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November, 1959
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A Message From the Editor

Well here we are in the middle of the hi-fi season. Chicago and New York have had their hi-fi shows, there is one now going on in Kansas City and very soon there will be one in Los Angeles. Stereo once again is stealing the show. For this reason the stereo record report in this issue merits your special attention. The information we gathered during our heartbreaking destruction of good records for this exclusive laboratory test report should increase your enjoyment of stereo records and help save those which you treasure most. We would like to take this opportunity to thank the Glaser-Steers, Garrard, Miracord, Heath and Webcor companies for submitting their record changers and the Shure, Electro-Voice, General Electric, Argonne, Pickering, Fairchild, Dynaco and Ronette companies for lending their stereo cartridges. Our thanks also to the various record companies who sent us records for these tests, especially London whose new recording of Petrushka we so mercilessly played to destruction.

Worthy of note in these back-to-school days is a new approach to public school education that could offer significant economies in overall school budgets while increasing quality of education. In this proposal by an executive of General Electric, a system of about four educational TV stations would serve all schools within a radius of 30 to 40 miles. These stations could be built for less than the average cost of one new classroom per district or about $28,000. The operating cost per student would break down to about $8.42 annually. This is less than 2% of the average $493 percent cost of education per student annually. The TV stations would permit an average of 1/2 of the school day to be taught by television in each of the grades, 1 through 12. Educational television has in the past been proposed as the only way that a vast number of students of all ages can be reached by the best teachers effectively, and this may be one step in this direction.

Many listeners to the shortwave bands may not know that an organization in Great Britain runs a contest strictly for them. This contest is being held on November 21 and 22 this year by the Radio Society of Great Britain. Actually there are two contests run simultaneously, one for radio amateurs, the other for shortwave listeners. These are separate and distinct and there are prizes awarded for the top entries in each. For additional information write to the Con-trove breakup was visible halfway through tests.
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Your editor visited the New York City Coliseum when the Russian Exhibition was in progress. I was accompanied on this trip by Mr. Lloyd Mallan author of Fawcett book, "Russia and the Big Red Lie," who spent two months travelling throughout Russia visiting top research labs, satellite tracking stations, etc. His comments comparing what the Russians displayed at the Coliseum with what he actually saw in their country were so enlightening that we are bringing them to you in an interview right off the tape recorder.

In our continuing tests with the new Class D Citizens Radio band, we recently erected a large ground plane antenna on the roof of our building and installed quarter-wave whip antennas on our cars. All of our tests to date indicate that the reception and distance covered depends to a great degree on the antennas used. If you plan to get the most out of your new two-way radio, read the article in this issue on antennas for this band. Incidentally, a recent notice from the FCC reports that of 100 violation notices sent out to licensees of Class D stations, Section 19.61 (c) of FCC Rules and Regulations was violated in 61 instances. This section requires that you be brief and to the point while on the air. Forty-four violators were would-be hams using this band for long distance rag chewing. There were also 57 instances of off-frequency operation. This band was given to us for a specific purpose—it can be taken away for excessive violations. The FCC will continue to monitor Citizens Radio frequencies. Let's keep this band!

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November, 1959
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...News

Yashica, a name long associated with
cameras, is now appearing on transistor
radios. The new Yashica YT-100 port-
able employs a superhet six-transistor
printed circuit with a frequency range
covering the complete AM broadcast
band. Measuring 2¾"x4½"x1½", it has a
high-impact case. $39.95/with ear-
phone, battery and leather case.

A new line of cartridges has been an-
nounced by General Electric. Called
the VR-22 series, two stereo units are
available; the VR-225, with a .5 mil
diamond stylus for professional turn-
table systems and the VR-227, with a .7
mil stylus for record changer and turn-
table use. The VR-225 is said to have
a 20-20,000 cycle frequency response
within 3 db and a tracking force of 2-4
grams. The VR-227 is claimed to have
a frequency response of 20-17,000 cycles,
and a tracking force of 5-7 grams.
The cost of the VR-225 is $27.95 and
$24.95 for the VR-227.

Electronics Illustrated
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News

JFD Electronics Corp. announces a new series of FM antennas for primary, secondary, and fringe areas. The Stereo Cone design consisting of 8 multi-element dipoles is packaged in two forms: the "Attach-It" for existing TV Antenna installations and also as a complete kit with all accessories. JFD is also producing a special FM Folded Dipole and Reflector Kit, and a Stereo Fringe FM antenna featuring a 6-element Satellite dipole Yagi System. Prices are $15.95 for the AFM 100 Stereo Cone Kit for new installations; $13.95 for the AFM 150 Stereo Cone "Attach-It," $14.95 for the AFM 200 Stereo Folded Dipole Kit; and $23.50 for the AFM 300 FM Yagi.

A Shield remote speaker with a built-in volume control has been made available by Olson Radio Warehouse. Volume control will not affect other speakers connected to sound source. Model CA-121 has a walnut casing in a high gloss finish with contrasting plastic grille. Its 4" PM speaker rated at 3 watts can be used with any phonograph, radio, TV, or intercom. One of the 8"x5¾"x 4¼" speakers is priced at $5.19—3 for $15. Olson Radio Warehouse, 260 S. Forge Street, Akron, Ohio.
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November, 1959

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Have you ever had to search for the correct size tools while you’re trying to install a hi-fi cartridge? Fairchild Recording Equipment Corp. has solved this annoying problem by including a kit complete with all the tools necessary to install their new SM-1 monophonic and stereo cartridge. A stylus gauge, and directions in English, French and Spanish are also included. The complete kit, with cartridge of course, is priced at $34.95 from Fairchild at 10-40 45th Avenue, Long Island City, New York.

The Vandel Alarm, a centralized sound surveillance system designed by Bogen-Presto, detects the presence of any intruder unbeknown to him. Loudspeakers operating as microphones are placed in the building. When the noise level of an area rises, an alarm is sounded in the watchman’s station signalling trouble may be brewing. The operator can turn off the alarm and listen for suspicious sounds picked up by the loudspeaker-mike.

IBM recently presented an IBM digital electronic computer experimental kit to the Electronics Institute in Detroit. This model, to be used in the Institute’s recently incorporated computer phase of the Electronic Engineering course, is an example of a laboratory instrument used in the design of basic circuits for a large IBM computer.
November, 1959

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...News

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Cleveland Institute of Electronics
4900 Euclid Ave., Desk El-14, Cleveland 3, Ohio

November, 1959
... News

A carrier current intercom, designed to plug into any wall socket supplying 110 volts current has been announced by Bennett Laboratories. The unit employs an automatic squelch control which eliminates noise while the intercom is idle. The monitor switch, a special feature, allows one intercom to be set for "constant talk" thus making it perfect for baby sitting. This wireless unit is priced at $44.75 for one. Further specs available from Bennett Laboratories, Emeryville, California.

Thermoelectricity will eventually be everywhere (see September 1959 EJ). Even hundreds of fathoms below the surface of the oceans. RCA is now planning to employ thermoelectric principles to cool our submarines. Because there is no need of compressors, motors or other moving parts, the equipment can be made more rugged, compact and more flexible than conventional air conditioners and will be easier to maintain, say RCA scientists.

"Death rays," and everything from countermissiles through antigravity in conjunction with defense against missile attack will be studied by Technical Operations, Burlington, Mass. The Defense Department has given the firm a $127,600 grant for this purpose.

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how good are Stereo Records?

If you want your records to last, here's what to do, as determined in our actual lab tests.

Electronics Illustrated has just finished nearly six weeks devoted to torturing the life out of stereo records under every conceivable condition of pickup installation, stylus force, and record care, to find out once and for all if the stereo disk is the born-today, dead-tomorrow weakling some have claimed it to be.

The heartening result: by following the principles outlined in this article the user can make his stereo records last, in usable

Battery of record changers, each with different pickup, played small number of grooves on each record hundreds of times. Records were inspected often and condition noted.

November, 1959
Microscope was mounted on wood bracket for ease of examining record grooves. Pilot lamps illuminate area.

Careful checks were made on various styli through microscopic examination. All were diamond, displayed little wear.

A cartridge is installed in tone arm of changer. Group of pickups (on the table) was chosen from available types.
form, for as long as he will conceivably want to hear them. “In usable form” requires a careful definition, which will be supplied in a few moments. Playing life, with long-life rules reasonably applied, will be in the range of 200 to 400 playings, probably many more than most record users will require of any record. By exercising special care, you can extend this several times over!

Here is a quick summary of the main long-life rules for stereo disks:

(1) Use a high-compliance, low-mass pickup—no other rule is more important.

(2) Set the stylus force correctly, using an accurate gauge, and check it from time to time. This rule is far more important than it was with monophonic pickups. Some of the inexpensive gauges available are wildly inaccurate.

(3) Cleanliness is equal to godliness, when it comes to making stereo records live. Keep a record really clean and you keep it going for an astounding number of plays.

(4) The stereo pickup must be installed with great care, to insure long record life.

How The Tests Were Made

The tests were made with the battery of Glaser-Steers GS-77 changers seen in the photographs. A solenoid was attached to each changer so the change cycle could be tripped with the pickup at any point on the record. The solenoids received 15-volt DC current through the relay systems seen in back of the changers. The relays were energized when the spring wires projecting back from the pickup arms met the upright
contact bars. The contact bars could be set to meet the wires when the pickup was at any point on the record.

By setting the index screw on the changer for the desired beginning spot, and the relay contacts for the desired ending spot, any part of a record, no matter how short, could be played automatically and repeatedly. In the tests, record bands not exceeding about 35 seconds playing time were used, in order to bring the total time within reasonable dimensions, and to put worn and unworn bands side by side on the record, for help in evaluating record wear.

What Is Wear

This brings us to the sticky question: what is record wear and when is a record "worn"? Investigation of top professional opinion on this subject lets you down through a net of intangibles. The head engineer of one of the largest recording companies said: "The decision on when a record is worn is just as subjective as that on when a tire is worn. You can keep going quite a while on a badly worn tire. The same applies to a record."

Not only the listener's personal standards, but also the refinement of the playing equipment affects the decision materially. Further, there are many kinds of record wear. Some of the most important are:

1. The extreme top highs above, say, 7500 cps will be worn off; but on a great deal of playing equipment (and with perhaps a majority of adult ears) this will be more or less unapparent.
2. The general noise level inevitably goes up with wear.
3. The groove wall at points of heavy modulation may break down, causing mistracking with its shatter or buzz.
4. Heavily modulated passages develop "modulation noise" which is a function of level. The result is a fuzz "in back of the music," which in its beginnings may be very subtle, a slight "veil" apparent only on careful comparison with the same passage on an unworn record. Many listeners are unaware of this effect until it is pointed out.
5. Loud bursts can be carried through from one groove to the next, an amusing effect in some cases but one putting an effective end to the record's useful life.
(6) Very complex high level passages may develop intermodulation distortion, by deformation of the record under influence of the heavy lower frequencies.

(7) Soft passages, particularly solos, wear hardly at all; a quiet violin passage may go on practically forever. No one has come up with a way of putting any of these effects into numbers. In the present tests, the seriousness of wear was evaluated in three main ways.

First, the existence of low-level wear was determined by A-B comparison between the worn passage and the identical passage on an unworn copy of the record. Two Pickering Gyropoise turntables, with identical pickups, were set up for all A-B comparisons.

