2A. You push in the three-prong plug. The switch is open, so nothing happens. Trace the whole circuit: the "hot" side of the power line goes to the plug prong that goes to the switch, the ground side of the power line goes to the far end of the tube circuits, and the extra ground wire goes to the chassis of the set. Since the second two wires, both "grounds," parallel each other, both ends of the tube circuits go to the same point; in other words, the tube circuits are short-circuited to themselves! However, no damage has been done because the circuit hasn't been energized as yet.

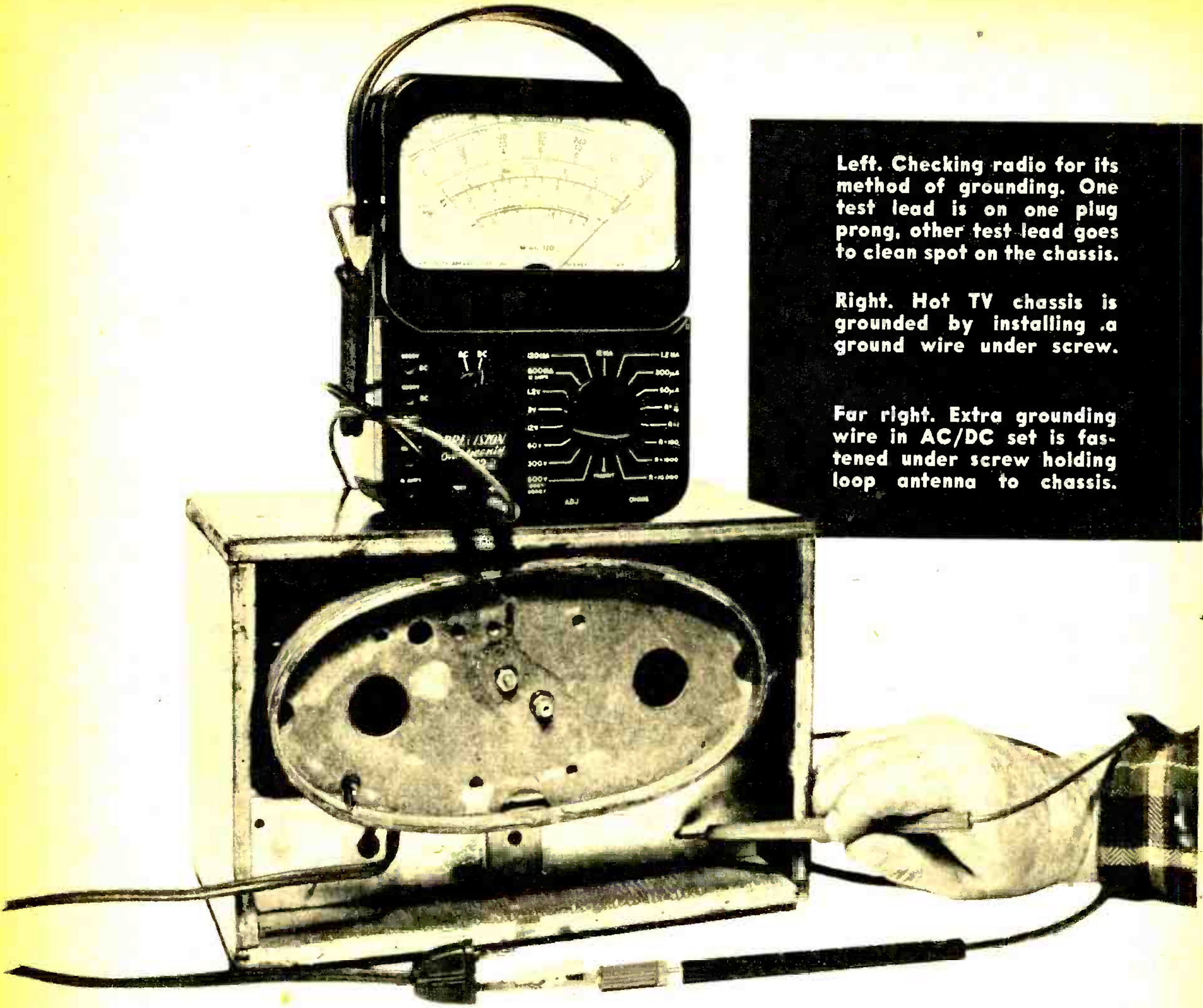
Now close the switch, and if there's still a light left working in the room trace the Fig. 2A circuit, or rather the dead short circuit, that results: hot side of power line, through switch, right



Polarized adapter fits into standard receptacle. It takes old-style or three-prong plug.



Three-prong polarized plugs can be used in old-style receptacles by means of an adapter.



Left. Checking radio for its method of grounding. One test lead is on one plug prong, other test lead goes to clean spot on the chassis.

Right. Hot TV chassis is grounded by installing a ground wire under screw.

Far right. Extra grounding wire in AC/DC set is fastened under screw holding loop antenna to chassis.

back to grounded side of line! No matter what its rating, the line fuse will burn out and in all probability the switch in the set will weld shut.

