WHAT HAPPENED TO THE DEATH RAY?

# ELECTRONICS ILLUSTRATED

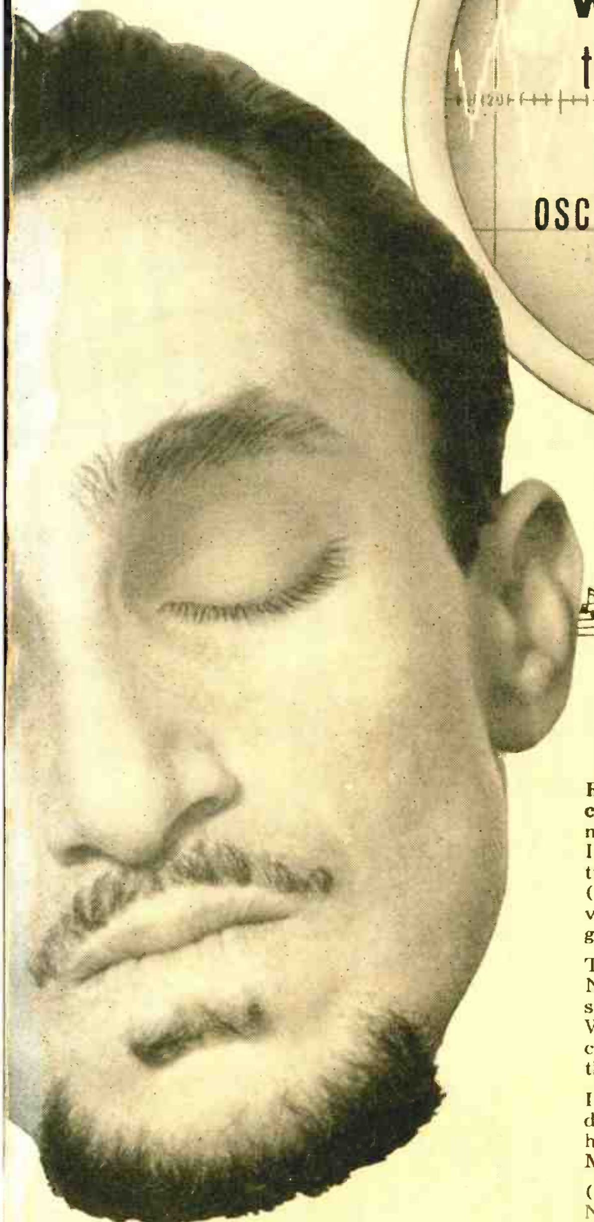
25c
DECEMBER

## HOW TO:

**Add Sound To Your Movies**
**Use a Neon Tester**
**Enjoy Tape Recorders**

**Tune In The World With Short Wave Radio**

# I used to WATCH the music on the oscilloscope...



# ...but a NORELCO® speaker made me LISTEN!

Every time I bought a record, I used to set up the calibrated microphone, connect the oscilloscope, start the music with bated breath, and — consumed with anxiety — I would keep my eyes glued to the screen of the cathode ray tube. If anything on the 'scope pattern looked suspicious (something always did), I would start checking tubes, voltages and crossover frequencies, and examine the record grooves under a microscope.

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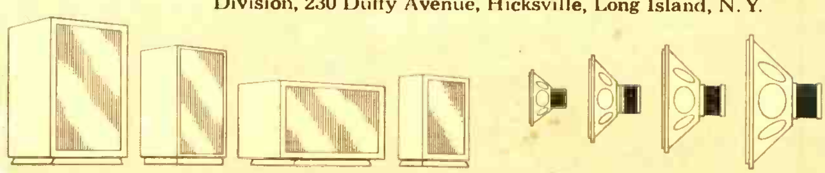

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TESTING APPLIANCES FOR ELECTRICAL TROUBLES
How to Learn
SERVICING ELECTRICAL APPLIANCES




# ELECTRONICS ILLUSTRATED

A Fawcett Publication

VOL. 1, No. 6 DEC. 1958


Contents



The Short Wave Receiver on the cover is the National NC 188.
Color photo taken by Fawcett Studios.




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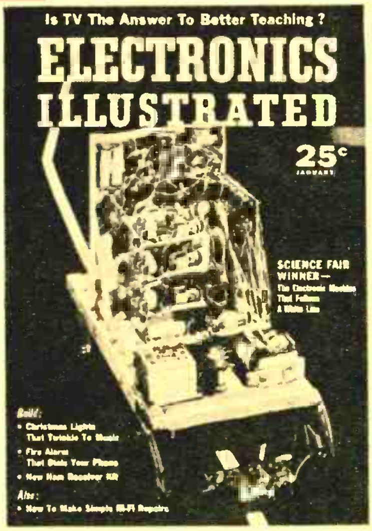
# A Message From the Editor




The recent introduction of regular educational TV programming in New York City has made many people aware of the potential for good that exists over the television airwaves. Actually, the use of television for teaching an out-of-school adult audience has barely begun. Up till now the programs produced served mainly to acquaint educators and stations with the problems involved. A report on what these problems are, how they are being solved, and what you can expect in the very near future in educational TV broadcasting and facilities, will appear in our next issue.

Many of us in the cold northern climes start thinking this time of year, enviously, of the better life we could lead in such sun-warmed areas as Florida and Southern California. Some of us go so far as to seriously consider moving our families and getting new jobs in these places. If you decided to do this, could you make a go of it? EI undertook to survey the Florida electronics job market and, in particular, we sent a writer down to interview personally some of the electronics technicians, servicemen and engineers who moved to Florida and are currently employed there. We won't tell you in advance what we discovered, but if you are interested in Florida, don't miss this story in our next issue.

Back in our October issue we carried an exclusive interview with G.E. consultant engineer, Charles Rouault, who had just returned from Russia. One of his most telling remarks was that he thought not enough U.S. engineers were familiar with Russian electronic research as reported in Russian scientific periodicals—mainly because English translations were not available. We have just gotten word that this situation is now being corrected. As of now, there are over 60,000 pages of English translations of important Soviet scientific and technical journals, in addition to four extensive series of translated abstracts of scientific papers. This work has been sponsored mainly by the National Science Foundation. The translations are sold on a subscription basis, and additional information may be obtained by writing to the National Science Foundation in Washington, D. C.

We're especially proud of some of the stories in this issue. Our exclusive interview with Commander Anderson and Lieutenant Jenks of the Nautilus brings out for the first time some hitherto unknown information on how electronics is used in

navigating devices on both submarines and ships. As a matter of fact, this interview really tells for the first time, just how the Nautilus did navigate to the North Pole under all that ice.

Long winter nights often inspire dreams of exotic places and interesting climes, as noted elsewhere. Many have satisfied these dreams, partially, by becoming short wave listeners and tuning in on the world. Jack Gould, volatile Radio and TV editor of the *N. Y. Times*, was long ago bitten by the short wave bug, and in a very clear and enjoyable article describes the joys and wonders to be found in listening to foreign broadcasts. It appears in this issue, and will be continued in our next issue.

Also forthcoming will be our giant table of short wave stations from hundreds of countries around the globe. If you want to get into this hobby but don't know whether you want to put out any great amount of cash at the moment, look at the article on page 68. Anyone can get into short wave if they have a spare table model radio around the house. Let me warn you though, it won't be long before you do buy one of the more advanced short wave sets.

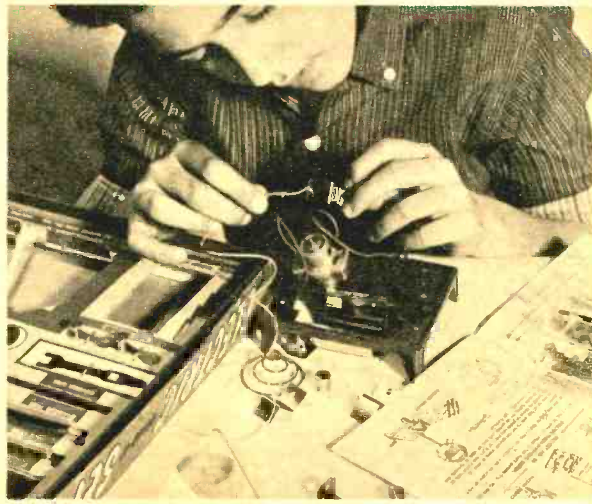
One of our regular features from now on will be a report to you on how and where electronics is being used in new industries—possibly the one that employs you. This month, we describe how electronics is used to speed the news from reporter to reader. We are tremendously excited over this project and in finding how important electronics is becoming, day by day.

We've got some very interesting build-it-yourself items for you next month. One in particular is a set of Christmas tree lights that twinkle in response to any record you play on your home phonograph.

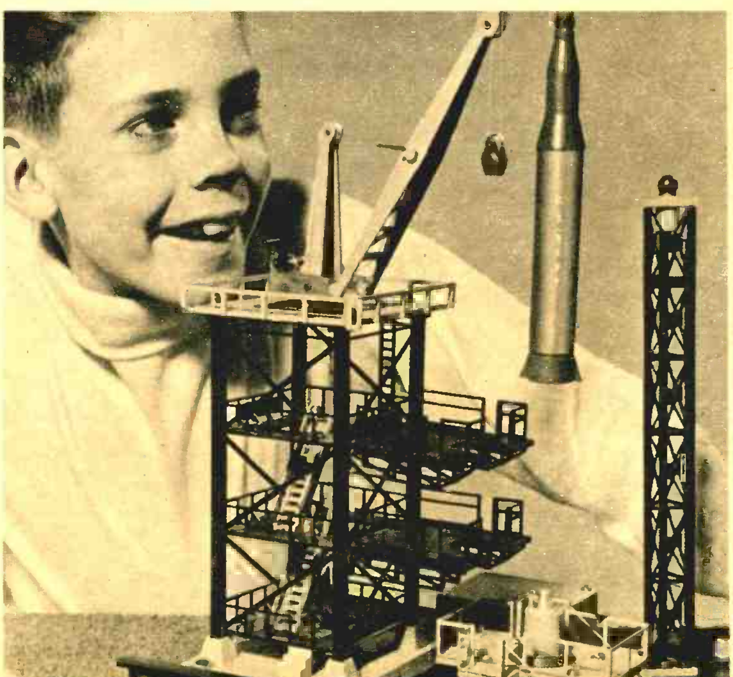
Another item is a fire alarm that dials your phone. It's fairly Rube Goldberg-ish in concept, but it really works. There'll be more, much more, than we've talked about, in the January issue—so be sure to get it.

Charles Tepfer

# Electronics in the News



Santa may be old-fashioned, but the toys he'll bring this year are entirely up-to-date. The electronic organ, left, has wonderful resonance, plays over 2 full octaves. $19.95. The Electric Build-It Set, $4.98, includes complete materials and instructions for building a burglar alarm, a bicycle horn, a toy hot rod. At better toy stores.



Lionel's Rocket Launcher, an electric train accessory, has a remote control device which handles a count-down mechanism and firing button. A magnetic crane swings the rocket to a motorized tower which in turn carries it to a launching platform. Tower moves away, count-down begins, then sponge-nosed missile soars into space. $17.95. These toys recommended by Toy Guidance Council.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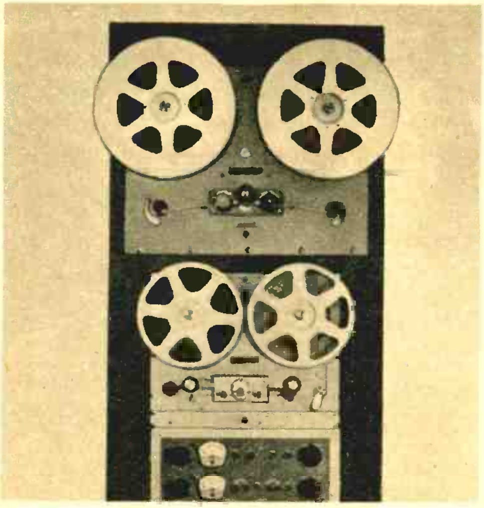

Adult radio audiences at last come into their own, with Muzak Corporation's fully automatic broadcasting service. This system, which will be available to radio stations all over the U.S. in early 1959, utilizes a machine capable of playing up to 8 hours of tape-recorded music plus up to 4 hours of locally-recorded commercials, announcements and programs. An electronic brain switches from music to local material and back again by means of subsonic control tones, pre-recorded on magnetic tapes.

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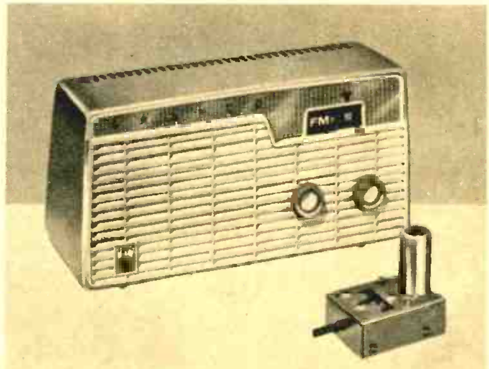

A new patented FM "front end" is now being used by Granco Products, Inc. in their small $30 table model FM radios. The low-cost tuner, now offered to other manufacturers also, contains the r.f. and oscillator stages and has good sensitivity with little drift.

Garrard Sales Corp. has brought out a professional-type 12″ turntable, complete with a transcription tone arm, all mounted on a single unit plate. Fully wired for stereophonic and monaural records, and featuring a variable plus or minus speed adjustment, the model 4HF sells for $59.50.

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The Strato-World III from RCA Victor is a seven-band, all transistor radio, weighing under 12 pounds and operating on 9 flashlight batteries. The Model 1MBT6 has a standard AM band, two ship-to-shore and amateur short-wave bands and four international short-wave bands. It has an air loop for domestic listening and a telescoping antenna for short wave, as well as provision for an external antenna. A world map on the lid of the black lizard case indicates time zones all over the world. $195.


Another short-wave portable radio, Zenith's Trans-Oceanic Royal 1000 D, has recently added a new wave band, the 150-400 kc band, making a total of nine. This is the band which carries Coast Guard and CAA weather navigation broadcasts. The set, which operates up to 300 hours on one set of flashlight batteries, has three antennas—a telescoping one for short-wave use, a built-in antenna for normal reception and a detachable one for listening on planes, trains and cars. There is also a time zone dial and a world time zone map. $275.

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The Second National Symposium on Global Communications (GLOBECOM II), under the joint sponsorship of the IRE Professional Group on Communication Systems and the American Institute of Electrical Engineers, will take place December 3-5, 1958, at the Colonial Inn-Desert Ranch, St. Petersburg, Fla. There will be 50 exhibitors.

—o—

A permanent professional placement office geared for scientists and engineers of senior level has been opened by RCA at 630 5th Avenue, New York City. Operating on an interview by appointment basis, Mondays through Saturdays, the office is interested in seeing engineers in the fields of high-power transmitters, logical design, weapons systems, microwave, equipment development and solid state devices.


The "Gold Bug" from Stereo-Ette Co. offers stereo through any existing self-contained record player and any ordinary radio receiver. It is hidden out of sight in or behind your record player, and has no connection to the radio. It also works with many tape recorders that have stereo heads and pre-amps. Designed for use with any ceramic cartridge, the Gold Bug is $16.75 less battery and stereo cartridge. Other models are from $23.50.

—o—

Bendix Aviation Corp. has announced a new DAP (Diffused-Alloy-Power) transistor, said to develop greater power, operate at higher frequencies and with greater circuit stability, than other germanium power types now in use. The new transistor will be used in the hi-fi field to improve frequency response and lessen distortion. Another application will be in the computer field, since DAP can record and recall numbers from computer memory cores at a rate of more than 1 million per second. DAP may also solve circuit problems in the design of portable TV sets, like the one which has included a search for a power transistor for the horizontal sweep circuit of the picture tube. DAP could be used to replace tubes that normally operate at high temperatures.


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knight-kit Amateur Communications Receiver Kit Y-726 $104.50
knight-kit Dual 30-Watt Stereo Hi-Fi Amplifier Kit Y-777 $84.50 (less case)
knight-kit 12-Watt Hi-Fi Amplifier Kit Y-784 $19.95 (less case)
knight-kit "Ranger III" AC-DC Radio Kit Y-736 $16.95
knight-kit "400" Tube Checker Kit Y-707 $19.95
knight-kit "Span-Master" 4-Band Receiver Kit Y-258 $24.95
knight-kit "Ranger" Clock-Radio Kit Y-737 $24.95
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Transistor Lab Kit
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The Grommes Premiere Model 240 is a new 40 watt stereo power amplifier for use with stereo preamplifiers. Consisting of two separate 20 watt channels with separate level controls and meter for checking channel balance, reading power output and checking frequency response, the set can be used as a 40 watt monaural amplifier or as a two channel amplifier with an electronic crossover. The sensitivity is .5 volts for the rated output. Outputs are 4, 8 and 16 ohms for each channel. $109.50.

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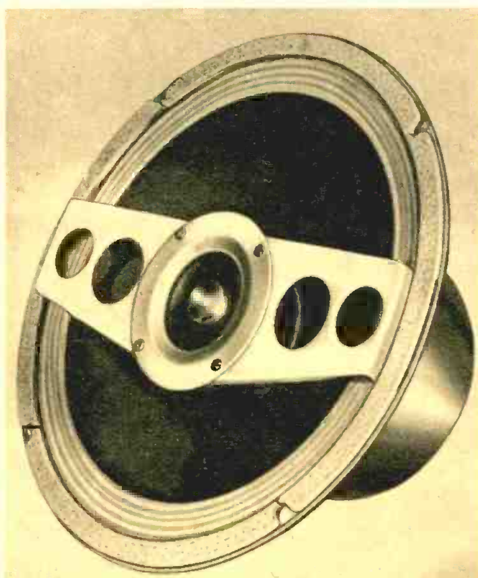

The "Stereo Classic," Model LH-12 from General Electric Co., uses dual-cone high fidelity speaker consisting of 12-inch "extended bass" woofer, a 2-inch direct radiator tweeter, and a new crossover network. These are mounted in a compact infinite baffle enclosure which may be placed horizontally or vertically. List price $129.95.

Electronics has not only shortened flying time, but also has speeded up the handling of airplane reservations and information. Agents of Eastern Air Lines are now able to look into the stockpile of unsold seats on any of their 324 daily flights, by just pushing a few buttons on this Remington Rand Univac file computer stystem. The set also gives instantaneous information about weather and flying conditions and estimated and actual arrival and departure times.

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Allied Radio Corp. announces their 1959 general catalog of electronic parts and equipment, including a complete line of hi-fi components and the Knight electronic kits. The new 452-page catalog lists over 32,000 items.

—o—

A new and larger third edition of the Transistor Manual is now available from General Electric Co., containing information on how to build things from a simple radio to a hi-fi stereo sound system using transistors. The manual also describes basic semiconductor theory, various transistor construction methods, meanings of transistor parameter symbols, and how to read a transistor specification sheet, as well as giving a complete listing of all transistors. Copies are available from G.E. Semiconductor Products Dept. Syracuse, N. Y. $1.00.

A new 36-watt amplifier, model 209, has been announced by H. H. Scott, Inc. Easily convertible to stereo, provisions have been made to operate two 209 amplifiers in tandem, with the Scott stereo-adaptor, as an integrated system. Front panel controls include pick-up selector switch, rumble and scratch filters, monaural-stereoadaptor switch, volume loudness switch, input selector switch, acoustic level control, bass and treble controls, speaker selector switch and level control. Net price is $139.95.

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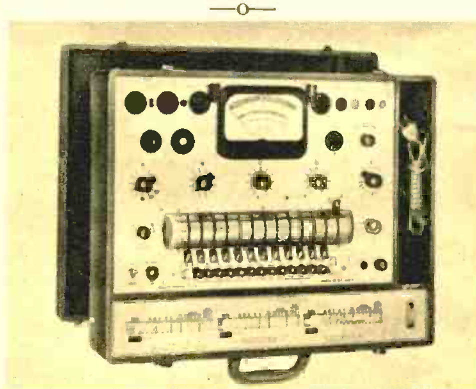

The "Electronamic" Tube Tester model 10-40 from Precision Apparatus Co., has been designed for industrial and communications applications as well as for service maintenance and technical education. It provides facilities for comprehensive testing of electronic tubes and TV picture tubes along with functional testing of voltage regulator tubes, an ultra-sensitive gas test for amplifier tubes and a beam-current test of TV picture tubes. Net price $149.50.

*Learn from men who are pioneering electronics!*

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***Choose your training*** before *enlistment!* . . . The Army's Graduate Specialist Program makes it possible for qualified young men to choose their training *before* enlistment. To be accepted, you must pass certain qualification and aptitude tests, and be a high school graduate. (High school seniors can apply *now* and enlist *after* graduation.)

***Successful candidates*** for this unusual program can choose from 107 technical training courses—and have their choice guaranteed *before* enlistment! You enlist as a Graduate Specialist, an important member of the Army's select team of key personnel. And you enlist for only *three* years. Here's a unique opportunity for a tremendous headstart toward a successful electronics career!

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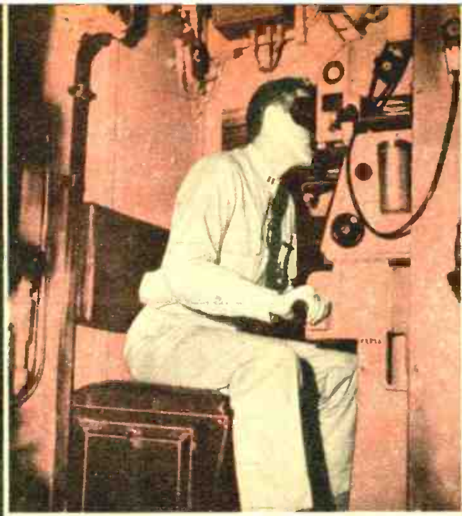
- Fire Control Instrument Repair
- Telephone Installation & Repair
- Radar Repair
- Guided Missile Electronic Equipment Repair
- Teletypewriter Equipment Repair

**APPLY EARLY!** Graduate Specialist appointments in each course are *limited.* This week, get the details from your Army Recruiter.

***Former Servicemen***—you may have electronics or other skills which the Army needs. See your local Army Recruiter for information on what the Army is offering men and women with prior military service.



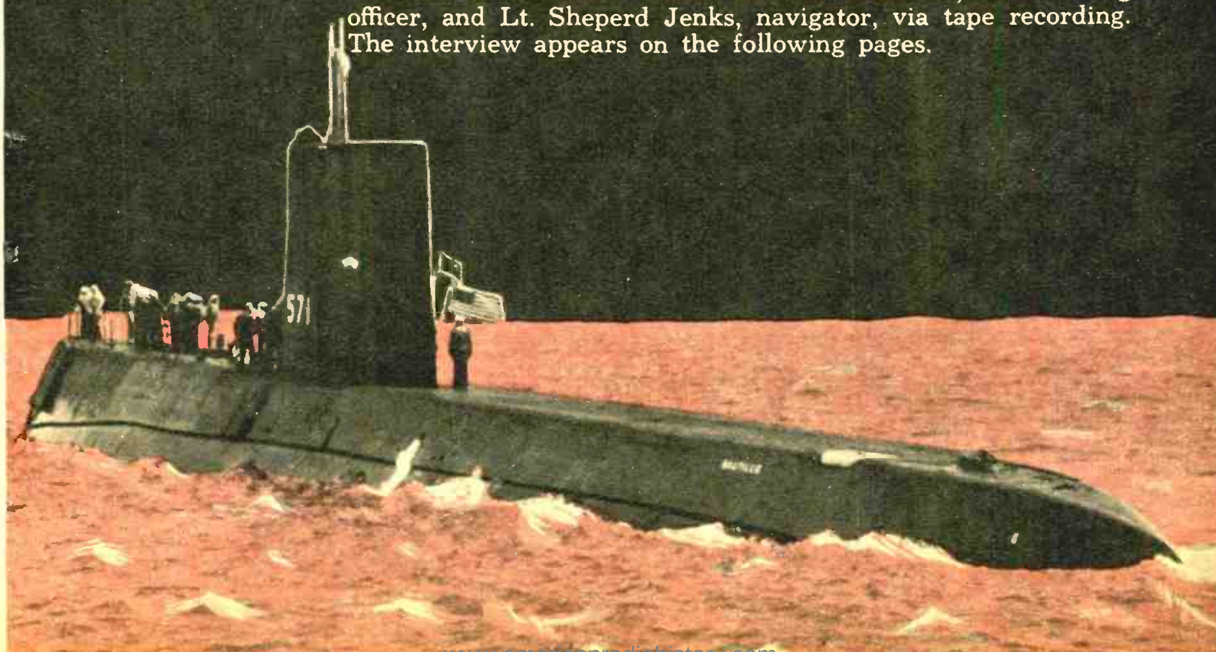
Periscope in attack room of the atomic sub automatically records angles, elevations, etc., when sighting officer presses handy button.

*EI interviews the men who took*

# Nautilus Under The Pole

**An exclusive interview with Nautilus' captain and navigator reveals how they navigated under ice.**

AT 11:15 p.m. (EDT) August 3, 1958, the USS Nautilus passed 400 feet beneath the ice at the North Pole, thereby making history. In crossing the Arctic Ocean from Pacific to Atlantic, the atomic submarine opened new commercial and military interest in the Arctic, and for a dangerous job well done, the first Presidential Unit Citation was awarded to the officers and men who took the Nautilus under the Pole. Obviously, this voyage could not have been made without modern electronics and atomic energy. To learn exactly what part electronics played in the historic trip, the navigation problems involved, and the future of electronics in submarines, the editors of *EI* went aboard the Nautilus to interview Cmdr. William Anderson, commanding officer, and Lt. Sheperd Jenks, navigator, via tape recording. The interview appears on the following pages.



As ship passes under ice cap, men in control room concentrate on maintaining course and depth.

**Ques.** *Captain Anderson, what is the significance of your trip under the Polar ice cap from ocean to ocean so far as the future of submarines is concerned?*

**Ans.** I think that with the trips the Nautilus has made, and recently the Skate, the Arctic Basin has been effectively "opened up" as another ocean which can be utilized by submarines for a variety of reasons, some of which are immediately apparent, others which we probably can't even visualize now. One example: Our trip was designed to show that the Arctic can be used as a transit area. We have tried to maintain a "two-ocean navy." We have large Atlantic and large Pacific forces. Now, by using the Arctic as a transit route, we vastly increase the flexibility of our submarines. Another thing is the use of the Arctic Basin as a staging area for ballistic missile-carrying submarines, a place where they could "hide"—be totally immune to detection, and dart out through openings in the ice to fire the missiles if there should ever be that requirement.

**Ques.** *Could your sub-polar trip have been made three years ago?*

**Ans.** No, it couldn't. The Nautilus was operational in the summer of 1955, but there wasn't enough experience at that time to permit making a trans-Polar crossing from one ocean to the other without doing so on a quite risky basis.

**Ques.** *Were the Gyrosyn and other gyro-compasses aboard the Nautilus when she went operational?*

**Ans.** No. The Nautilus initially had an almost completely different compass installation than we have aboard right now, and I would not want to take the Nautilus' original equipment on

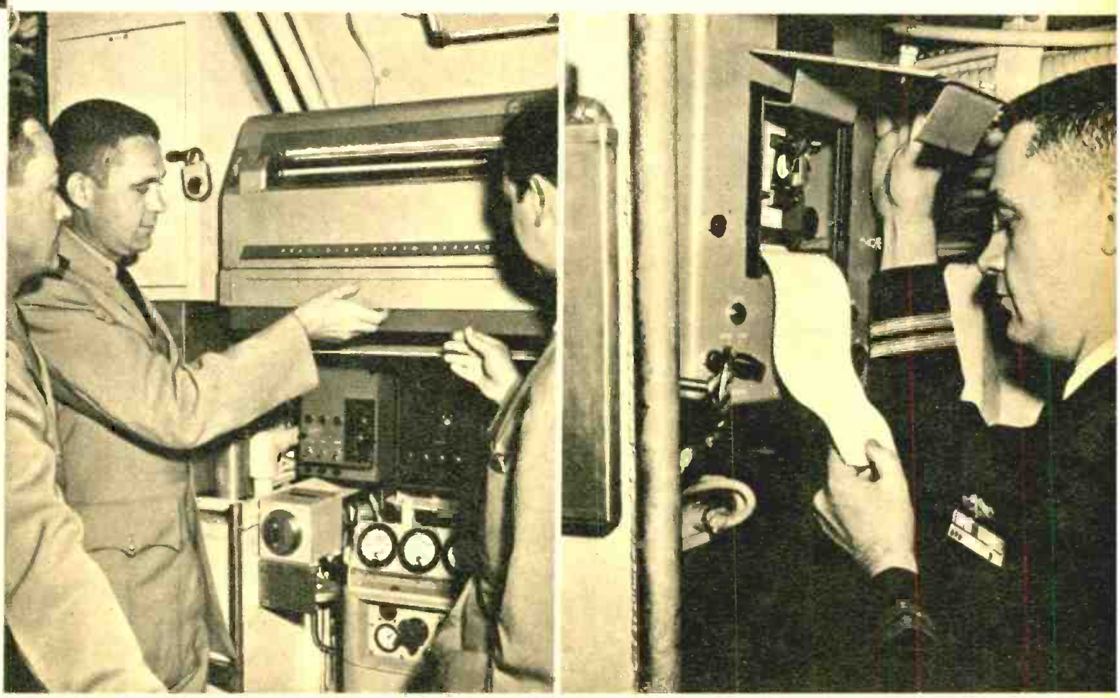
the trip we've just completed. We have better compasses on board, and they have been extensively modified by Sperry to make them work under Polar conditions. This has been done since our 1957 trip. Modifications were based on our experiences and some of our navigation difficulties on that trip. It's only a matter of months that we have had some of our present equipment.