Second, worn records were compared with each other, to determine which was the worse worn.

Third, wear ratings were assigned, based on group evaluation, in three broad classes: Class I, wear perceptible, but not at all bothersome; Class II, wear strongly evident, but record still playable if the music is badly wanted; Class III, record destroyed—unplayable.

Admittedly these are imprecise and [Continued on page 96]
The Philco all-transistor TV is truly portable—no line cord. You look at a 7½ X 4½ inch mirror but see a 10½ X 7¼ inch picture thanks to curved mirror in optic box. Picture tube is stuck in at bottom. Finger points to small deflection yoke.

Transistor TV Portables

One is on the market now with more to come. El checked the Philco and reports on its innards.

In the midst of persistent rumors that the Japanese had an all-transistor TV set which they were going to market in this country and after RCA and G-E displayed laboratory models three and one year ago respectively, Philco beat everyone in the world to the punch and produced the first transistor portable TV set for the market. This 15-pound, 21 transistor job sells for about $250 and is oil-can size.

What size picture does it have on its mirrored screen? Well, it all depends on how you look at it. As a matter of fact, the distance from which you view the picture will determine the size picture you see. From the optimum viewing distance, about four and one-half feet from the face of the set, you see eighty square inches of picture, approximately the same size as the picture you get from a conventional 14-inch picture tube. This picture is magnified seven times from its original size on the receiver's postage-stamp-size cathode ray tube. You view a larger picture because you look at the apparent image through first a 45 degree and then a concave mirror. This mirror system has the same advantage as the old-time projection TV receivers which were popular over ten years ago when direct view tubes were limited to about ten inch size. The projection system gives you the effect of viewing a much larger picture, however, and herein lies [Continued on page 92]
Close to 90% of components are on printed wiring boards but high voltage cage is separate. Two rectifiers are used, these and CRT are the only tube types in entire set. The special battery pack consists of five alkaline rechargeable units good for 80 hours. Recharger is built into receiver.

The Emerson 17 inch direct view transistor TV looks like conventional "portable," will be available in 1960. This uses a rechargeable battery.
Compact Simpson scope has 5-inch tube for general purpose work. Horizontal and vertical lines (grid) over face of tube aid in calibration, measuring signal voltage.

Milt Kiver on Oscilloscopes-1

They are easier to operate than they look, and there is almost no limitation on their usefulness.

THE oscilloscope is one of the most important test instruments the technician has. Unfortunately, it is also the one that is understood the least, so that many who have oscilloscopes seldom use them.

Actually, the oscilloscope should be no more difficult to adjust than a television receiver since both possess many features in common. On the front panel of the oscilloscope you will find positioning controls which move the pattern up or down and to the right or left, focusing controls which bring the beam to sharp focus, gain controls which increase the height or width of the pattern and an intensity control comparable in its action to the...
Fig. 1. Block diagram showing major sections of a general service oscilloscope.

The magnetic shield around the cathode ray tube in this DuMont keeps beam sharp.

Fig. 2. C. R. tube's electron beam generating and deflecting elements are below.
Fig. 3. Two sets of deflection plates, one horizontal and the other vertical, bend the electron beam in a cathode ray tube as shown in this diagram.

Fig. 4. This is a perfect sine wave pattern as it may appear on the face of a cathode-ray oscilloscope tube. The distance of each point above axis corresponds to its voltage.

brightness control on a television receiver. There are additional controls which have no counterpart in television receivers, but their adjustment is not difficult and can be mastered easily by anyone who can use a VOM or VTVM.

The chief function of an oscilloscope is to enable you to see what is occurring in an electronic circuit. It will show you the form of the voltage which is present or the shape of the current flowing through the wires. The oscilloscope will also enable you to measure the peak amplitude of any current or any voltage.

Accurate frequency measurements are another feature of an oscilloscope when this is combined with an auxiliary signal generator. Finally, when used in conjunction with a sweep generator, an oscilloscope will enable you to visually adjust a tuned circuit. This is particularly valuable since you can see the effect of each adjustment and ascertain when the precise alignment point has been reached. In a radio set, it is possible to properly adjust the RF and IF coils by using only a signal generator and a VOM or VTVM. In a television receiver, this approach is not nearly as accurate because of the wide bandpass of the circuitry. It is here
that an oscilloscope simplifies the alignment procedure considerably and enables you to achieve a high degree of accuracy. The same is true in FM receivers, although to a somewhat lesser extent.

A block diagram of a cathode-ray oscilloscope is given in Fig. 1. The principal components are the cathode-ray tube, a sawtooth sweep generator, vertical and horizontal deflection amplifiers, and suitable controls, switches, and input terminals for the proper operation of the unit.

The heart of the oscilloscope is the cathode-ray tube (see Fig. 2). This is similar to the picture tube in a television receiver except that the beam is deflected electrostatically by plates, rather than electromagnetically by a coil mounted on the neck of the tube. The scanning beam starts at a cathode capable of emitting a relatively large number of electrons. These electrons are forced to pass through a cylindrical control grid which is completely closed at one end except for a minute circular opening which permits only a small beam of electrons to pass through. The grid serves the same function here as in any conventional electron tube; that is, it controls the number of electrons which leave the cathode. Thus, by varying the potential on this grid, we can control the intensity of the beam.

Further beam concentration occurs in several additional cylinders which follow the control grid. These cylinders, known as anodes (i.e., Nos. 1, 2, etc.) have positive voltages which not only attract the beam forward but also vary its diameter. The extent of the latter action is determined by the relative voltages between the anodes and by varying these voltages, we can alter the beam focus at the screen. The control which does this is known as the “Focusing Control.”

Once the electron beam has been formed, it is accelerated down the length of the tube by high positive voltages on the forwardmost anode and also on a special coating which is deposited around the inner side of the cathode tube bulb. This coating, known as an “aquadag” coating, consists chiefly of graphite. It not only helps accelerate the electron beam to the fluorescent screen but also shields the beam electrostatically and provides a return path for the electrons after they have served their purpose at the screen.

The end goal of the electron beam is to strike a fluorescent screen which is deposited over the front end of the tube.

[Continued on page 94]
It took a year to construct, but all agree it was worth the trouble. Here the boys rotate the antenna by hand and rope, while phone contact is maintained with room downstairs.

Highschool Boys Build a . . . . .

Homemade Radio Telescope

A FLOCK of schoolboys at the Dartford Grammar School near London, England, has been stealing some thunder from professional radio astronomers at the huge Jodrell Bank radio telescope. They have built their own private radio telescope, and it only cost them £15 ($40)! This isn't an adolescent joke, for as you can see, their 12-foot-wide dish antenna has become a permanent fixture on the school's roof. Like its big Jodrell Bank brother, it can be aimed (manually) at any point in the sky.

The youths already have pulled in signals from the Milky Way, our sun, and the constellation Sagittarius. Led by 16-year-old Doug Miller (who has been an electronics buff since age 13), the boys ripped apart a donated TV set to obtain parts for receiver.
Antennas For Citizens Radio

By Len Buckwalter
Associate Editor

To get the most range out of Class D 2-way radio you need the best antenna—here's what's available.

All the antennas pictured here are departures from the basic type—the half-wave dipole. For Class D Citizens Radio, a dipole consists of a wire, approximately 17 feet long, fed at the center with coaxial cable. For mobile use this length is inconvenient; for fixed stations, improvement is possible.

The vertical whip is one answer to the problem of carrying 17

This is a full size 1/4-wave ground plane antenna, the model GP-1 made by Hy-gain and sold for about $30. Author is using an indicator for tune-up.

Tele-beam 1/4-wave ground plane has loading coils in its elements.
feet of antenna atop a car. It is cut to a quarter-wave, or half the length of the dipole. When mounted, the body of the car itself is electrically equivalent to the missing quarter wave.

The 8½ feet of whip may also be reduced. It takes the form of the 2 or 3 foot clip-on antenna that mounts easily on the car's rain gutter. A loading coil is used to achieve this extremely short length. Its effect is to electrically lengthen the whip to 8½ feet, but permits it to remain physically short. This is a compromise. Full transmitter power is absorbed by the coil and whip, but the radiation is less than with the full 8½-foot whip. Of course, a shortened whip with no loading coil is virtually useless.

A popular fixed station antenna is the ground plane. An 8½-foot radiator is mounted vertically. Several radials are attached to the base and slant down and away from it. The radials establish a good electrical ground for the radiator, usually located atop a building. The ground plane, shown on page 41, may be shortened with loading coils, in the interest of saving space.

The beam is among the high gain antennas, and the most elaborate. A reflector and director are spaced on either side of the 17-foot dipole. Power is radiated in just one direction (toward the director). Essentially, the multiplication of power is caused by beaming the energy into a narrow arc. The beam is not customarily used for working mobile stations since the cars may be located on the "dead side." But, it yields the greatest range between two fixed stations.

Installation

In mounting a mobile antenna, bumper and clip-on mounts can solve one problem—marring the body of the car with drill holes. The cowl mount, replacing the original broadcast antenna, is another resort. If drilling holes is not a factor, the traditional whip loca-

[Continued on page 95]
Small loaded whip antenna shown on this receiver is sold by Globe Electronics for under $6. This unit can also be modified for use on auto. It is telescopic type.

The Tele-beam "Magic Wand" automobile fender-mounting antenna shown below is a loaded whip which replaces broadcast whip, is used for both sets.

The Heath clip-on base loaded whip shown here can be placed on rain gutter of any car and is removable. The car acts as ground.
Electronic Photoquiz

By John A. Comstock

Identify the five "familiar" items pictured here. They are likely to be found on, or near the electronic hobbyist's bench. Correct answers are on page 100.
El report on the

Russian New York Fair

ANYONE who exhibits at a State Fair puts his best foot forward. It was common sense to expect, then, that the Russians would show the best of their electronic equipment, home conveniences, cars, etc., at their Fair in New York City this past Summer. We expected to see the best of what they had, that is, NOT the best they could handmake for special exhibition purposes. We are not stating definitely that this is in fact what they did, rather, we will let this interview speak for itself.

Lloyd Mallan, widely read and respected analyst of missile and space research, and EI Editor Charles Tepfer walked through the Coliseum in New York City, took pictures of the electronic equipment models, talked with the Russian guides and science advisers and recorded their comments on a miniature Dictet tape recorder. Lloyd had just returned from a two-month, 14,000 mile tour through European and Siberian Russia. During this trip he had visited private homes, lived in hotels, gone to department and special stores, observatories, research labs, and universities. Here we present Lloyd’s comments and answers to EI Editor Tepfer's questions, not as an electronics expert but as a careful and astute observer.

21-inch Russian TV set resembled latest models available from capitalistic U.S. but, American visitor to USSR did not see a set over 14-inch size there.
Notice the tuner in this plastic-cased TV set. It looks exactly like U.S. Standard Coil unit. Russians claimed this TV set worked off auto battery, had transistors—but wouldn't open it.

Lloyd, I count twenty-four distinct TV models on display here. Did you see these TV sets during your trip to Russia?

No, except that model on the end of the counter, the one that's sort of squared-off, it looks similar to the general style in use.

Here. See this portable . . . ?

... but I never saw a portable TV receiver in the Soviet Union. Not in 14,000 miles of traveling there.

Not even in any of the big department stores in Moscow?