Suppose the other combination of plug connections exists, as in Fig. 2B. With the switch off, you insert the plug in the power outlet. To your surprise, the filaments light up and the set starts working in normal fashion . . . *with the switch off*. How come? Easy: hot side of power line to far end of tube circuits, left end of tube circuits to center ground lead, and back through ground side of power line.

With sets of the Fig. 1B variety, the

If three-prong plug is added to circuit of Fig. 1A, short circuit occurs when switch is closed.

If connections of two outer prongs of plug are exchanged, danger of short circuit is removed.

FIG. 2A

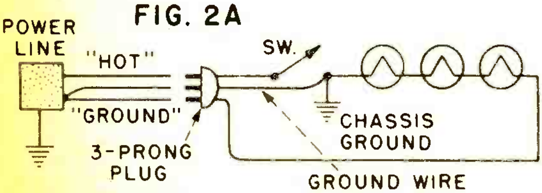
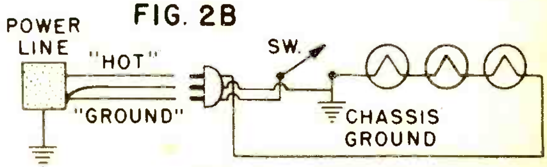
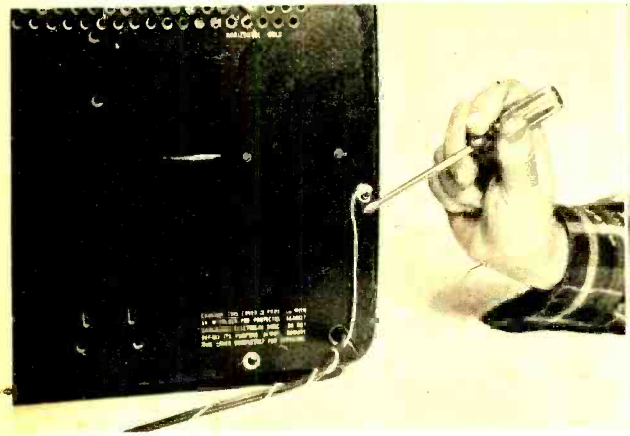
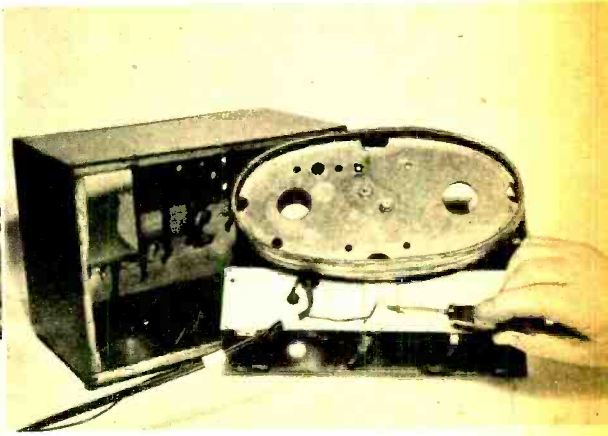


FIG. 2B







wrong plug connections will again short circuit the line switch through ground. However, the other plug connections afford complete protection, as Fig. 2C proves. With the switch open, the set is off, since the hot line ends at the switch. If you accidentally touch the chassis while you are in contact with a water pipe, a radiator or some other grounded object, absolutely nothing happens, because the chassis is already connected to the grounded side of the power line, not merely by one but by *two* wires! The three-prong safety plug can be inserted only one way, so the protection is automatic and permanent. With an ordinary two-prong plug there is *always* the possibility of inserting it in such a manner that an ungrounded set chassis becomes 115 volts "hot" in relation to any ground. If you get between it and ground you can very easily get yourself killed.

Why Three Prongs?

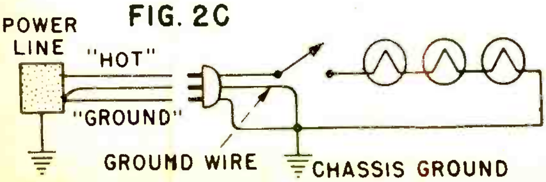
You are probably wondering why a special three-prong plug should be needed at all. Why not simply use a polarized two-prong plug, having prongs of unequal size to match the unequal slots in power outlets? Connect the set chassis to the wide prong, which fits only into the grounded leg of the power line, and the set is safely grounded. This would be easy except for the fact that polarized two-prong plugs to fit common two-slot outlets are extremely difficult to obtain. Neighborhood hardware stores don't carry them at all, whereas they do have the new three-prong plugs and matching adapters. Only a very few electrical supply firms, catering to industrial customers, have polarized two-prong plugs in stock.

Sets using the arrangement of Fig. 1A are real stinkers, because the chassis ground must remain isolated elec-

[*Continued on page* 100]

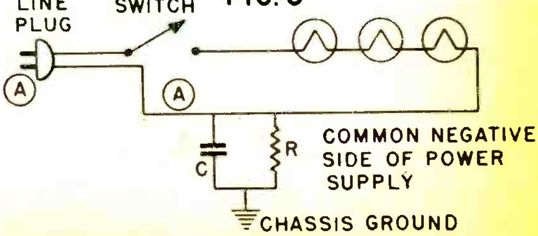
Complete protection against chassis shock is obtained with this variation of Fig. 1B circuit.