**Ques.** *Based on your experiences with the equipment taken on this trip, would you say that other operational nuclear subs could now go in and do the same thing?*

**Ans.** Oh, very definitely.

**Ques.** *Captain Anderson, how do the electronics personnel on this ship compare in importance, in function, to those who served in World War II submarines?*

**Ans.** Well, the difference is the difference between the capabilities of nuclear powered submarines as compared with conventional submarines. The Nautilus has extensive electronics equipment, not only in the conventional sense of ship controls and communications circuits, but also in the power plant itself—in the controls for the nuclear reactor and the instrumentation required to operate it. The part that is played by electronics technicians is a much greater part than has even been played in any submarine before. And we have far greater numbers on board than the submarine used to carry. A large number of our crew, all the engineering ratings, the people that run the power plant and the less specialized mechanical aspects



**Left, Lt. Jenks explains precision depth recorder to *EI* editor as Cmdr. Anderson looks on. At right, the navigator checks SCAR (Submarine Celestial Altitude Recorder) which permits the taking of star fixes through the periscope.**

**Gyro-compass installation (Sperry Mark 19) senses ship's heading, roll and pitch and was primary means of navigation under ice.**

**Ultra-precise inertial navigation system for use at sea is assembled ashore. Inertial system on Nautilus proved accurate.**

**Designed for high-speed aircraft in polar regions, Sperry Gyrosyn compass system was checked on Nautilus' submerged trip.**

of the ship—they all receive a basic course in electricity and in electronics. Only the electronics technicians and "interior communications" men have highly specialized electronic training.

**Ques.** *Could the trip have been done in the winter?*

**Ans.** That really can't be answered until we try the same trip in the wintertime. The Atlantic approaches to the Arctic Basin are deep water approaches; there is no reason in the world why you can't go up to the North Pole or anywhere in the Arctic Basin by making your approach from the Atlantic side. On the Pacific side you've got a special problem, a shallow water problem. What the ice conditions are in the shallow water in the wintertime, no one knows. Until the Nautilus trip this year, we didn't know what the relationship of the summer ice conditions was to that "shallow water" approach problem. We learned some very interesting things that no one suspected! There's a possibility—and I want to emphasize "possibility"—that a wintertime trip could be *easier* than the summertime trip. But we really won't know until somebody gives it a try.

**Ques.** *You mentioned the "shallow water approach." I think of this in terms of the Bering Straits. Is that correct?*

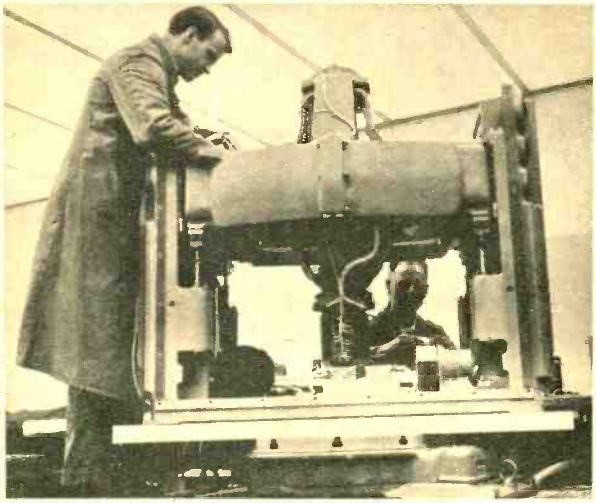
**Ans.** The Bering Straits and the Chuckchi Sea.

**Ques.** *How shallow are they?*

**Ans.** Well, the Chuckchi will run down as shallow as 102 feet. The Nautilus is about 50 feet from top to bottom so you can see that in cruising very close to the bottom we don't have too much clearance. As I said before, wintertime may be a better time . . . would you like me to explain why?

**Ques.** *Yes. We're very interested! Of course, during the winter the water would be iced over, wouldn't it?*

**Ans.** Yes, it would be. We found on this trip something that we didn't expect. On the Atlantic side, in which we had experience last fall, you see beautiful white regular ice floes—ice that has spent its entire history in the open sea. It forms in a predictable fashion. You can pretty well predict what the thickness, draft, and other characteristics of the ice are going to be.



Now, in the Chuckchi Sea and in the Bering Straits we encountered summer ice that was dark, dirty and rugged; ice that had been land-massed along the coast somewhere, Siberia, Alaska, northern Canada, where it had an opportunity to absorb pressures and become a lot more rugged than ice in the open sea. Apparently during the spring thaw, this ice is cast loose from the coast and goes out into the open sea and becomes somewhat of a menace. Perhaps some of that ice wastes away toward the end of summer, and is replaced in the wintertime by sea-ice, which forms in a regular, more predictable pattern. For that reason, we "may" find that the winter is really a better time for such a trip.

**Ques.** *What do you think the submarine of the future will be like?*

**Ans.** We are starting to see a large number of different types of submarines. People conjecture that around the corner are cargo submarines and tanker submarines—entirely feasible, as far as I know. We're going to see more diversified employment of the submarine. We are also going to see a much better design as far as the submarine hull is concerned. For example: the optimum submarine would be one completely fared—something that would resemble a torpedo. You wouldn't have that big "sail" sticking up there; the entire ship would be a perfect cylinder. And we'll see, perhaps, true streamlining, where we've got optimum "dynamic shape" for submerged performance. It's perfectly possible to build a submarine that will go 60 knots. A large surface ship designed to do 60 knots would be very hard to build.

**Ques.** *Do you think that future submarines will have fewer personnel because there will be more electronically automated apparatus aboard?*

**Ans.** You can add a lot of efficient control equipment and cut down on operating personnel, but then you have to add almost as many personnel to monitor and maintain that equipment. Building a submarine where you just punch a button and it automatically dives off New York and surfaces off England is in the "Buck Rogers" future. You need the human mind to

[*Continued on page* 104]

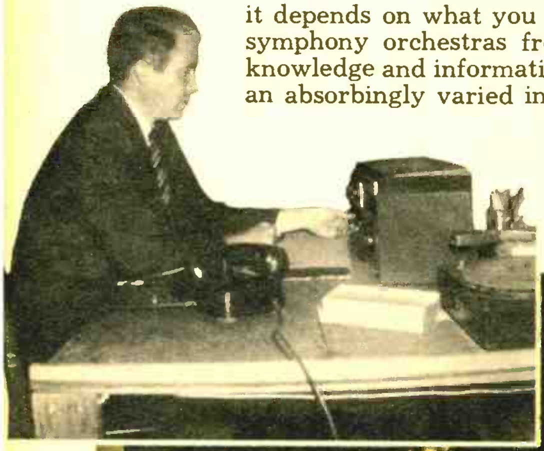
# All About Short-wave Listening

**By Jack Gould**
Radio-TV Editor, New York *Times*

**Tuning in the world via short-wave radio can be a rich and rewarding experience, an exciting hobby.**

DO YOU want an exciting and fascinating adventure in your own home? That is what short-wave radio offers. With the flick of a switch and the twist of a dial you can roam the world. Night and day hundreds of programs are carried across oceans and continents and brought into your own living room.

On short-wave radio there is something for almost everybody; it depends on what you want to hear. There's entertainment—symphony orchestras from the capitals of the world. There's knowledge and information—news and commentary that provide an absorbingly varied insight into international affairs.



**Variety in listening adds spice to your home entertainment. Author, left, can twist dial to hear All India Radio halfway around world.**

**Radio Japan broadcasts schedules in English, in addition to programs of traditional Kabuki music.**

There's a hobby—the game of trying to hear every country in the world or eavesdropping on the amateur radio operators who chatter back and forth over thousands of miles. There's the fun of being a parlor detective or the "supervisor" of a control tower—listening to police alarms or overhearing airplane pilots report their positions over the Atlantic and Pacific.

Short-wave radio, in a word, opens new vistas for the inquiring listener. Merely to hear familiar local radio stations is to miss out on a major treat of the broadcasting art. For little expense and trouble there is the whole world to choose from.

Getting started in short-wave radio depends on the state of one's pocketbook and the extent of one's interest; there are receivers for every purse and taste.

If a soldering iron, pliers and screw driver hold no terrors for the prospective monitor of the international airwaves, he can begin with the durable old standby—the regenerative receiver of two or three tubes. These come in kit form at the mail order houses, have very clear instructions on assembly, and can provide many hours of diversion. Even with incidental extras—a set of earphones may be helpful to hear weak stations and perhaps not everybody has a soldering iron at hand—the total investment can be under $25.

The next step upward is the superheterodyne receiver; it affords vastly increased volume, greater ease of tuning and more ability to pick up distant stations. The simplest superhets come in the $50 to $60 bracket—if you have the necessary skills and equipment, they can be had in kit form for even less. For the prospective short-wave listener who

On-the-scene special events, such as shipboard broadcast from India, can be tuned in at home.

The world also listens to us. Moscow radio club members do not own equipment, share its use.

wants maximum service with the least fuss for reasonable cost these sets make a good starting point.

The addition of a second stage of intermediate frequency amplification may bring the cost of a receiver up to $80 or so. Moving up to the category of $100 to $200 makes it possible to obtain receivers with a stage of radio frequency amplification, which aids sensitivity and selectivity very substantially.

For $200 or more there is a wide choice of superb receivers, though some are designed solely to cover the bands of interest to amateur radio operators rather than the channels assigned for general international broadcasting. A super-duper short-wave set that not only does just about everything electronically but practically cleans up the house and puts out the cat can be ordered for $1,500.

In weighing the cost of short-wave sets it is well to remember that in a popular sense they represent two receivers in one. Virtually all SW sets cover regular broadcast stations with their familiar output of rock 'n' roll, soap operas, disk jockeys and commercials; short-wave radio is something added.

One of the major differences between regular radio and short-wave is that stations on the international airwaves are badly crowded together. This means that some form of bandspreading is virtually indispensable. The bandspread tuning dial, as the name suggests, spaces the stations out so that an Englishman in London can discuss the joys of gardening without interruption by the young lady in Moscow who reads the Soviet manifestos.

Once a set has been built or bought, there is the matter of an aerial. In many locations fifteen feet of wire draped around the room will bring the voices and melodies of many lands into the house. An antenna out in the open, particularly if a listener lives in an apartment house with steel girders, generally proves most satisfactory.

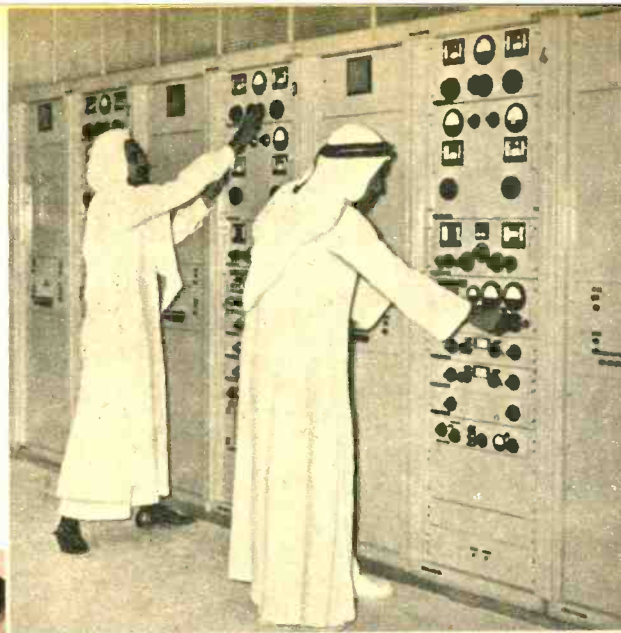
Even though the art and technique of short-wave radio goes back many years, it is still an awing and exciting experience to turn on a short-wave receiver for the first time, tinker with the dial and suddenly hear the chimes of "Big Ben" striking the hour in the tower of the House of Parliament in London. It makes the world seem uncannily tiny.

But to obtain maximum pleasure from a short-wave receiver—and to understand the language commonly used over the air—familiarity with a few words and phrases can be helpful.

It may be asked, "What is a short wave?" A radio wave can be likened to an ocean wave. At the beach you have seen a wave go up and down, up and down. Each time it completes an

[*Continued on page* 96]

Technicians in United Arab Republic tune transmitters which broadcast their views on troubled Mid-East to many foreign nations.



Listeners who acknowledge hearing a broadcast, by mail, often receive in return colorful QSL cards which confirm short-wave contact.

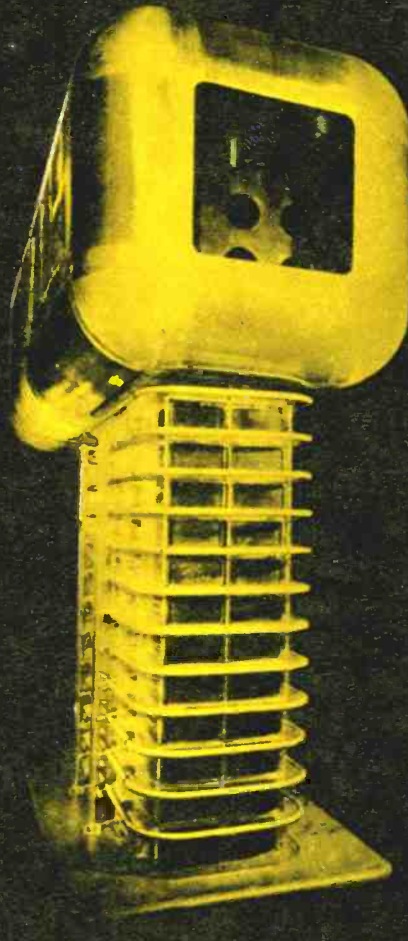
*what happened to*

# The Death Ray?

**By E. G. Louis**

**With present knowledge of energy sources, how close have we come to a practical death ray?**

SCIENTISTS often catch up with and surpass the most fantastic predictions of science-fiction writers. The airplane, automobile and submarine, for examples, at one time existed only in human imaginations. More recently, the long range rockets, missiles, color television, artificial satellites and atomic-powered ships have become realities. Interplanetary travel, long a dream of science-fiction writers, is on the verge of practical realization. In fact, at the present rate of progress, it takes a very imaginative writer to keep even a short step ahead of science.



This is part of giant Bevatron at Berkeley Radiation Lab. It starts particles on a 300,000 mile journey through machine which boosts particles to 10-million electron volts, then to the energy of cosmic rays.

University of California

But there is one invention referred to time and again in science-fiction that, as yet, has not been practically developed—the death ray. What happened to the death ray? Has its development been held up by lack of interest? It doesn't seem that way. A practical death ray has been a priority item for military researchers and such a device has been on the official list of the National Inventor's Council for many years.

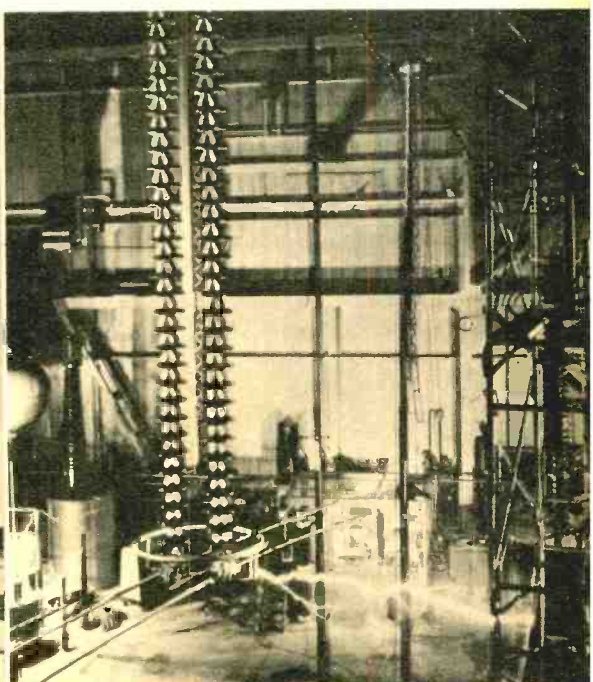
Earlier this year, Roy W. Johnson, head of the Advanced Research Projects Agency, told the Congressional Space Committee that the "ultimate" weapon of tomorrow might be a death ray that would make the hydrogen bomb obsolete. Referring to some of his agency's experimentation, America's research chief said, ". . . . our work might lead to a death ray. That would be the weapon of tomorrow. . . The (hydrogen) bomb today is considered the ultimate weapon, but I suspect that 20 years from now the bomb will be passe."

The majority of present day weapons, including the highly touted ICBM, are merely advanced versions of that prehistoric weapon, the thrown stone. This was the first ballistic missile and later weapons—pistol, rifle, machine gun and today's rockets—are just more efficient forms of that first missile. Even when an explosive warhead is added to a rocket, the only real change is to increase the weapon's area of destruction.

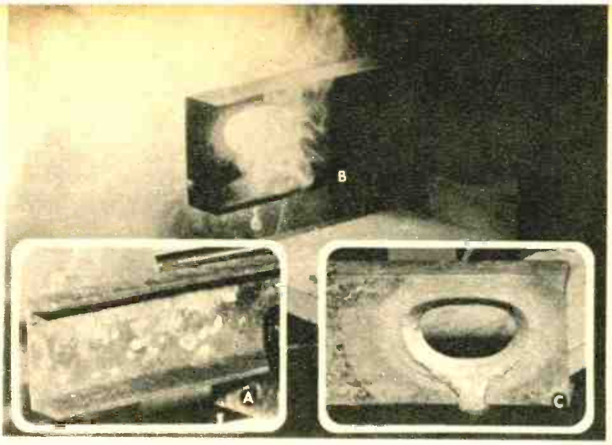
In a sense, "death ray" is a misnomer. It is a broad term describing a whole class of weapons, just as "gun" describes everything from a child's cap pistol to an atomic cannon. As commonly

**Great radar antennas are capable of concentrating microwave radio energy into directional beams. Right, experiments with high-voltage artificial lightning may lead to "ball" lightning, which Russians already claim.**

U.S. Army photo



**Unexplored areas in high energy will be researched in new Brookhaven (N. Y.) synchrotron, which will be the largest in United States.**




**Army's new solar furnace creates intense heat: (A) Steel I-beam; (B) same exposed to concentrated sunlight; (C) resulting hole.**

used, "death ray" refers to weapons projecting a beam of almost pure energy, as contrasted to missile weapons, which utilize an actual physical object.

Several types of ray weapons are of interest to the military, such as rays which can stun, paralyze, or kill animal life. There are also "force" rays which develop a push (or pull) against material objects, and "disintegration" rays which may be used to destroy matter.

Microwaves (extremely high frequency radio waves) have been suggested as a possible death ray. Concentrated microwave energy is used to cook food in seconds in the commercially available *Radar Range*. Recently, a radar technician was killed when his internal organs were "cooked" after he accidentally stepped into the concentrated beam of a giant radar antenna. Experiments have been conducted where extremely tight beams of microwave energy have been used to ignite balls of steel scrapings over fairly short distances. Expanded projects along these lines could lead to a workable, highly effective weapon.

On September 4 of this year, the Civil Aeronautics Administration warned pilots away from the Naval Research Laboratory at Stump Neck, Md., after the Navy announced that experiments involving beams of a secret radio device there might result in harm to humans. A giant radar-like antenna is said to transmit powerful electro-magnetic impulses. Helicopter pilots hovering in the secret beams were singled out for particular warning. The CAA pointed out that two airways used by commercial airliners bypassing Washington, D. C., fly over the danger zone at 3,000 feet or higher. This is believed to be a safe altitude. The Navy said it expected to curtail its secret operations, transfer them to another area, or make the present area restricted.

### Nuclear Fission By-products

Gamma rays and alpha and beta particles are a secondary result of nuclear explosions. The thousands of humans killed and injured by radiation burns at Hiroshima and Nagasaki bear ample testimony to the potential effectiveness of such a weapon. However, the problem here is to produce and focus such rays in a tight beam and direct them over great distances with reasonable accuracy. Highly efficient shielding against such beams is necessary, and without that shielding the ray "gun" would be more dangerous to the operator than to his intended victims.

Experiments have been conducted with the creation of "anti-matter." Such matter is similar to conventional matter, but its individual atoms have a reversed electrical polarity—the atoms have a negative (rather than positive) nucleus and are surrounded with shells of positive electrons (positrons).

When "anti-matter" comes into contact with conventional matter, both are annihilated and converted into pure energy. A strong beam of anti-matter particles could disintegrate any object against which it is directed, including the toughest armor plate, concrete, lead, water, air, and even that old stand-

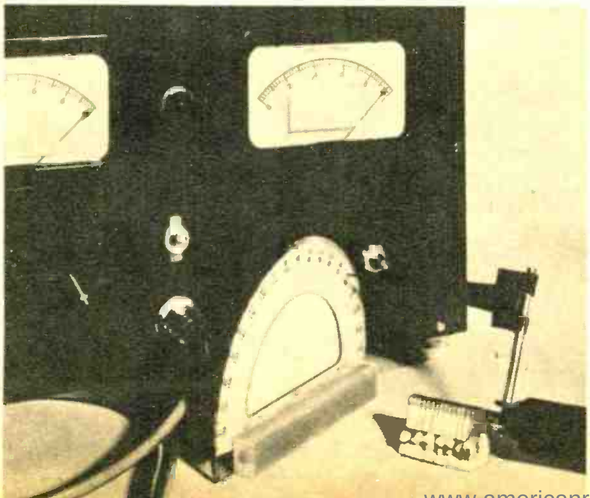
[*Continued on page* 92]

An electronic recorder built into the enlarged handle of a toothbrush measures torque and pressure with which the brush is applied. This information is fed into a receiver which shows the scientist how adequately a subject brushes her teeth.

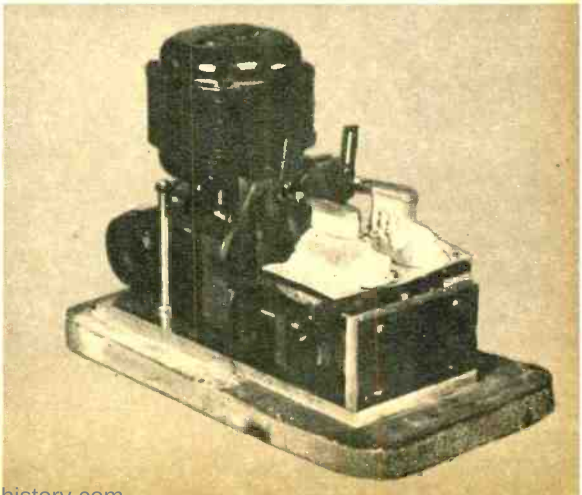
# How Good Is Your Toothbrush?

**The perfect toothbrush, devised with the aid of electronics, has been 3000 years in the making.**

TOOTHBRUSHES have come a long way since twigs and roots were used. With two specially designed electronic machines and several human volunteers, scientists at the Albert Einstein Medical Center in Philadelphia conducted a series of tests aimed at finding the most superior toothbrush. After experimenting with 15 models, they concluded that the best brush would have inner rows of stiff bristles, each .012 inches in diameter, hard enough to clean the teeth satisfactorily, and outer, softer rows, with bristles .009 inches in diameter, to massage the gums without damage.



This machine tests many toothbrushes, comparing their cleaning and massaging action.



Pattern of actual toothbrush movement is simulated on sets of dye-painted teeth.

*electronics explores*

# The Secrets Of Life

**By R. E. Atkinson**

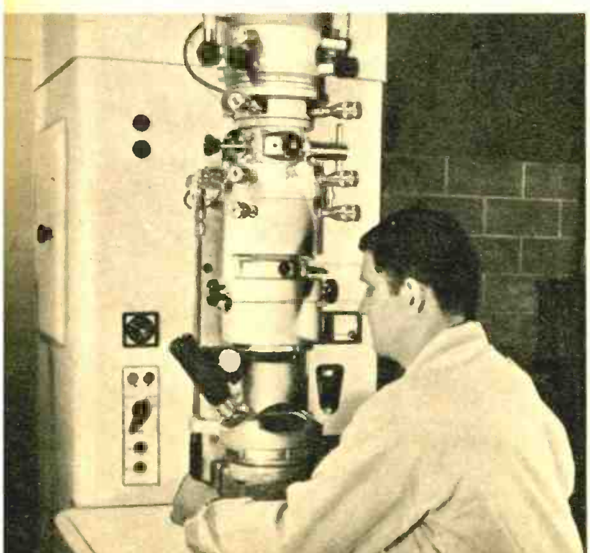
**Once a scientific mystery, the cell—key to all life—is becoming known to us thru electronics.**

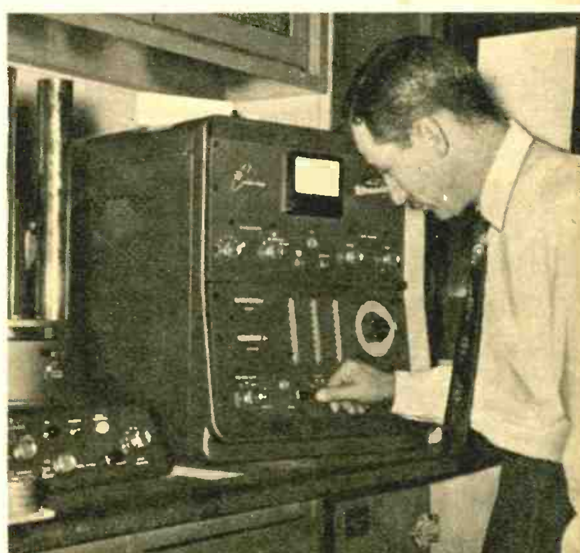
IT has been predicted that the electronic brain will someday replace the human diagnostician in medicine. A computer will receive the patient's symptoms as recorded by X-rays, blood pressure, pulse, reflex reactions, etc., and out will come the name of the disease and perhaps even recommended treatment. This, of course, is not yet the case, but electronics today is a very useful medical assistant providing such items as cardiographs, fluoroscopes, X-rays, etc. But ahead lies a role for electronics which is even more important to humanity—aiding research into the basic unit of life itself—the cell.

In a portion of blood about the size of two pinheads there are normally some 5 million red blood cells alone, to say nothing of the white cells! Cells come in infinite variety and form many different things, plant and animal. Background on these pages shows TB-like organisms magnified 88,000 times for medical study. In the same creature

**Electron microscopes, such as one at left, are capable of magnifying 160,000 times. At this rate, a human hair would seem 15 feet thick.**

**National Institute of Health biologist, right, adjusts scintillation counter to measure radioactivity in cells for clues to life processes.**





United States Steel Corp.

different cells perform different functions. Some are disease; some are life-giving. With the aid of electronics, scientists are not only studying cells intact, but are actually taking these tiny building blocks of life apart.

Not all research, however, is merely seeking biological knowledge per se. Projects combining bioengineering and electronics are paying off today in instruments actually used to save lives. Georgetown University Hospital in Washington, D. C., for example, is the first hospital to use a new electronic machine that does blood cell counts in 15 seconds. A blood count, necessary before an operation to indicate the degree of bodily infection, usually takes a good technician 45 minutes to an hour to complete with a microscope. By using the electronic blood counting apparatus, the time saved can mean the difference between life and death.

In an effort to learn what happens when one cell, such as a disease organism, meets a healthy cell in combat, Harvard University researchers have tagged the tuberculosis germ with radioactive carbon 14. Then they introduced the germ to some healthy cells. With the aid of scintillation counters and electron microscopes they followed the action of the tuberculosis germ.

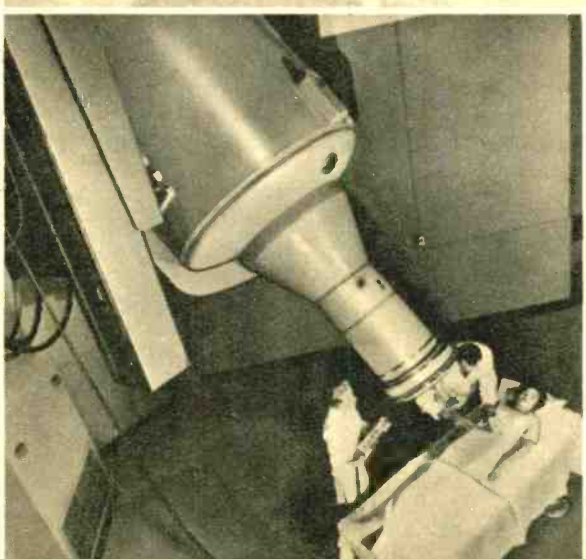
Phagocytes, such as white blood cells, usually engulf and digest foreign particles that invade the body. But this time they showed up as failing to disintegrate the hard-shelled TB organism, unless the TB cell was first *shattered by high frequency sound waves*. These findings help explain why tuberculosis is a notably stubborn disease, but if the precise attack strategy of the TB cell can be viewed electronically, it may be possible to reinforce the body defenses at a strategic point to defend against and destroy the invading particle. The defense may take the form of drugs or high frequency sound waves.

Each year about 50,000 women develop cancer of the uterus and 15,000 die of it. Electronic methods of diagnosis may cut this toll. The new cyto-analyzer (cell analyzer) developed by the Public Health Service's National Cancer Institute consists of a scanning microscope, computer-analyzer, and recorder, and is being used for the early detection of cancer.