Never. Nor even in any of the luxury hotels or anywhere else.

Now here's a unique receiver. About a 21-inch screen, I'd say. See, you can fold it back into the table, like a sewing machine. There's an inlaid chess board on top. Did you ever notice anything like this in Russia?

No, I never saw it before. This is the first time, right here in the New York Coliseum, but this may be an advance model for 1960.

This TV receiver is designed to work off a car battery—it doesn't seem much heavier than the Philco all-transistor battery portable we tested recently. Lloyd, did you ever see this model in Russia?

I never found a TV set in any of the many Intourist cars I rode in. Actually I can't recall their even having radios and Intourist is the official greeter and guide for almost all foreign travelers in the Soviet Union. You'd think they would want to make an impression on foreigners—if they had anything like this.

There's a model of a completely automatic airport nearby. I'd like your opinion of it.

Fine. I'm quite familiar with Russian airports. All of my travel there, except locally, was by air.

Here it is. How many airports like this did you land at or take off from?

Not one.

Not one? How about Moscow?
I repeat. Not one. Vnuko Airport at Moscow is probably the Soviet Union’s most important commercial airport. In fact, it’s the international airport. The only kind of radar I noticed there was ILS (Instrument Landing System) radar. It’s the only kind of radar I ever saw at any airport in the Soviet Union. There were no height-finder radar antennas—not even at air defense centers.

**Ques.** You saw air defense installations?

**Ans.** At least five of them.

**Ques.** How did you see these air defense locations? You mean, you flew over them?

**Ans.** No, I saw them closeup. I even landed at two of them—the big air defense center at Yerevan, in Soviet Armenia, and another big one at Kharkov. Not one of the five had a height-finding radar, such as is shown here in this model. In fact, this little model looks as if it was copied exactly from pictures of American height finders.

**Ques.** Here’s some interesting looking electronic devices for nuclear research. Here they have what appears to [Continued on page 89]
Above, preamp is shown unplugged from other units; audio amplifier, AM tuner and power supply at upper right. Left, project plugged together.

the E I

Build-it Course-3

Add a preamplifier to the plug-in projects already described. It controls tone, volume and equalization.

To date, a basic power supply and amplifier have been described in this series of plug-in units that form the building blocks of a working unit. The preamplifier is introduced here.

In present usage, the preamplifier has come to mean more than just a tube that brings signals up to the proper strength for feeding the main amplifier. Preamps also have equalization and tone controls. In more elaborate equipment, they provide a control center where most-often used knobs are mounted on one convenient panel.

First a look at equalization—and why it's important. When a recording is cut, two undesirable effects occur. Strong bass notes cause the stylus to cut inordinately wide grooves. High tones, on the other hand, produce an opposite effect. Groove modulation is weak, and quite often lost in the noise on the record surface.

In an effort to counter this, bass tones are reduced and treble tones boosted before being fed to the cutting head. Although the two original problems have been corrected, what happens when
Underside view of preamplifier, completely wired. Schematic is at right. SW2, the AC power switch seen at lower right, is actually attached at rear of volume control R28 (at upper right).

C12, below, is removed for clarity. Center lugs on Bass and Treble controls are soldered together.
**HOW THE PREAMPLIFIER WORKS**

**EQUALIZATION**

First stage boosts low-level signal from magnetic phono cartridge. Equalization, boosting bass and reducing treble, takes place in the resistor-capacitor network. Signals pass through DC blocking capacitor CA, then load resistor RA. They encounter the series combination RB-CC. As frequency increases, it finds an easier path to ground through CC. This is due to the decreasing reactance of capacitor CC at the higher frequencies. The lows reach the tube grid since they would find a difficult path to ground through CC. Further shunting of the highs occurs through capacitor CB. Net result is bass boost, treble roll-off.

**CATHODE FOLLOWER**

Phono signals enter the selector switch SW. Tuner signals need not be equalized since this is done at the radio station. Cathode follower is an impedance transforming device. High impedance of the previous stage is reduced to a low value and signals are fed to tone controls from top of cathode resistor RD. RC is grid resistor. Purpose of low impedance at this point in the circuit is to prevent interaction with input. The second half of the tube is an amplifier. It boosts signals that have passed through the tone controls. The plate of the tube feeds the main power amplifier. See upper right. Signal level is approximately 2 volts.

**TONE CONTROLS**

Potentiometer RE affects treble response. RG controls Bass. Signals containing both highs and lows appear at the top of the network. High tones enter CD-RE-CE. CD has low reactance to highs and they appear across RE. Arm of RE receives desired amount of highs, depending on its position. When moved up, maximum voltage is fed to tube grid. Low tones encounter high reactance at CD and appear across the bass leg at right. The arm of RG selects desired amount of bass voltage. Basically, each section of the tone control is an AC voltage divider, capable of discriminating between high and low frequencies.
Plug PL2 is at rear of preamp, selector switch SW1 and phono jack along the side.

The equalizer and tone control circuits are basically the same. The equalizer's response is fixed, however, since it must conform to a specific curve (RIAA). It is in the tone control section where continuously variable potentiometers allow for variation in the system's response. The heart of both circuits is a simple resistor-capacitor

[Continued on page 112]

The recording is played back in the home? It will sound deficient in bass, with far too much emphasis in the treble range. Here is where the preamp's equalization circuit operates. It boosts the bass and reduces treble. This is simply a reverse process when compared to the equalization used by the recording engineer.

The preamplifier illustrated here utilizes RIAA (Record Industry Association of America) equalization. This was adopted by the industry several years ago as a standard. Previously, many companies equalized differently, necessitating a preamp that could compensate for each one; NAB, AES, etc.

This preamplifier is designed for a magnetic cartridge on the phono input. One important consideration is the input resistor. Various cartridges work into different loads. Resistor R14 is shown as a 27,000 ohm unit, but the manufacturer's literature should be consulted for the optimum value of a particular type.

A selector switch permits the use of a tuner input. Tuner signals are not low-level and therefore may by-pass the first stage of amplification. They are fed directly into the tone control circuit.

Tone controls are an important adjunct to the playback system. They permit the listener to balance the sound according to individual preference. Variations in room acoustics, and speaker systems may be compensated for by tone controls.
Two Amplifiers Feed One Speaker

How can I connect a single speaker to two different receivers, both receiving the same program but on two different frequencies? This would help to reduce the effects of fading on one frequency since the fading pattern would be different for the two frequencies.

J. A. Russell, San Diego, Calif.

This idea has much merit and will reduce the effects of fading substantially, particularly when the two stations broadcast on frequencies that are well separated in the spectrum.

The diagram above shows the best way to do this. The two output transformers should be of the “universal” type with a number of taps on the primary of each one to enable you to establish the best impedance match between the particular output tubes you have in each radio and the speaker to be operated. It goes without saying, of course, that the individual receiver gains should be adjusted so that they are as nearly alike as possible. The system would work best with two identical receivers, if this is possible in your case.

When the circuit is finished, the transformers should be phased properly to prevent cancellation of signals. This is best done by listening; if the output is weak, reverse the wires on the secondary of either of the two output transformers.

TV Interference Filter

Our local television station operating on Channel 10 blocks our reception of other more distant stations on Channels 8, 9, 11, and 12. Can I remedy this difficulty?

Dave Currie, London, Ontario

We would interpret the word “blocks” as used in your question to mean that the signal strength of this television station is so great in your location that its influence extends into the tuning range of the other channels you mention. If this interpretation is correct, you can cure your trouble by installing transmission-line rejection filters at the terminals of your present antenna feeders. These traps must tune very sharply to Channel 10; that is, from 192-198 mc.

The most convenient way to do this is to cut a length of twinlead somewhat longer than a quarter-wave at the rejection frequency. For Channel 10, connect a two-foot length of twinlead directly to the antenna terminals of the receiver; then, using a pair of diagonal cutters, remove ½ inch of the twinlead at a time while watching the picture. As you approach a quarter wavelength (about 1 ¾ feet), the signal should begin to show evidence of weakening. Continue to do this until you get the “snowiest” picture; this is maximum attenuation, obtained by what is referred to as an open, quarter-wave rejection line. Naturally, you want to attenuate Channel 10 only when receiving other channels so that the rejection filter should be removed when receiving this channel.

Electronics Illustrated
Shorted Tuning Capacitor

All I can get are crackling noises below a certain spot on the dial of my communications receiver. The noise begins at the same spot on every one of the four bands as I tune the variable capacitor; when the noises begin the signal disappears. What causes this?

Stan Zawrothy, Barth, New York

Your trouble is probably being caused by short-circuiting between rotor and stator plates on one or more of the main tuning variable capacitor sections. This would account for both symptoms you mention: crackling noise as the plates make intermittent shorting contact and lack of signals in this area of the dial.

It will be necessary for you to inspect the tuning capacitors very carefully to determine where the plates touch. It is usually possible to bend one or more plates ever so slightly to remove the short-circuit permanently.

Voltage Regulator

I would appreciate a circuit of a voltage regulator that would operate on 12 volts DC. Please make it as simple as possible.

John A. Sampson, Bronx, N. Y.

![Circuit Diagram]

We shall be happy to provide you with the circuit you wish. Since you mention only the voltage regulator, we shall go on the assumption that you already have a 12 volt DC source.

Regulation is provided by a power transistor of the inexpensive variety—a 2N307. It employs a 12 volt battery of the standard type as a reference voltage source. Since this battery current is balanced out during operation, it should last several years, or for its shelf life.

The regulator should be adjusted as follows: Insert a milliammeter in series with the battery (temporarily) and adjust the 250 ohm potentiometer for zero current with the power supply loaded as it will be during normal operation. Remove the milliammeter and replace it with a short jumper. The balance should be checked occasionally in the same way. Be sure to include a switch as shown to open the battery circuit when the power supply is idle. This switch may be ganged with the one used to turn the power supply on and off.

Receiver Antenna

What kind of an antenna would you recommend for use with a Hallicrafters SX-100 receiver? I have about 40 feet of straight-run available.

E. F. Martin, San Diego, Calif.

![Antenna Diagram]

NO. 14 ENAMELLED WIRE, SOFT-DRAWN COPPER

GLASS INSULATOR CENTER LEAD SHIELD

72 OHM COAXIAL CABLE, ANY LENGTH

RECEIVER TERMINALS

A simple, yet satisfactory antenna for a communications or short-wave receiver such as yours is a long wire. Its length may run from thirty to a hundred feet. Keep it as high as possible and clear of metal surfaces that might reduce its efficiency.

An improvement over the single wire is the doublet shown in the diagram above. The coaxial cable lead-in is shielded and therefore reduces the amount of noise pickup from man-made sources found near the ground and low levels; motors, power lines, etc. The shield of the cable should go to the ground terminal on the receiver and also to a building ground—a cold water pipe, for example.

This antenna will be bi-directional and most sensitive broadside to the horizontal wire.

November, 1959
Unique wireless system sends six different messages to a transistorized receiver. Used by UN, others.

**Six Channels In A Loop**

By Steven Hahn

The United Nations, Geneva, Chile, the Summit, disarmament, cultural exchanges, medical meetings—our daily headlines spell out a steady stream of international conferences. The easier it is for people to travel intercontinental distances via air, the more and more they are getting together to exchange ideas.