FIG. 2C



In better receivers "floating chassis" is isolated from circuit by a resistor and capacitor.

FIG. 3



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Careers In Astronautics

Continued from page 90

an engineer will be at a premium. He or she will not only be in the top salary brackets but will also originate the major advances made in the science of astrionics.

About a half-year ago, the American Rocket Society (a serious engineering society comprised of 7,000 engineers, physicists and technicians) proposed a six-stage program to the President. Following are the stages.

1. Within five years: orbiting vehicles in outer space carrying payloads of thousands of pounds.
2. Within five to ten years: payloads of 100 to several hundreds of pounds (electronic and optical detecting equipment) to be placed on the moon or in orbits about the moon.
3. Also within five to ten years: payloads of several hundreds of pounds of instruments to be sent as far out as the nearer planets (Venus and Mars).
4. Within ten years: Earth satellites carrying men for extended periods and manned spaceflight between any two points on the Earth's surface.
5. Within fifteen years: manned flights around the moon.
6. Within twenty years: manned two-way lunar flights, including a landing on the moon.

John Gustavson, a design engineer at Convair-Astronautics, has this to say: "Closely related to the missile is the space vehicle, the means of transportation by which man, within a few decades perhaps, will escape from the Earth and travel to other planets . . . Thus any missile engineer is concerned either directly or indirectly with spaceflight in his daily work."

The missile industry is *your* industry —if you want to become a specialist in astrionics. The sooner you canvass that industry for a job, position or scholarship—the sooner will you be on your way in the field of spaceflight electronics. Good luck to you.

See you on the moon! ●

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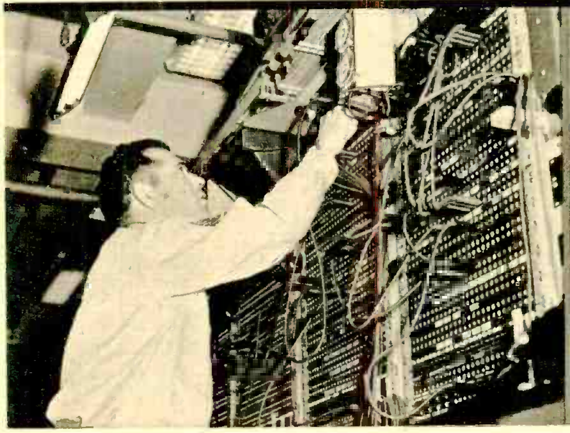

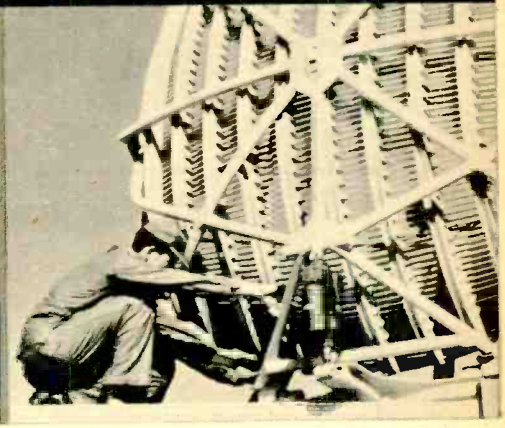

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Play It Safe

Continued from page 95

trically from the power line ground, unless you want to rewire the power circuit. To make them as safe as possible, make sure that the chassis is isolated physically. Examine the bottoms for protruding screw heads, and tape them over. Also check the control knobs, and if they have set screws cover them with narrow strips of tape. One particularly bad case of the electrocution of a child in a bathtub was traced to contact between her wet, soapy fingers and an exposed screw in a tuning dial. Is the set's back open? A cover of perforated hardboard is called for.

Sets of the Fig. 1B type are at least half safe if not treated, and all safe if fitted in accordance with Fig. 2C.

In some sets made by manufacturers who like to see their customers remain alive, the bite is taken out of the power circuit by what is called the "floating chassis" circuit. This is shown in Fig. 3. The unswitched common negative side of the power supply in the receiver, instead of going directly to the metal chassis, connects to it through either a fixed capacitor *C* alone or a combination of a capacitor and a fixed resistor *R*. Their values are not critical and vary greatly; *C* is perhaps .1 or .2 microfarad, and *R* is 220,000 or 470,000 ohms. Since the chassis is blocked off from the power circuit, it is no longer "hot" in relation to an external ground and it is no longer a shock hazard. The position of the line plug in the outlet is immaterial, although it is probably better to arrange it so that the wire marked "A" goes to the prong of the line plug that fits the grounded side "A" of the power line. Then, if capacitor C should develop an internal short circuit (unlikely, but always a possibility), you have the same grounded chassis protection afforded by the circuit of Fig. 2C.

The metal cabinet portable TV receiver has had a very bad press recently because a boy was killed by one.

Sets of this type should positively be fitted with polarized three-prong plugs and extra ground wires. Make sure the grounded chassis lead connects to the wide prong of the plug. Fasten the separate grounding wire under a screw that goes into the cabinet, and the other end to the round ground prong on the plug. This gives the equivalent of the circuit of Fig. 2C.