The scanner converts optical information from slides of vaginal cells into an electron beam which moves on to the computer-analyzer. This unit applies

[*Continued on page* 109]

**New 2,000,000 volt X-ray unit destroys cancer cells at pin-pointed site within human body.**



**Apparatus does blood counts electronically in 15 seconds by counting 50,000 cells per sec.**


*what are they doing about*

# Mid-Air Collisions?

**By Paul Beame**

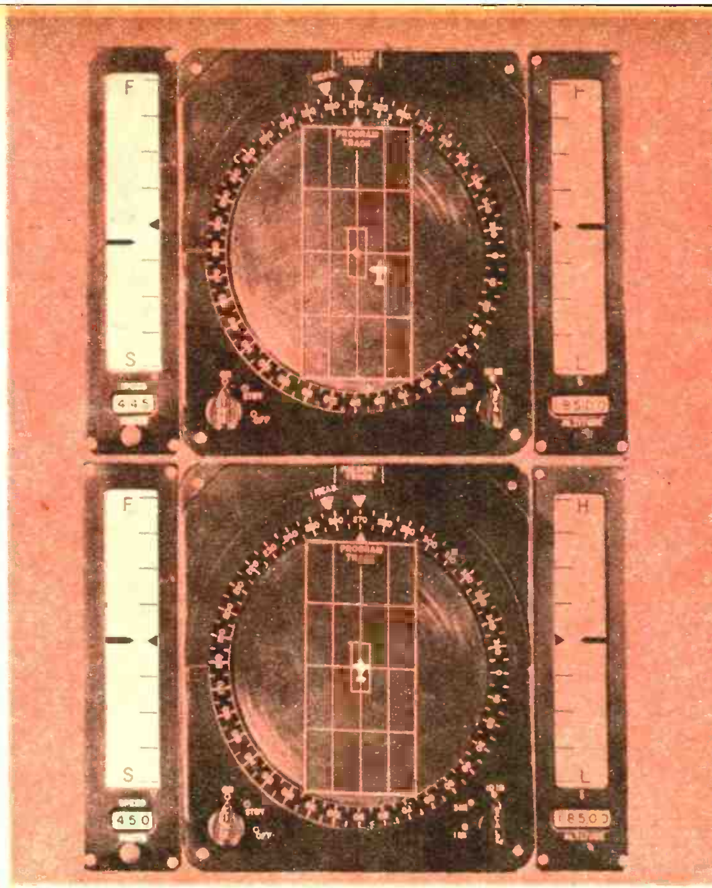
**The Jet Age in air travel brings new air traffic control problems which need new answers—and *fast!***

WE ARE rapidly moving into the Jet Age of commercial aviation and unless we work fast we are liable to jump right into disaster. The pilots of two jet planes approaching each other at full speed have about as much chance of missing each other as you would in trying to duck under a .45 caliber bullet.

There were more than 65 mid-air collisions with heavy loss of life in the years 1950-55. In the past two years there have been seven major air disasters involving piston engine planes cruising at 300-350 mph, or even less. "Near misses" have become so commonplace that pilots often do not even bother to report them. Yet, despite the discouraging statistics, the commercial airlines are adding 600 mph Douglas and Boeing jets to their air fleets—five this year, 70 in 1959, and 145 more in 1960.

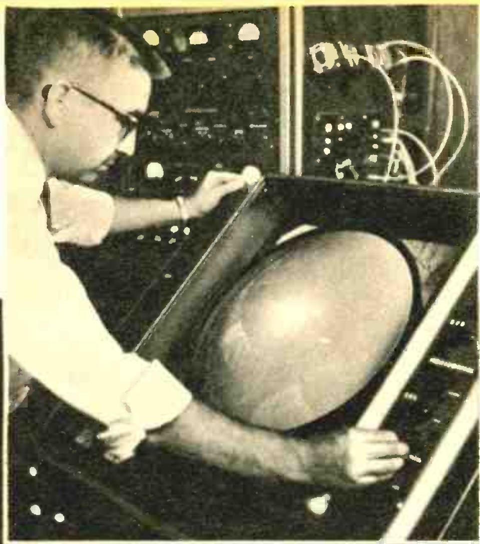
With hundreds of commercial jets in the air in the near future, does it mean that we have to sacrifice safety for speed? Or will jetliners have to be delayed beyond the point of paying their way in order not to overcrowd the already crowded airways?

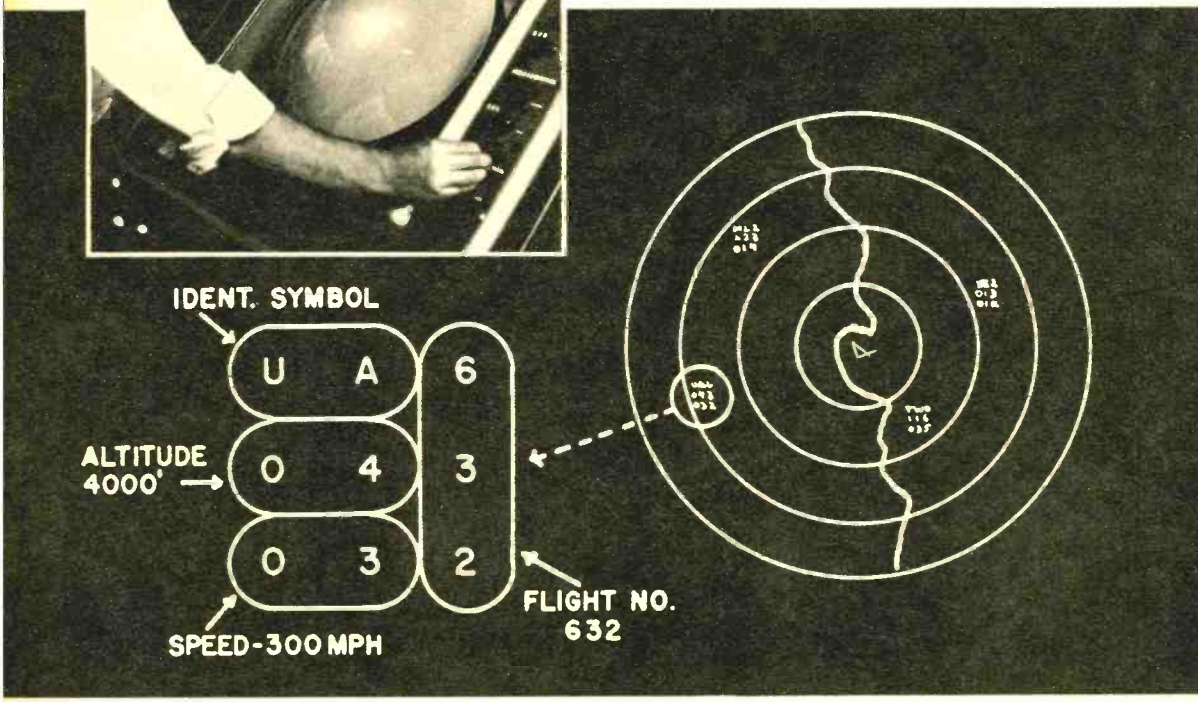
The reason for this shaky situation is an aircraft control system which grew up helter skelter over the years. Essentially it is a system of air paths between principal cities, paths defined by low frequency beacons. Each airline pilot is assigned one of




**HIDAN** shows pilot where he is, where he's supposed to be. When small plane is at grid's center (lower photo), aircraft is on course and on schedule. At top, plane has been moving too slowly and is off course.

Part of instrument runway at LaGuardia, hidden from tower personnel by hangars, can now be viewed with 24-hour closed circuit television.






**Charactron air survey display gives instant and steady target identification, altitude and speed. Set of 9 characters, "written" electronically on screen, corresponds to an airplane's position as determined by radar.**

these paths before takeoff. He knows that air traffic controllers with radar on the ground will see to it that his is the only commercial airliner in a "tunnel" of air 10 miles wide, 2,000 feet deep, and that there will be 50 miles between him and any other plane in that tunnel. The 50-mile separation is actually a time interval of 10 minutes, since it takes approximately that length of time for a piston engine airliner to fly 50 miles. Jets moving at 600 mph on these same airways would have to be spaced 100 miles apart to achieve a safe interval under present conditions.

Complicating the problem is the fact that the whole sky is open for planes flying off the earmarked air lanes not under instrument flight rules (IFR). These aircraft fly on a "see-and-be-seen" basis. There are some 66,000 planes registered in this country and when you add countless military planes, you begin to get some idea of the enormous problem of air traffic control.

Airline pilots generally fly IFR and receive route instructions from personnel on the ground. Non-commercial aircraft usually fly visual flight rules (VFR), which require the pilot to keep alert for planes in his vicinity. When a plane flying VFR enters an IFR airway, trouble can be expected. Most mid-air collisions occur when the pilot of a VFR aircraft accidentally or purposely moves into the domain of IFR aircraft and fails to see an oncoming plane in time to take appropriate avoiding action. There has been some talk in governmental circles about setting up a Federal Aviation Agency that would control *all* flights—civilian, military and commercial—in certain congested areas. But this has not been implemented as yet.

One measure that *has* been taken to meet Jet Age air traffic problems is the Civil Aeronautics Administration's

(CAA) spending plan for the current fiscal year. Upwards of $175,000,000 is to be spent before June 30, 1959, for the actual installation of air navigation and traffic control equipment and the training of personnel.

The Air Modernization Board (AMB), under the President, has been established specifically to work out entirely new methods of gathering, processing and displaying information for the airways controller on the ground and the pilot in the air. A program already underway calls for installation by 1962 of 73 new radar units with a 300-mile range, as well as 115 airport surveillance radars, local installations. Some busy fields are already using the airport surveillance radar to break up bottlenecks in landing aircraft during bad weather.

Electronics is playing a primary role in AMB and CAA plans. The first steps are toward improving communications between plane and ground. New systems to be installed in the early 1960s will automate the routine part of this operation so that the controllers will have more time for decision making and emergencies. To cut down the number of voice transmissions between air controller and pilot, the CAA plans to use 48 special radar beacons that will permit controllers to identify any target on their screen by sending out a coded signal which triggers a device in the aircraft itself. This device automatically transmits back to the ground the desired identification information.

One of the more interesting projects under development by the AMB designed to keep planes within their carefully delimited air spaces has already been tested. HIDAN (High Density Air Navigation), developed by General Precision Labs, is a fully automatic, self-contained airborne navigational control system. The developers of HIDAN believe that with very careful navigation more efficient use may be made of available airspace and the large reserve space envelopes now required for each plane can be enormously reduced without reducing the safety factor.

With HIDAN in the cockpit the pilot has before him at all times a picture of where his plane is in relation to where

[*Continued on page* 100]

In instrument flight room at airport, these CAA controllers literally talk pilots within 50-mile radius down to safe radar landings.

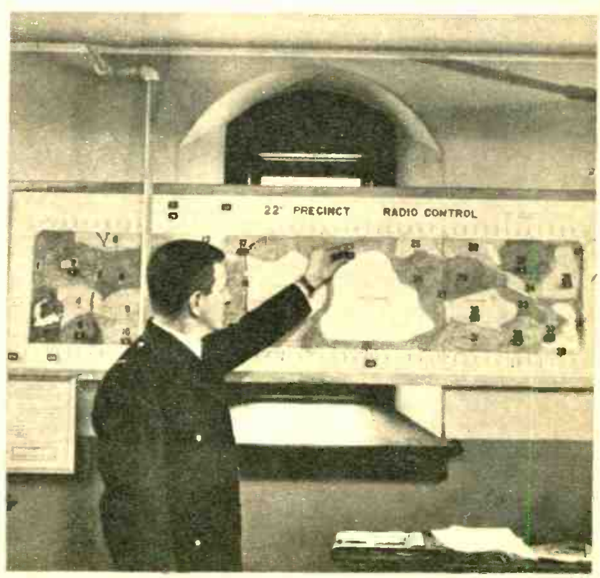
Sovfoto

Moscow tower differs from our towers in that it must handle jetliners, has a woman controller, and a unique runway display, left.

# Police Use Pocket Radio

**Lawmen in New York's vast Central Park now use FM radio with 2-way capability in their fight on crime.**

Trouble call is logged at precinct house as transmitter for 150 mc band sits on desk top.




Location of trouble is spotted on map of park which is divided into individual patrol areas.

MUGGERS beware! Foot patrolmen in Manhattan's sprawling Central Park now have a new and powerful weapon clipped to their belts alongside their .38 caliber revolvers. This weapon is radio—FM radio so small that the officer carrying it hardly knows it's with him.

It used to be that the park policeman walking his lonely beat was pretty much on his own, completely out of touch with 22nd Precinct Headquarters or his fellow officer on other beats. Periodically he would have to call the stationhouse on one of the police telephones scattered through the park. It was impossible for the officers at headquarters to contact him and even in an emergency they would just have to wait for his regular telephone call.

Now the system is different, thanks to a fully transistorized receiver which weighs only 10 ounces and is just 6½ inches long. This receiver is small enough to be tucked into a shirt pocket or carried in a leather belt case. The policeman need only be concerned with the on-off switch and the cord which feeds his lapel loudspeaker. One tiny battery provides enough power for 150 hours of operation.

As soon as a trouble report reaches headquarters, the man on desk duty pinpoints the exact location on a large map of the park which is marked off into individual beat areas. On the main desk sits a transmitter for the 150 mc band. As soon as the desk man knows which beat officer to call, he broadcasts the troublemaker's description, his direction of flight, and any other pertinent information which will alert patrolmen near the trouble scene and result in the rapid blocking of park exits, all before the culprit can escape the park proper.

Soon to go into operation is a 28-ounce miniature FM transmitter, fully portable with a push-button-to-talk microphone. This RCA transmitter has a 2-mile range.

**Alarm goes out to beat patrolman, who hears call come over transistorized pocket receiver.**

**Small loudspeaker, right, can be clipped to shirt. The receiver weighs only ten ounces.**

View from control room shows control consoles and eight test autos being put through paces on treadmill, each car duplicating a recorded road trip.

**How do your driving habits affect your gas mileage?**

**Electronics tries to find out by putting these . . .**

# Test Cars On A Treadmill

ONE man in a control booth can "drive" eight cars simultaneously through city traffic without ever putting his hand on a wheel or his foot on an accelerator or brake pedal! He does it with magnetic tape—and an "eight-lane" treadmill at the Esso Research Center in Linden, N. J.

Test cars go nowhere on this unique test track. Instead, the "road" moves beneath them, for each lane is actually a pair of dynamometer rollers turned by a car's rear wheels. The acceleration and braking cycle of the test cars is an exact duplication of the way a motorist would start, accelerate, slow down and stop his auto during normal driving, enabling fuel engineers to measure octane ratings and combustion chamber deposits—data necessary for developing more efficient gasolines.

Cars on the treadmill can be made to perform as if they were on the open road or in city traffic. Different fuels and lubricants now can be compared under unvarying conditions because the tapes that control the treadmill can be used over and over again.

A laboratory auto is fitted with electronic devices which detect accelerator pedal movements and braking patterns as the car travels over an actual road with an average driver at the wheel. Throttle changes, as indicated by accelerator movements, are converted into throttle frequencies by a potentiometer and oscillator. This varying frequency is automatically recorded on magnetic tape carried in the car. An on-off braking frequency simultaneously adds braking information to the tape. The starts and stops of the average driver, his jiggling of the accelerator, etc., are all recorded on the tape.

These taped driving patterns are then played back through a reproducer in the treadmill control room, which separates the throttle and braking frequencies and sends them through a set of controls, to the test cars on the treadmill.

The test cars' rear wheels ride on and rotate wide steel drums, which are belted to inertia discs and large fans. The inertia discs absorb the power a car would use in acceleration, while the fans provide varying degrees of wind resistance and cool the auto engines.

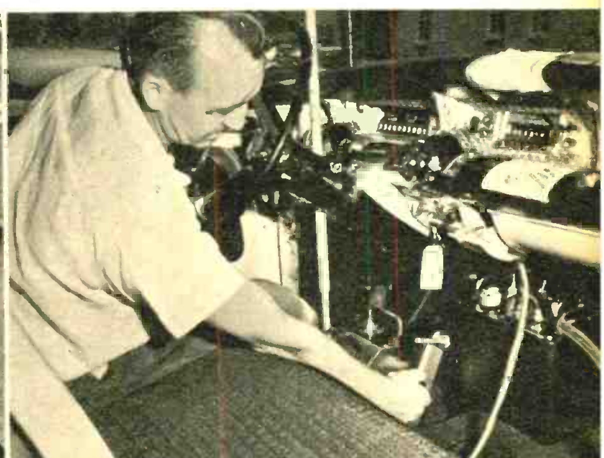
Recording driving habits has revealed that the average driver, listening to popular music on his car radio, unconsciously jiggles the accelerator in rhythm with the music. This unnecessary working of the pedal results in reduced gas mileage, so if you want to get more miles to the gallon, you certainly had better avoid rock 'n roll.

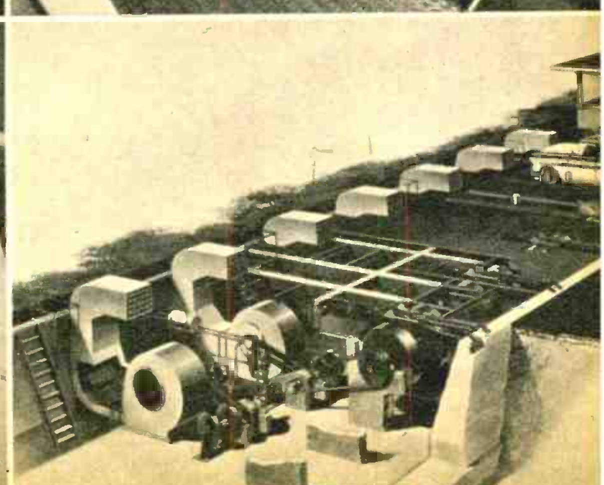
**Upper left, new car is driven onto treadmill. Control attachments are in "post-like" unit.**

**Top right, car for taping road run is fitted with devices to measure acceleration, braking.**

**Bottom left, adjustments to tape programmer and reproducer are made in the control room.**

**Bottom right, treadmill cutaway shows control room, far right, giant fans and wheel rollers.**





Child, encouraged by teacher, makes vocal sounds into microphone, succeeds in lighting two of nine bulbs on panel.

Technician removes multi-colored glass and panel to reveal 6-watt bulbs in a line and a standard audioamplifier.

*near-deaf children:*

# They See Their Voices

**By Henry F. Unger**

**Electronic gadget with colored lights helps almost deaf children realize that they, too, have voices.**

AN audio amplifier, 18 relays and nine 6-watt bulbs covered with colored glass are bringing a joyful new experience to a group of near-deaf children who attend Samuel Gompers Memorial Clinic, Phoenix, Ariz.

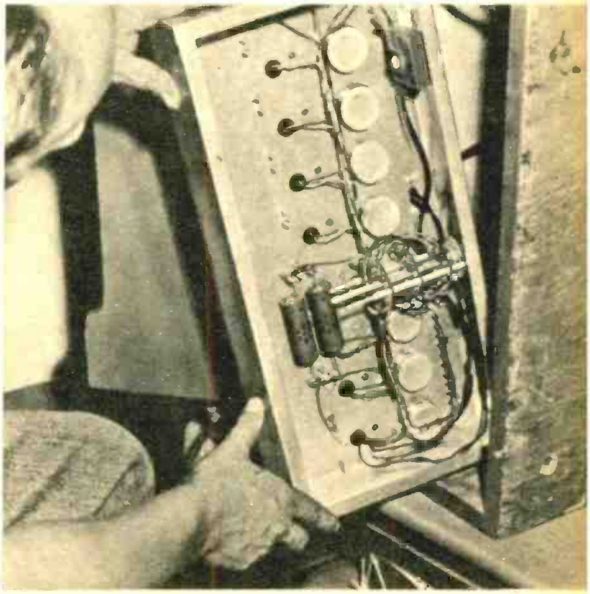
The equipment is designed to help the almost deaf child realize he has a voice. Once he realizes this, his disposition brightens, and so does his future. The operation of the voice machine is simple:

The human voice is made up of many tones ranging from a few hundred cycles to about 2,000. As vocal sounds enter the unit, they are broken up by a series of narrow range filters. Each filter actuates a relay which, in turn, lights a bulb when its particular tone is uttered.

After making a few sounds into the microphone, the happy child sees the connection between the lights and his speech attempts. Low tones light only the lower green lights, but as his voice develops in strength and tone, other colored lights flash on until all nine are lit.

**Filters and relays, back to back, break up child's vocal tones, activate proper light.**

**Homemade voice machine was simply designed with minimum of resistors, condensers, etc.**



*new fields for electronics*

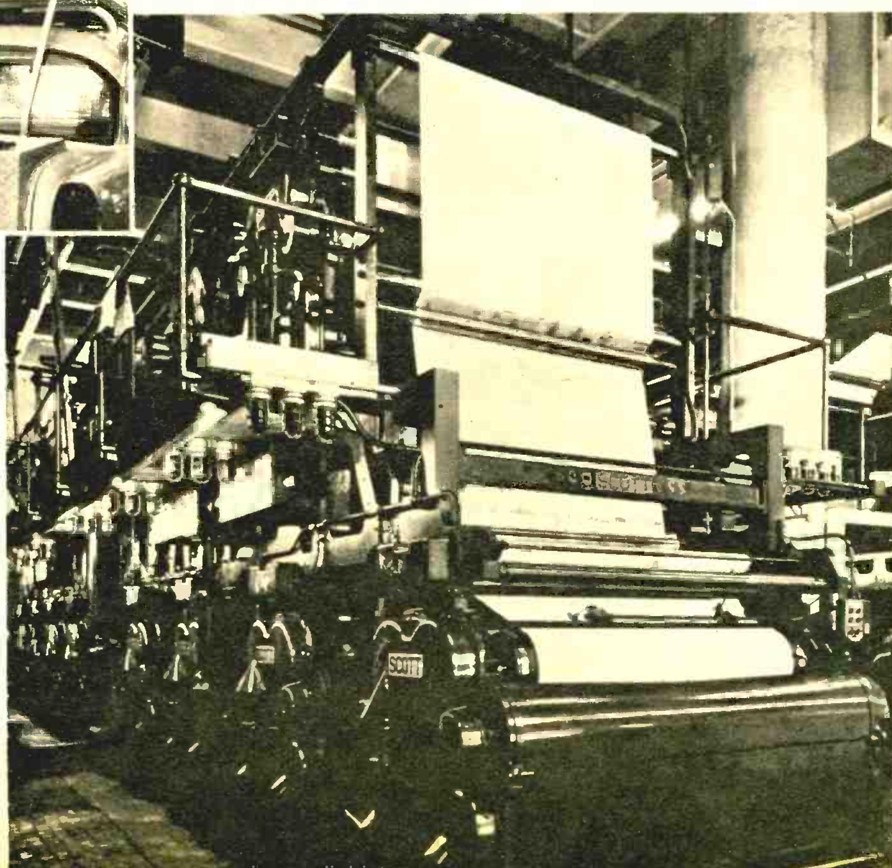
# Speeding The News

**By Al Toffler**

**From reporter to huge rumbling presses, electronics helps produce your newspaper faster than ever.**

WE all know that radio and television are built on solid foundations of electronics. But how many Americans realize that the oldest mass communications medium in the country—the newspaper—is also thoroughly dependent on the vacuum tube and the electrical circuit?

Recently, ELECTRONICS ILLUSTRATED toured the Washington *Post's* new seven-story building and found everything from a radio antenna on the roof to oscilloscopes in the basement. With a circulation of 390,000 daily and 430,000 Sunday, the *Post*




**As Washington *Post* photographer gets his next assignment over pocket radio receiver, gigantic presses turn out the next edition at 42,000 copies each hour. The split-second timing required in press operation is done electronically.**

Setting type for lengthy stock market lists does not require an operator. Wire service transmits coded signal which punches holes in tape by means of reperforator (inset closeup). Tape passes through electronic tape reader which activates linotype.

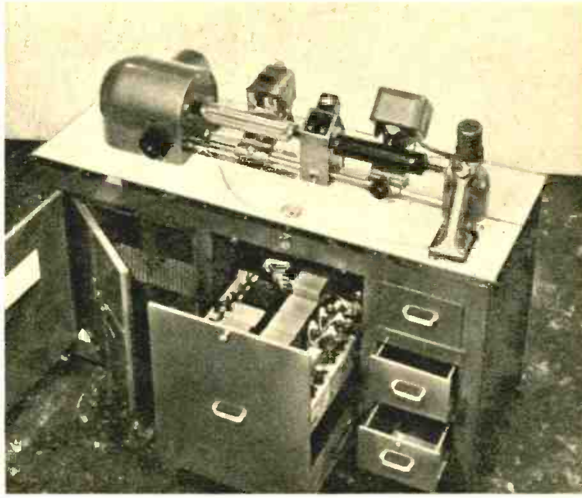
is big-league in the newspaper world, and it uses dozens of electronic devices. But the number of electronic aids adapted for special use in publishing is so great that no paper, not even the *Post*, could use them all.

News is the raw material, and its collection of primary importance. Few readers realize how heartily dependent the average paper is on news copy brought to it by the familiar teletype, or "ticker." An entire paper could be filled with ticker copy. The teletype is a simple electromechanical device dependent upon AT&T transmission systems which in themselves are intricate electronic arrangements making possible the swift (60 words per minute) and efficient flow of words. A press service correspondent can cover a Congressional hearing in Washington, hand his story to a teletype operator, and within minutes it is in the hands of hundreds of newspaper editors all over the country.

Speeding both the spoken and written word, the *Post* has 390 telephones and related switchboard equipment, and devices such as speakerphones, which permit the listener to hear the person on the other end of the line without lifting the receiver. This is particularly handy when the listener is typing at the same time. Special dictation hook-ups have been installed so that a reporter can phone in a story and have the call recorded on standard Dictaphone machines for transcription at a later, more convenient time.

Two-way car radio and portable tape

Accuracy of color scanners on presses are monitored by this bank of electronic gear.



Some newspapers use this Fairchild Scan-A-Graver to make photo engravings on plastic.

recorders for accurate interviewing are used by many papers. The *Post* passes these up, but each fast-moving photographer carries a tiny transistorized radio receiver about the size of a package of cigarettes through which he gets his new assignment while still outside the office.

Electronics has also entered the field of typesetting. News is transmitted directly into a linotype machine without the intervention of a human operator. Called teletypesetter (TTS) service, the *Post* uses it mainly for handling pages of stock market quotations. The wire services, instead of transmitting written copy, punch coded holes into a strip of yellow tape. In the composing room, an electronic "reperforator" punches the same pattern of holes in a similar tape, which is then fed automatically through an electronic tape "reader." The coded holes allow certain electrical contacts to be made. The contacts activate the linotype, which produces the called for characters on slugs of hot lead. An operator stands by, but does not have to manually operate the linotype keyboard.

Photographs, too, reach the paper through electronics. A wire service cameraman in Paris takes an exciting shot of immediate interest to American readers. He places the photo in an electronic machine which projects a tiny spot of light on it. The reflection from the photo varies depending upon whether the light is bounced off a light or dark area. As the scanning light moves, reflections from the photo are picked up by a phototube which converts them into varying electrical frequencies. These frequencies are then amplified and transmitted by telephone line, cable or radio.

The signal, once received in this country, is reconverted back to light values and applied to photosensitive paper, producing an exact duplicate of the original. When you see the word "Wirephoto" or "Radiophoto" or "Telephoto" under a newspaper picture, you know it was transmitted in this fashion.

A newspaper's production engineer can choose from a wide range of electronic devices ranging from static eliminators (which keep newsprint racing through the presses properly) to newsprint moisture meters, ink-flow controls, conveyor drives and counting equipment. Even stuffing, bundling and wrapping operations are speeded electronically.

Thousands of newspapers, large and small, use an ingenious machine developed by the Fairchild Camera and Instrument Corporation to etch photo

[*Continued on page* 88]

# A Telephone Recording Beeper

By John T. Frye

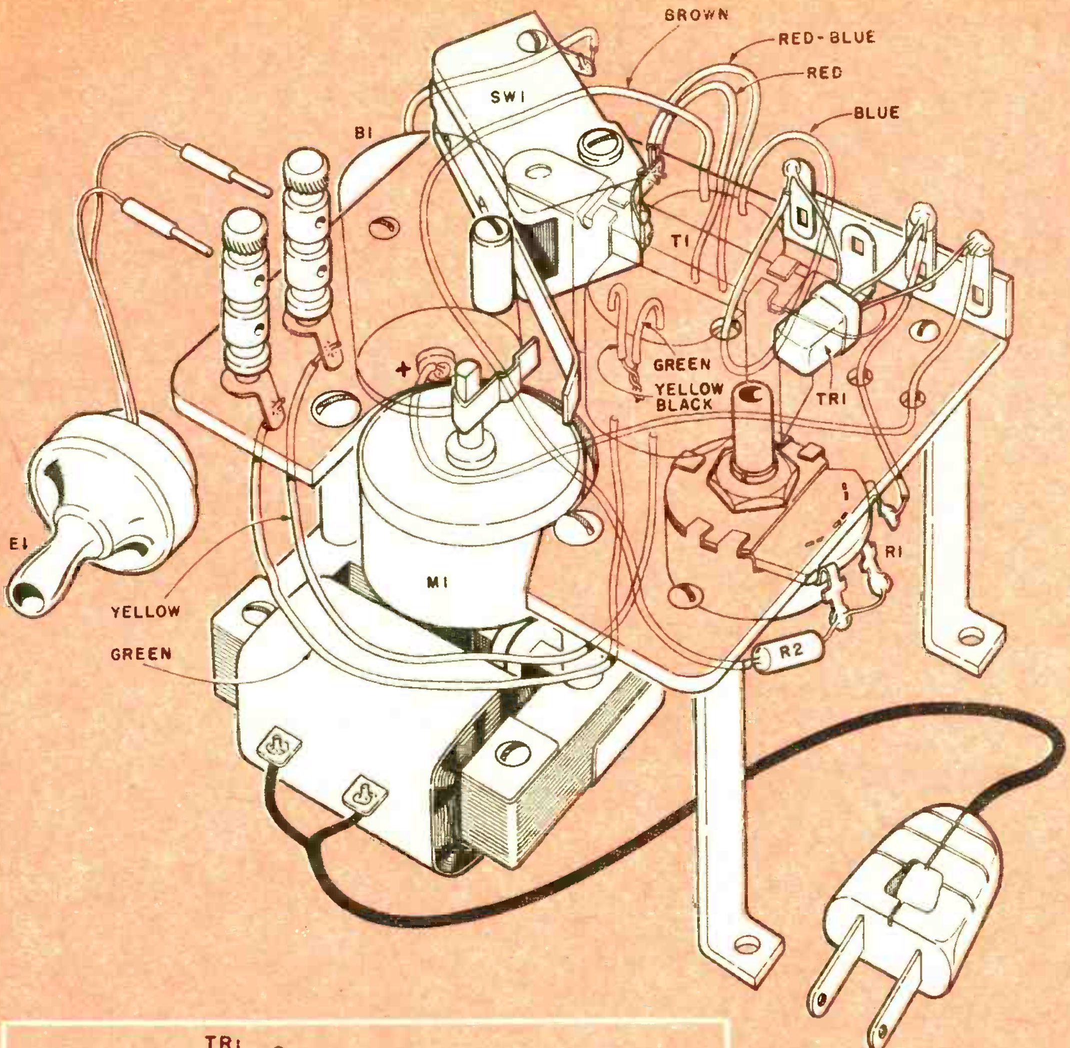
**Comply with FCC regulations! This unit warns the person you are recording by a tone every 15 seconds.**

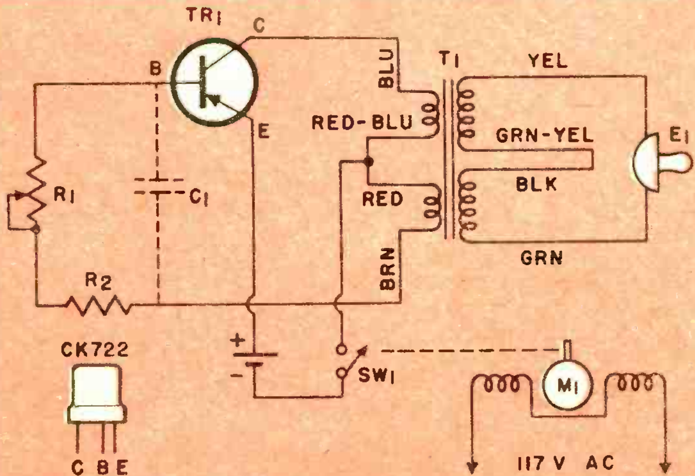
The Beeper, seen at lower left, feeds its signal to the earphone mounted on telephone mouthpiece. Person at other end of the line hears the tone.