But it is very difficult to have a useful exchange if the participants cannot understand each other. Indeed, the very success or failure of an international conference may well depend on the translation of a speaker's remarks into the varied native languages of the participants. Also, to keep a conference alive and interesting, these translations should be simultaneous. In other words, the translation must follow right along with the speaker and end not more than a few seconds after the applause begins.

Electronics companies the world over have tried to find the most convenient, unobtrusive means of relaying these translations. Their problems are many. Sometimes five or six different languages must be made available to the listeners. Conferences don't always take place in the same... [Continued on page 93]

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Lightweight receiver can be worn around neck, permits freedom of movement. Tiny unit has special "thief" circuit.

Selector switch has six positions, each representing a different translation on a harmonic of 22.5 kc, basic frequency.

There are 3 transistors in receiver package, but only two are actually used in receiver section. Note ferrite antenna.
Expert interpreters, isolated in sound-proof booths, provide simultaneous translations for all the delegates.

Not all delegates require translation. Those who understand language of speaker need not listen over headset.

At right, author checks out transmitter setup that can be dismantled, moved from one meeting to another.
A Wireless Earphone

By Steven Hahn

This pocket receiver can be used with a hi-fi set or TV for private listening or for indoor paging.

Wireless transmission of sound by means of audio induction is a simple, foolproof method. In this type of system, a standard audio amplifier feeds a loop of wire strung around the area in which the receiver is to be located. The receiver simply consists of a high gain audio amplifier whose antenna is a small coil. Thus, this circuit can be likened to a large audio transformer whose primary is the outside loop and whose secondary is the small detection loop in the receiver. A system of this kind has...

The complete receiver is shown at left and in use below. Volume knob is on eyeglass case.
The circuit board has been lifted off the pickup coil and flipped in the wiring guide above for clarity's sake.

Use spaghetti tubing as shown over the connection points on board. Pickup coil is sold at parts suppliers.

Circuit diagram of receiver indicates simplicity of this two-stage high gain audio amplifier. Cost is about $15.
Note tight placement of parts on the circuit board. Actually the parts can be arranged in any manner since placement is not critical.

The complete receiver before insertion in the eyeglass case. Circuit board and battery are held to pickup coil with rubber bands or glue.

Two methods of rigging transmission coil are shown above and at right. Resistor is used to help match impedance of loop to radio.

many advantages: it is extremely dependable and very economical to build. In addition, since only audio power is radiated, it does not fall under the jurisdiction of the Federal Communications Commission and any amount of power can be fed into the radiating loop. With a fairly sensitive receiver, the efficiency of such a system is remarkable and less than three watts of audio power are required to cover every thousand square feet. Thus, utilizing a 15-watt audio amplifier, an area of 100 feet by 50 feet can be handled. All that need be observed is that the impedance of the transmitting [Continued on page 89]

**PARTS LIST**

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>Telephone pickup coil</td>
</tr>
<tr>
<td>C1, C2, C3</td>
<td>1 mfd paper or ceramic disc 200 volt capacitor</td>
</tr>
<tr>
<td>R1, R5</td>
<td>1 megohm, 1/4 watt resistor</td>
</tr>
<tr>
<td>R2-5600 ohm, 1/4 watt resistor</td>
<td></td>
</tr>
<tr>
<td>R3-6800 ohm, 1/4 watt resistor</td>
<td></td>
</tr>
<tr>
<td>R4-5000 ohm miniature volume control with switch and knob</td>
<td></td>
</tr>
<tr>
<td>TRI, TR2</td>
<td>GT 82 transistor</td>
</tr>
<tr>
<td>B</td>
<td>9-volt battery (Eveready 216)</td>
</tr>
<tr>
<td>Misc</td>
<td>Battery clip, 5000 ohm magnetic earphone, phenolic board 1 1/2&quot;x2&quot;, large eyeglass case</td>
</tr>
</tbody>
</table>
Photos courtesy
La Salle Tube Mfg. Co.

Phosphors and aluminum sometime flake or peel off inside tube when air is let in to remove old electron gun. Best rebuilds have new inside surfaces.

Vacuum seal of dud is broken by hot wire which cuts glass evenly and slowly so that new neck can be welded on later. Glass envelopes do not implode during delicate process.

Neck of tube is carefully cleaned with acid baths, then rinsed to remove any trace of the acid. Old gun and base of tube have been taken out, thrown away.

all about
Rebuilt TV Picture Tubes
By E. M. Delman

Wonder how good rebuilt video tubes really are? How they fix the "dud"? Here's the inside story.

CHANCES are three-to-one the next time you replace the picture tube in your TV set, the glass envelope will have seen service in someone else's set at least once—and perhaps two, three, or four times!

Using the glass envelopes of burned-out picture tubes over and over again makes a lot of sense. After all, it's what's inside
New electron guns, which "paint" picture on tube's face, are inspected at RCA's plant in Marion, Ind. There is no difference between guns in new, rebuilt tubes.

Here electron gun is ready to be inserted into neck of TV tube. Additional glass tubing to replace that part cut off when seal was broken, has been welded on.

Tubes at Sylvania plant are put on conveyors where they are re-phosphored. As bulb moves down line, phosphors settle uniformly. Screens are heat-dried.

The "bottle" that you’re buying. In picture tubes, only the insides, the electron gun and phosphor screen, wear out. As long as the glass envelope isn’t broken or the tube face isn’t badly scratched, it can be used again.

Picture tube rebuilding goes back practically to the advent of commercial television. The first rebuilder set up his little shop in 1949. Since the glass envelope is the most expensive part of the tube, he reasoned that the electron guns and phosphor screens could be replaced cheaply enough in burned-out tubes (called "duds") to sell the rebuilt units considerably below the price of new picture tubes. In addition, the Federal excise tax on new tubes apparently did not apply.

Some of the new picture tube manufacturers tried to make it hot for the rebuilders by stirring up the Federal Trade Commission. Eventually, the government applied the excise tax to rebuilds. However, that has not kept over 100 rebuilders from doing a land-office business selling replacement tubes from 20-40 percent less than all-new ones. The time finally came when major

[Continued on page 108]
"Merry-go-round" machine seals electron gun on RCA factory rebuilt "Monogram" tube line. Series of gas burners melt glass in neck of bulb temporarily, securing gun in correct position.

Rebuilt tubes pass through machine that performs an emission and gas check at the end of Sylvania's tube production line at Seneca Falls, N.Y. Rebuilt tubes receive as many, if not more tests than new ones.

Before being packed and shipped to dealers and TV servicemen, rebuilt tubes have their face-plates carefully buffed with rouge to insure a smooth viewing surface.

November, 1959
Since many compact FM tuners will not have room for the eye, it may be mounted on an external panel. Diagrams on next page show how eye reacts.

Add a Tuning Eye to Your FM Set

By Paul Hertzberg

Precise visual tuning of FM stations is possible with an electron-ray tube. Here's how to install one.

If you are constantly turning the knob of your FM receiver trying to tune in the station clearly, installing a tuning indicator is certain to solve the problem. Adjusting the tuning dial is critical, since the proper adjustment is not the one that gives maximum speaker output.

An indicator tube, 6AL7, has been designed to show visually the effects of tuning in a signal. The FM receiver's limiter grid voltage and discriminator output voltage control the illuminated portions of this special tube. The accompanying patterns show what happens when a station is not tuned in at all, when the station is tuned to its low or high frequency edge, and properly tuned.

The tuning indicator can be mounted in the tuner cabinet or on a front panel near the chassis. The socket leads enable you to place the tube up to 22" from the connections in the receiver.

A typical limiter and discriminator circuit are shown with the points indicated where the two main connections are to be made. Filament voltage is easily obtained by wiring in parallel with another tube's filament. [Continued on page 112]
Limiter-discriminator in FM set. Note "X" points.

Eye tube schematic and its color coded connections.

Various patterns on face of eye as FM dial is tuned.

A 3,300 ohm resistor, added to circuit, goes to ground of FM set and pin 8 of eye tube.

After wiring is done, 6AL7 tube is plugged into its octal socket and snapped into the clamp.
How to
Fix Your 45 RPM Phono

By Joe W. Rocke

HAS your 45 rpm record changer been relegated to a back shelf because it will no longer change records automatically? Chances are that all it needs is a tune-up. The mechanism in the '45 is sturdy and dependable; an ideal combination in an automatic changer for the small fry. Follow these hints for many more hours of trouble-free listening.

Turntable removal. First scribe mark on cam so it may be re-installed in same position. Loosen set screws then pry off circlips on turntable shaft. Pull turntable straight off.

Worn idler wheel causes turntable slippage. To replace it, dashpot must be removed (mark position). Circlip on idler is slipped off with screwdriver. Swing idler to right and pull off.
Apply small amount of light grease to grooved track on underside of turntable. Wipe inside rim of turntable and remove glaze with fine sandpaper. Apply light oil on turntable shaft. If turntable fails to cycle, check for excess friction at point shown and apply tiny smear of grease. Check all levers for free movement, oil their pivots lightly with a toothpick.

Tone arm height is adjusted so arm clears stack of records. Another hole, further forward (not visible) is for the needle setdown position. Adjustments are trial and error. If audio output seems weak or scratchy, clean points with extra-fine sandpaper. Make sure they close completely. A weak spring on the cycling arm may tend to let them remain open.
Hi-Fi Clinic

Send in your questions on hi-fi, the clinic answers each one by mail. If of general interest, they will appear in this column.

Hum and Noise

Whenever I increase the Bass control on my hi-fi set, there is a noticeable hum in the speaker. When the Treble control is advanced there is a hissing or frying sound. Is there a remedy for this?

Gene Morrison, New York, N. Y.

First we'll assume that your trouble was not present when the amplifier was new, thus ruling out poor design. Most noise or hum is traceable to the preamplifier, where signals are low level.

Try replacing the tube with one of the low-noise types now available. Be sure the ground between preamplifier and amplifier is secure. Adjust the hum balance control (if there is one) for minimum hum. Replace the preamplifier plate and grid resistor with low-noise types. Check if the tube shield is properly in place. Reverse the AC plug in the wall outlet.

Only the more expensive equipment fulfills the stringent design requirements for reducing hum and noise to very low levels. However, it is rare that tone controls are used at the extreme ends of their travel where the difficulties become annoying. Some of the causes are shown in the diagram. Shot noise occurs when electrons arrive at the plate. Current noise is produced from the movement of electrons through resistors and other elements in the circuit. Thermal agitation (not shown) produces minute noise since electrons do not move evenly through a conductor.

Hum may be amplified through cathode to heater leakage, or picked up from strong AC fields near the preamplifier. A poorly filtered power supply also contributes to hum.

Using An Old Speaker

I have an old speaker with a five-wire cable coming from it. I would like to know how I may use this speaker in conjunction with a radio that has two speaker leads.

Guy Fischetti, Bronxville, N. Y.

If three of the wires go to a transformer mounted on the speaker frame, and two emerge from the dust cover at the rear of the speaker, your job would be difficult. The speaker has a field coil that must be energized. All newer speakers utilize permanent magnets of the Alnico type.

The radio must be specifically designed to feed the proper amount of current to the field coil. Another difficult (and expensive) alternative is building a small power supply external to the radio.

Harmonics

Would you please explain to me what harmonics are?

Denis Williamson, New York, N. Y.

Harmonics are tones whose frequencies are mathematically related to a single, lower-pitched tone (which is referred to as the fundamental tone or frequency).