With the aid of that indispensable tool, the voltohmmeter or the vacuum tube voltmeter, you can check the basic power circuit of any AC/DC receiver and identify the prongs of the line plug. Set the meter for low ohms. Leave the set switch open; that is, off. Touch one test lead to the chassis and the other to either plug prong. If the needle bangs over to zero ohms, the set is of the common Fig. 1B type and you have the prong that connects directly to the chassis. The wire now going to this prong is to be attached to the *wide* prong of the polarized three-prong plug. If the needle doesn't move, you have chanced on the switch side of the line, which of course is open.

Close the switch and touch the test leads to the two prongs of the line plug. The meter should read about 100 ohms; maybe more, probably not much less. This is the normal resistance of the tube filaments, which are connected in series.

If the meter doesn't read at all on the first two tests, switch it to high ohms and try again. If you get an indication of 100,000 to 500,000 ohms between the chassis and one plug prong, the set is of the floating chassis type and uses both a capacitor and a resistor, as in Fig. 3. If the needle flicks upward momentarily and then falls back to its starting point, there is only a capacitor in the circuit. The reading is of a small charge put into the capacitor by the test battery in the meter.

If the meter shows a value of about 100 ohms between the chassis and one plug prong, with the line switch open, the set is of the Fig. 1A type. You can verify this by closing the switch, leaving one test lead on the chassis and moving the other to the other plug prong; the meter will now read zero, as the circuit between the plug and the grounded chassis side of the switch is very short.

Play it safe! It's better to ground an equipment chassis electrically than to have your own chassis put into the ground permanently.

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The Invisible Switch

Continued from page 75

The neon "flushlite" on-off indicator fits nicely in one corner at the top of the chassis; two 3/8" diameter holes spaced 7/16" between centers allow the neon light terminals to pass through to the bottom of the chassis without touching the metal. One of these serves as the incoming terminal for either leg of the AC line while the other AC leg is connected directly to the on-off switch.

The bakelite subchassis carries the two tubes (6AT6 and 6AK6), the oscillator coil, the fine tuning capacitor (*C2*), the two disc bypass capacitors (*C1* and *C5*) and resistor *R2*. The other resistor (*R1*) is soldered directly across the terminals of the fine tuning capacitor.

The oscillator coil consists of a total of 200 turns all in the same direction wound on a commercial 1⅛"x⅜" bakelite coil form with a built-in ferrite core. Space the terminal rings that come with the coil form about ⅜" apart; starting from either end, wind 100 turns of No. 32 enameled wire between two adjacent rings, terminating each end of the winding by soldering to the ring projections. Repeat this procedure starting from the center ring—again 100 turns of the same wire *in the same direction* as before. This will give you a 200-turn center-tapped coil. Screw the ferrite core into about the center of the coil form and lock it in position with the locking screw provided. This setting will not be adjusted from this point on.

Drill the holes in the subchassis to take the tube sockets, the coil, and the fine tuning capacitor. You will also need a tiny bracket of scrap aluminum or steel to hold the subchassis to the inside of the case. Allow sufficient space for the plates of the fine tuning capacitor to unmesh fully.

When all the parts have been mounted, you can wire almost all connections on the subchassis before installing it in the case. Then make the connections between the chassis parts and those on the bakelite plate. While you are wiring be sure that none of the binding posts ground out to the metal chassis; also note that the chassis is not used as a ground connection.

Check for short-circuits with an ohmmeter or continuity tester before plugging in the unit. The readings across both windings of the transformer on the "low ohms" scale of the meter should be reasonably high.

Check the operation of the unit as follows:

1. Cut a piece of wire about 5 or 6 feet in length to serve as the sensor antenna and connect it to the antenna binding post. Stretch it out on the table top well away from the case.
2. Set both variable capacitors at maximum capacitance (fully meshed).
3. Connect a battery and pilot light (or any other indicating device such as a 120 volt line cord and a regular mazda lamp) in series across the relay contact binding posts.
4. Plug the proximity detector into a 120 volt AC receptacle and turn the switch to the on position. Allow the unit to warm up. *During the warm-up period, the relay may pull in and then release after about 10 seconds.* This is perfectly normal if the 6AT6 tube has a longer warm-up time than the 6AK6.
5. After about 1 minute of warm-up, slowly reduce the capacitance of the coarse tuning control (*C3*) using an insulated screwdriver. Somewhere along the way, the relay should pull in and the indicator device should glow. Back off the capacitor so relay *just* drops out.
6. Now slowly reduce the capacitance of the fine tuning control until the indicator flashes on and off as your hand approaches within 1 foot of the sensor antenna. This capacitor is the final sensitivity adjustment.