YOUR telephone book probably has a notice in the front like this:

"A short high 'beep' tone heard on the telephone about every 15 seconds means that the person with whom you are talking is recording your telephone conversation. . . . Use of a recorder without the signal is unlawful."

It is unlawful no matter if the telephone conversation is led into the recorder by direct connection to the line, by use of an inductive pickup, or even by simply holding the recorder mike close to the earpiece. Furthermore, the use of the distinctive signal is the *only* legal way you can tell the other party and all




Wiring guide and schematic appear above. If all parts are purchased new, cost is about $15. Observe battery polarity.

concerned the conversation is being recorded.

A pickup coil beneath the telephone permits you to record a conversation without tampering with the telephone line at all. The device pictured enables you to insert the proper beep signal also without making any physical connection to the line.

The FCC carefully specifies the beep signal's characteristics: (1) it must occur every 15 seconds, plus or minus 3 seconds; (2) it must last for 20/100 of a second, plus or minus 20%; (3) the tone must have a pitch of 1400 cycles per second, plus or minus 10%; (4) the level should be equal to the average telephone talking signal strength.

The "beeper" constructed to meet these specifications consists of a 4 rpm synchronous motor actuating a microswitch that turns on a transistorized audio oscillator for a short, measured length of time each revolution. The output of the oscillator feeds a crystal earphone held near the telephone microphone.

A 4"x3¼"x⅛" piece of tempered hardboard is fastened to the clock motor and all other parts are mounted on this. When mounting the transformer, connect the earphone across one of the windings and position the transformer for minimum hum pickup from the running motor. Make one of the microswitch mounting holes large enough so that the tongue end can be swung through a small arc. Transistor leads are held with pliers when soldering them to the tie-point terminals to prevent heat traveling up the leads and damaging the transistor.

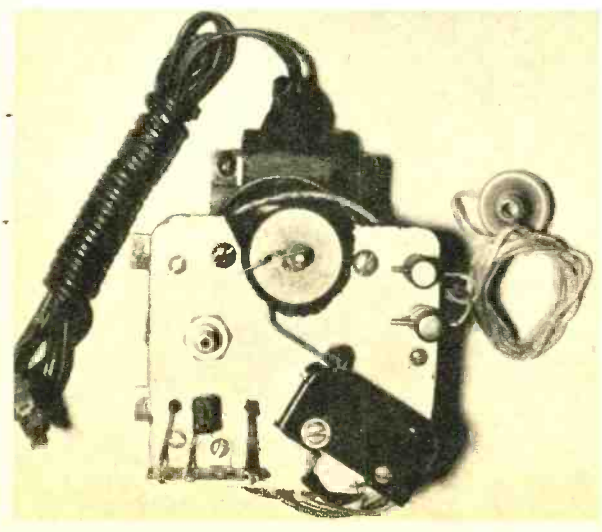
Leads are soldered directly to the case and terminal of the battery, which is held in place by a clamp fastened under a transformer mounting bolt. A piece of stiff brass, 3/16" wide and 1/32" thick was bent as shown and shoved over the end of the flattened motor shaft. The length of the formed piece is 1".

R1 adjusts the tone of the oscillator. If a calibrated audio oscillator is not

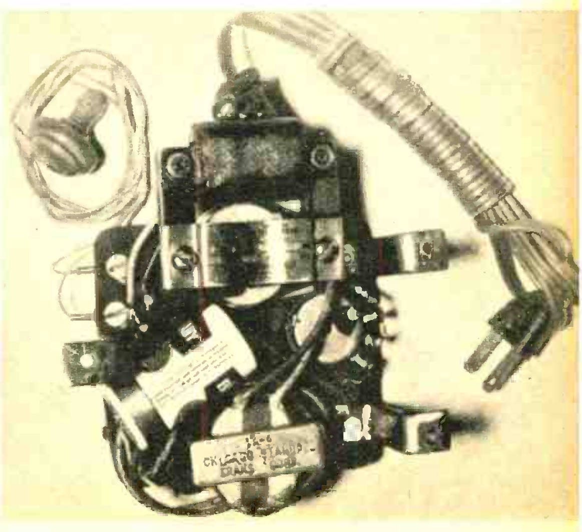
[*Continued on page* 94]

PARTS LIST

T1—Transistor interstage transformer, 500 ohms CT to 5000 ohms CT (Stancor TA-4)
R1—100,000 ohm linear taper potentiometer
R2—10,000 ohm, ½ w
SW1—SPST microswitch, leaf type, normally open
TR1—CK722 transistor
E1—High impedance crystal earphone
M1—4 rpm synchronous motor, Surplus Telechron B3, or Synchron H1-4 from Herback & Rademan, 1204 Arch St., Phila., Pa., at $4.50
C1—See text
Misc.—3-terminal tie point, two binding posts, large cable clamp, 4" x 3¼" hardboard or plywood.



**Top view. Leaf of microswitch, lower right, is actuated by rotating armature at center.**



**Underside view shows motor (top), battery, and transformer. To the right of battery is R1.**

# A Child's Radiophone

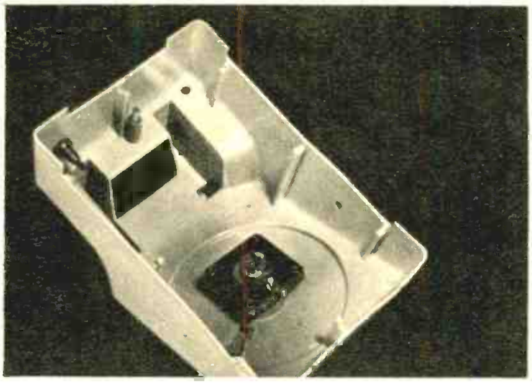
**By Lou Garner**

**Your child will love this gift—Build a 2-transistor radio that will play when he picks up the handset.**

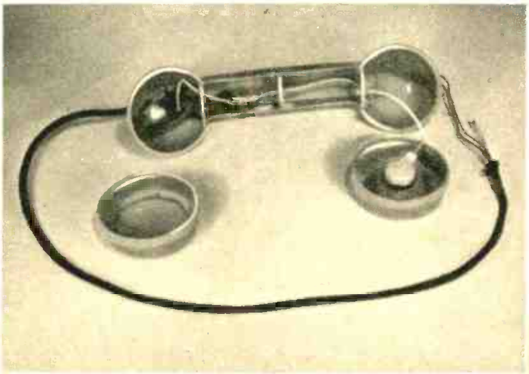
COMBINING the fascination of the telephone with the entertainment value of a radio receiver, the "Radiophone" is an inexpensive and easy-to-build toy you can assemble for a member of your family or for a neighbor's child . . . and you'll have a lot of fun in the process! Actually a broadcast receiver, the "Radiophone" is operated much like a standard telephone. When the handset is lifted to the ear, the radio turns itself ON auto-

**The plastic telephone, widely available in toy stores, is the cabinet for the broadcast band radio. The child listens in the earpiece and tunes in the various stations by "dialing."**

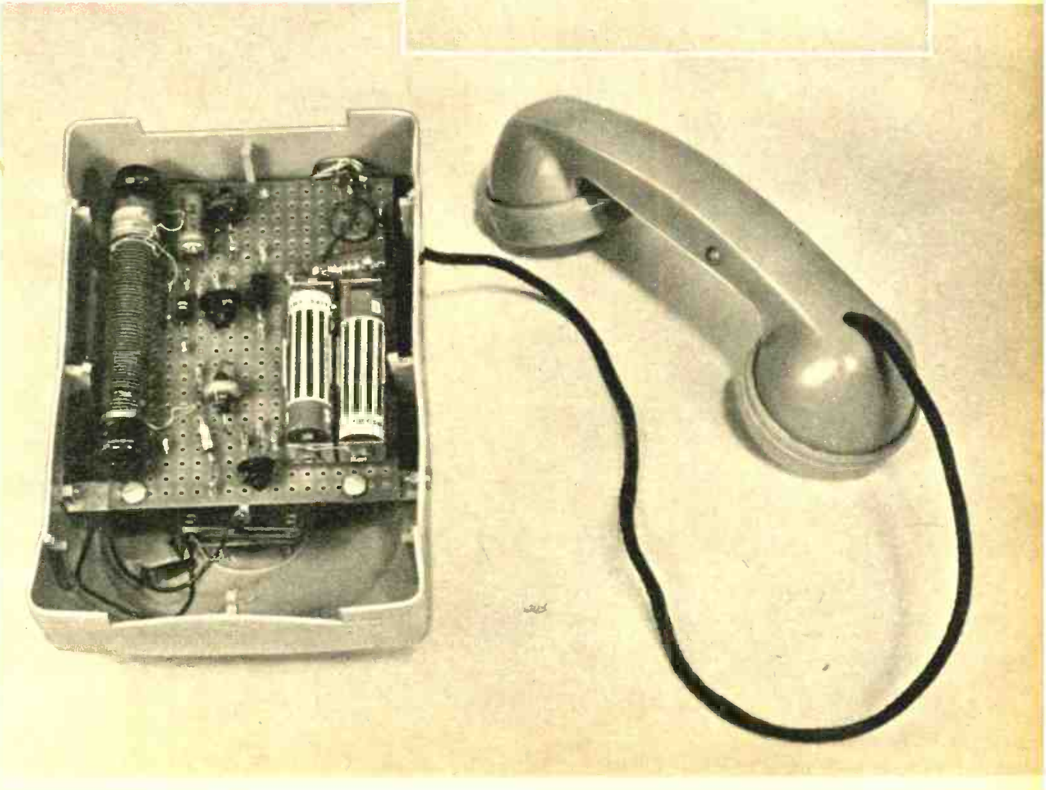
Tuning condenser C1 is mounted below the dial, in the base of the phone. Its shaft is pressed and glued to the dial.

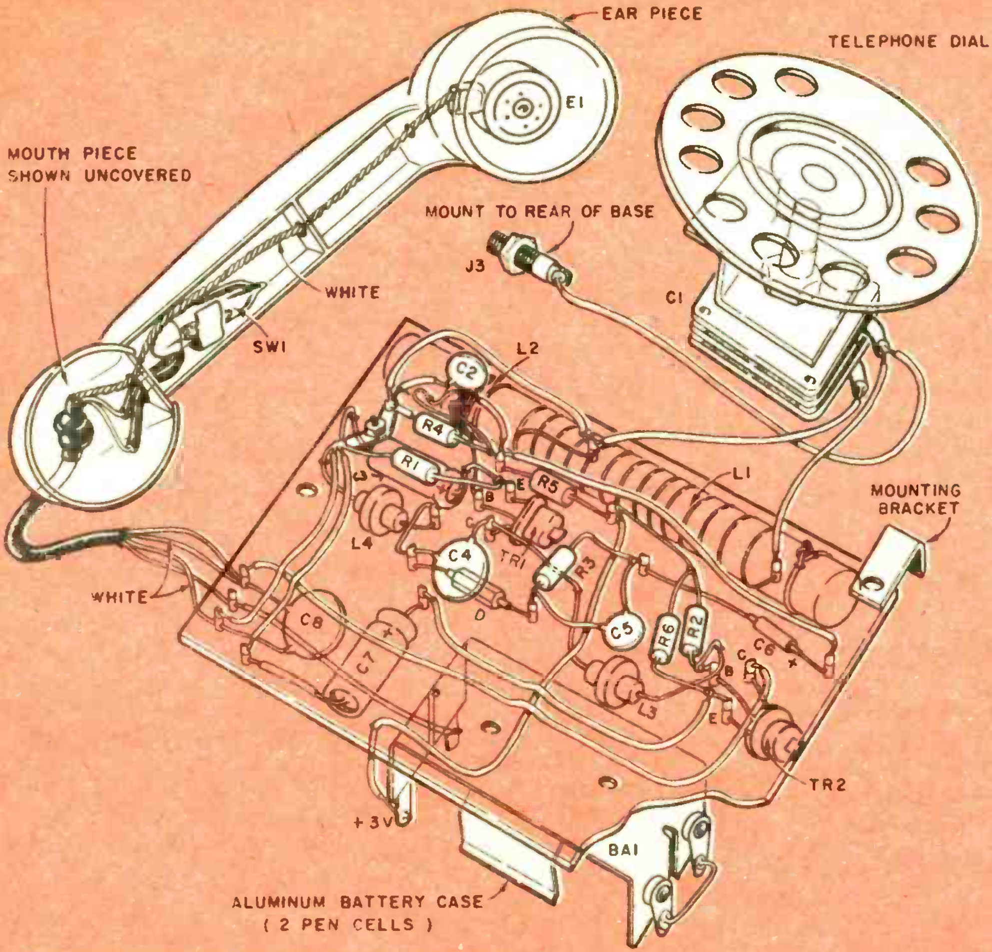


Earphone is mounted in handset (right). The ON-OFF mercury switch in shank of handset (center) is held by fuse clip.

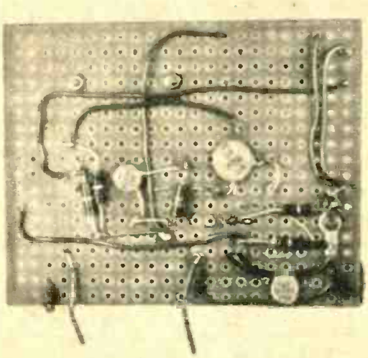


Below, Bakelite board with all components mounted. L2 is seen wound at the top of the large antenna coil L1 (at left).






**Do not install the transistors, diode, or batteries until wiring is completed. Be certain to observe correct polarity.**



**The board is cut to fit in base of phone. These parts are identified in the wiring pictorial above; they appear in white.**

PARTS LIST

R1, R2, R6—1000 ohm, ½ w.
R3, R5—10,000 ohm, ½ w.
R4—4700 ohm, ½ w.
C1—365 mmfd., tuning capacitor (Lafayette MS-215).
C2, C5—.002 mfd., ceramic.
C3, C7—50 mfd., 15 volt miniature electrolytics.
C4—150 mmfd., ceramic.
C6—2 mfd., 6 volt miniature electrolytic.
C8—.02 mfd. ceramic.
L1, L2—Transistor ferrite antenna coil.
L3, L4—500 microhenry FR chokes.
TR1—NPN RF transistor, 2N168A.
TR2—PNP Audio transistor, 2N107 or CK722.
D—Crystal diode, 1N48, 1N64, or equivalent.
J3—phone jack.
BA1—3 volt battery (two 1.5 volt penlight cells).
SW1—SPST mercury switch.
E1—Dynamic earphone, 7000 ohms.
Misc. Toy telephone (Model 2000, Handi-Craft, St. Louis, Mo.).
Perforated Bakelite board.
"Flea clips."
Battery holder for two penlight cells.
Note: Almost all electrical parts except for one 10,000 ohm resistor, the earphone E1, and mercury switch may be purchased together in Lafayette Radio's "Sunflex" transistor receiver kit, No. KT-132.

matically. Individual stations are tuned by the phone's dial. When the handset is replaced, the set is turned off.

The receiver's cabinet is a modified plastic toy telephone. The unit used in the author's model is a popular item manufactured by the Handi-craft Co., St. Louis, Mo.

In order to simplify the wiring, the electronic circuit is based on the use of one of Lafayette Radio's "Sunflex" receiver kits. However, all components are standard and readily available from local or mail order parts stores.

You'll find that several minor changes have been made in the "Sunflex" circuit. The 10,000 ohm volume control has been replaced by a fixed resistor (R3). The connections to switch type jacks are replaced by a permanently connected earphone (E1) and SPST mercury switch (SW1).

Electrical components are assembled on both sides of a small piece of perforated Bakelite. Metal flea clips are used for all terminal connections.

The ferrite antenna coil (L1-L2) is held in place by loops of strong twine or insulated hook-up wire. If you use wire, take care that the free ends don't short together.

When mounting the battery holder you can avoid later difficulties by applying small dabs of red fingernail polish to the positive terminals. Use this identification when making connections and later, when installing the batteries. Once you've completed receiver wiring, place the unit aside until you've completed work on the telephone's base and handset.

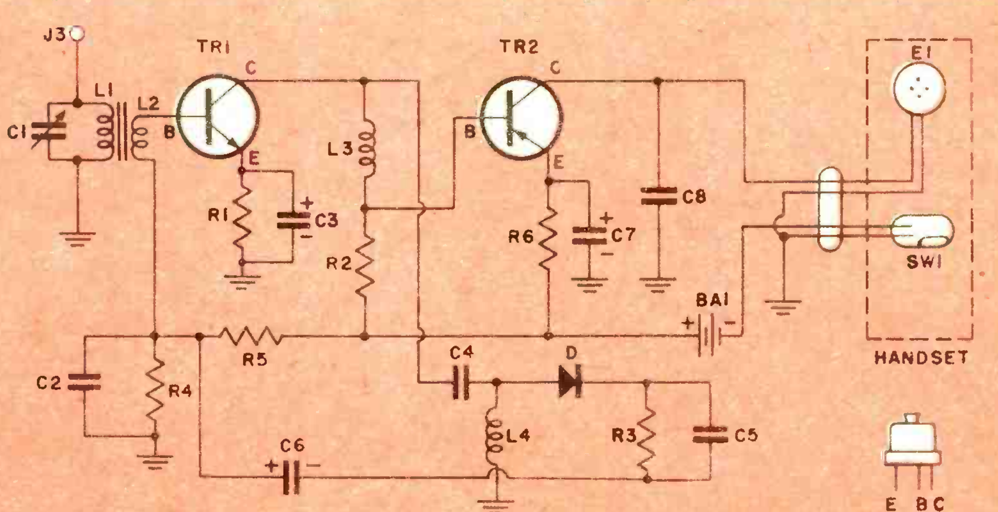
Two components are mounted in the handset . . . the dynamic earphone (E1) and the receiver's ON-OFF switch (SW1). SW1 is snapped into a small fuse clip which, in turn, is mounted on the side of the handle with a machine screw and nut. Arrange the switch's angle so that it is open (set OFF) when in a normal horizontal position, but such that it closes (set ON) when the handset is turned toward a vertical position.

To mount the earpiece, first remove the unit's earplug. Drill a slightly undersized hole in the handset's "receiver" cap so the earphone must be forced into place. Apply a thin coating of household cement to the underside of the cap and snap E1 in place.

With both the earphone and mercury switch mounted, thread their leads

[*Continued on page* 111]

**This is a reflex circuit. After amplifying radio frequencies, TR1 serves as an audio amplifier.**



# Add Sound To Your Movies

**By Art Zuckerman**

**A tape recorder, special tape, and a few other accessories will help enliven your home movies.**

DO YOUR guests display a glassy-eyed smile of resignation whenever you pull out the old movie projector?

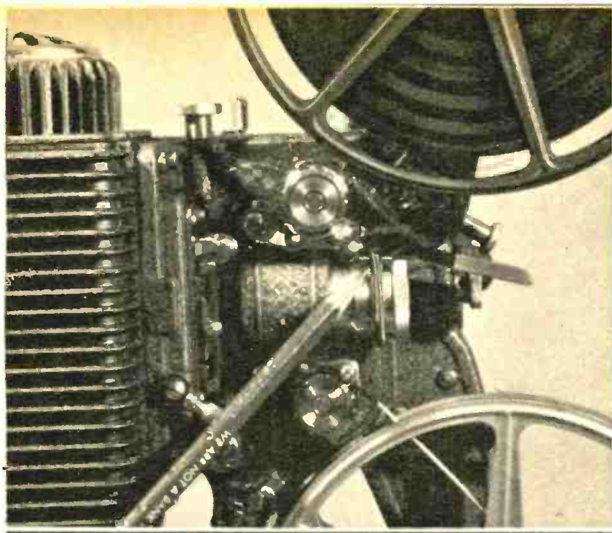
You can't really blame them, you know. The best home movies suffer from the whirr of the projector in stark silence; a silence otherwise punctuated by sudden exclamations like; "Oh, there I am at the waterfall!"

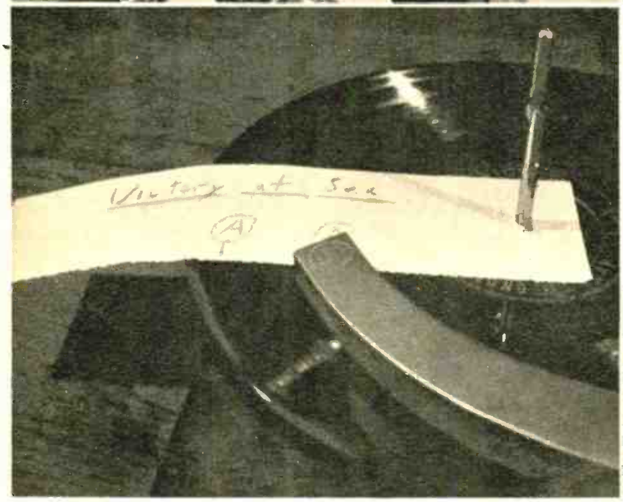
After all, even in the pre-talkie era there was always a piano player to set the mood for the folks at the nickelodeon.

But if you own a tape recorder there's no need to despair. With this and a few accessories, you can make movies that will have your friends begging for more. And it doesn't matter whether your films are 8mm. or 16mm.

The heart of this system is a special magnetic tape designed for synchronization. Available in most camera stores, it has evenly-spaced vertical stripes printed on the outer, non-magnetic surface, and it comes packed with a small reflector that fits

Film is screened and sound required for each scene is noted on cue sheet.






Top shows reflector mounted on lens. It throws a synchronous light on the tape (upper right). Vertical stripes on tape (top). If speed is OK, they appear motionless in the projector light.

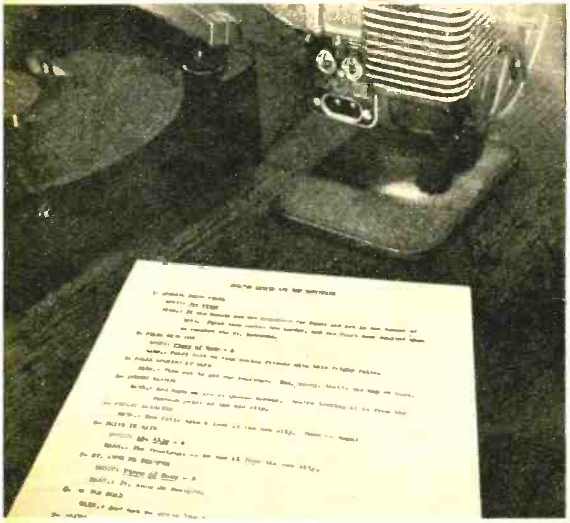
A cue strip is made for each recording. This permits quick location of a particular passage. A mixer will enable you to properly balance the sound from mike and two phonographs.

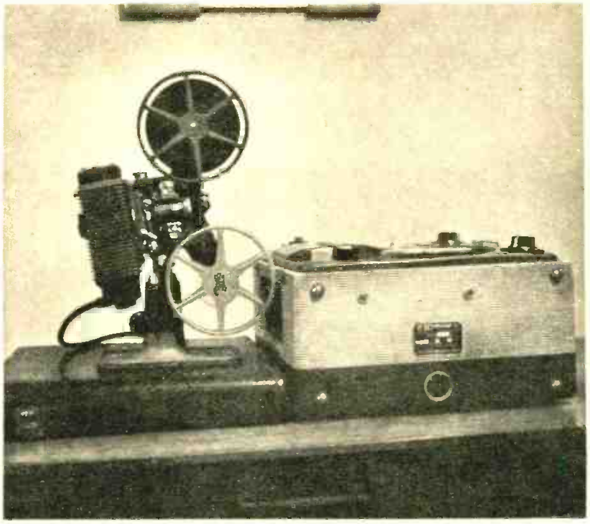
over the lens of your movie projector.

When the projector is set up behind and slightly above the tape recorder, this reflector throws some of the excess light from the lens onto the moving tape. The light illuminating the tape is intermittent, phased by the projector shutter. This results in a stroboscopic effect. When the projector is running at the proper speed for synchronization, the vertical stripes on the back of the tape appear to stand still. Should they start to wander one way, you speed the projector up. Should they travel the other way, the projector is slowed down. The tape speed is 3¾ inches per second.

In addition to the special tape, all you absolutely need are the appropriate records and two phonographs. The microphone is set up in front of the phonographs and you speak into it when you want to add narration, turning down the phonograph that is playing. With this technique, it is possible to make a thoroughly acceptable sound movie. It's true that proper balance of sound levels is difficult. This, together with the distortion from phono speaker-to-mike recordings, would make for a poor tape. But, combined with the movies, these drawbacks are not quite as objectionable.

A bit of an investment in a few other items of equipment will allow you to make vastly superior sound films with perfect control of audio balance. The





The final cue sheet, used during the actual recording, contains narration and music cues. At right is playback arrangement. Projector is positioned behind and slightly above the tape recorder.

main item on this list of extras is an electronic mike mixer. This will allow you to blend the signal from more than one microphone with the output of two record players and gives you complete control of each sound level.

In addition to the mixer, you need a pair of earphones and two plug-in record players to replace the phonographs.

The first step in making a sound track is to screen the movie. Note the spots that call for narration; note the changes of scene and subject matter. Jot this information down. Then think of the music in your record collection and try to single out those pieces with passages that fit the scenes you've just run off.

When you've set up a tentative list of records, test them on a phonograph against your film. Start the projector again. When you come to a scene, play a likely selection against it and see how well it meshes. If it doesn't, rerun the scene and try another selection. Note down your choice. Then, when the next scene comes up, stop the projector, put on the next disk, get the film going again, and proceed as before until you've made all your choices.

Now you're ready to set up a cue sheet. Run the film once more, noting the time for each sequence. At points where you want to change the musical setting, note exactly what's on the screen at the moment, together with the music that will be cued by the appearance of this scene.

Spot the places where narration is in order and write your narrative remarks. These should be kept to a minimum, both in number and in length. Say no more than you must to establish the setting and to explain what's going on. Let the film itself and the mood music do the main story telling job.

When the cue sheet is completed, make a cue strip for each individual record. This consists of a strip of paper with a spindle hole at one end. Print the name of the record on it and slip it onto the player, over the disk. Locate on the record the beginning of the passage you are going to use. At this point make a distinctive mark on the cue strip, preferably with a colored crayon pencil. If more than one selection from the record is to be used, assign a number or letter to each cue mark in order of use and print it alongside the mark. These sub-markings should also be indicated on the main cue sheet.

Now divide the records into two groups, stacked in order of use. Record number one goes with the first player, record two with the second player, rec-

[*Continued on page* 102]

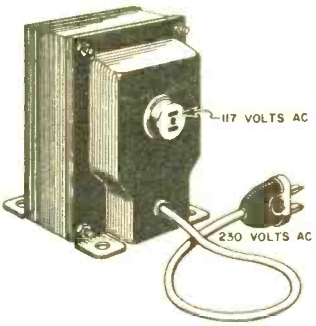
# The Electronic Brain

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

### Converting Line Voltage

*I am interested in trying my hand at some of the constructional plans I find in ELECTRONICS ILLUSTRATED. How does one go about compensating for the difference in line voltages? The line voltage in New Zealand is 230 volts AC.*

*S. Lewis, Auckland, N. Z.*




The best way to convert any equipment from 117 volt to 230 volt operation involves the use of a 2:1 turns ratio transformer.