For instance, if 1,000 cps is taken as the fundamental tone, its second harmonic will be a tone of 2,000 cps and its [Continued on page 95]
At left, stiff wire receiving antenna protrudes from decoy’s back. Below, hunter concealed in duck blind maneuvers decoy by depressing transmitter button.

**R/C Duck Decoy**

*By Paul Hertzberg*

Entice the real duck into range with this decoy—maneuverable around the lake by radio control.

Instead of just bobbing aimlessly on the water, this “duck” can be directed anywhere on the lake. Decoys can be purchased at almost any sporting goods store for a few dollars. In order to install the equipment inside the decoy it is necessary to remove the top section shown in the photos. This is done with a razor, knife or similar instrument in order to make a clean cut. The bottom of the decoy is cut out, and a flat piece of pine fitted in place. It is absolutely necessary to waterproof this piece with several coats of clear dope or shellac. This wood base helps to stabilize the duck and provide a solid mount for the motors and other equipment.

The propeller drive motor shown is a K and O No. 2 mounted on a small block to give the proper propeller angle. It is fastened with small wood screws. Power is supplied to the motor by
a two-cell rechargeable wet battery. This type battery is sold at local hobby stores for about $2.50.

The rudder servo motor is a Berkley Wonder Motor attached to a 324:1 gear reduction box.

As long as the transmitter is keyed and the receiver picking up the signal, the servo motor will run. The motor turns the rudder through its straight-right-straight-left cycle. The rudder remains in any position until the transmitter is keyed again, continuing the cycle from wherever it stopped.

The duck can be stopped in the water by shutting off the drive motor. This is done by utilizing a set of breaker points actuated by the rudder mechanism. In the full right rudder position the points open, cutting the power to the drive motor. This system eliminates the purchase of an expensive motor control escapement.

A small, light-weight receiver such as the Gyro DX22 is ideal. The receiver and transmitter are operated on the 27.255 mc model control frequency. The receiver uses one small 22½ volt hearing aid battery and one 1½ volt size C battery. A thin piece of piano wire about 18" long serves as an antenna and is almost invisible when the duck is more than a few feet from the shore. To add the finishing touch to the duck, paint it with colored dope to match the ducks on the pond. Check with your local authorities—in some states this electronic means of outwitting the ducks is illegal!

Various equipment suitable for in-

The back of the decoy duck is removable to permit installation and access to equipment.

Linkage translates rotation of gears to rudder action. Breaker stops motor at right rudder.
Installation in the decoy is available from:

Gyro, 325 Canal St., New York, N. Y.
Lafayette Radio, 145-08 Liberty Ave., Jamaica, N. Y.
Babcock, Van Nuys, Calif.
Polks, 314 Fifth Ave., New York, N. Y.

The transmitting equipment must be licensed by the FCC. No theory or code test is required to secure this ticket, which falls into the category of Citizens Radio. Complete details on rules and regulations are covered in Part 19 of the FCC's rules and regulations. This is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Include ten cents with your order.

The license form itself, if not packed with the equipment, is available from the FCC, Washington 25, D. C. Ask for form 505.

Equipment is visible within the body of the decoy. Finger points to 4 volt rechargeable battery for rudder servo and drive motors.

Block diagram of complete system using factory-built components. See text for parts.

Receiver is along lower right edge, in plastic box. Rudder servo motor is just above it.

November, 1959
Mounted atop pipe, unit responds to beam from car headlights. It is unaffected by daylight.

Driveway Light Control

By Wayne Chou

Pull in driveway, open garage, then walk to house—with outdoor illumination automatically controlled.

One side of chassis wiring and parts. PC2 photocell protrudes from chassis lip at top. Other side of chassis. White circle near top shows rear view of PC1, the control photocell.
For reasons of clarity, assembly at upper left has been drawn away from chassis. See photos on previous page for actual location of PC1, PC2.

How many times have you come home late at night, especially during the icy winter months, and wished it was still light enough to walk to your house without fear? The unit described here solves this problem by automatically turning on an outdoor light as your car enters the driveway.

The light remains on for three minutes to enable you to walk to the house. An indoor switch permits the reverse situation to occur. Flip it on and you may walk out to the garage, your pathway lit for three minutes. An over-ride feature allows the outdoor light to remain on for any length of time.

Two photocells were incorporated into the design of the unit. One is activated by the car headlights, while the other prevents operation during the day when sunlight falls on the control cell.
Note in the wiring guide that they are mounted at right angles to each other.

Follow the illustrations for construction information. Plexiglas was used to encase the unit. It must be carefully assembled for weatherproofing. Other alternatives are food containers, fish bowls and the like, but the material must be transparent and as distortion free as possible.

After the circuit is wired, checks are made to verify its proper operation. Short the indoor switch terminals and pins 5 and 7 at RY2. Then connect the 117 volt AC terminals to house current. Rotate the balance potentiometer R6 in either direction and note if relay RY1 closes. If it does not, check for 18 volts DC across the relay coil. Failure of the relay to operate with this voltage usually indicates that its spring tension is too tight. Bend the spring to remedy

[Continued on page 104]

Here's Homer, K9DYP, in clothes closet hamshack. By judicious use of shelves, he has been able to cram just about everything he needs into this "hole in the wall." Now running out of QSL card display area, he has made contacts clear around the world without benefit of kw transmitter.

Your Hamshack Can Go Anywhere!

By Carole F. Hoover, K9AMD

Wherever they live, wherever they go, amateur radio ops somehow find a way to get on the air.

WHERE to put the equipment? Now this can be a delicate matter when there are wives and landlords with which to contend. But every ham knows if you give him an inch, he'll soon have a "shack," whether it's in the attic, alongside the furnace, on land, sea or above the clouds.

Fortunate, but few, are the amateurs who enjoy the ideal situation—a spacious, air conditioned radio room or workshop where they can accumulate receivers, transmitters, and the precious spare parts known to most outsiders as "junk." Many more are stuck with a dark corner or stuffy slot in an otherwise uninhabited part of the house. One such ham, who was quick to meet
Left: Each shelf in "console" arrangement of YL Bobbie Pattie, K9GOL, was designed with a specific piece (or two) of gear in mind. Custom-built shelves are usually most satisfactory. Dick Pattie, W9VWJ (right), operates from table in corner of family living room. "I prefer calling my CQ's from a big, stuffed chair," he says.

Gene Markos, K9JFE, operates from the basement laundry room, but he has to stay on CW until the noisy washing machine has done its chores. Then he can switch to phone. XYL, Nita, is K9JFD; uses same rig.

Spacious basement workshop is ideal for the ham who puts together his own gear, once the dampness problem has been licked. Wires may be strung at will without disturbing others.
While the XYL sleeps, Bill Jenkins, W9WHL, happily works electronic "bug" from writing desk situated in bedroom. His wife has become almost immune to the sounds of hamming at bedtime.

the no-elbow-room challenge, operates from a tiny clothes closet.

"It's crowded, but I make contacts from New Zealand to Africa," laughs Homer Hucker, K9DYP. "Now I'm even considering the problem of squeezing a kilowatt transmitter in there!"

By taking advantage of shelf space, Homer tunes his receiver at chair level, dips the final of his transmitter on the second shelf, and stacks the rest of his gear up to the ceiling. He usually leaves the door open for ventilation, but when his wife has a bridge party, the only tell-tale sign that Homer is hamming is a thin, white stream of cigarette smoke curling up from the crack at the bottom of the door. [Continued on page 104]

WHERE TO PUT YOUR HAMSHACK

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>PLUS FACTORS</th>
<th>MINUS FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basement</td>
<td>storage space; privacy</td>
<td>dampness; rubber runners</td>
</tr>
<tr>
<td>Kitchen</td>
<td>convenient for hamming XYL</td>
<td>desirable near equipment</td>
</tr>
<tr>
<td>Living room</td>
<td>comfortable</td>
<td>cooking grease gums gear;</td>
</tr>
<tr>
<td>Bedroom</td>
<td>comfortable</td>
<td>shock hazard on wet counters</td>
</tr>
<tr>
<td>Attic</td>
<td>ease of antenna installation;</td>
<td>and tables</td>
</tr>
<tr>
<td>Garage</td>
<td>ideal after you lug up gear</td>
<td>disturbs others in family;</td>
</tr>
<tr>
<td>Auto</td>
<td>will not disturb others</td>
<td>difficult to stow gear; string</td>
</tr>
<tr>
<td>Boat</td>
<td>no TVI; you can ask directions</td>
<td>wire neatly</td>
</tr>
<tr>
<td>Auto</td>
<td>of local hams when on long trip</td>
<td>same as living room</td>
</tr>
<tr>
<td>Airplane</td>
<td>no TVI; rig is available for</td>
<td>special antenna problems on</td>
</tr>
<tr>
<td></td>
<td>possible distress use</td>
<td>lower frequencies; capacity of</td>
</tr>
<tr>
<td></td>
<td>high antenna</td>
<td>car's electrical system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>important</td>
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</tbody>
</table>

November, 1959
the new art of
Electronic Music

Serious composers and audio engineers join forces
in effort to create lasting works of musical art.

A NEW art form, generally called “electronic music,” has come
into being and has captured the imagination of serious com-
posers as well as electronics experimenters all over the world.
Here in the United States, creating electronic works and study-
ing compositional possibilities of sounds manipulated by elec-
tronic devices is centered in a studio located at Columbia Uni-
versity. This studio is now in the process of greatly expanding its
facilities with the aid of a Rockefeller Foundation Grant given
jointly to Columbia and Princeton Universities. The new elec-
nronic music center is administered by four composers: Otto

With an array of complex equipment in background, Professor Luening
listens as electronically manipulated sounds are mixed with those of flute.

Photos by Fietow
1. Composer Ussachevsky (with score) and Peter Mauzey, engineer, listen for unwanted distortion on final tape. 2. Composer adjusts long tape loop which stretches from tape recorder all the way across studio and back. Loop in motion will repeat sound pattern while composer shapes sound with filters, speed variations, etc. 3. Composer Luening checks and times one passage of composition. Convenience of being able to hear each step of work in progress is big advantage of composing with tape. 4. Percussive sounds, such as those from Oriental gongs and temple blocks, make valuable raw material which can be modified and mutated by electronic means to produce new, interesting timbres. 5. "Conductor" can reach controls from one location.

Luening and Vladimir Ussachevsky of Columbia and Roger Sessions and Milton Babbitt of Princeton. The engineer in charge is Peter Mauzey of the Electrical Engineering Department at Columbia.

The accompanying photos show how composers have functioned in the original small, but nicely diversified Columbia studio. Organization of any electronic music studio depends on the kind of sound material with which the composers prefer to work. In Germany composers use only electronic instruments to generate their sounds. In France they rely mainly on the electronic modification of existing sounds, including conventional musical instruments. In the United States, the original Columbia studio has not restricted itself to any single class of sound sources, using whatever sound manipulation techniques were available. The compositions produced in this studio became known as "tape music."

It is popularly thought that in order
to live up to the designation "music," a combination of sounds must be pleasing, expressive, or intelligible to the listener. To create an electronic musical composition, five basic steps are necessary to achieve the most comprehensive results. First, one must decide on the electronic or non-electronic origin of the sounds, which are then recorded. Next, the sounds are usually modified. Thirdly, the various sounds are mixed. Then these combinations of sounds are arranged in a pre-determined sequence on several reels. Finally, the material on these reels is combined to produce the final composition.