VOLTAGES BETWEEN INDICATED POINTS AND COMMON LEAD

(Taken with a standard vacuum-tube voltmeter)

Pin #	*6AT6*	*6AK6*
1	-2 volts d-c	-20 volts d-c
2	zero	zero
3	O.K. if tube is lit	O.K. if tube is lit
4	ditto	ditto
5	-20 volts d-c	125 volts a-c
6	-20 volts d-c	125 volts a-c
7	120 volts a-c	zero

In the final installation of the unit, you will find that the maximum antenna length you will be able to use is about 10 feet. Should you want to use a longer one, you will have to increase the capacitance of C3 to 365 mmfd. or more. Too long an antenna, however, reduces sensitivity and should be avoided. Before making the final sensitivity adjustment, allow the unit to heat for at least 15 minutes. All capacitance devices tend to increase in sensitivity with heat. If you want very high sensitivity without self-triggering, this precaution is an important one to observe.

The invisible switch consists of a radio-frequency oscillator (6AT6 and its associated components), and a DC amplifier (6AK6) together with a sensitive plate-circuit relay. When there is no body capacitance close to the sensor antenna, the 6AT6 oscillates strongly at a medium radio frequency. The r.f. voltage developed across the lower half of the coil *L* causes a rectified current of the same frequency to flow through the diode resistor R2. The voltage drop across this resistor charges C5 to the peak value of the r.f. Thus, the rectified r.f. voltage is impressed across the control grid and cathode of the 6AK6 DC amplifier in such a direction as to cut off the plate current of this tube so that the relay is not energized.

As the capacitance between the sensor and ground is increased by the approach of a conducting body, some r.f. current is passed into ground, leaving less r.f. voltage on the grid of the oscillator tube. This causes the oscillation amplitude to diminish, thereby reducing the negative bias holding down the plate current of the 6AK6. When the oscillation has been weakened sufficiently, the plate current of the 6AK6 rises to the pull-in value of the relay (about 5 milliamperes) and the system is energized. In a normal room, an approach-sensitivity of one foot may be anticipated.

All About Bugging

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If one wishes a volume control on the "bug" as for phono broadcasting duty, make *R5* variable. A 100,000 ohm miniature potentiometer can be installed instead of this resistor. Insert a 2200 ohm resistor in series with the pot., so the transistor will not be damaged if the pot. is reduced to zero resistance.

The pickup radio should have good sensitivity and a fairly high-gain audio. Addition of an external aerial and ground to it may greatly improve results. If either the "bug" or the pickup radio are used alone (without aerial and ground) they may have to be oriented for best results.

Professional wireless microphones employ more audio amplification, higher powered oscillators, and larger oscillator coils so that the range is greater. These devices are complicated. They must be rather critically engineered to conserve battery power since they may have to operate for a day or two continuously.

All types of wireless "bugs" may use the power line as an aerial and a ground. A small capacitor (33 to 47 mmfd.) couples the aerial to one side of the line while another capacitor couples ground to the remaining side of the power line. Since one power line wire is grounded it may be necessary to reverse the attachment plug for best results. This method can be employed with wireless "bugs" using batteries as well.

Assembling An FM Tuner Kit

Continued from page 67

up" as recommended in the kit manual its performance in all respects approached that of the "standard."

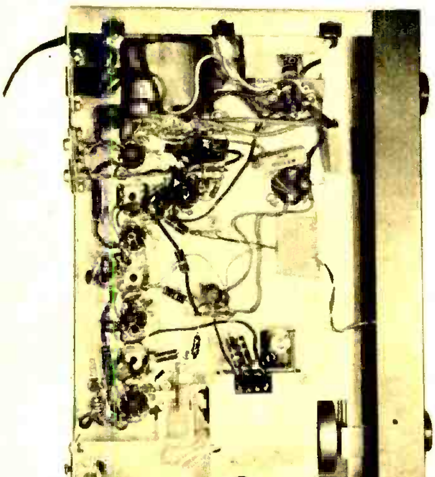
The audio quality of this tuner is excellent; its frequency response very wide, its distortion low. Noise pickup, both between stations and when on a station, was minimal.

Drift, and this was most surprising, was *absolutely absent*. From a cold start, the HFT-90 would lock into a station in about 30 seconds—and stay locked in! However, the same circuit factors which contribute to the stability of this tuner also make its audio output level relatively low. If the gain of your amplifier is high, no difficulties will be experienced.

The hum level was slightly high and for best signal-to-noise ratio the tuner should be operated with its volume control on full.

The novel dial pointer which is also a tuning eye is quite effective.

As a result of building and testing the EICO HFT-90 tuner, ELECTRONICS ILLUSTRATED rates it a *Good Buy*.



Bottom view of completely wired EICO tuner, piece of tape holds down the tuning eye lead.

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sent to Alaska, where White Alice relays them by telephone to NORAD.

This telephone system is a major triumph in itself, since it represents the largest over-the-horizon scatter network in the world, and is serving as the prototype of other, smaller installations elsewhere.

What OHS does is to make use of the "scatter" phenomenon to pick up minute portions of a powerful broadcast beamed toward a receiver beyond the horizon. Most of the radio frequency, of course, penetrates the troposphere and ionosphere, but the small portion which is scattered back is sufficient to be amplified, and relayed to the next station in the same manner.

Also linked to White Alice is a DEW Line extension, island-hopping the Aleutians out into the Pacific Ocean.