You must consider power handling ability since such transformers have wattage ratings as well as step-down values. Cost goes up with power rating; so does the overall volume or space requirement. On the other hand, if the transformer is to be versatile, it should be selected on the basis of future as well as present needs. The choice resolves itself, therefore, into a compromise between cost and available space on the one hand, and the greatest possible power rating on the other.

### Faulty Switch

*I have a communications receiver that has better sensitivity when the band switch is placed slightly off position than when it is in its proper position for a given band. Although I have cleaned the switch contacts with carbon tetrachloride, the condition still persists. What might cause this trouble?*

*David Boudreau, Ontario, Canada*

We must assume that the switch in question is a multideck wafer type since you did not specify the receiver model or manufacturer. If this is the case, the trouble lies in the improper alignment of the wiper arms on the different decks. This may be due to normal wear on one or more of the wiper fastenings, or it may be due to shift in the position of the detent. In most wafer switches, the detent consists of a steel ball-bearing carried around with the arm as it is rotated; this ball drops into separations between bowed metallic segments in the bearing surface to establish the stopping position.

If wafer arms are worn, it will be necessary to replace the entire switch. On the other hand, should the trouble lie in the detent, it may be possible to adjust its position by careful realignment of the wafer sections.

### Tube Leakage

*How many megohms of resistance must exist between tube elements before we may safely say that there is no leakage?*

*David Truitt, Longview, Texas*

Normally, a leakage resistance of 25 megohms from the heater to the cathode of a low gain triode will not evidence itself in the form of hum since the gain of the tube is not sufficiently great to bring the leakage current up into the audible range; also, the series impedances are relatively low so that small leakage currents do not cause significantly large voltage drops for further amplification. On the other hand, when the same resistance exists in the first stage of a very high-gain, cascaded pentode voltage amplifier, it is almost certain to cause hum.

# Guitar Amplifier - With Tremolo

By Harvey Pollack

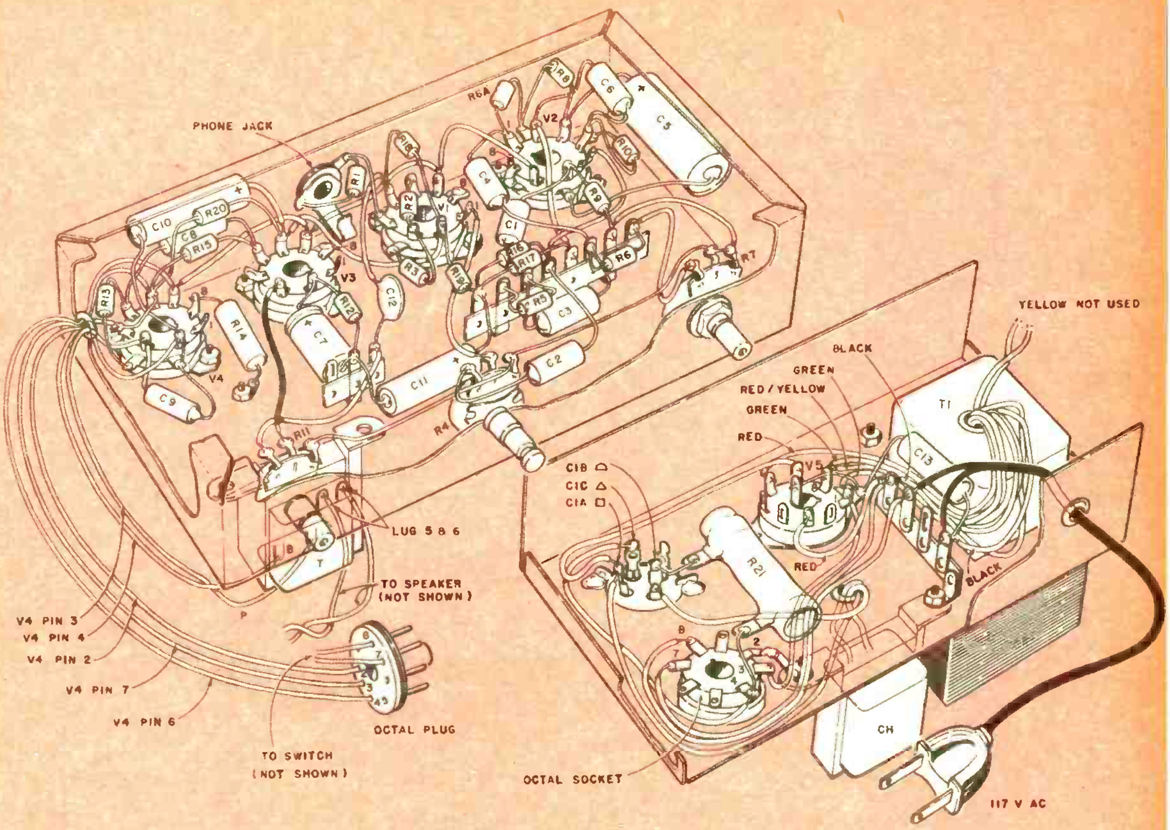
**Make a small instrument sound like a big one. This amplifier will impart a pleasing variation in tone.**

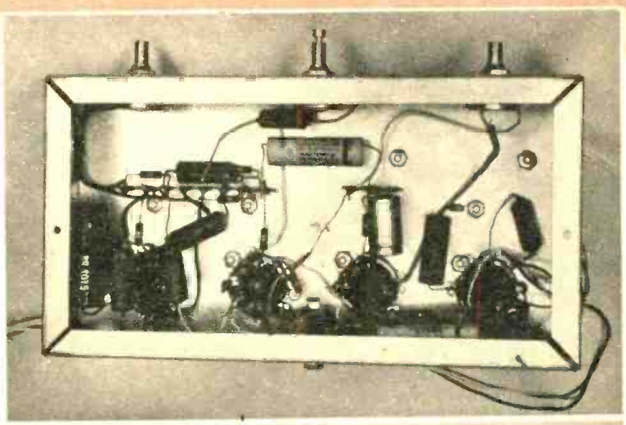
A LITTLE bit of talent goes a long way with a guitar amplifier that not only provides a wide tonal range at full volume, but permits the player to add exactly the right amount of tremolo by a touch of his fingers. The cost of the parts is only a small fraction of what you would pay for a similar unit—if you could buy it at all.

The design is based on the use of two separate chassis, one for the power supply and the other for the tremolo and amplifier sections. To cut down on the amount of work required, a commercial power supply was utilized at a cost only slightly greater than the total price of the individual components (see Parts List). For those who insist upon building up everything from scratch, a list of components required for the construction of the power supply is provided.

We strongly recommend that the tremolo oscillator (V2) be wired first because the placement of the small parts (capacitors

A "contact" type microphone is clipped on to the instrument and plugged into the amplifier. The amplifier power is sufficient to fill a small auditorium.

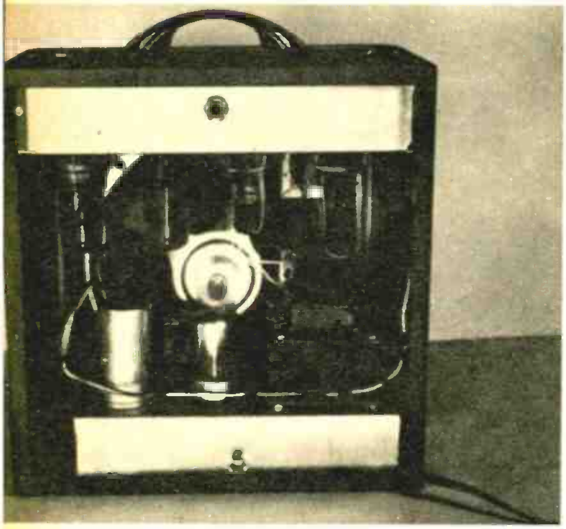


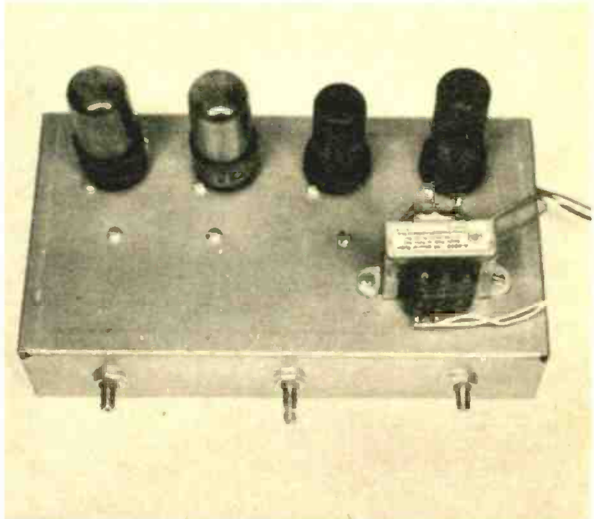
Wiring guide above shows 2-chassis construction. Upper unit is amplifier, lower is power supply.

Underside of amplifier. Shafts at the top control tremolo rate (R7), tremolo depth (R4). volume (R11).

The speaker cabinet and 2 chassis. Amplifier is at left, power supply which plugs into it is to the right.



The amplifier is mounted upside down (at the top of the cabinet) with power supply below.



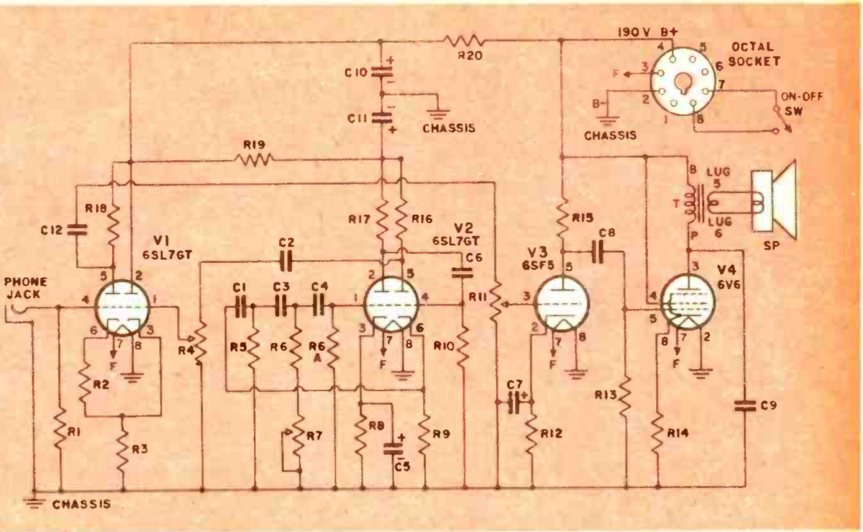
On amplifier chassis from left to right are V2, V1, V3, V4. Audio transformer is below V4.

PARTS LIST

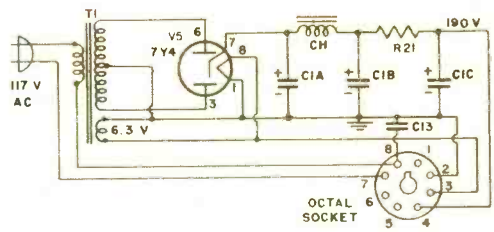
All resistors ½ watt unless otherwise noted
R1,R15—470,000 ohm
R2—1000 ohm
R3—33,000 ohm
R4,R11—500,000 ohm audio taper potentiometer
R5,R6A,R16,R19—270,000 ohm
R6—100,000 ohm
R7—1 megohm linear taper potentiometer
R8—4700 ohm
R9,R17—150,000 ohm
R10—1 megohm
R12—6800 ohm
R13—330,000 ohm
R14—250 ohm, 5 watt
R18—56,000 ohm
R20—27,000 ohm
C1,C3,C4,C6—.05 mfd., 400 volt
C2,C8—.01 mfd., 400 volt
C5—40 mfd., 50 volt electrolytic
C7—16 mfd., 50 volt electrolytic
C9—.001 mfd., 400 volt
C10,C11—8 mfd., 450 volt electrolytic
C12—.005 mfd., 450 volt
V1,V2—6SL7GT
V3—6SF5
V4—6V6
4—octal sockets (with ground lugs)
T—Audio output transformer (Stancor A-3849)
SP—8" speaker, 3.2 ohm
SW—SPST switch
Phone jack, headphone type
Chassis—5"x9½"x2" aluminum (Bud AC-403)
Cabinet—Metal speaker type 10"x10"x6"
Microphones—Guitar or harmonica contact type
Power supply may be purchased completely wired (Lafayette A-620). If built from schematic, the following parts are required
V5—7Y2
CH—Choke, 8 henries, 50 ma. (Stancor C-1707)
T1—Power transformer 250-0-250 volts, 55 ma. (Stancor PM-8402)
R21—1300 ohm, 20 watts
C1A,C1B,C1C—3-section electrolytic 10-10-20 mfd., 350 volt
C13—.05 mfd., 600 volt
Chassis—5"x7"x2" (Bud CB-629)
1 Loktal socket for 7Y2
1 octal socket for power plug

and resistors associated with this stage) may present a problem if left until later. Keep all the leads as short as possible, grouping C1 through C6 and R5 through R10 closely around the tube socket. The use of a terminal strip to support some of these components will make the wiring easier and the finished job neater. The circuit of the signal mixer (V1) should be wired next. Here again it is wise to keep the leads short and dressed close to the chassis. Although no shielded wire for the grid leads was found to be necessary in the author's model, you may find it necessary if you permit the leads to be longer than an inch or two.

The remainder of the amplifier may now be completed. The grid circuit of V3 is still a sensitive point and connections here should also be short, but from the 6SF5 to the 6V6 the wiring is not at all critical. The output transformer is a universal type, but you may use any output transformer that matches a 6V6 plate to the voice coil of your speaker. Another mechanical precaution to be noted at this point is this: the speaker is a rather flat PM type designed to occupy little space inside the cabinet. If you use the same case and general layout, don't yield to the temptation to buy a hi-fi type of speaker because the voice




Amplifier schematic. Keep the leads to V1 and V3 very short to avoid picking up hum.




**Power supply schematic is at right. It may be bought already wired, as noted in parts list.**

coil covers of such units are large and bulky—so much so that you may not be able to fit both chassis into the cabinet.

After completing construction, insert V3, V4, and V5 in their sockets and apply power. After a 15 second warmup period, you should be able to hear a loud hum or buzz from the speaker when you touch the grid of V3 (pin No. 3) with your finger. This is a rough test for the amplifier. If the hum is not heard, do not proceed with the remaining test until the trouble has been corrected. Since the amplifier circuit is relatively simple, an inoperative condition here is usually caused by poor solder connections or incorrect wiring, seldom by obscure defects you encounter in complex equipment.

Now plug in V1 and V2, and rotate all the potentiometers to maximum clockwise position. When the tubes have warmed up sufficiently, you should hear a soft rushing sound from the speaker fluctuating at the rate of about 10 vibrations per second. This sound is due to the gain variation produced by the tremolo oscillator and indicates that everything is working properly. Test the action of the controls as follows: rotation of R4 to its full off position should stop the tremolo effect in the tube rush without affecting the tremolo rate at any setting; R7 should change the tremolo rate down from 10 cycles per second to about 3 cycles per second when rotated to full off; R11 should control the overall gain so that you hear the rush diminish smoothly.

Any one of the microphones for guitar, harmonica or other instruments may now be plugged into the phone jack. The individual settings of the three controls are made to suit your particular taste.

The most probable cause of lack of tremolo is an inoperative oscillator V2. This may be due to a bad tube or by defective capacitors or resistors in this circuit. The parts to check are C1 through C6, R5 through R10, R16 and R17. As always, the tube should be the primary suspect.

Excessive thumping at the tremolo frequency may be due to capacitive feedthrough from the plate circuit of the oscillator to the grid of V3 without going through the mixer tube. To cure this, oscillator plate leads must be shifted until the thump is minimized.

# Receive Short Wave On Your Home Radio

**By Len Buckwalter**
Associate Editor

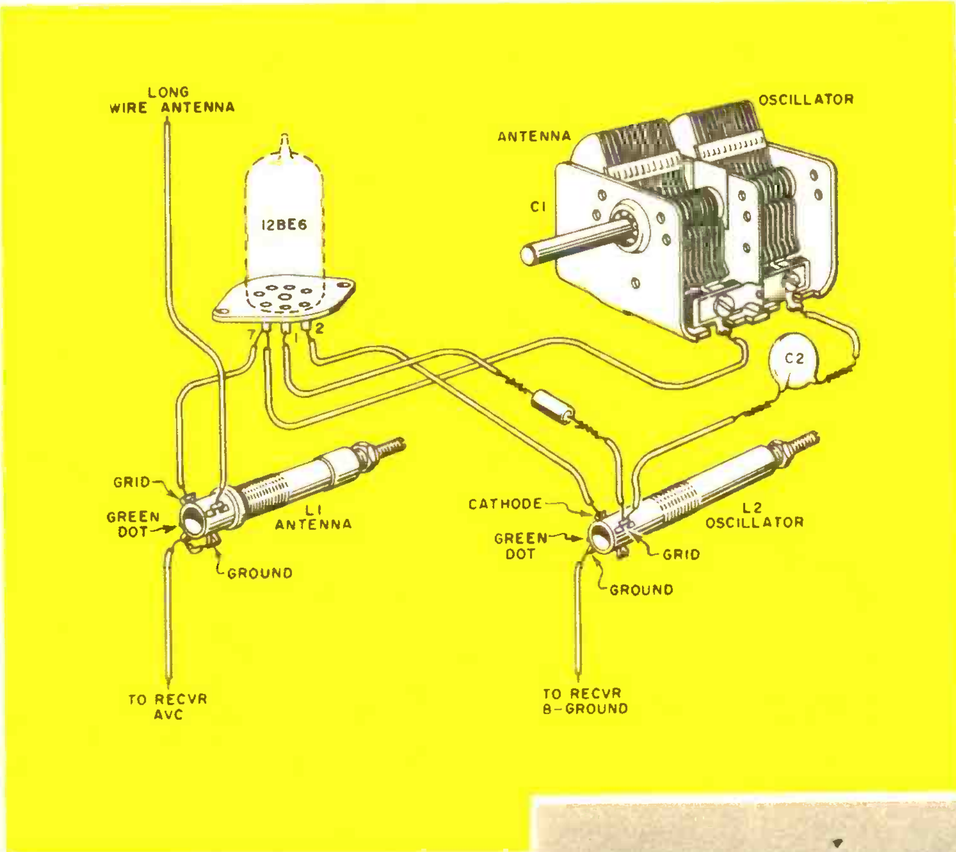
**Here is the most inexpensive route to short-wave listening—the conversion of a table model radio.**

JUST above the broadcast band exists the bustling activity of various communications services. A sweep across the dial from 1.7 to 5.5 mc will tune ship-to-shore stations, commercial telephone, weather, WWV time signals, and the 80 meter ham band.

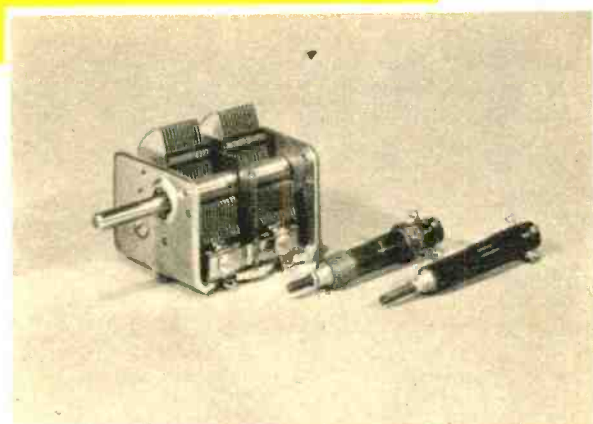
With little expense or special skill a table model AC-DC radio can easily be converted for use on these frequencies. The cost may be kept below $4.50 even if all the parts are purchased new.

Here's how it works. The tuning range of the home receiver is altered by replacing the antenna and oscillator coils and tuning condenser. The parts are readily available from local distributors or mail order houses. Alignment, described later, is accomplished with signals received off-the-air.

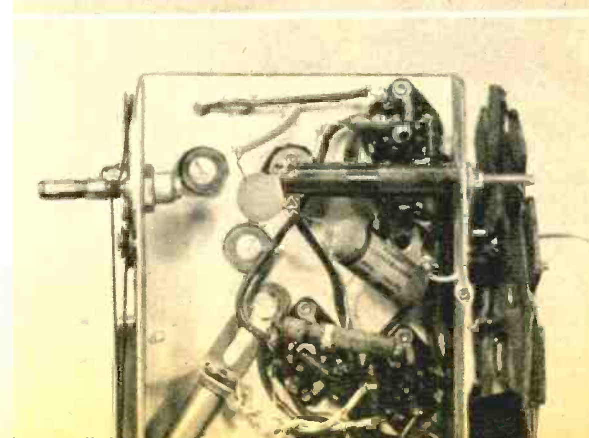
The converted receiver may be used with its original speaker. However, headphone reception, valuable for receiving weak stations, is provided for.



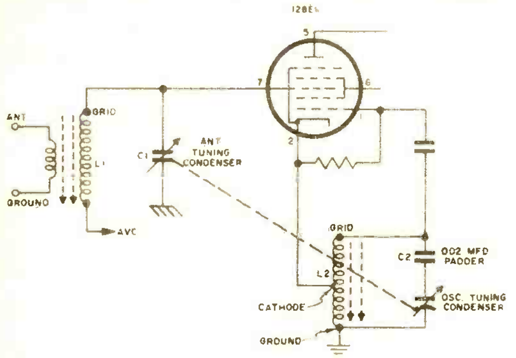

The new parts are wired into receiver as above. They are L1, L2, C1, and C2. Note points in circuit to which they are connected (12BE6, AVC, B--).



Main tuning condenser C1 and the two coils. At the right is the tapped oscillator coil L2. Antenna coil L1 above it has two separate windings.



Underside of chassis showing mounting detail of oscillator coil L2 at the upper right hand corner. Immediately above it is the 12BE6 converter tube.

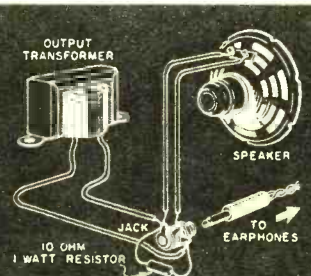



**Partial schematic of receiver after conversion coinciding with the wiring guide on page 69.**

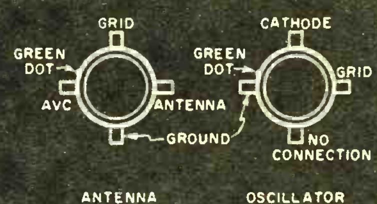
To begin, the main tuning condenser is removed since the broadcast type does not offer a favorable tuning ratio. Clip the two wires going to the condenser lugs plus any ground strap attached to the frame. Remember which wire goes to the *smaller* group of plates. For future reference, this is the *oscillator* lead, the other is in the *antenna* section. Installing the new condenser shouldn't present too much of a mounting problem as these units are well standardized. The Miller #2112, used in the illustrated model, fit perfectly over the old mounting holes. Its outside dimensions were identical to the original part. Be sure to change the dial cord drum.

The new antenna coil, another Miller part, will replace the original broadcast loop. A convenient mounting spot is directly on the cardboard where the loop is wound. Referring to the diagram wire it as follows. Locate the lead that runs from the loop to the converter tube. In many cases this will be pin 7 on a 12BE6. This lead will continue to the *antenna* section of the variable condenser. Clip this wire from the loop and solder it to the "Grid" lug of the new coil. The other lead from the loop connects to the "AVC" lug. Be sure the other end of this lead runs into the chassis. Now jump the "AVC" and "Ground" lugs together with a short piece of bare wire. Add a length of lead, about 30 feet long, to the remaining "Antenna" lug of the coil. The new tuning circuit is now complete.

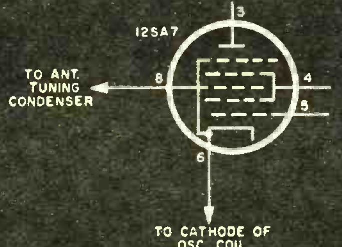
The second half of the receiver conversion is in the oscillator section. The procedure outlined here assumes a 12BE6 tube and a tapped-coil type oscil-



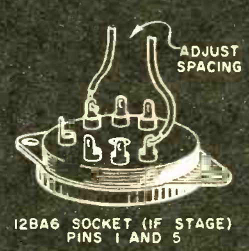

**Follow this guide for adding a headphone jack. The jack and 10 ohm resistor are new parts.**




**Use these base diagrams to identify the lugs on coils. Green dot must be in position shown.**




**If your receiver uses a 12SA7 converter tube instead of the 12BE6, use these pin numbers.**




**Adding the two "gimmick" wires for receiving code. The length should be about a half inch.**

lator, quite commonly used in these receivers. In any event, the circuit may be wired to conform with the winding on this coil.

Remove the old oscillator coil (the small one below the chassis and close to the tuning condenser) carefully clipping the connections. Mount the new unit as shown.

The diagrams should provide enough information. However, here are some points to be aware of. Include the .002 mfd. padder condenser. One side is soldered to the "Grid" lug of the coil, the other to the section of the tuning condenser previously identified as *oscillator*. The "Cathode" connection is the lead going directly to pin 2 of the 12BE6. The remaining wire(s) comprise the "Ground."

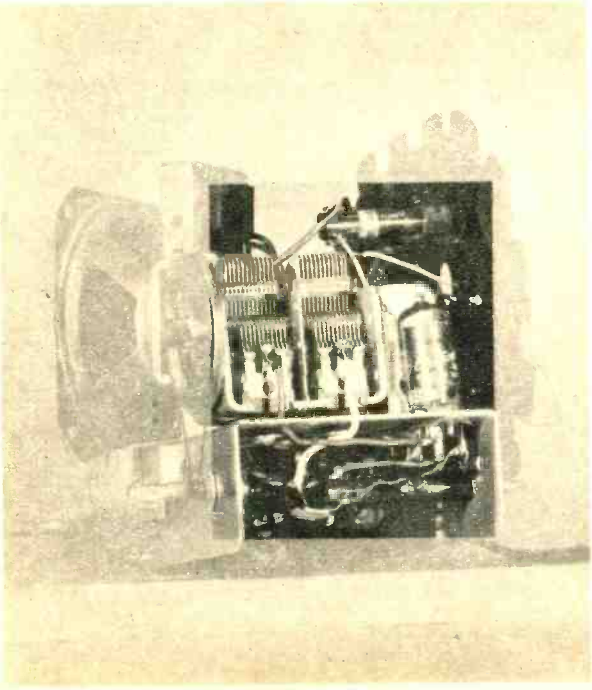
Turn the receiver on for about 15 minutes to permit it to stabilize itself for alignment. Since this will be done with off-the-air signals, it will be helpful to connect the outside antenna at this time. It was found that by clipping a short wire to the fingerstop of a telephone, strong signals were pulled in. Another quickie antenna is a TV leadin wire.

Set the tuning condenser in the fully meshed position and turn the oscillator tuning slug, starting from the maximum clockwise position (all the way in). The idea is to receive the upper end of the broadcast band and approximate a rough adjustment of the coil. Keep turning until the broadcast station of the highest frequency is heard. Tune the antenna slug for maximum volume. Now fully unmesh the tuning condenser. Slowly turn the oscillator slug counterclockwise until WWV is heard. This powerful station emits a ticking signal at 1-second intervals with time announcements in code and voice each

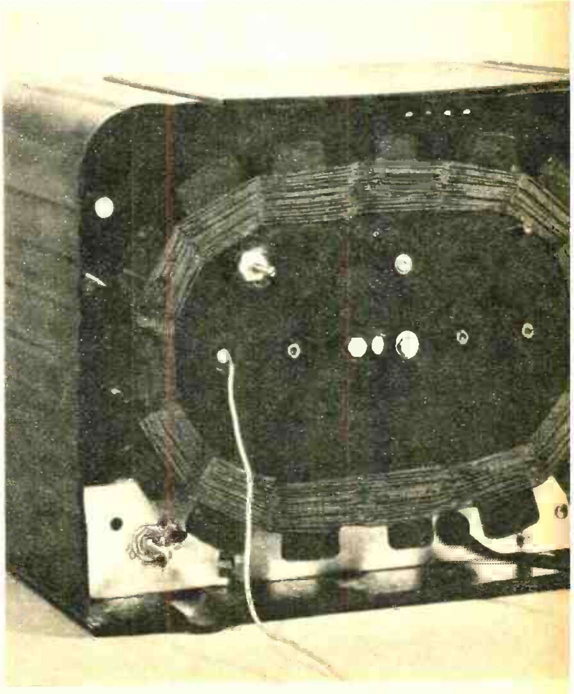
[*Continued on page* 94]

PARTS LIST

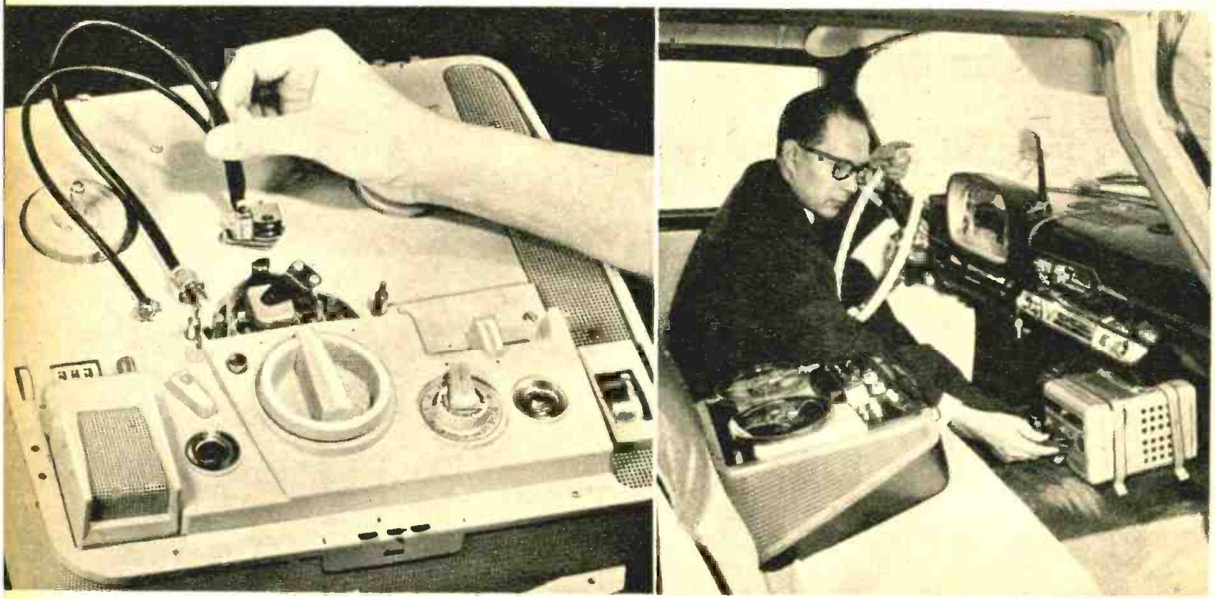
C1—10-365 mmfd. variable 2-section capacitor (J. W. Miller 2112)
C2—.002 mfd. molded mica
L1—Antenna coil (J. W. Miller B-5495-A)
L2—Oscillator coil (J. W. Miller B-5496-C)



**Antenna coil L1 is seen above the main tuning condenser. Below chassis is oscillator coil L2.**



**Old antenna loop on rear of receiver is no longer used. White lead is new antenna wire.**



**Bring your tape recorder up to date, by converting to stereophonic playback. The Revere SK-707 conversion kit, left, priced at $35 is one of several that you can install yourself. Take your tape recorder with you, with the addition of an inverter like the ATR model, right, which steps up 6 or 12 volt DC car battery current to 110 volts AC. Inverters range from $25 to $100.**

# Get More Out of Your Tape Recorder

**By Ronald L. Anderson**

**Here are ten simple, inexpensive ways to improve the quality and expand the use of your recorder.**

WHILE the home tape recorder is a mighty versatile device just as it comes out of its shipping case, you can extend its versatility even further through some of the accessory items available and through some of the ideas and gimmicks that other tape fans have developed in the past.