The equipment used at Columbia to accomplish these varied functions was set up by Peter Mauzey. To supplement sounds from conventional musical instruments and recordings of those instruments, several electronic sound sources, such as sinusoidal oscillators and square-wave generators, are used. These sounds can be modified by filters, equalizers, modulation, and judicious tape editing, while mixing devices can blend as many as eight inputs to produce a single output. The tape recorders are all Ampex professional units.

The recording of original sounds on tape represents only the first step. The composer must then take the original sound, modify and combine it to produce new timbres and to create new rhythmic patterns. Original sounds seldom are retained in the final composition, but are altered, one by one, cut and spliced in a planned sequence by the composer.

There are many ways in which sounds or segments of sounds can be prolonged, but one of the most interesting is the tape loop. A loop can be made of a tape recording of any sound; it can be made as large as the size of the room allows. The loops can provide a repeated sound of short duration, or an uninterrupted sound.

Composers of electronic music use a variety of filters not normally found in recording studios. Equalizers and band-pass filters are useful, but octave filters, such as third-of-an-octave filters with individual attenuation on each channel are more versatile.

Filters provide a means of carefully controlling changes in frequency content. Composers know that changes of timbre have a subtle psychological effect, and a group of individually controlled filters allows the composer to shape gradually a sound spectrum into

[Continued on page 109]
Here is a line-up of budget-priced communications receivers designed in simple to assemble kit form, any one of which will add to your short-wave enjoyment. Both Knight-kits shown sell for under $20, while the new Philmore 4-band receiver is under $40.

Kits for the Short-wave Listener

So you want to listen to shortwave, but you don't think you can afford a receiver. Look at these!

"SURE there's adventure on the airways! That shortwave's great stuff. I'd sure like to tune in the world and listen to all that exotic programming. I might even want to collect QSL cards as a hobby and eavesdrop on the amateur bands as well. But I'll tell you something: I'm not ready to plunk down $100 or $200 for a receiver!"

Well, you don't have to. There are plenty of inexpensive short-wave receivers on the market and there are always the kits. Know how much they cost? As low as $15.95!

The Knight-kit "Ocean Hopper" receiver sells for that price. For about $3 more you can get a set of five plug-in coils that will bring in frequencies from 155 kc to 35 mc, including the standard broadcast band. In addition to the main tuning dial there is an all-important bandspread tuning feature. Bandspread tuning is almost essential in a short-wave receiver for ease and accuracy in separating overlapping stations. Also on the front panel of this receiver is an antenna trimmer to provide sharp reception. No speaker in this model, so you'll have to listen via headphones.
At top is the Heathkit model AR-3 4-band receiver which sells for $29.95 without the cabinet. Its tube complement numbers five, with beam power output. Amateur bands are marked off on the slide rule dial face. Below is the Lafayette 3-tube "Explor-Air" kit that can be bought for only $18.50, less case. It has features found in more expensive receivers, such as bandspread tuning.

Another budget-priced Knight-kit short-wave receiver is the "Space Spanner" which carries a price tag of only $18.95, including case. Again there is bandspread tuning. In addition to local broadcast signals, you can pull in short-wave between 6.5 and 17 mc. These frequencies include the 20 and 40 meter amateur bands, police, aircraft and marine stations, and broadcast stations overseas. There's a built-in 4" speaker in addition to headphone connectors, while a speaker cut-out switch lets you select private listening or both speaker and headset.

If you've never built a kit, chances are you're wondering about the level of electronic knowledge required. You can set your mind at ease on this score. Most kits can be assembled by a beginner in a matter of hours, and all you need is a soldering iron and a screw driver.

Kit manufacturers, along with their design engineers, take great pains to clearly mark and identify parts and prepare foolproof, step-by-step, instruction booklets. If you follow the instructions, checking off each step as you complete it, you'll have no difficulty. You don't even have to know how to read a schematic diagram since the instruction booklets include wiring diagrams that actually picture the various components and connections.

Typical of the easy-to-follow instructions are those issued with the new Philmore communications receiver kit Model CR-5AC. Here is a lot of radio
for $39.95 (less cabinet). There are four bands covering all frequencies up to 30 mc, including the standard broadcast band. The amateur and novice ham might take serious notice of this kit since it covers the 10, 15, 20, 40 and 80 meter bands as well as the 11 meter Citizens Band.

Some of the more sophisticated features of Philmore's 5-tube superhet receiver are electrical bandspread tuning on each band, a horizontal tuning dial 11 inches long, flywheel tuning and a built-in S-meter that can be used for precise tuning in addition to a signal-strength meter. There is also a built-in BFO with adjustable tone control, a big help when listening to CW signals. Additional features are a noise limiter, AVC switch, standby position for use with transmitting equipment, an input jack for an external Q-multiplier, and an auxiliary power socket. A built-in speaker rounds out the picture. The chassis is designed either for rack mounting or insertion into a heavy-gauge steel bookshelf type cabinet. The cabinet sells for $7.95.

Heathkit's AR-3 receiver is $29.95 less cabinet, which costs another $4.95. Frequency coverage is 550 kc to 30 mc in four bands which are marked off on a slide-rule dial. RF and AF controls, bandswitch, bandspread, standby switches are additional features, as is the antenna trimmer. There is also a noise limiter, and a Q-multiplier can easily be added.

Lafayette's entry into the low-priced short-wave receiver kit market is the "Explor-Air," which also covers 550 kc to 30 mc in four bands. It sells for $18.50 with a wooden-based cabinet costing an additional $2.75. Bandspread, band-switch and antenna tuning are all on the front panel.

Of course, the better your antenna the better your reception on any receiver. However, for the receivers described above, no special antennas are required. Generally speaking, a standard long wire assembly will bring in some pretty exciting listening.

Keep the antenna wire high for best results. Its length should run about thirty to a hundred feet. Keep it clear of steel structures, which reduce signals considerably.

Glass insulators are available for preventing the antenna from grounding out against the tree or pole it is tied to.

Schematic diagrams of most kits are similar to this one of Heath's, detail drawings are furnished.
Radio-TV Troublefinder

By Paul Hertzberg

This compact signal tracer, with built-in speaker, will help locate faulty audio or radio stages.

Perforated board is cut to fit case; leads on parts are threaded through holes. Leave room for battery, at lower edge. At right is schematic.
In the wiring guide, the perforated board has been displaced to the left to clarify the connections. Transistor bases are also shown in schematic.

One of the most effective instruments for the radio-TV serviceman is the signal tracer. This instrument is used to follow a known signal through a piece of equipment.

This transistorized tracer may easily be built pocket size. It is designed to check auto, home or portable broadcast receivers and audio amplifiers. Many circuits in TV sets may also be checked.

The tracer is composed of a diode detector coupled to a two stage audio amplifier. A 100 mmfd capacitor couples the incoming signal to the diode in the RF switch position. When the switch is in the AF position the diode is shorted out and a .05 mfd capacitor couples the audio signal to the volume control.
Total cost of the parts, shown here prior to assembly, runs about $7. Hand holds speaker.

First stage of construction is mounting the larger parts to plastic box, then wiring board.

Check points shown are usually tube grids on the input side, tube plates on output side.

PARTS LIST

C1—0.05 mfd disc ceramic capacitor
C2—100 mfd disc ceramic capacitor
C3, C5—2 mfd 12 volt miniature electrolytic capacitor
C4—10 mfd 12 volt miniature electrolytic capacitor
R1—100,000 ohm resistor (all resistors 1/2 watt)
R2—25,000 ohm potentiometer
R3, R6—170,000 ohm resistor
R4—62 ohm resistor
R5—4,700 ohm resistor
SW1—DPDT slide switch
SW2—SPST switch (mounted on volume control R2)
B—9 volta battery (Burgess P6 or equiv.)
T—Output transformer with speaker (Lafayette SK-96)
TR1—CK748 transistor
TR2—CK722 transistor
D—Crystal diode IN295
Misc.—Battery clip, plastic box 1"x2"x3", perforated board, alligator clip, stiff wire for probe

First stage of construction is mounting the larger parts to plastic box, then wiring board.

and amplifier circuits. The output of the amplifier is heard over a miniature PM speaker.

Wiring is not critical and all the parts can be housed in a small plastic box. Mechanical construction starts by cutting a slot and drilling holes for the slide switch SW1. Mount the output transformer using two small nuts and bolts and locate the speaker between the transformer and a corner of the box to hold it in place. The volume control is mounted through a hole in the box and fastened with a lockwasher and nut. The test probe is fastened to the box with a nut, bolt and solder lug. Then mount and solder in place parts C1, C2, C3, C4, R1, R3 and the diode IN295. A small piece of perforated board will serve as a chassis. Transistor leads are pushed up through holes in the board and parts R4, R5, R6 and C5 are connected as shown.

[Continued on page 89]
Try These

Extension Jack
A neat extension jack for use with phono plugs can be made from tube shield and jack.

Nail Polish Marker
Milady's nail polish is fine for marking test points, leads, tested or questionable parts.

Secure Tape End
A small piece of foam rubber pressed between reel prevents loose tape from slipping out.
Complete kit appears at left. Plug-in coil, wound for 80 meters, is along right edge with 6V6 tube next to it. Below, crystal is plugged into 8-pin socket that also serves as the key jack. Controls on panel are, AC on-off at left, plate tuning, antenna loading.

E I assembles the

AMECO AC-1T
Ham Transmitter

Primarily a first transmitter for the Novice, this CW rig provides 15 watts on the 80 or 40 meter band.

THE AC-1T is a transmitter reduced to the simplest form. One tube performs the job of oscillator and amplifier. A full-wave rectifier in the power supply completes the tube line-up.

All basic parts are included in the kit except key and crystal. The single coil form supplied may be wound for 80 or 40 meter operation. An additional form is available for fifty cents. The transmitter's performance will fall off if coils are wound for bands higher in frequency than 80 or 40 meters. Another practice not recommended is using 80 meter crystals to attain 40 meter output. Frequency doubling, in this case, reduces the rig's efficiency considerably.

The unit can be built in three or four hours. Care must be taken in assembling the coil. Wind the turns tightly and keep them close-wound, that is, touching each other. The two coil leads are soldered to pins on the coil-form base. When too much heat is applied, the pins will melt the plastic in which they are imbedded. If this happens, prop up the pin and

[Continued on page 111]
Schematic shows circuit simplicity. Oscillator is 6V6, which feeds antenna through a pi-network.

Layout of parts supplied with kit, available from Ameco, 1203 Bryant Ave., N. Y. 59, N. Y. (price is $18.70). Underside view of wired unit shows tuning capacitors along right edge.

At lower left, hand holds antenna wire. The other lead, connected to terminal strip, goes to a cold-water pipe ground. Other photo shows coil form being wound for 80 meters.
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In the United States, possessions and Canada.

* (Appropriate gift announcement card in your name, will be mailed to each recipient in time for Christmas)

ELECTRONICS ILLUSTRATED

Fawcett Building, Greenwich, Conn.
A Wireless Earphone

Continued from page 58

loop roughly matches the impedance of the audio amplifier output transformer tap.

The receiver actually consists of a two-stage low noise, transistorized audio amplifier mounted on a perforated phenolic board 1½ by 2 inches. Almost any type of earphone will work with this receiver as long as it is of the magnetic variety having a DC resistance of 5,000 ohms or less.