This forward picket fence is backed up by two other lines farther south in Canada—the Mid-Canada Line and the Pinetree System, the latter close to the United States border. Pinetree is also semi-automatic, while Mid-Canada is completely automatic. These lines are insurance, in case planes manage to slip by the DEW Line.

As an additional northern safeguard, radar bases have been posted on remote Thule in Greenland and at our establishment in Iceland. These are linked to NORAD by radio.

Planes and Ships

Starting at the western tip of the DEW Line in the Aleutians and extending far south into the Pacific Ocean runs the Mid-Ocean Line, made up of radar-equipped picket planes on constant patrol, their sensitive instruments continually on the alert for unidentified aircraft. Another line, this one made up of radar-equipped picket ships, stands about 300 miles off the West Coast from Alaska to Mexico. This, too, is additional insurance. This Offshore Line is also connected to headquarters by radio.

Another fence of picket ships and planes starts at the eastern tip of Newfoundland and extends for an indeterminate distance into the Atlantic Ocean. This is our eastern Mid-Ocean Line, linked to NORAD by radio.

Lastly, the eastern Offshore Line, extending down the Atlantic Coast, is made up of planes and ships equipped with radar. But in addition, a small fleet of blimps backs up the air reconnaissance, while a covey of three Texas Towers supplements the ships.

The Texas Tower, its name derived from its similarity to the offshore oil rigs in the Gulf of Mexico, are in effect sea-based radar stations. Also semi-automatic, these are huge platforms sitting atop concrete piles sunk deep into the ocean bed scores of miles off the East Coast. The third and last tower was recently activated off Sandy Hook, New Jersey.

The towers, equipped with the latest in detection devices, are supplied by helicopter, and are built to withstand the roughest Nor'easter the Atlantic can brew. They, too, are linked to headquarters by radio.

Initially, it was planned for all these outposts, from the DEW Line to the Texas Towers, to flash their data to NORAD, where men would compute their movements and feed instructions to the district defense commands. However, the newest addition to the defense network, SAGE (Semi-Automatic Ground Environment) has taken over that time-consuming job and can now come up with the "answers" in a matter of moments.

SAGE is made up of International Business Machines computers, one to each command, linked by land lines to each other and to Colorado Springs headquarters. The electronic computers are fed data on every aircraft flight in the United States and Canada, some 30,000 a day, and keep automatic tabs on them from start to finish. In the event an unidentified plane is reported, the computers are alerted, and the plane is tracked until it is determined whether it is "Friendly" or "Hostile." If the ship is "Hostile," after counterattack orders are flashed from NORAD, the SAGE network will take over and actually "fly" the show. Each computer will automatically make the decision on when to "scramble" the fighters in its command, it will actually control the fighters in the air and in the attack, order them back to base when fuel is low, send up replacements and pass the battle to the next computer when it shifts out of its territory.

In addition, it will control ground batteries and anti-aircraft missiles like Nike, in conjunction with the new Missile Master system, a localized electronic means of controlling and coordinating ground-to-air missiles.

The SAGE computers are housed in huge, air-conditioned, windowless blockhouses, as nearly bomb resistant as modern building methods can make them. The computers are fed by their own power systems, each of which is capable of lighting a small city. In addition to the usual memory drums, the electronic brains have added banks of tape on which data has been filed, to allow these machines to have instantly available all the necessary data to guide a supersonic war in the air.

Each computer contains 123 miles of wire and 58,500 tubes. Despite this complexity, IBM produces them on an assembly line basis. The computer was designed by the Lincoln Laboratory of the Massachusetts Institute of Technology.

Until last October, the 200,000 men in NORAD and its complex electronic network looked like a pretty effective means of preventing a surprise attack which would wipe us off the face of the planet. But the Sputniks have torn a terrible hole in this system and in our confidence. We now realize that an intercontinental ballistic missile, traveling at perhaps 15,000 miles an hour, would blast a target into particles less than a half hour after launching. The sensitivity of the radars we now employ would be almost useless; we could get only a few minutes warning, if that.

What we must have is the time to develop a warning, tracking and interception system against the Soviet ICBM, which is expected, according to reliable reports, to be operational by July. We may take the first step this summer, if everything goes according to plan, in constructing missile-warning radar stations in the north which would increase the height of our radar fence from its present 15 miles to many hundreds of miles above the earth, and extend its range to 3,500 miles or more. It is known we have designed and built such systems. We have detected the Soviet rocket experiments from such a station we built in Turkey. Another such experimental station has been built in the Southwest.

Neither of these are where they would count in defense, however. Fortunately, with such enormous range, only three stations of this type would be needed on the northern perimeter—one in Alaska, one in Greenland, and the third midway between. They would be constructed as far north of the DEW Line as possible. It is estimated, however, that they cannot be completed before 1960.

Integrating such stations into the SAGE network would be feasible, it is believed, and would solve the tracking problem. A big poser remains: Once we spot the ICBMs, how do we knock them down?

Anti-Missile Missile

The answer is the anti-missile missile. This device is conceived as an ICBM with a nuclear warhead, which would be launched against an oncoming missile, meet it in empty space hundreds of miles above the earth's surface, and blast it out of existence when it comes within range.