What's more, you'll find that your recordings will be better—vastly better, in some cases—and that you never knew just how terrific the little old box could be.

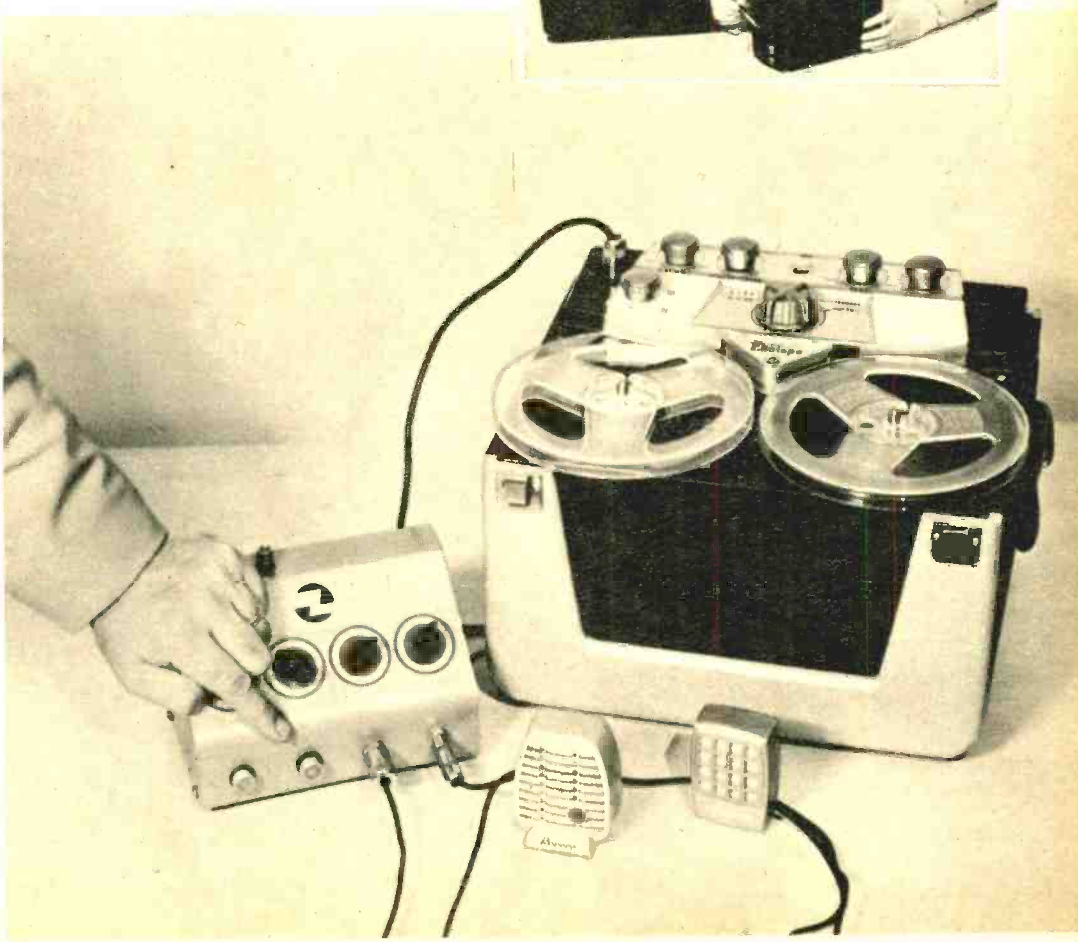
Undoubtedly the biggest boost in the quality of your recordings will come from tampering with the transducers—that is, the microphone and the loudspeaker—since these are usually the weakest links in your machine's recording and playback chain.

Here, then, on these two and the following page, are 10 basic ways to get *more* out of your tape recorder.

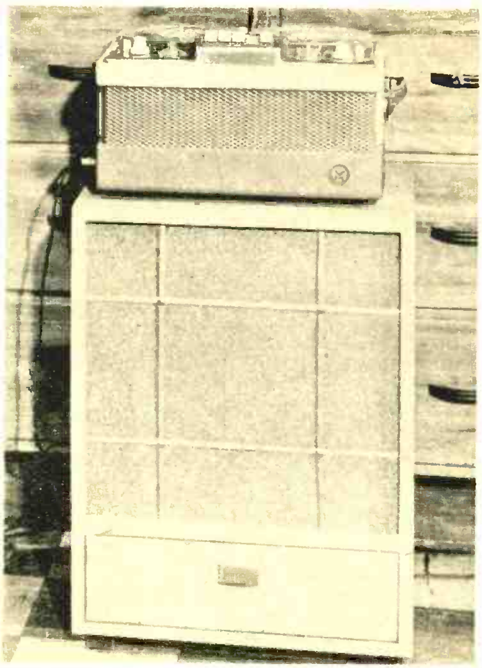
An emergency kit for your tape recorder should include wire cutters, screwdriver, scissors, extra magnetic tape, empty reels and boxes, and other items pictured here.

A permanent radio jack simplifies recording. On radios not using a power transformer, be sure speaker voice coil is isolated from the chassis to prevent shock.

Mixing the sound from several microphones will increase your recorder's versatility. Simple tubeless mixers start at $3; amplifier type units are $25 and up.



Though called portable, most tape recorders are too heavy to be easily moved. Any kind of table or cart with casters, like this TV stand for $4, will keep your recorder handy.



Improve sound with an extension speaker plugged into the output jack. Speaker wattage should be greater than that of recorder amplifier, impedance same as recorder output.

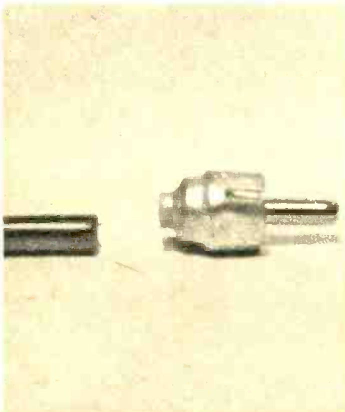
"Dubbing" your records onto tape can save a considerable amount of record wear. If an output jack is added to an AC-DC type phono be sure to check for possible shock hazard.

A low impedance microphone will do for your recorder what a good lens does for a camera, besides eliminating hum and loss of high frequencies. Such mikes cost $15 to $100.

A cross-reference card file for your tape is a must for pleasureable listening without fuss. File alphabetically according to name of selection, as well as according to the reel number.

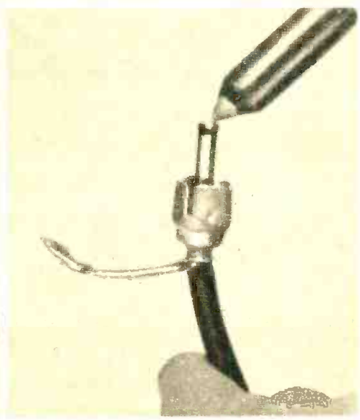
# Wiring Phono Pin Plugs

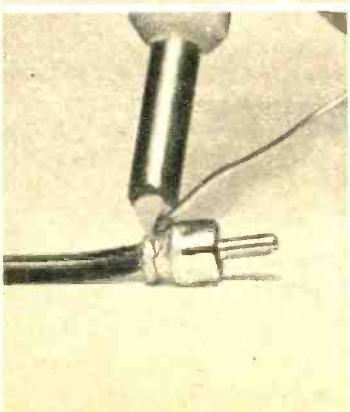
**Eliminate a cause of hum and noise in your hi-fi system by wiring plugs and cables as shown here.**



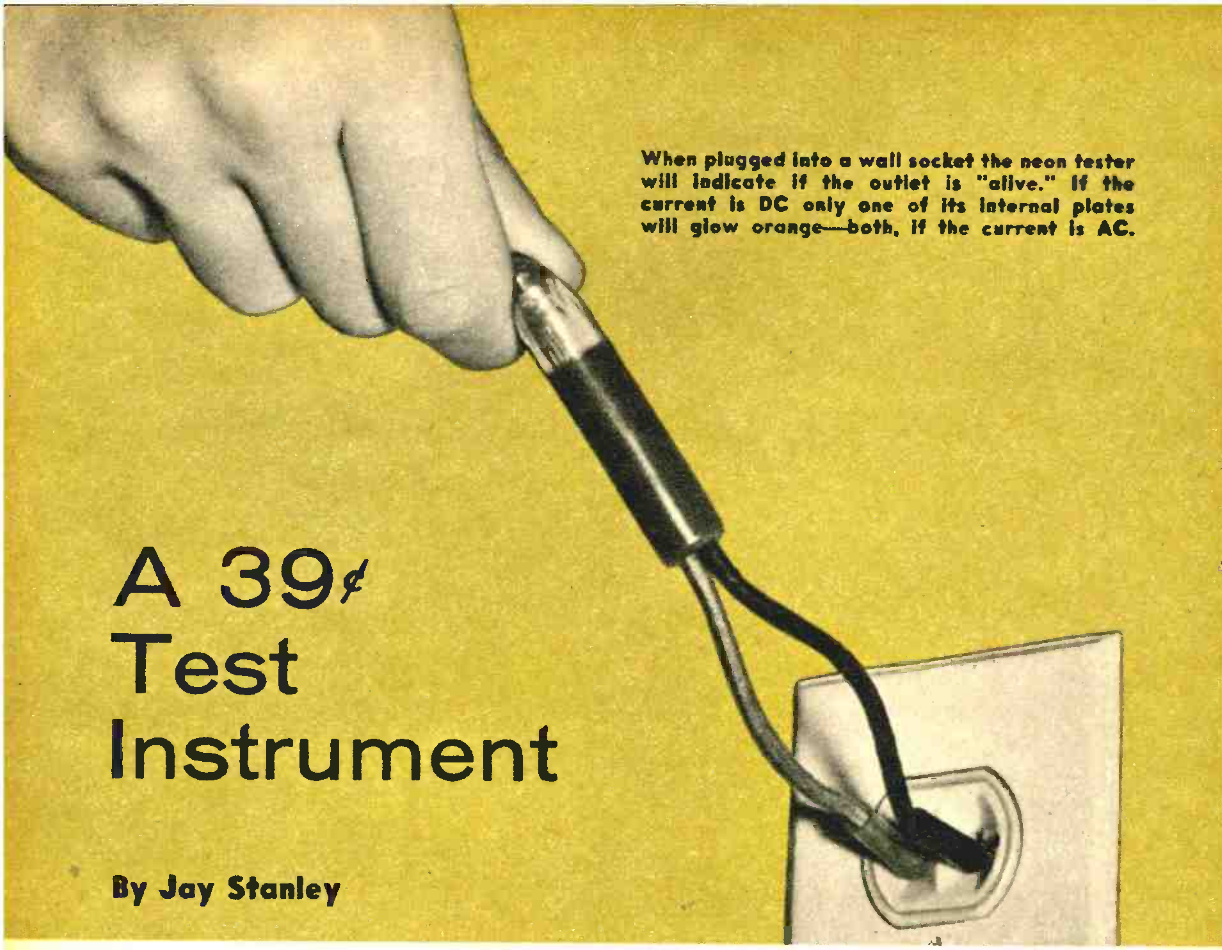
**Most hi-fi interconnecting cables are shielded type, have a solid inner wire surrounded by and insulated from an outer braided conductor. To connect such a cable to the pin plug (far left) pare off 1" of the outer insulation.**

**Twist back outer braid and pare off about ¾" of the inner insulation. Twist together strands of inner conductor and push wire up into shaft of pin plug till end protrudes slightly. Solder wire to end of plug, allow some wire to flow inside.**





**Outer insulation should meet neck of plug. Twist the braid shielding around the plug's neck, running a bead of solder all around it. Finally, use a fine file and remove excess solder from around pin of plug; snip off loose wire.**



When plugged into a wall socket the neon tester will indicate if the outlet is "alive." If the current is DC only one of its internal plates will glow orange—both, if the current is AC.

# A 39¢ Test Instrument

**By Jay Stanley**

## Use a simple neon tester—It is ideal for quick tests on AC or DC, open fuses, or high voltage.

A TEST instrument for 39¢? Yes, there is one—and you can find it at almost any hardware store, lumber yard, or mail order house selling electrical supplies: the neon bulb tester.

Actually, this useful device was designed originally to aid electricians in determining if a wall socket or other 117-volt wiring is working. But because the neon bulb will light when connected to either AC or DC of approximately 90 volts—and is responsive to radio frequencies, it has many uses in practical testing of both radio and TV sets. It has advantages other than low cost, too—it is faster to use, takes up little space in the tool kit, and will withstand abuse that would smash an ordinary meter.

Such a tester, of course, will only tell if voltage is present—*not* how much. But for many types of servicing—particularly when shooting trouble on "dead" sets—quick checks to determine if key spots in the set have voltage will isolate the trouble without using more complicated test equipment.

The circuit of most AC-DC table model radios is such that the "hot" side of the 117-volt AC line is connected to the chassis, directly or through a condenser—if the power plug is put into the wall socket in one of the two ways possible. Thus if the plug is in the *wrong* way—the chassis may be "hot" and dangerous with AC. So unless (like the professional service man) you can isolate the chassis by means of an isolation transformer, always determine which way the plug should be "polarized" before doing any work on the set. This is easy to do with the neon bulb circuit tester, as shown in the photo.

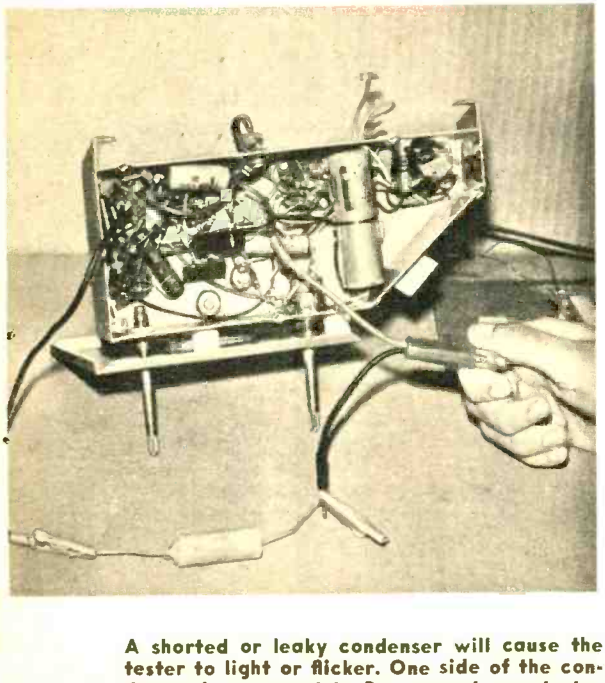
The On-Off switch on electronic equipment gets a lot of use and may open up. To test it, follow the two AC power leads as they enter the chassis. One will go to a terminal point and the other to the switch. Hook one lead of the tester to the terminal point, the other to each of the two switch lugs. If the bulb glows when each of the switch lugs is touched, the switch is OK. During this test the set must be plugged in with the switch on.

Does the set have "B" voltage? A good place to pick up this DC output is between the B— lead and the screen pin of the power output tube socket. The B— lead is usually easy to locate because in nearly all sets it is connected to the black lead from the large 3-wire filter condenser. The tube layout diagram pasted in the set will usually indicate the power output tube—and a tube data booklet will indicate the number of the screen pin.

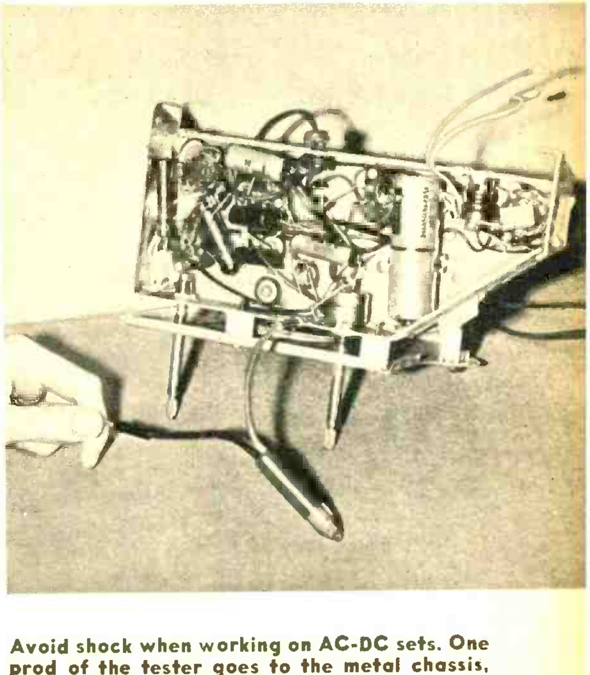
In an AC-DC set the tubes are all connected in series—so if one is "open" none of the tubes will light. Using the tube data booklet for each tube, locate the heater pins. Use the neon tester on the heater pins as illustrated. If the neon tester *lights*—the tube heater is burned out.

The examples given are by no means all of the possibilities for testing—rather they are typical examples to show the general idea. Many of these checks not only apply to AC-DC radios, but TV sets as well.

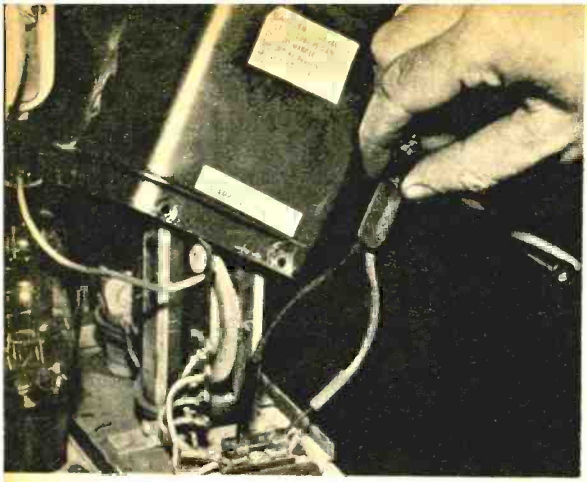
A dark screen on a TV set may mean that the high voltage circuit is inoperative. A quick check is to hold the neon bulb tester near the lead to the high voltage rectifier tube (see photo). It is not necessary to touch the lead—and you can avoid any possibility of shock by simply coming *near* the lead. (Do not make this test unless you are the kind of person who can keep his head

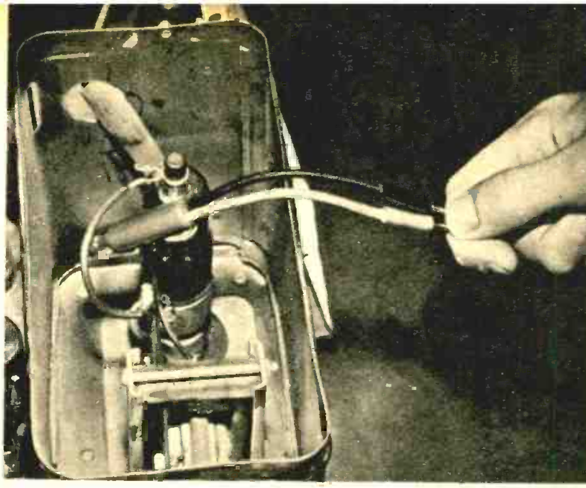


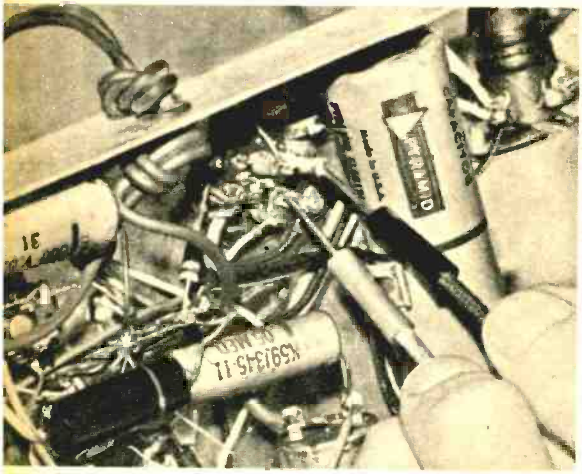
**A shorted or leaky condenser will cause the tester to light or flicker. One side of the condenser is conected to B— ground, one tester lead goes to the B+ supply voltage of the set.**



**Avoid shock when working on AC-DC sets. One prod of the tester goes to the metal chassis, while the other is held in the hand. If the bulb glows, reverse the plug in wall socket.**







Upper left shows how to check fuses. With the set on touch the prods to the ends of fuse. If tester lights, fuse is bad.

The bulb indicates the presence of high voltage in TV set. Hold the tester as in the photo above to prevent shock.

Finding an open filament in an AC-DC set. Hold the prods on heater pins. An open filament causes tester to light.

in the game—you are working close to the tube cap and *dangerous* high voltage.) If the bulb glows, high voltage is present—so the trouble is elsewhere. The next logical move is to check the high voltage rectifier—often a 1B3GT.

Another valuable feature of the neon tester is its ability to glow in the presence of radio frequency fields. This is useful for the design and testing of amateur transmitters. An important advantage is that the tester does not have to be connected to a tuned circuit in order to pick up the RF energy.

To detect whether an oscillator is operative the bulb is brought near the coil. Since the wattage required by the neon bulb is so slight it will glow when used with surprisingly low-powered circuits. It is best to move bulb along length of coil since the "hot" side of coil fires it.

Tuning a transmitting antenna is made simpler through use of the neon tester. Here again it is the RF energy supplying the voltage that causes the bulb to glow. With the transmitter on, move the tester along the antenna wire until the glow is seen. The optimum point must be found since voltage will only exist at certain points on the wire. Once it is found, it is an easy matter to tune the controls of the rig for maximum brightness of the bulb. This is an especially convenient procedure for use on mobile antennas since no source of AC power is required. In the home rig bulb may be hooked to antenna leadin as a permanent "on-the-air" monitor.

A final caution: all of the tests described are "dynamic"—the power is on and voltage appears at many different points. Be certain that you are touching—with the tester—*only* the points you want to test. Accidentally brushing a tube pin with your little finger at the same time may give you an additional—and unexpected—test for voltage!

# Hi-Fi Clinic

**Got a question on hi-fi—how to install, how to adjust, how to repair? Send it in to us; the clinic will send an answer to each query.**

### Pressure Pads

*My tape recorder has recently started to act peculiarly. The volume seems to shift up and down during both recording and playback. The recording level indicator doesn't indicate the same sort of volume change, so I assume the trouble is not in the record-playback amplifier. Is there any quick check of the tape heads I could make?*

*John Wintenski, New York, N. Y.*

A good bet would be to check the pressure pads (see photo). If you find the pads to be hard or glazed they should be replaced as they are probably not holding the tape properly, from the point of view of either position or pressure, to the playback-record head. The manufacturer of your recorder should be able to supply replacement pads. If unobtainable from that source, an old felt hat will provide you with a lifetime supply of pads. This felt is fairly close to that used in the pads.

### What's Watt

*I'm thinking of buying one of the English amplifiers. I would like about a 50 watt model because I have a low efficiency speaker. Now, I'm told that an English amplifier rated at 30 watts is the equivalent of an American 40 or 50 watt job. Is this true?*

*Mark Phillips, Boise, Idaho*

First of all, a watt is a watt, be it American or English. The discrepancy between the American and English ratings is due to the English system of rating the maximum wattage output of an amplifier at a very low distortion level. An English amplifier manufacturer may rate his product at 30 watts at 0.1% distortion, and an American manufacturer rate the identical amplifier at 60 watts at 2% distortion. The moral of the story is not that either rating is wrong or "souped-up," it's that a power output rating of an amplifier without a statement as to the distortion level *at that rating* is meaningless.

### Stereo Conversion

*I want to purchase one of the new stereo cartridges and other equipment to play the new stereo discs through my present hi-fi system. I understand that I need another amplifier, preamp, and speaker. I was told that in addition I'll have to replace my turntable and tone arm. Why can't I use my present equipment?*

*Joe Goglia, Villanova, Pa.*

The tone arm requirement for stereo is (1) that it be provided with at least three conductors (two hot leads and a shield or common), and (2) that its resonances be reduced as much as possible. Most tone arm manufacturers have at the present time, or shortly will have, conversion kits that take care of both these problems.

The turntable question is a little bit more involved. The standard monaural cartridge is insensitive to turntable rumble in the vertical plane. A number of turntables which are rumble-free with standard cartridges will rumble when used with a good stereo pickup. If excessive rumble is experienced when using a stereo pickup, check with the manufacturers of the cartridge and turntable. They will probably have specific recommendations to alleviate the situation.


# "...and here's EI's gift to you."

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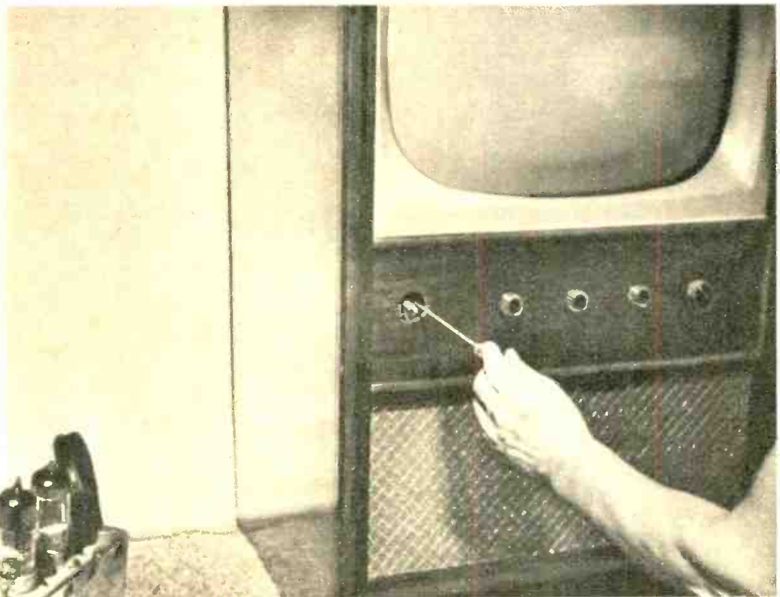
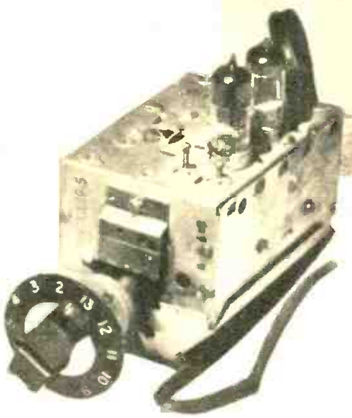
# Fix Your TV Set - 2

**By Herbert Greenberg**

**Perform these 3 simple repairs on your TV tuner and avoid "snowy" pictures and erratic tuning.**

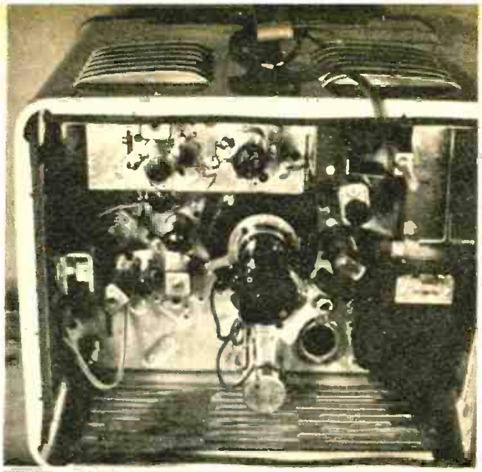


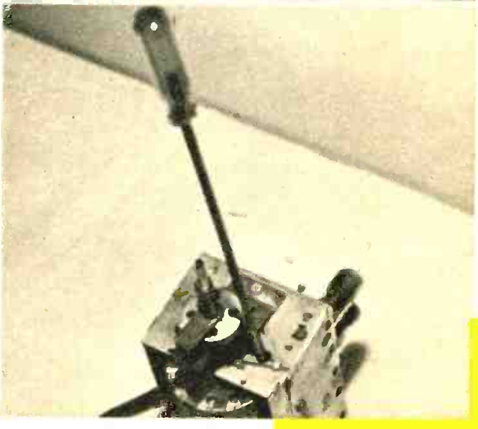


**The tuner is located in the cabinet directly behind the channel selector knob. Alignment of the fine tuning, to bring it to the center of its range, is shown here. The screwdriver used must be non-metallic. Both the channel selector and fine tuning knobs are removed to gain access to the tuner for this adjustment.**

ONE of the more critical parts of your TV set is the tuner. As you twist the channel selector knob it tunes in the desired station and amplifies the tiny signal from the antenna. Its third job is to convert the high channel frequency down to where the rest of the set can handle it more efficiently. Present day tuners are a marvel of design. Though subjected daily to mechanical shock and vibration as channels are switched most of the delicate components function well for long periods of time.