Any audio amplifier can be used to power the transmitting loop. The following table for various sizes of wire is given to facilitate proper matching.

Wire Size vs Impedance

<table>
<thead>
<tr>
<th>AWG</th>
<th>Ohms per 1,000-ft length</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>3.8</td>
</tr>
<tr>
<td>14</td>
<td>2.7</td>
</tr>
<tr>
<td>12</td>
<td>1.9</td>
</tr>
<tr>
<td>10</td>
<td>1.2</td>
</tr>
<tr>
<td>8</td>
<td>0.75</td>
</tr>
</tbody>
</table>

To avoid grounding the system, the loop should use insulated wire even though the voltages in it are too low to cause shock or fire. The table indicates that, using a No. 16 wire, 1,000 feet will be required to obtain a resistance of 3.8 ohms. If the circumference of your room is considerably less than 1,000 feet and a good impedance match to the output of your amplifier cannot be obtained even when the thinnest practical wire is used, a 4 to 10 ohm resistor with a wattage rating equal to the wattage of the audio amplifier may be inserted in series with the loop for proper matching. If the audio amplifier which is used also drives a speaker, a separate volume control for the speaker may be desired. This can easily be done by wiring a standard L-pad into the speaker circuit.

With this receiver the volume will vary very little, if at all, as you move around in the transmitting area. As soon as you step outside of the loop the volume will drop off quite rapidly. Ordinarily, excellent results are obtained if the loop is strung around the floor or ceiling. When reception is desired over two or three floors of a building, two separate loops can be strung and fed from the same amplifier, observing impedance matching of course.

Russian New York Fair

Continued from page 47

be a particle-counter. Beside it is a standard oscilloscope. Their exhibition guides are supposed to be specialists, so this one ought to be a physicist.

Ques. (directed at Russian Guide) We've been looking over your equipment here and don't notice any tubes that display numbers. Do you have them in the USSR?

Guide (puzzled) Tubes and numbers?

Ques. Do you have tubes that actually flash a number—we call them nixie tubes?

Guide I understand very well what you mean. No we do not have them. Oh, in the Soviet Union we have such counters, but we cannot...we may not show here everything we have.

Ques. Thank you very much.

Guide Such counters are too special for the people's interest.

Radio-TV Trouble Finder

Continued from page 84

To use the tracer for checking a receiver, be sure the set is turned on and tuned to a strong local station. Turn on the tracer to full volume and attach the ground lead to the receiver chassis. Switch to the RF position. Start by touching the probe to the antenna loop terminals. A strong station will be heard from the tracer speaker. Move the probe from the input of one stage to its output and then to the next stage. If the signal is lost from one point to the next, you have found the defective area. Further checks with a voltmeter or ohmmeter should reveal the defective components.

The tracer can be used to find defective stages in hi-fi amplifiers by applying a tuner or phono signal to the amplifier input and tracing the audio signal toward the output transformer circuit and speaker. For this test the switch must be in the AF position.
Housed in sturdy handsome finish steel case, it comes complete with MULTI-HEAD.

CRT TESTER-REACTIVATOR Model CRT-2

NOW . . . a TESTER-REACTIVATOR really designed to test, repair and reactivate EVERY PICTURE TUBE MADE—whether black and white or color . . . with exclusive features never before found in picture tube testers.

1. THE MULTI-HEAD (patent pending) . A SINGLE PLUG IN CABLE AND UNIQUE TEST HEAD . A tremendous advance over the maze of cumbersome testers usually found with other testers. Enables you to test, repair and reactivate every type of picture tube with greater convenience than ever before . . . 50 degree to 410 degree test range, the very latest 7 pin base. A special color switch on the MULTI-HEAD enables you to test, repair and reactivate each of the red, green and blue color guns separately.

2. WATCH IT REACTIVATE THE PICTURE TUBE . You actually see and control the reactivation directly on the meter as it takes place, allowing you for the first time to properly control the reactivation voltage. This eliminates the danger of shorting the cathode of the oxide coating. It enables you to adjust the speed of reactivation and when used with the MULTI-HEAD, you will see if the tube contamination is too great and if the picture tube is too far gone to be reactivated.

3. CONTROLLED "SHOT" WITH HIGHER VOLTAGE FOR BETTER REACTIVATION . Stronger than any found in other testers . . . high enough to really do the job . . . yet controlled to avoid damage to the picture tube.

4. UNIQUE HIGH VOLTAGE PULSE CIRCUIT . Will burn out inter-element shorts without opening circuits with complete safety to the picture tube.

5. VISUAL LIFE TEST . Enables both you and your customer to see the life expectancy of any picture tube just right on the meter. The fact that your customer can see the results of your tests as you make them virtually eliminates resistance to picture tube replacement. Now, it’s never necessary.

6. TRIPS, REPAIRS AND REACTIVATES SPECIAL LOW SCREEN VOLTAGE TUBES . . . Many new type picture tubes use special low voltage of approximately 50 volts. The CRT-2 will test, repair and reactivate these tubes with the same thoroughness as the regular types with complete safety.

7. SEPARATE FILAMENT VOLTAGES— including the very latest 2.35 volt and 8.4 volt types as well as the older 6.3 volt types.

8. TESTS, REPAIRS AND REACTIVATES 5" PICTURE TUBES . . . found in the newest Sylvania and Philco TV sets. These picture tubes have different base pin connections than standard picture tubes and there is always an element of risk that the tube may be burned out when tested with ordinary testers. CRT-2 is designed to accommodate this new base pin arrangement and will test the tube with no danger of damage.

ADDITIONAL FEATURES

- Employs the time proven dynamic cathode emission test principle . Large 4½ digit meter with heavily damped movement for smooth action, accuracy and long life.
- Provides separate checks for each element in the picture tube. A filament continuity check may be run on a separate glow indicator. An easy to follow test manual included with the latest testing information. And new CRT-2 design uses in handsome hand-rubbed oak carrying case with special compartment for MULTI-HEAD and line cord. patent pending

IN-CIRCUIT CONDENSER TESTER Model CT-1

Here is an IN-CIRCUIT CONDENSER that DOES THE WHOLE JOB! The CT-1 actually steps in and takes over in all cases where other in-circuit condenser testers fail, and makes it an absolute must for every serviceman.

in-circuit checks:

- Quality of over 90% of all condensers even with circuit short resistance . . . (This includes leakage, shorts, open and interconnections)
- Value of all condensers from 200 mfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
- Transformer, socket and wiring leakage capacity

out-of-circuit checks:

- Quality of 100% of all condensers . . . (This includes leakage, shorts, open and interconnections)
- Value of all condensers from 50 mfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
- High resistance leakage up to 300 megohms
- New or unknown condensers . . . transformer, socket, component and wiring leakage capacity

OUTSTANDING FEATURES

- Ultra-sensitive 2 tube dft-free circuitry
- Multi-color direct scale readings for both quality and value . . . in-circuit or out-of-circuit
- Simultaneous readings of circuit capacity and circuit resistance
- Built-in hi-leakage indicator sensitive to over 300 megohms
- Cannot damage circuit components
- Electronic eye balance indicator for every greater accuracy
- Isolated power line
- Housed in sturdy hammer tone finish steel case . . . Comes complete with test leads

TERMS: $9.50 within 10 days. Balance 55 monthly for 5 months

EASY TO BUY IF SATISFIED – see order form on facing page
**FOR 10 DAY FREE TRIAL**

Convince yourself at no risk that CENTURY instruments are indispensable in your every day work. Send for instruments of your choice without obligation...try them for 10 days before your buy...then only, when satisfied, pay in easy-to-buy monthly installments — without any financing or carrying charges added.

**NOW a Battery Operated Peak-to-Peak VACUUM TUBE VOLT METER** Model VT-1

FEATURING THE SENSATIONAL NEW MULTI-PROBE * Patent Pending

No extra probes to buy! The versatile MULTI-PROBE does the work of 4 probes

**MULTI-PROBE**

1. AC-Ohms Probe
2. RF Probe
3. Lo-Cap Probe
4. DC Voltmeter

The VT-1 is a tremendous achievement in test equipment. With its unique MULTI-PROBE it will do all the jobs a V.T.V.M. should do without the expense of buying additional probes. No longer do you have to cut around a maze of entangled cables, lose time alternating cables or hunting for a misplaced probe. With just a twist of the MULTI-PROBE tip you can select it to do any one of many time-saving jobs. A special holder on side of case keeps MULTI-PROBE firmly in place ready for use.

**OUTSTANDING FEATURES**

- Completely portable — self powered with long life batteries — permits use everywhere — New advanced amplifier circuit assures amazingly low battery drain. Large 6. 100-microampere meter...many times more accurate than any scale used in most V.T.V.M.'s. Laboratory accuracy performance — 2% of full scale.
- DC, 50, 100 and 500 volts. Low current readings for DC, 100 volts, 600 and 1500 volts.
- DC Voltmeter...will measure D.C. down to 0.5 volts full scale with minimum circuit loading and give accurate readings on any block of scale divisions as low as 0.035 volts. Will measure low A.C. and oscillator voltages from 1 volt to 500 volts with consistent laboratory accuracy on all ranges.
- Zero center guaranteed on all balancing measurements such as distributor, ratio detector alignment and A.C., amplifier balancing.
- AC Voltmeter...True Peak-to-Peak measurements...down to 3 volts of any wave form including s.a.m., d.c., a.c, Rectifier, Output, Gates, etc.
- Scale divisions are easily read down to 2 ohms. Will measure resistance values with high resistance leakage in electrolytic and paper capacitors.
- RF and LO-CAP MEASUREMENTS...with this extra V.T.1 function you can measure voltages in extremely high-inductance circuits such as new short-needles 110 degree type for calculating pilot, interstage, or line-emission, shorts and life expectancy. Also to check parasitic weak picture tubes.

**SPECIFICATIONS**

- DC Volt...0 to 1/5/10/15/50/150/300/600/1500 volts.
- AC Volt (rms) and Peak to Peak - 1/5/10/15/20/25/30/40/50/60/100 volts.
- AC Meters (2) - 10 to 100 or 100 to 1000 volts a.c., 100 to 1000, 1000 to 10000 volts or 0 to 1000 volts.
- Zero Center — available on all DC, 100 volts range with zero at mid-scale.
- Shaft movement...1 inch per volt.
- D.C. accuracy...± 1ohm per volt.
- RF Range — 0.01 to 10 megacycles per volt.
- Input Capacity — 130 microhenrys.
- Power Supply...V.T.V.M., 6 volts for non-polarized voltages.
- Power Supply...VA, 10 megacycles for polarized voltages.
- Size — 6 1/8 x 10 x 2 1/2 inches.
- Weight...10 pounds.

**PREDUCENT TIME PAYMENT PLAN**

ALL CENTURY INSTRUMENTS ARE GUARANTEED FOR ONE FULL YEAR

The extremely low prices are made possible because you are buying directly from the manufacturer.