But even if we do design, build and stockpile a workable anti-missile missile, we still face another problem. Suppose the Russians build into their ICBMs an evasive system? What if they change the course of their missiles at a randomly chosen moment? How will our anti-missile missiles, launched to meet the ICBMs minutes after their launching at a point precisely calculated by the initial trajectory of the ICBMs, be able to meet the enemy rocket?

There is no real answer at this time to this question. It is a good bet, however, that whatever system of defense we evolve—and we must evolve it as rapidly as possible—some missiles will get through.

There may be an answer which approaches from the opposite direction, however. The threat of retaliation, which has stood us in good stead in the age of the bomber just passed, can be revamped and made to serve in the missile age. Our present concept of retaliation is one of using intercontinental missiles. So far, however, we have been notoriously unsuccessful in launching such weapons. But until the time when our own ICBM is thoroughly reliable, we can fall back on the use of the much more reliable intermediate range missiles, of which we possess a whole stableful. Missiles such as the Polaris and the Regulus, which can be launched from floating platforms, or from under the sea.

Since land-based missile stations in Europe would be notoriously easy prey for the enemy, we may do well to consider launching a massive building program of sea stations—submarines and surface ships—which could launch these IRBMs. These could be stationed on the open sea, within rocket range of the Soviet Union, ready at a moment's notice to launch a massive retaliatory blow.

We could then sit back, breathe a bit easier, and say, "Care to launch the first shot?"

Build A Safe Model Missile

Continued from page 33

different diameters. This is done to lighten the weight of the rocket. Rocket fuel has been known to ignite when the nose plug is screwed into the casing after loading. This is caused by a small amount of fuel being hung up in the threaded section, hence Safety Rule #14. In order to prevent this, there is an alternate design shown on the plans. If the former design is used, then use a funnel when loading.

We are now finished with the metal work. The rest is simple. Take a piece of hard wood about 2 inches in diameter and 8 inches long. First drill a ¾ inch hole about 2 to 3 inches deep into one end of the wood. Fill this with a ¾ inch dowel and cut off flush with the stock. Place this end at the head of the lathe and turn to the dimensions shown in the drawing. When finished, remove the dowel; this is the nose cone.

Next we'll discuss fueling and testing, and give plans for a test stand.

The Commuter Travalarm

Continued from page 81

The device itself is extremely simple, but the trick is to compress it into a vest pocket package. Use a small perforated Bakelite board, 2″x1¾″, to mount the components. You'll find that in most or all cases, you'll merely have to wire the leads together, thus eliminating hookup wire. Use extreme care, however, not to short any components.

After all components are in, connect the battery across the terminals with an eye on polarity—remember, you may damage your transistor if you hook it in the wrong way! Then connect the earpiece terminals to the proper points on your board, and if you hear a ringing, you're practically set.

Next, take the earpiece (available at many electronics parts supply houses) and thread the ends of its wire cable through the board and solder them to the proper points, as in the wiring guide. You'll need a 9-volt battery to power the alarm. A Burgess P6 will do nicely—it is only about an inch wide and deep.

The Case

A 2″x4″x2″ plastic case works very well as the container for the alarm. Fit your board into the case, using a bit of cement to hold it in place. Then fit the battery. You may wish to cement this in also because the battery life will be approximately shelf life. Then fit the watch. Put it under the cover, face up, and note the position of the winding stem. Cut a hole in the edge of the box to allow the stem to protrude. This will allow the hands to be set from the outside.

Next, with the point of a safety pin, punch a small hole in the plastic crystal near the edge—I did it at 6 o'clock point, but you can put it wherever you wish. Insert a small wire lead bared at the end. Use the finest and most flexible wire to allow the minute hand to make contact, brush it aside and move on. Use another piece of the Bakelite board, cut slightly wider than the case, to hold the watch in the case. This can be fastened with cement too.

Solder the lead that goes to the watch

case, making sure you have good contact. Solder the minute hand contact lead to the battery, and you're finished. You're now ready for operation, here's how to work it:

Setting the Alarm

You'll be able to set this timer for from one minute up to about 58 or 59 minutes, according to how long your trip takes. Let's say it's 50 minutes. Set the minute hand to the proper time interval from the contact. In other words, you will want 45 minutes of interval, so if your contact is at 6 o'clock set the minute hand at 9 o'clock on the watch. Then clip in your battery lead, or plug in your jack, or close your switch —according to the method you have chosen for making and breaking contact.

Insert the plug in your ear and put the timer in your pocket. Settle back in your seat and sleep, resting assured that 45 minutes later, or five minutes before you reach your station, you will hear the piercing tone of the oscillator in your ear. Sweet Dreams.

How To Buy Hi-Fi

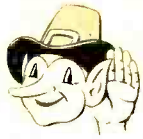
Continued from page 63

music for background purposes and relaxation, may not want stereo. In addition, most component hi-fi systems are so flexible that they will very easily convert to stereo when desired.