About ninety percent of all tuner trouble falls into three groups—faulty tubes, dirty contacts, and fine tuning alignment. Anyone following the simple procedures described in this article should have little difficulty in curing each of these. Fortunately, the tuner illustrated in the photographs is the type adopted by many manufacturers. For reasons of clarity only, this unit was removed from its mounting on the chassis of the set.





Of the three troubles mentioned, only "dirty contacts" requires removal of the chassis from the cabinet. Faulty tubes and fine tuning alignment may be treated with the chassis in place.

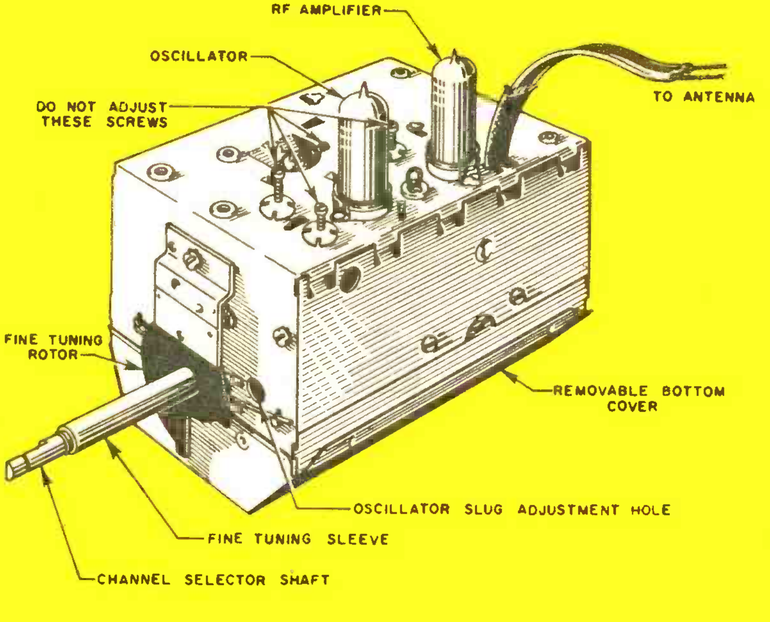
Poor tuner performance is most commonly caused by faulty tubes—the RF amplifier and oscillator. It is easy to locate their position on the tuner. The oscillator is almost always in a forward position, closest to the tuning shaft, with the RF amplifier in back of it—toward the rear of the set. The 6J6 is a popular oscillator type while RF amplifiers are customarily a 6BQ7, 6BK7, 6BZ7, or 6AG5.

A troublesome RF amplifier will often show up as "snow" in the picture. Another symptom is loss of sound and picture with the presence of white light on the screen. A malfunctioning oscillator will also cut the sound and picture, but

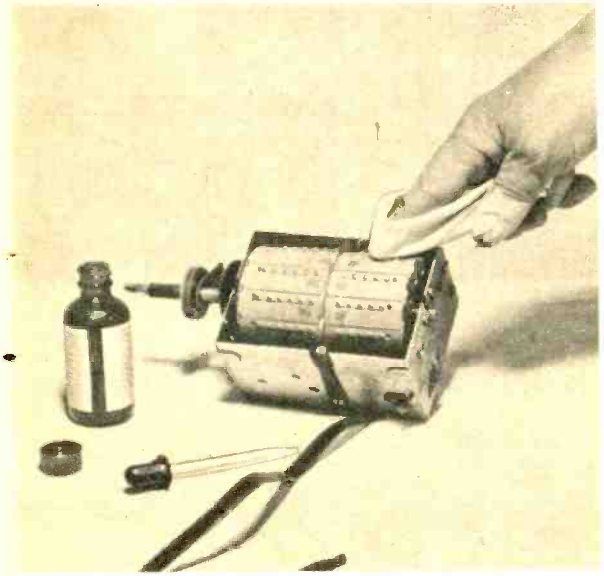
**Top shows tuner location in vertical chassis sets. It is the metal box along inside top of cabinet.**

**The screwdriver is shown inserted into fine tuning alignment hole. It can be done with tuner in cabinet.**

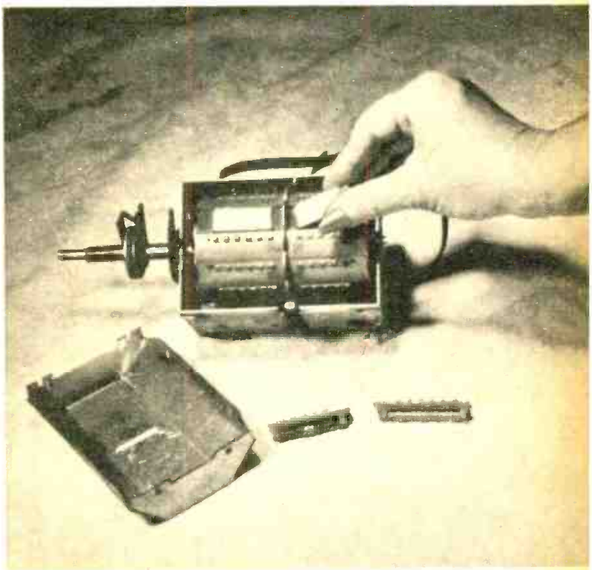
**Locate fine tuning rotor at right. It must be in this position during the alignment.**



Erratic channel selector is cured by shining contact points with cloth and cleaning fluid.



One pair of unused channel coils are replaced by snap-in cleaners, left there permanently.



this is accompanied by the steady rushing sound of atmospheric noise pickup. A very good indication of a poor oscillator tube is when channels 2 through 6 are received and 7 through 13 are not.

One of the petty annoyances in operating a TV set is the need to adjust the fine tuning each time the channel is changed. The remedy is so simple that the chassis need not be removed to correct it. The fine tuning knob actually shifts the oscillator frequency a tiny amount. Within the tuner proper there is another adjustment for this—the oscillator coil slug. This slug should be readjusted as tubes and components slightly change in value because of aging. In some cases this process shifts the fine tuning range so far that it is impossible to tune for a clear picture. Here is how to zero in the fine tuning. It will then be possible to flip the channel selector around, with each station coming in "on the nose."

First pull off the channel selector knob and the fine tuning knob behind it. This exposes the tuner shaft and sleeve. This sleeve (turned by the fine tuning knob) is rotated to its mid-point of travel and *not moved* during the remainder of these adjustments. With the aid of a flashlight peer into the large hole in the cabinet through which the tuning shaft emerges. You will see, to the right of the shaft, the hole for adjusting the slotted oscillator slug.

Insert a *non-metallic* screw driver (it may be whittled from wood) into the slug hole and slowly turn. It is imperative that the slug not be turned more than once or twice in either direction—otherwise the slug will unthread from the coil form. If this happens it cannot be recovered without a special screwdriver known as a slug retriever—or by taking the tuner out of the cabinet.

The oscillator slug is turned until you hear the clearest sound with the least buzz. Do not tune for the best picture since they are not supposed to coincide. Repeat this for all the stations in your area. After replacing the knobs all channels should be received without the need of adjusting the fine tuning knob.

The tuner contact points are another troublesome area. Their surfaces will become blackened with the passage of time and interfere with proper operation. There are several symptoms that indicate dirty points. Snap in a channel —when pressure is applied to the selec-

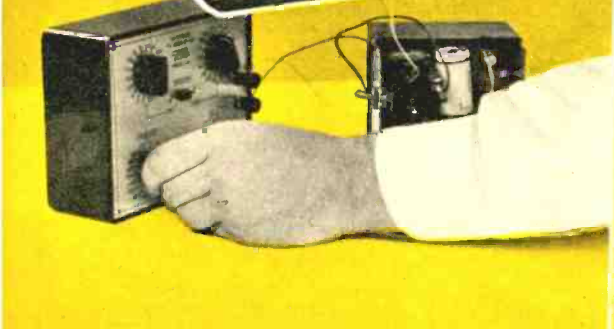
[*Continued on page* 88]

*EI assembles*

# A Resistor-Capacitor Box

**Here is our report on the Eico substitution box—1,350 resistor-capacitor combinations for testing.**

IF you've ever built any of the numerous transistor circuits you may have encountered something like this, "Adjust the resistor to assure starting of the oscillator." Another variation is, "Select R2 for a collector current of 5 ma." This is where a substitution box is handy—a twist of the knobs gives you a choice of many resistors to try in the circuit. If a capacitor is needed, the unit also supplies a choice of standard values. This can be helpful

**Front panel showing the various function switches. The test leads connect to terminal posts on the right side. At lower left the unit is shown in actual use as test capacitor within the unit, is clipped across a questionable one in the chassis. At the lower right may be seen components packed with the kit. Checking parts list is first step.**

Photos by Mike Bonvino

when attempting to select a particular tone for an audio oscillator. The frequency response of an amplifier may also be juggled by varying the coupling capacitors.

The advantages of a substitution box for troubleshooting are obvious. At the end of the test leads are many combinations of component values ready to be used in a faulty circuit for comparison.

Eico has introduced the Series-Parallel R-C Combination box (Model 1140) which should be equally at home in the design lab and service shop. However, a hobbyist dabbling in any type of electronic construction will find it a valuable aid. In kit form it sells for $13.95.

The Model 1140 offers a choice of thirty-six resistors and eighteen capacitors, all standard RETMA values. In addition, it will place in series or parallel any combination of one resistor or capacitor. This is helpful to the experimenter seeking the best values for differentiating or integrating circuits. The selector switch on the front panel will also short or open the terminal posts to which the test leads are connected.

The only point of caution while using this unit is not to exceed ratings. The resistors are all 1 watt, with the capacitors ranging in groups from 400 to 600 working volts.

This Eico kit is simple and straightforward. The components are close enough in tolerance to be adequate for most applications. The switch lugs take solder readily and, in general, the instrument should give many years of reliable service.

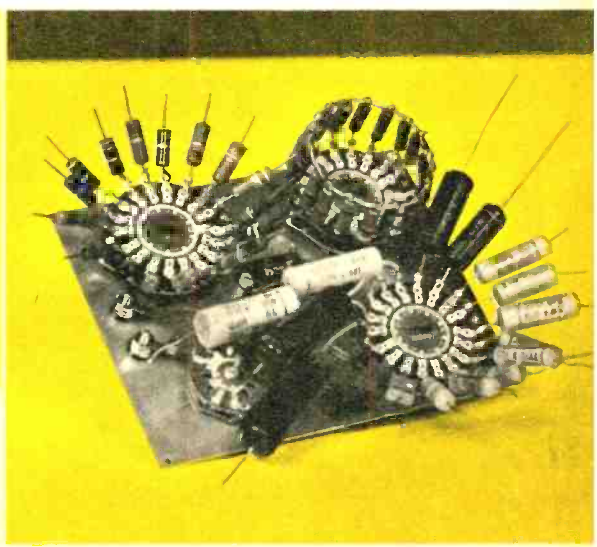
The sequence of construction is intelligently laid out and should provoke no difficulty while building except, perhaps, for one small blooper in the manual. R29, a 680K ohm resistor, is erroneously called "blue, *green*, yellow" (the color code should be blue, *gray*, yellow). The manufacturer has assured us that the necessary manual changes are being made. We also learned that the smaller capacitors with color codes that could possibly cause confusion will be eliminated. They are to be supplanted by the newer disc type, stamped with the value numerically.

The photographs show the basic layout and wiring technique used in assembly. Note the circular arrangement of the resistors and capacitors. After these parts are soldered to the switches, a 2-inch circle of heavy wire is pushed on to their free ends forming a convenient common ground.

*EI* rates this kit a good buy for both the beginner and advanced experimenter.

**Wiring to the numerous lugs is simple. You circle each switch, adding parts consecutively.**

**Upper right shows ring ground. Unit was finished with 2 rings and a few interconnections.**



# The ABC's of Electronics-6

By Donald Hoefler

**Here is the solution to last month's resistance problem, solved through use of Kirchhoff's Laws.**

THIS month we shall solve the problem on Kirchhoff's Law that appeared in the last issue—find the resistance between points A and B in Fig. 1.

Solving this requires a technique known as a *delta-Y transformation*. A simple delta circuit is shown in Fig. 2A, and a Y is shown in Fig. 2B. Now suppose we had both of these circuits enclosed in boxes, without knowing what is inside them. The only information we can get about their arrangement is what we can learn by connecting an ohmmeter across their terminals. Then if the values of the resistors were right, we could conceivably measure the same resistance between terminals 1 and 2 of both boxes (A) and (B). Similarly, we might get the same readings between each set of terminals 2 and 3, and 1 and 3.

If this were all true, then it wouldn't matter to any external circuit whether there were a delta or a Y inside the box, because electrically they would be *equivalent*. Under these circumstances, a delta could be substituted for a Y, or a Y for a delta, both in an actual circuit, or on paper to simplify the solution of a problem.

Referring again to Fig. 2, if we should wish to transform a delta to an equivalent Y, we'd just use these formulas:

$$(1)\quad R_a = \frac{R_1R_2}{R_1+R_2+R_3} \qquad (2)\quad R_b = \frac{R_1R_3}{R_1+R_2+R_3}$$

$$(3)\quad R_c = \frac{R_2R_3}{R_1+R_2+R_3}$$

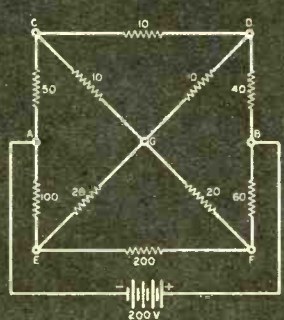



Fig. 1

A network like this is solved by delta-Y transformations and the use of Kirchhoff's Laws.

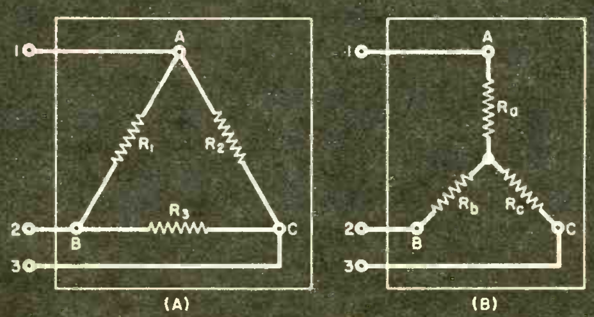



Fig. 2

Resistance measurements taken across the terminals of delta (A) and Y (B) are identical.

For a Y-to-delta transformation, these formulas will apply:

$$(4) \quad R_1 = \frac{R_aR_b + R_bR_c + R_aR_c}{R_c}$$

$$(5) \quad R_2 = \frac{R_aR_b + R_bR_c + R_aR_c}{R_b}$$

$$(6) \quad R_3 = \frac{R_aR_b + R_bR_c + R_aR_c}{R_a}$$

Using these formulas, let's get to work on Fig. 1, transforming deltas CGD and EGF into equivalent Y's. This done, we have the equivalent circuit of Fig. 3.

Note that in Fig. 3 the diagram consists of solid and broken lines. The broken lines are simply a redrawing of Fig. 1, the solid lines representing the new Y circuit. For example, the three 10 ohm resistors in the delta CGD become the equivalent Y consisting of three resistors of 3.33 ohms each; $R_a$, $R_b$, and $R_c$. The same transformation applies to lower delta EGF. Once this is done, all the resistors in series are combined to comprise Fig. 4.

A sample combination is the 50 ohm resistor between points C and A in Fig. 3 plus $R_c$ which is 3.33 ohms. In Fig. 4 they become $R_2$, 53.3 ohms.

Once again we must perform a delta-Y transformation. Either delta will work equally well, so we choose AHJ. The equivalent Y we calculate from the formulas is drawn with broken lines. Again combining series resistors, we simplify down to the circuit of Fig. 5. From here on it's a simple Ohm's Law problem, which we solve for $R_t$. Thus the total resistance between points A and B in Fig. 1 is 81 ohms.

This article concludes our study of the basic principles of DC circuits.

## Introducing AC

A glance at any book on basic electronics will quickly reveal that the amount of space devoted to DC compared to AC (alternating current) is relatively small. The reason is simple. Once we cause a flow of current to reverse itself periodically, effects are produced that are not possible with DC. These very effects give rise to many of the basic branches of electronics.

Oscillators, amplifiers, high voltage, power supplies, radio waves, and innumerable other phenomena owe their existence to the rapidly changing fields of electrostatic and magnetic energy found in AC circuits.

The wave form of AC may assume an endless variety of shapes, from the symmetrical sine wave to sawteeth and square pulses. However, as will be described next month, the most complex of these forms may be explained in terms of the simple sine wave.

**Fig. 1 is now converted to Fig. 3. The series resistances are then combined to form Fig. 4.**

**Fig. 5 shows the final stage of the problem solved by Ohm's Law. Answer is 81 ohms.**

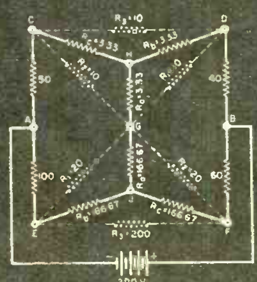



Fig. 3

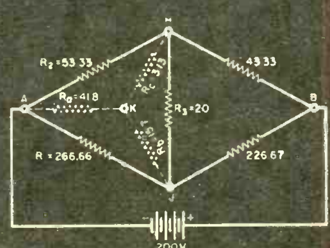



Fig. 4

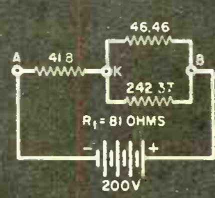



Fig. 5

## Speeding the News

*Continued from page 52*

plates. The photo transmitting machine, the Fairchild "Scan-A-Graver" depends on the conversion of light reflections into electrical current. The light impulses are amplified several million times and used to actuate a heated stylus. The stylus moves along a plastic or metal plate, punching tiny holes in the surface at a rate of several hundred per second. These holes vary in depth according to the strength of the impulses transmitted by the scanner. The result is a "half-tone" plate whose pitted surface holds varying amounts of ink according to the depth of the penetrations. This yields a range of blacks and grays when the ink is transferred to paper. This explains why some newspaper photos, when looked at closely, show up as tiny dots.

In the *Post's* cavernous pressroom, two- and three-story machines stand like hulking monsters in dim light. The machinery is heavy, coated with ink and oil. Here, too, electronics does delicate work. At cruising speed, these presses pour out 42,000 copies an hour. It takes split-second sequencing to maintain this fantastic pace. Newsprint, for example, comes on 1700-pound rolls. These rolls are fed into the presses through a complex series of web belts. When the old roll is almost played out, the press operator pushes a button, setting into motion a careful, electronically timed sequence of events. The small roll is braked; a liquid is sprayed on the new roll to activate a pre-applied dry glue; the webs pick up the tacky paper and feed it into the machinery while the tail of the old roll is severed by a knife.

Without electronic aids fine color printing, now routine at the *Post*, would be impossible. Electric eyes, electronic switches and amplifiers make possible the near perfect "register" which is the key to good color work. As the paper passes through the cylinders which apply the first color, a small "register mark" is printed in color on the paper. A selector switch rotating in the cylinder sends a signal to an amplifier in the control box. As the paper moves past one roller and onto the next set of color-applying cylinders there is a certain amount of slippage. Unless this is compensated for, the second color will overlay the first in the wrong places.

To prevent this, an electric eye scans the moving paper, records the precise position of the register mark, and activates a valve in the hydraulic system which raises or lowers the "compensating" roller located between the two sets of color cylinders. The movement of the roller either takes up the slack or eases up, bringing the paper back into exact color alignment.

The *Post's* accounting department uses about $350,000 worth of computer equipment to simplify the commercial part of publishing. An IBM 403 Tabulator handles checks and billing. An IBM 602A Calculator figures advertising linage and multiplies it by ad rates to determine amounts due.

Newspaper publishing today is a very complex business. Under constant pressure, working against the clock to beat deadlines, the daily press has found a crucial ally in electronics.

## Fix Your TV Set

*Continued from page 83*

tor knob, in either direction, does reception improve? Can you jump back and forth between stations and always end up with a clear picture? Do you get flashes of light on the screen when you walk across the room? Ruling out antenna performance, are all channels received properly?

The chassis must be removed to gain access to the tuner contact points. Remove front knobs, chassis bolts, plugs to the picture tube and speaker. Carefully withdraw the chassis without striking the picture tube. When the bottom cover of the tuner is removed the contact points will be exposed. Each row in the drum represents one channel. Rub the points with a cloth until they are shiny. Do this several times until the residue no longer appears after a complete rotation of the drum. The job will be hastened if tuner cleaning fluid is purchased.

If these hints on tuner maintenance are performed regularly you will be rewarded with a high quality picture.

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- Model 77 employs a sensitive six inch meter. Extra large meter scale enables us to print all calibrations in large easy-to-read type.
- Model 77 uses new improved SICO printed circuitry.
- Model 77 employs a 12AU7 as D.C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability.
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Now, Model 79, the latest SUPER-METER includes not only every circuit improvement perfected in 20 years of specialization, but in addition includes those services which are "musts" for properly servicing the ever-increasing number of new components used in all phases of today's electronic production. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes—components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily required extra meter scale, SICO used its new full-view 6-inch meter.

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The following components are all tested for QUALITY at appropriate test potentials. Two separate BAD-GOOD scales on the meter are used for direct readings.

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Superior's New Model 70 UTILITY TESTER®

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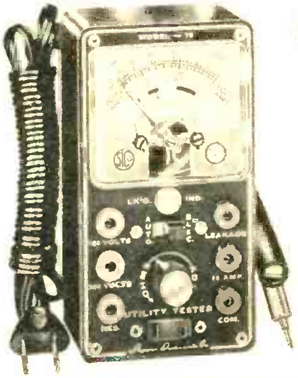


*As an electrical trouble shooter the Model 70:*

- Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Switches, Thermostats, etc.
- Will test *all* TV tubes for open filaments, inter-element shorts, burned out tubes, etc. (Will not test TV tubes for *quality*. An emission type tester such as the model 82 described below, is required to test tubes for *quality*.)
- Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakage, etc.
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- Incorporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, motors, etc.
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• How to test all TV tubes; also simple procedure for determining which specific tube (or tubes) is causing the trouble.

• How to trace trouble in the electrical circuits and parts in automobiles and trucks.

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- Dual Scale meter permits testing of low current tubes.
- 7 and 9 pin straighteners mounted on panel.
- All sections of multi-element tubes tested simultaneously.
- Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms.

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

*Model 82 comes complete, housed in portable, hand-rubbed oak cabinet with removable cover. Only* **$36.50**

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☐ Model 82 ......... Total Price $36.50
$6.50 within 10 days. Balance $6.00 monthly for 5 months.

## The Death Ray

*Continued from page 36*

by of the military forces, the sand bag.

There is the real possibility that a way will be found to create and direct powerful ion beams of anti-matter particles by using machines similar to present day particle-accelerators—cyclotrons, bevatrons and synchrotrons.

### Artificial Lightning

Artificial lightning produced by high voltage electricity has been suggested as a possible ray-like weapon and recent reports from the Soviet Union indicate that scientists there are developing a military weapon based on the use of "ball" lightning that can be carefully aimed and "fired." There is no question that conventional bolts of lightning can be quite damaging. Such bolts can kill instantly, shatter trees and houses, and start fires. However, lightning is unpredictable and effective range is limited.

The most obvious source of heat is the sun itself, and much has been done to harness the sun's power and amplify its rays on earth. Last September 30, the United States Army Quartermaster Corps at Natick, Mass., put into operation the largest solar furnace in this country. It is capable of concentrating the sun's rays sufficiently to produce temperatures up to 5,000 degrees Fahrenheit. Most materials, including metals, cannot withstand such extreme heat. To bring it even closer to the death ray concept, the furnace is fixed with a controllable shutter which makes it possible to simulate the brief flash of a nuclear explosion.

One of the major components of the solar furnace is what the army calls a "heliostat." This unit has 355 adjustable mirrors which reflect the sun's rays into a horizontal beam. Another set of 185 mirrors, called the "concentrator," converges the beam from the heliostat on an area as small as *four inches in diameter*—a devastating concentration of solar energy.

What happened to the death ray? It's on its way—closer than ever before. It might well make the terrible destruction of nuclear weapons seem mild by comparison.

# 48¢ ea. for any tube

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0B2 | 3AL5 | 5V6GT | 6BE6 | 6S4 | 7F7 | 12Q7 | 32L7GT |
| 0Z4 | 3AU6 | 5W6GT | 6BF5 | 6S8GT | 7F8 | 12SA7 | 35/51 |
| 1A5GT | 3AV6 | 5X4G | 6BG6G | 6SA7 | 7G7 | 12SG7 | 35A5 |
| 1A7GT | 3BA6 | 5X8 | 6BH6 | 6SB7Y | 7H7 | 12SJ7 | 35B5 |
| 1B3GT | 3BC5 | 5Y3GT | 6BH8 | 6SC7 | 7J7 | 12SK7 | 35C5 |
| 1C5GT | 3BE6 | 5Y4G | 6BJ6 | 6SF5 | 7K7 | 12SN7GT | 35L6GT |
| 1C6 | 3BN6 | 5Z3 | 6BK5 | 6SF76SG7 | 7L7 | 12SQ7 | 35W4 |
| 1C7 | 3BU8 | 5Z4 | 6BK7 | 6SH7 | 7N7 | 12SR7 | 35Y4 |
| 1H4G | 3BY6 | 6A8 | 6BL7GT | 6SJ7 | 7Q7 | 12V6GT | 35Z4GT |
| 1H5GT | 3BZ6 | 6AB4 | 6BN6 | 6SK7 | 7R7 | 12W6GT | 35Z5GT |
| 1L6 | 3C2 | 6AC7 | 6BQ6GT | 6SL7GT | 7S7 | 12X4 | #37 |
| 1LA4 | 3CB6 | 6AF4 | 6BQ7 | 6SN7GT | 7V7 | 12Z3 | #39/44 |
| 1LA6 | 3CF6 | 6AG5 | 6BR8 | 6SQ7 | 7W7 | 14A7 | #41 |
| 1LB4 | 3CS6 | 6AG7 | 6BS8 | 6SR7 | 7X6 | 14AF7 | #42 |
| 1LC5 | 3DT6 | 6AH4GT | 6BY5G | 6T4 | 7X7 | 14B6 | #43 |
| 1LC6 | 3Q4 | 6AH6 | 6BZ6 | 6T8 | 7Y4 | 14F7 | #45 |
| 1LH4 | 3Q5GT | 6AK5 | 6BZ7 | 6U4GT | 7Z4 | 14F8 | #47 |
| 1LN5 | 3S4 | 6AK6 | 6C4 | 6U5 | 8AW8 | 14H7 | 50A5 |
| 1N5GT | 3V4 | 6AL5 | 6C5 | 6U8 | 12A8 | 14N7 | 50B5 |
| 1P5GT | 4BC8 | 6AL7GT | 6CB5 | 6V3 | 12AB5 | 14Q7 | 50C5 |
| 1Q5GT | 4BQ7A | 6AM8 | 6CB6 | 6V6GT | 12AQ5 | 14S7 | 50C6G |
| 1R5 | 4BS8 | 6AN8 | 6CD6G | 6W4GT | 12AT6 | 17AX4GT | 50L6GT |
| 1S5 | 4BU8 | 6AQ5 | 6CF6 | 6W6GT | 12AT7 | 17DQ6 | 50Y6 |
| 1T4 | 4BZ7 | 6AQ6 | 6CG7 | 6X4 | 12AU6 | 19AU4 | 50Y7 |
| 1T5GT | 4CB6 | 6AQ7GT | 6CG8 | 6X5GT | 12AU7 | 19BG6G | #57 |
| 1U4 | 5AM8 | 6AR5 | 6CH8 | 6X8 | 12AV6 | 19C8 | #58 |
| 1U5 | 5AN8 | 6AS5 | 6CL6 | 6Y6G | 12AV7 | 19J6 | #80 |
| 1V | 5AQ5 | 6AS8 | 6CM6 | 7A4 | 12AX4GT | 19T8 | #81 |
| 1V2 | 5AS8 | 6AT6 | 6CM7 | 7A5 | 12AX7 | 19X8 | 117L7GT |
| 1X2 | 5AT8 | 6AU4GT | 6CN7 | 7A6 | 12AZ7 | 25AC5 | 117N7GT |
| 2A3 | 5AV8 | 6AU5GT | 6CU6 | 7A7 | 12B4 | 25AV5GT | 117P7GT |
| 2A5 | 5AW4 | 6AU6 | 6DG6 | 7A8 | 12BA6 | 25AX4GT | 117Z3 |
| 2A7 | 5AZ4 | 6AU8 | 6DQ6 | 7B4 | 12BE6 | 25BK5 | 117Z4GT |
| 2AF4A | 5BK7 | 6AV5GT | 6DT6 | 7B5 | 12BF6 | 25BQ6 | 117Z6GT |
| 2B7 | 5BR8 | 6AV6 | 6E5 | 7B6 | 12BH7 | 25CD6G | 807 |
| 2BN4 | 5BQ7 | 6AW8 | 6H6 | 7B7 | 12BK5 | 25CU6 | 9002 |
| 2D21 | 5BZ7 | 6AX4GT | 6J4 | 7B8 | 12BQ6 | 25L6GT | 9003 |
| 2E5 | 5CG8 | 6AX5GT | 6J5 | 7C4 | 12BR7 | 25W4GT | 9006 |
| 2X2A | 5J6 | 6AZ8 | 6J6 | 7C5 | 12CA5 | 25Z5 | |
| 3A2 | 5T8 | 6BA6 | 6K6GT | 7C6 | 12CU6 | 25Z6 | |
| 3A3 | 5U8 | 6BC5 | 6K7 | 7C7 | 12DQ6 | #27 | |
| 3A4 | 5U4G | 6BC8 | 6L6 | 7E6 | 12J5 | #30 | |
| 3A5 | 5V4G | 6BD6 | 6L7 | 7E7 | 12L6GT | #31 | |

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## Short-Wave Converter

*Continued from page 71*

minute. The frequency range is now 5 mc on the high end of the dial and just above the broadcast band on the low side. Though precise alignment requires a signal generator, this method has proved adequate. Touch up the IF transformers for maximum sensitivity.

A *gimmick* connection that permits the reception of code (CW) with this receiver is also shown. Solder the two wires to the indicated pins and change their spacing until the code signal becomes audible as tone rather than a series of hissing sounds.

The writer has logged stations across the country, especially at night when signals begin skipping great distances. During the day small-boat captains provide a continuous flow of chatter on local fishing conditions. The converted receiver affords a simple and inexpensive road to short-wave listening.

## A Telephone Recording Beeper

*Continued from page 55*

available, adjust the tone to zero beat with F in the third octave about middle C of a piano (the twelfth white key from the right-hand end). On a piano tuned to the standard tempered scale, this note has a frequency of 1396.913 cycles—plenty close enough! Have the clock motor going while adjusting frequency.

Record the beep at 7½ ips. Move the tape back and forth past the playback head with your hands and mark the points where the tone starts and stops. Keep moving the leaf of the switch toward or away from the motor shaft until the tone is recorded for exactly 1½″ on the tape. Then the beep will be 20/100 of a second in duration.

With some transistors, it may be necessary to connect a capacitor, shown as dashed C1, to make the oscillator operate at the desired frequency. Try values between .0001 and .1 mfd.

The three small brackets shown are used here to mount the beeper beneath the tape recorder stand. If it is placed in a case, the case must be well ventilated; otherwise, heat from the clock motor may change the frequency.

## Short-Wave Listening

*Continued from page 33*

up-and-down motion it is said to have gone through one cycle. If ten waves come along in a second's time we can say they have a frequency of 10 cycles. If there were a hundred waves, their frequency would be 100.

At the beach you have seen waves come in very slowly; the distance between one wave and the next is long. But if hundreds of waves hit the beach you will see that they arrive one after another very quickly; the distance between waves is short. The distance between the top of one wave and the top of next is the length of the wave. In other words, the higher the frequency of the waves, the shorter their length.

What a broadcasting station does is push radio waves out into space. And each series of radio waves can be identified either by its frequency or by its length; one determines the other.

In radio a cycle is not too handy a word. Radio waves move so quickly that the words "kilocycle" (a thousand cycles) and "megacycle" (a million cycles) are used. The length of waves could be measured in inches or feet but since most of the world follows the metric system the wave lengths of short-wave stations are expressed in meters (1 meter equals 39.37 inches).

The regular radio set that picks up local broadcast stations covers the range from 540 to 1,600 kilocycles, or 555 to 187 meters. Short-wave sets run from 1.6 megacycles to at least 30 megacycles, or 187 to 10 meters. Many short waves go even higher in frequency, adding to the number of stations that can be picked up.

But the intriguing aspect of the short waves—and the heart of their usefulness—is their delightfully crazy behavior. Depending on whether it's day or night, winter or summer, this year or next, short waves travel different distances. On short-wave radio it may take only 40 watts of power to send the human voice from Chicago to Wellington, New Zealand. On regular radio a power of 50,000 watts would not make the jump.

The miracle of short-wave radio comes about through unseen "electronic mirrors" that rise and fall in the sky and reflect short-wave signals back to earth over vast distances.

But the enigma of the short waves only adds to the interest and fun of exploring them. Unlike other forms of radio, they are used for many different purposes, not only program broadcasting.

Leave behind the upper limit of regular radio around 1,600 kilocycles and a listener is immediately introduced to a veritable babble. Yachts and tugs, police alarms, weather bulletins of the Coast Guard, aviation stations galore and vessels plying the Ohio and Mississippi Rivers can be heard.

Want to know the correct time to the split second? Tune in the National Bureau of Standards (Station WWV) on either 2.5, 5, 10, 15, 20 or 25 megacycles. Or the Dominion Observatory in Canada (3.33, 7.33 and 14.67 megacycles).

The international stations come in clusters—on the 6, 7, 9, 11, 15, 17, 19, 21 and 25 megacycles bands. The trick is to try one band first, then the other until the best reception is found. Upwards of sixty languages are employed on the airwaves but almost every country now has some service in English.

The larger countries of the world have transmitters working on several bands simultaneously so do not be surprised to hear the same program in many different spots on the dial. The hobbyist may wish to hear just enough to identify a station definitely and then go on to the next country; the first hundred countries are the hardest!

But short-wave radio can be much more than a game. Weary of commercials and desire radio of some substance? Try the British Broadcasting Corporation, which has news, talks, games, plays and concerts and discussions of an extremely high order. The whole pace of BBC radio is leisurely and enormously civilized; it can be quite a change from television.

Let there occur a world crisis and short-wave listening is a primer in the trials and tribulations of modern society. Take the same news item and listen to how it is handled by the Voice of America, Radio Moscow, London, West Germany, Radio Bucharest, Ra-


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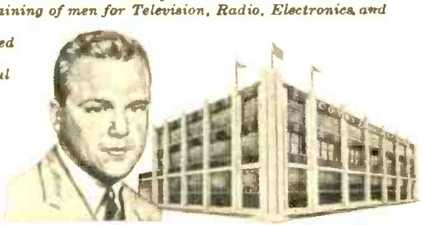

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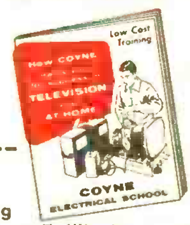


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dio Cairo, Radio Stockholm, the Voice of Zion in Jerusalem and the French Broadcasting System over Radio Brazzaville. Contrasts in emphasis and concern can be illuminating.

The SWL can hear for himself the Soviet jamming of the Voice of America; it resembles a million buzz saws working at once. If your interest lies in the United Nations, often you can hear the full proceedings in the 21 megacycle band.

Or perhaps one's taste may run to a reflective commentary on rural life in Scandinavia, some European jazz from Holland, the nightly rate of currency exchange as reported by Switzerland, lovely symphonic music from West Germany or an account of the latest happenings in Australia. Trying to learn a foreign language? There's no better place for some extra practice than short-wave radio.

On 8.9 megacycles it is possible to hear the trans-Atlantic airplanes reporting into Idlewild Airport in New York, Gander, Newfoundland, and Shannon, Ireland. Interest can be further enhanced by use of a map to pinpoint the latitude and longitude of a plane's location.

Morning, noon, and night there are the amateur radio operators. Mostly, their talk is of a technical nature but frequently one can overhear revealing remarks on different ways of life in various parts of the world. In terms of cordial and fruitful international relations the "hams" could give a lesson to the statesmen of the world.

Not the least of short-wave radio's attraction is its attraction for the younger generation—and indeed for adults—who either want a career or a hobby. The dial is a bedlam of code signals and sooner or later one's curiosity is pricked by what is being transmitted. Moreover, there is the endless fascination of perhaps trying a different aerial or adding a piece of supplementary equipment that will improve a set's performance. From there it is but a short step to study of the theory of electronics. Many outstanding engineers and scientists of today can harken back to their early experiences as an "SWL".

[*Continued next month*]

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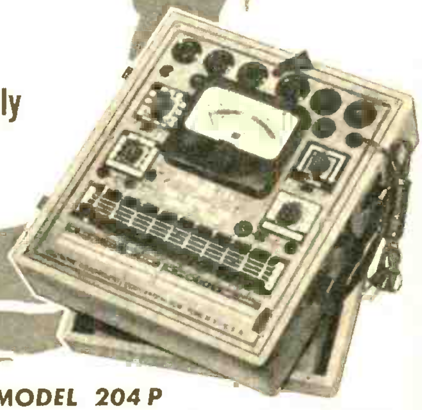

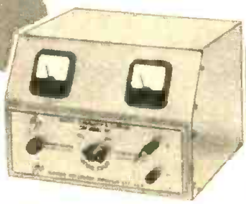

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An Emission Tube Tester, with a completely flexible switching arrangement. Test all tubes. Checks batteries under rated load on "reject-good" scale. Uses 25W line voltage control. Checks condenser leakage to 1 meg. Checks resistance up to 4 megs. Checks capacity from .01 to 1 mfd.

**Model 204P (illustrated) ........ $55.90**
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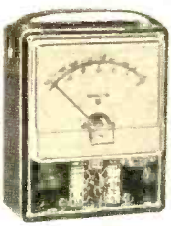

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## Mid-Air Collisions

*Continued from page 43*

it is supposed to be in the airlanes. HIDAN is made up of two parts—an external detection system which automatically figures ground speed and wind-drift angle; and a computer which continuously calculates the divergence of the plane from the planned position.

Directly attacking the mid-air collision problem, Federal Telecommunications Labs came up with a device designed to protect even the fastest jetliners from mid-air crashes. This system uses four miniature radars to search a pie-shaped sector extending in front of the plane. Return impulses from the radar feed an electronic brain in the aircraft which computes the hazard and possibility of collision—all within two seconds. The computer also determines the course to safety, which is presented to the pilot on a visual indicator. A horn alerts the pilot, who swerves the plane in the direction indicated. The system can "see" as far as eight miles.

Aside from proposed airborne search systems, an important factor in preventing mid-air collisions will be the way in which traffic control data and radar information is displayed to the controller. The new Charactron beam tube, developed by Stromberg-Carlson, is expected to replace many of the slow manual operations now used to identify aircraft.

With the Charactron, the controller gets instantaneous electronic displays of data. Information on incoming and outgoing flights—including the name of the commercial carrier, flight number, altitude and speed—is shown by letter-number symbols superimposed on the face of a radar screen. The sets of symbols move on the screen corresponding to the movement of the plane, providing up-to-the-minute identification.

At New York's vast International Airport (Idlewild), the CAA air traffic control center will soon have a Univac computer. Into this computer will be fed pilots' pre-flight flight plans for every take-off within a 300-mile radius. In a split second controllers at the center will know if two or more planes will be flying over the same location at the same altitude at the same time—or close enough to cause concern.

Even the ground control tower is getting the gimlet eye of safety experts, since it must provide an unobstructed view of all parts of the airfield at all times. At busy LaGuardia Airport in New York, one section of a runway hidden by three large hangars now can be seen from the tower thanks to a DuMont closed circuit television system. A light compensation unit provides correct lens settings for around-the-clock operation.

These and other new developments in electronics will gradually make safety in flying routine until that time when planes will be guided safely across country and across oceans with no hand at the controls.

But until that time, much depends on highly skilled aircraft controllers on the ground and first-rate pilots in the air. These men are not alone in the fight against mid-air collisions, for the CAA and the AMB are fast developing new electronic means to help them. The sooner these developments are used. the better—the Jet Age won't wait.

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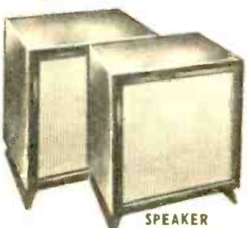

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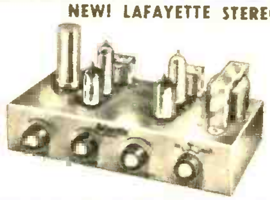

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## Add Sound to Your Movies

*Continued from page 62*

ord three with the first player, record four with the second player, and so on.

The next job is to set up the sound levels. Take the selection with the loudest passages and put it on one of the players. Record the passage, setting the tape recorder and mixer for optimum recording level. Then fade down the music by cutting the volume of the record's channel on the mixer. At the same time, bring in the microphone channel. Talk into the mike with the music continuing at a reduced level.

A little experimentation will establish the settings for music, for speech, and for music backgrounding speech.

In order to use some light so you can see what you're doing, it's best to set up the screen a short distance from the projector during recording. Since you won't be projecting for an audience, the resulting small image will be perfectly satisfactory for your needs.

The final preparatory step is to cue the film and the tape. Put a small piece of splicing tape on the starting point of the sound tape, and line this point up with a recognizable point on the recorder. Make a pinhole in the film leader a few inches ahead of the first frame. Start your first record spinning. Turn on the projector and watch for the flare on the screen when the hole in the leader passes the film gate. As soon as you see it, start the recorder.

Your sound track is now in the making.

When you want to insert narration, simply lower the volume setting on the record player's channel to the predetermined background position and bring up the volume on the mike channel. When the narration is completed, cut the mike channel out and restore the player channel to its full volume setting.

In order to minimize external noises, such as the projector motor, the mike channel should be kept at zero right up to the moment you're ready to talk and should be returned to zero as soon as you are finished.

To make switching from one record to another as easy as possible, keep both turntables spinning throughout the session. As the time for music change nears, put the tone arm on the appropriate spot of the new record. Then, when you actually see the cue scene on the screen, all you have to do is twirl two dials on the mixer.

In making a changeover, the first record should be faded out gradually and the new piece faded in at the same gradual rate. This transition is more pleasant than an abrupt change and is less likely to jar if the picture and sound aren't in perfect register. As soon as the first selection is "off the air," the record should be replaced with the next one slated for that player.

About the only way you can correct an error without a complete remake is to use a tape recorder that permits recording to be started after the tape is already moving in the playback mode. If you have such a machine, you can follow film and sound through to the music switchover that comes just before the error. Here you can break in without stopping either tape or film and record properly from there.

Now the film is completed, and you're ready to show it. For screening, all you need, of course, are the projector and the tape recorder. They are set up the same way they were for the recording session, with the projector behind and slightly above the recorder, and with the reflector mounted over the projection lens.

Just as in recording, the projectionist must watch his strobe-frozen stripes and keep the projector in synch with the recorder. However, should he goof, a hasty speedup or slowdown should set things to right.

For extra realism, it's a good idea to plug an extension speaker into your recorder and set it up by the screen. This will give you a real movie theatre effect. If you don't have a speaker but do have a hi-fi set, you can patch your recorder to the amplifier and put the screen near the speaker system of your rig.

The final success of your sound track depends mainly on the music. If you pick the right piece to establish the right mood at the right place, your production will shine.

Making a sound track is a lot of work, but that first showing will be well worth the effort.

## Nautilus Under the Pole

*Continued from page 39*

watch, monitor, and be able to keep the gear and circuits in proper function.

**Ques.** *Captain Anderson, exactly how did the Nautilus navigate under the Polar ice cap?*

**Ans.** I think my navigator, Lt. Sheperd Jenks sitting here beside me, can answer any detailed questions you may have regarding navigation problems on the trip. Why don't you take over, Mr. Jenks. . . .

**Ques.** *Thank you, Captain Anderson. Mister Jenks, as Nautilus' navigator, what would you say were the major electronic problems?*

**Ans.** Electronic navigation problems were pretty much solved. We have aboard two separate navigating devices, and of course they are both completely electronic. Our gyro-compasses are a Sperry Mark 19 and a Sperry Mark 23. In addition, we have an electro-magnetic log system to measure our speed through the water. Aside from these relatively conventional devices we've got an inertial navigating system, again completely electronic. This is the North American N-6A equipment. We approached our navigating problem by assuming that each device was entirely independent of the others. Fortunately, both the gyro and the inertial indicated the same solutions, agreeing on our position at all times.

**Ques.** *What is the conventional method of navigation?*

**Ans.** The primary method of navigating is "dead reckoning"—combining our gyro-compasses with our speed as indicated by the electro-magnetic log—and plotting from our last position to determine our present position. This is the "conventional" system but it's not really conventional, because the equipment we have aboard is highly refined and modified for high latitudes.

**Ques.** *Just what kind of modification was necessary for high latitudes?*

**Ans.** The compasses have to be modified for compass "settling" characteristics. The north-seeking force becomes less and less as you approach the Pole. When you get to the Pole itself, your compass has zero north-seeking force.

If your compass is no longer north-seeking, you can't use it. But you don't want to jettison all this equipment. So one modification converts the compass to a directional gyro, so that it indicates a straight line rather than true North.

**Ques.** *Could you very simply explain how the gyro-compass operates?*

**Ans.** A basic gyro-compass is similar to a toy gyro that can be held in your hand. As you rotate your hand under it, it continues to point in one direction at a constant point in space, rather than on earth. That's the gyroscopic principle. As the earth rotates beneath it, it changes only in relation to the earth. So a directional gyro, to be useful, has to be corrected for the rotation of the earth to keep it pointing at the same point on the earth, not the same point in space. This gyro is then refined to make it a north-seeking gyro. As the earth rotates, the gyro platform remains level with respect to space, and appears to "tilt" with respect to earth. This "tilt" is measured by an electrical signal it generates.

**Ques.** *Is the Sperry Gyrosyn a refinement of this?*

**Ans.** The Gyrosyn, our third compass, was designed for aircraft. Basically, it's a directional gyro-compass with a magnetic feature. The gyro, instead of being oriented to the geographical North Pole, indicates the magnetic North Pole.

**Ques.** *If you had this equipment alone, without the inertial guidance system, would you have successfully accomplished navigation under the North Pole?*

**Ans.** Yes. When we first made our plans for this trip, we did not have an inertial guidance system aboard. There was none available. They found this N-6A system, and installed it. This system was not made for shipboard operation; it was not designed to run continuously for long periods of time on shipboard and we weren't sure that it would operate properly. We had determined earlier that we could make the trip with our compass installation and dead reckoning. However, we wanted the inertial guidance system to check against the conventional systems. Almost up to the time that we left we weren't sure whether it was going to give answers or not, but it did operate perfectly. If one gyro system had failed the inertial system would have been real handy. It gave us a lot more confidence in our position, especially when we were under the North Pole.

**Ques.** *Is the inertial guidance system pre-set before the trip?*

**Ans.** The system is basically a gyroscopically controlled stable "platform," level in relation to the earth, with a central axis pointing to the earth's center of gravity. The system is capable of measuring the angle between the spin-axis of the earth, and its own Z-axis. This angle is closely related to latitude. The system is not capable of measuring longitude; it is only capable of measuring *changes* in longitude. So, the typical operation would be to set it up alongside the dock, a known position. It then calculates its own latitude. Setting in the longitude of the starting point, it will continually measure changes in longtitude and, through a digital computer, it gives a continuous reading of ship's position.

**Ques.** *Is there any way of navigating by the stars from under the Polar ice cap?*

**Ans.** No. Not while you're under the ice. If you can find a hole in the ice, you can surface, or put up the periscope, and get a celestial fix.

**Ques.** *How do you get a celestial fix while you are submerged through your periscope alone?*

**Ans.** Our installation is called "SCAR" for "Submarine Celestial Altitude Recorder." Basically, it measures the altitude of a known star sighted through the periscope; at the same time, from a stable platform, it measures the pitch or roll of the ship at the moment of sighting the star. Combining these you get the true altitude of the star, and you just check your navigational tables to get your celestial fix.

**Ques.** *Is this picture of what the periscope "sees" recorded automatically?*

**Ans.** I have a push-button on the scope and as the star crosses the hairline of the scope, I push the button. Altitude and time are automatically recorded for me as the celestial body crosses the hairline. There are a couple of things that look promising for getting a true navigational position from underneath the ice. For instance, once we get complete, accurate sounding information and find out where all the hills and valleys and peaks are in the Arctic Ocean floor, we can then navigate by using them for check points and fixes. We are working on this right now. Another possibility is to set off an explosion at a fixed shore station at a fixed time, and have sound equipment aboard ship to measure the time it takes to receive the shock waves. This will enable us to get a range and a bearing from the point of the explosion.

**Ques.** *Another method of navigation is getting a "loran" radio fix, which is very accurate in some oceans. Can we assume it is unreliable up near the Polar ice cap, even if you did get into an open water ice-lead?*

**Ans.** Yes. Communications in Arctic regions always have been poor because of atmospheric disturbances close to the magnetic pole. Continual daylight and continual darkness in different seasons, frequent cloudiness, the Aurora Borealis, all tend to make radio communications basically unreliable. There is no usable loran up there today. There are some radio direction finding stations for aircraft, but those are not very reliable. I believe that if we are to have submarines operating up there, that we'll need communications reliability, whether for navigation or for normal communications. It's just a matter of a little more research to find out what is the best equipment.

**Ques.** *One of the missions of some atomic submarines is developing the capability to launch guided missiles such as the Polaris. Submarines can be undetected missile-launching platforms. With the inertial guidance system and existing compasses, do you feel that you could navigate with the extreme accuracy necessary to a spot from which you could launch a missile?*

**Ans.** I think you can draw your own conclusions from the fact that we and the Skate were able to navigate across the Pole without getting lost.

**Ques.** *Could conventional, non-atomic submarines be able to navigate under the Pole?*

**Ans.** Nuclear power is the one thing that made this trip possible. Without it we would never have been able to do it. The main thing that nuclear power gives us is the ability to stay submerged for long periods of time. Also, there is no surface roll or pitch and consequently our navigational equipment has an extremely stable platform. That's one of the main reasons why our gyros operate so well.

**Ques.** *If a young man wanted to make a career in nuclear subs, what would you say would be the most important educational preparation he can make?*

**Ans.** Build up a good scientific background while he's in high school, primarily in mathematics. I think that mathematics and physics are all important.

**Ques.** *To what extent are the men in charge of the nuclear power plant electronics engineers?*

**Ans.** In charge of the plant are officers who have been trained in nuclear propulsion, reactor theory, reactor hazards. The reactor operator is an electronics technician or an inter-communications man with a heavy electronics background. These are the men who actually control the reactor and watch the instrumentation. The reactor is entirely electronically controlled, and the electronics technicians are schooled both practically and theoretically in reactor control. They not only operate all the circuits, but also do all the maintenance work.

**Ques.** *In all your electronic equipment, to what extent have transistors been used?*

**Ans.** Most of our electronic equipment still uses vacuum tubes or magnetic amplifiers. However, there are transistors in much of it. In the inertial navigation system there are quite a few.

**Ques.** *One last question—in so far as Arctic operations are concerned, what is the immediate goal for submarines such as the Nautilus?*

**Ans.** We are going to work toward year-round operation. We've only operated our submarines up there in the summertime, but we can see nothing that is going to keep us from achieving a goal of year-round operation.

**Ques.** *Thank you, Lt. Jenks . . . and Captain Anderson.*

## Secrets of Life

*Continued from page 39*

rules of admission or rejection to the signals, measures the nuclear size and optical density of the cells, and distinguishes between signals arising from normal and suspect cells. A high intensity cathode ray tube and oscillograph camera make recordings of the nuclear measurements. All computations are completed and recorded in less than one-fifth of a millisecond.

The National Institute of Health again turned to electronics with a scintillation counter designed to measure the amounts of food used by certain cells or parts of cells. It is known that viruses steal food from healthy cells. If medical scientists can find out which part of the food is stolen, they may be able to starve invading viruses without greatly damaging healthy cells.

In this connection researchers have developed balanced feeding fluids of amino acids (from which proteins are derived) to grow certain cells into sheets of living tissue. Viruses can be grown on these tissues. To study cell nutrition, the scientists make one element of the cell food radioactive and the cells absorb this radioactivity as they feed.

Measured portions of the cell material, along with the viruses, are then placed on discs which are fed one at a time into a chamber of ionizing gas (stable atmosphere). The scintillation counter then goes to work. The radioactive particles are not stable and yield impulses as they disintegrate. These impulses are picked up by the scintillation counter, greatly amplified, and then made to activate visible dials which indicate the different rates of disintegration for different samples. Thus researchers learn how much of the radioactive nutrient has been used by the cell for food, and how much has been stolen by the virus.

Through cell study and the resulting improved methods of disease prevention, diagnosis and treatment, you will probably have more years of life as well as a better life. And you can be sure that electronics will have played a big part in your good fortune.

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## A Child's Radiophone

*Continued from page 59*

through a section of flexible black tubing.

Remove the bell in the phone and use the dial as the tuning knob for the receiver. Modify this dial by cutting its shaft short and drilling a slightly undersized hole to fit the tuning capacitor's shaft.

C1 is mounted on a small metal bracket under the dial. The exact shape and size of the bracket, as well as its material, are unimportant. Use aluminum, steel, or brass, mounting the bracket with two or more machine screws and hex nuts. Depending on the bracket used, you may have to shorten C1's shaft to insure that the dial fits in a normal position. Cut off excess shaft length with a hacksaw, taking care not to injure the capacitor and making sure that no metal filings drop between its plates. With the tuning capacitor mounted, force the rotary dial over its shaft, applying a drop of general purpose household cement to secure in place. Finally, install the external antenna jack (J3) at the rear of the base.

Pass the free end of the handset cable through the hole in the telephone's base and secure in place by tying a knot in its end or by using a cable clamp. Install the transistors (TR1 and TR2) and the diode (D) in the receiver and mount the chassis in the base using small "L" brackets, spacers, and machine screws and nuts. Make sure that the battery holder can be reached easily.

Connect a pair of leads from the receiver chassis to C1 (previously mounted in the base) and the external antenna lead to J3. Complete the wiring by connecting the handset cable leads to appropriate terminals on the chassis.

With the assembly completed and final connections made and checked, install the batteries. Place the "Radiophone" in a normal upright position and hold the handset to your ear as you would a conventional telephone. Adjust the rotary dial to tune in different stations. If in a weak signal area, you may have to connect an external antenna to J3 for satisfactory pickup.

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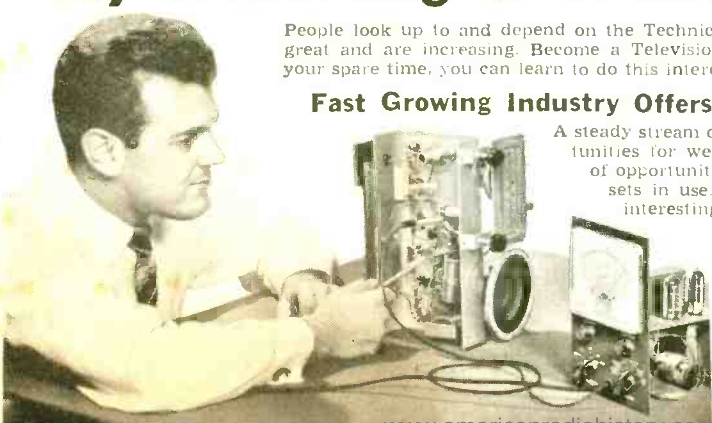
# "Lucky Guys...They're Set for Life
## Good Pay, Good Future, Prestige Jobs"


# Learn RADIO-TELEVISION SERVICING OR COMMUNICATION
# By Practicing at Home in Spare Time



People look up to and depend on the Technician, more than ever before. His opportunities ar great and are increasing. Become a Television-Radio-Electronics Technician. At home, and i your spare time, you can learn to do this interesting, satisfying work—qualify for important pa

## Fast Growing Industry Offers Good Pay, Bright Future, Succes

A steady stream of new Electronic products is increasing the oppor tunities for well trained Technicians. Right now, a proven fiel of opportunity is servicing the millions of Television and Radi sets in use. Hundreds of Television and Radio stations offe interesting jobs for Operators and Technicians.

## You LEARN-BY-DOING with Equipment NRI Sends at No Extra Cost

Well illustrated NRI lessons teach Radio-TV Electronic principles. Without extra charg you get NRI kits developed especially to giv you practical experience. You build, test, ex periment with TV-Radio circuits; build, use test ing equipment; use it to earn extra money.

# BIG NEWS!


# A RONDINE TURNTABLE IN KIT FORM

## only $39^{95}

Also see the all-new, improved factory-assembled Rondines at your dealer!

A revolutionary breakthrough in the industry! A stereo turntable kit with traditionally superior Rek-O-Kut performance! It's engineered to give Rek-O-Kut's famous silent operation, eliminating all traces of record changer rumble in stereo disc playback.

The kit contains the same exclusive, precision-machined turntable and bearing-well used on all Rondine models. Assembles easily and quickly to the deck plate. The motor installs on a specially-made mounting plate. A minimum number of working parts go together accurately, in 30 minutes or less . . . reflecting the simplicity and trouble-free operation of Rek-O-Kut design. This new Rondine offers you superb quality...unmatched performance, the kind you need for better monaural reproduction...the kind you **must have for stereo!**

### ADVANCED FEATURES OF NEW RONDINE K-33 STEREO TURNTABLE!

- Single-speed (33⅓) Crown-Spindle Belt Drive. Custom-made endless-woven fabric belt with thickness held to ± .001. Adjustment for belt tension.
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- Noise level: 47db.
- Motor: 4-pole induction, designed and built to Rek-O-Kut specifications.
- Built-in strobe disc for checking speed.
- Turntable: Heavy Cast Aluminum, lathe-turned. Tapered for easy disc handling.

### PERFECT TURNTABLE MATE...AUDAX TONEARM the only stereo tonearm in kit form!

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