Q. In general, is there anything you'd like to add on the subject of buying, or selling, hi-fi?

A. Selling hi-fi, we've found is a process of education. It's a series of steps with most people—going from a 10 watt amplifier to a 25 watt one, and from a low-priced speaker to a higher priced one. Day after day people come in here who have had hi-fi previously, but have had low wattage amplifiers, inexpensive speakers, and poor quality changers. They come back to buy better things now. I can't emphasize enough that it's much better to buy the best you can afford at the beginning, and not be sorry later when you hear other systems that may be better than yours, or as continued listening makes you more discriminating.

Did Someone Say "Switch?"



When the art of recording was just taking shape
And it seemed to the experts that tape was just tape,
It made sense to try switching from this brand to that—
Until **irish** pulled **FERRO-SHEEN** out of the hat!

Now the **FERRO-SHEEN** process, the experts agree,
Has made **irish** tape different in *kind*, not degree,
So there's no earthly reason for switching your brand,
Save from Long Play to Double, or Brown to Green Band!

...if you are using
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(an inexpensive general-purpose tape of excellent characteristics)
. . . and want all the advantages of FERRO-SHEEN . . .

...switch to
irish
***FERRO-SHEEN* GREEN BAND**
(it costs no more than old-fashioned coated tape)
. . . if you then want 50% more playing time on the same size reel . . .

...switch to
irish
***FERRO-SHEEN* LONG PLAY**
(on 1-mil Mylar or acetate base)
. . . if you then want twice the normal playing time on the same size reel . . .

...switch to
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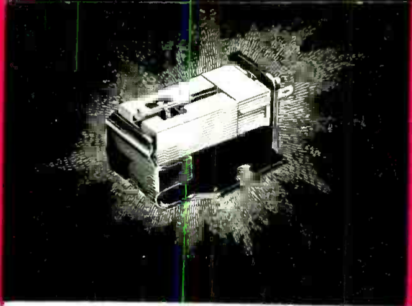
***FERRO-SHEEN* DOUBLE PLAY**
(made on ½-mil Mylar base and available on 5" and 7" reels)
There's an **irish** tape for every recording purpose!

Available wherever quality tape is sold.

ORRadio Industries, Inc., Opelika, Alabama
Export: Morhan Exporting Corp., 458 Broadway, New York 13, N.Y., U.S.A.
Canada: Atlas Radio Corp., Ltd., 50 Wingold Ave., Toronto 10, Ontario



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high fidelity phonograph cartridge until you've read this vital stereo report . . .

SPECIFICATIONS

RESPONSE:	20-16000 cps. ± 2.5 db to RIAA
ELEMENTS:	Ceramic
OUTPUT:	(Westrex 1A) .5 volt rms.
COMPLIANCE:	2 x 10^{-6} CM/dyne
TRACKING FORCE:	6 grams
WEIGHT:	2.4 grams
STYLUS:	.7 mil
MOUNT:	EIA (RETMA). Standard ½" and 7/16" centers
CHANNEL ISOLATION:	20 db

THE MISSING LINK to popular-priced stereophonic sound reproduction has been found: It's the new Electro-Voice TOTALLY COMPATIBLE Stereo Cartridge . . . plays the new stereo discs superbly . . . LP's too . . . even better than existing cartridges.

By breaking the stereo cartridge cost bottleneck, Electro-Voice has made popular-priced quality stereo a reality. E-V's ceramic stereo cartridge (Model 21D with .7 mil diamond stylus) sells for only $19.50 (Audiophile net) and is available now at your audio dealer or from your serviceman.

Here are some of the answers to your questions concerning stereo:

Q How does the COMPATIBLE E-V Stereo Cartridge differ from CONVENTIONAL cartridges?

A It has the ability to play both the new type stereophonic discs and conventional records. Inherent in its design is an improved monaural performance. *Exclusive* design for rumble suppression of 15 db or better will permit the use of Electro-Voice's Stereo Cartridge *with any type of changer or transcription player!*

Q Are stereo discs compatible with conventional cartridges?

A Most cartridges damage the stereo record. DO NOT BUY STEREO DISCS UNTIL YOU HAVE AN E-V STEREO CARTRIDGE. You may then play monaural or stereo discs monaurally. Add a second speaker and amplifier, and you have stereophonic sound.

Q What about modification problems?

A Using an Electro-Voice Stereo Cartridge, which is constructed so that its output is already corrected to the RIAA curve, you will not require the equalization of the *second* amplifier. Inserting the cartridge is simple. It will fit virtually any standard tone or transcription arm. The addition of a second amplifier and speaker is not complicated.

Q What about record availability?

A Recordings by major record manufacturers will be available in mid-1958.

Q What effect will stereo cartridges and records have on your present equipment?

A Only your cartridge will be obsolete. All other components are compatible with stereo.

Q What if you don't have a HI-FI system now . . . should you wait?

A *No.* Proceed as before—with one exception: you should insist on a stereo cartridge initially. When you are ready for stereo, merely add a *second* speaker and amplifier.

Q How do you go about getting your Electro-Voice Stereo Cartridge?

A Visit your dealer. If you don't know the name of your nearest dealer, please write Electro-Voice. Ask for E-V Stereo Model 21 D with .7 mil diamond stylus or E-V Stereo Model 26 DST Turnover with .7 mil diamond Stereo tip and 3 mil sapphire tip for monaural 78 rpm records ($22.50).

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