**CONVENIENT TIME PAYMENT PLAN**

**FINANCING CHARGES**

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Payment Plan</th>
<th>Terms</th>
<th>Balance</th>
<th>Payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model VT-1</td>
<td></td>
<td>$14.50/month</td>
<td>$58.50</td>
<td></td>
</tr>
<tr>
<td>Model FC-2</td>
<td></td>
<td>$15.90/month</td>
<td>$58.50</td>
<td></td>
</tr>
</tbody>
</table>

**FAST-CHECK TUBE TESTER** Model FC-2

Simply set two controls...insert tube...and press quality button to test any of over 700 tube types completely, accurately...in SECONDS!

Over 20,000 servicemen are now using the FAST-CHECK in their everyday work and are saving time, removing unprofitable callbacks and increasing their dollar earnings check the FAST-CHECK today with all other tube testers.

**RANGE OF OPERATION**

- Checks quality of over 700 tube types, employing the time proven dynamic cathode emission test. Checks 99% of all tubes in use today, including the newest series-tube types, tubes, degree types, for calculating pilot, interstage, or line-emission, shorts and life expectancy. Also to check parasitic weak picture tubes.

**SPECIFICATIONS**

- No time consuming multiple switching...only two settings are required instead of banks of switches located inside case. New listings are added without costly roll chart replacement. Checks each tube up to 300 volts.
- Checks 99% of all tubes in use today, including the newest series-tube types, tubes, degree types, for calculating pilot, interstage, or line-emission, shorts and life expectancy. Also to check parasitic weak picture tubes.
- Exclusive feature found only in FAST-CHECK — new short-needles (110 degree) type for calculating pilot, interstage, or line-emission, shorts and life expectancy. Also to check parasitic weak picture tubes.

**CENTURY ELECTRONICS CO., INC.**

111 Roosevelt Avenue, Dept. 411, Mineola, New York

Please rush the instruments checked for a 10 day free trial. If satisfied I agree to pay $1.00 down, followed within 10 days and the monthly installments as shown. If not within 10 days, no further obligation. It is understood there will be no INTEREST or FINANCING charges added.

Name
Address
City State

Prices Net F.O.B., Mineola, N. Y.

N ovember, 1959

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Transistor Portable TV's

Continued from page 34

its big fault, you must view the picture head-on. If you stand even slightly to either side of center, you do not see the full picture.

The total power consumed by this set is four and one-half watts as contrasted with the power taken by the average home TV set, about two hundred watts. This power is drawn from a specially developed battery pack, consisting of alkaline rechargeable batteries, which sells for about $5.25. Its power cycle permits four full hours of operation before a 16-hour recharge, which is accomplished simply by connecting the set to a household AC outlet. A special charge function switch is built into the set for convenient overnight recharging. According to Philco, this special battery may be recharged as many as twenty times, giving it an operating life of eighty hours or more.

One of the problems in designing a transistor TV set, and this is one of the problems that has held back many other manufacturers, is to get a transistor which can operate reliably at the high frequencies used in television. Such transistors are presently available but they're super expensive. Philco's answer is to use seven MADT (for micro alloy diffused transistor) type transistors which they developed and produce. These transistors are capable of VHF service and, as a matter of fact, have been used in military equipment heretofore. Three are used in the tuner, four are in the video IF.

In order to test this receiver under the worst and most favorable conditions, we took the receiver on a New York Central commuter train out of Grand Central Station, New York City, north about forty-five miles. This set, working off its own single-rod telescoping antenna, pulled in stations from the Empire State tower, while running under electric lines in a steel railroad coach right out to the limit. Its sensitivity is greater than that of most AC operated portable TV sets. There was a good picture and good sound reception for all of the low channel stations and most of the higher channels. In driving around a suburban town about thirty miles from New York City, we received a fairly good picture in the car. In a side-by-side comparison with a conventional AC operated portable receiver in a home in a suburban area, 45 miles from New York City, the Philco job pulled in stations clearer and sharper. In New York City reception under all kinds of conditions was excellent.

Although Philco entered the market with a transistor portable TV set first, it will not have the market to itself for very long. The Emerson Radio and Phonograph Corporation has just announced a 17-inch direct view tube transistor TV receiver to sell for approximately $250. It too will operate on rechargeable batteries which can be recharged up to forty times. The total computed cost to operate this set on the Emerson battery pack will be only three cents per operating hour. This set has twenty-five transistors and will probably be introduced very late this year but is expected to go on sale the beginning of next year.

Outwardly the Emerson receiver does not appear to be at all different from a conventional AC operated 17-inch portable. This, of course, is to be expected since it uses the same type of direct view tube and the size of the set, after all, is regulated by the size of the TV picture tube.

What are the Japanese doing? Well, one thing is definite, they will not let the Americans have the market all to themselves. Original Japanese research in tunnel diodes and other transistor techniques have produced transistors which operate stably on high frequencies. One Japanese television broadcasting company has already built and demonstrated an all-transistor, battery operated portable, however, it is not interested in going into production on such a commodity. The well-known manufacturers of Japanese radios and televisions like Toshiba and Sony definitely intend to have a TV set on the market in the United States in the next year if they can. And when they do, watch for the $250 price to tumble.
Six Channels In A Loop

Continued from page 55

place and the location may be a large convention hall or a small meeting room. The General Assembly of the United Nations, for instance, has a permanently wired arrangement. But what about their countless committee rooms? What about that International Conference on Geriatrics scheduled to meet for only three days in a hotel ballroom?

A new transistorized wireless communication system ideal for such conferences has been introduced by a large West German electronics firm, the Siemens Co. It is marketed in this country by the International Visitors Center in New York. In this system, each conference delegate receives a transistorized receiver from which he can select one of six languages.

The transmitters are housed in four wooden cases, interconnected by cables and easily dismantled for portability. The carrier frequencies are:

<table>
<thead>
<tr>
<th>Channel</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel 1</td>
<td>67.5 kc</td>
</tr>
<tr>
<td>Channel 2</td>
<td>90.0 kc</td>
</tr>
<tr>
<td>Channel 3</td>
<td>112.5 kc</td>
</tr>
<tr>
<td>Channel 4</td>
<td>135.0 kc</td>
</tr>
<tr>
<td>Channel 5</td>
<td>180.0 kc</td>
</tr>
<tr>
<td>Channel 6</td>
<td>225.0 kc</td>
</tr>
</tbody>
</table>

All carriers are developed in one of two identical master oscillators. Should one oscillator fail, plate voltage may be transferred to the other unit by the flick of a switch, thus insuring continuous operation. The master oscillator is crystal controlled and operates at a basic frequency of 22.5 kc. RF drive for the transmitters' frequencies is obtained by utilizing harmonics of the basic crystal oscillator. Simple arithmetic reveals that the above listed frequencies are all harmonics of the basic frequency.

Each transmitter has a seven-position selector switch for continuously monitoring critical voltages and currents in the circuit, which include those of the audio amplifier, RF amplifier and modulator cathodes. In addition, a five-step attenuator is used to control RF output. The outputs of all six transmitters (as high as eight watts), are coupled in series and fed to an antenna tuning panel. Now we come to the most unusual feature of the system: the antenna.

The typical antenna is simply some number 16 insulated wire strung as a loop around the conference hall or meeting room. The signal on the inside of the loop, as measured by a field strength meter, remains virtually the same at any point. But outside the loop, the signal falls off by the square, thereby meeting federal radiation laws.

Receivers are only three inches in their largest dimension and are powered by a single 1.5 volt nickel cadmium battery good for more than 50 hours of continuous operation. Additionally, the batteries are easily rechargeable.

There are three transistors in the six channel receiver. One serves as a detector and initial audio amplifier; the second drives standard magnetic 300 ohm earphones. The third has a most unusual function, which you'll learn about in the next paragraph. The six channels, with their 22.5 kc separation, are free from crosstalk. In addition, the high "Q" ferrite antenna provides increased selectivity. The receiver may be worn about the neck, thereby allowing complete freedom of movement. When the earphone is disconnected, the battery is electrically isolated from the receiver, thus conserving power.

Now about that third transistor: Sometimes conference delegates are forgetful. Sometimes they have so many important things on their minds, and the receivers are so small and lightweight, that they forget to leave them behind when they leave. This third transistor, for lack of a better name, operates in a "theft protection" circuit. It acts as an unmodulated oscillator at 392 kc. In temporary setups where many receivers are distributed, a loop is strung around each exit. The signal in the loop is detected by a special tuned radio frequency (TRF) receiver. If someone inadvertently leaves the room without returning his receiver, the 392 kc signal emitted by the oscillator triggers an alarm circuit in the TRF receiver. This circuit is in operation even though the earphone has been disconnected.
Continued from page 39

When the beam strikes this screen, light is emitted. The ability of some materials to produce light in this fashion is known as fluorescence. The intensity of the spot on the screen depends on two factors—the speed of the electrons in the beam and the number of electrons that strike the screen at a given point per unit of time.

Now, if this is all that the cathode-ray tube contained, then the beam would always strike the fluorescent screen at one spot, in the center. In order to have the beam move up and down and back and forth across the screen, two sets of plates straddle the path of the beam between the point where it leaves the electron gun and where it strikes the fluorescent coating. The two sets of plates are positioned perpendicular to each other, so that each will swing the beam in a different direction.

In order to see what happens when voltages are applied to both sets of plates, consider Fig. 3. One plate of each set is so connected that it can receive either a positive or a negative voltage from a voltage divider.

One vertical deflection plate is connected to potentiometer P1 while its mate connects to ground. For the horizontal deflection pair, one plate connects to P2 while its partner also goes to ground.

Initially, let us assume that the arm of each potentiometer is at the point marked ground. In this position, neither set of plates has any voltage difference across it. Under these conditions, the beam will pass through the plates, unaffected, and strike the screen in its central region. Now consider the vertical plates VP1 and VP2. If the arm of P1 is moved above the ground point, a positive voltage will be applied to plate VP1 and the electron beam will be attracted upward; therefore, the beam will strike the screen at a point above center. If we also apply a negative voltage to horizontal plate HP2 from P2, the same electron beam, while it is being attracted upward by plate VP1 will also be repelled to the right by HP2, finally coming to rest at point A on the screen.

To move the electron beam to point B on the screen as indicated in Fig. 3, a negative voltage should be applied to VP1 and a positive voltage to HP2. This means moving the arm of P1 below the ground point and moving the arm of P2 above the ground point. If potentiometers P1 and P2 are moved back and forth across the zero point at the same time and at the same rate, what you will see on the screen is a solid line extending from point A to point B. This is the screen trace. By applying a variety of different voltages to both sets of plates, we can obtain an infinite number of patterns on the screen.

It has been assumed that in the absence of any voltages on either set of deflection plates, the electron beams from the gun would strike the fluorescent screen precisely at its center. Due to slight imperfections which generally arise in manufacture, it is more probable that the beam will strike the screen some point off center. In order to center the beam, vertical and horizontal positioning controls are provided. All these controls do is apply a small positive or negative voltage to each of the deflection plates to bring the beam to the desired point on the screen.

In order to obtain significant deflection of the beam, horizontally and vertically, it is necessary to apply fairly large voltages to the deflection plates. Such voltages are seldom available directly from the electronic circuits where the oscilloscope is to be used, and it is customary to build into the oscilloscope special horizontal and vertical deflection amplifiers. These amplifiers raise the input voltages to the necessary level and then apply them to the deflection plates.

In addition to a deflection amplifier, the horizontal system also contains a sweep generator. This is a circuit which develops sawtooth waves. A sawtooth wave will move the beam horizontally from left to right at a uniform rate of speed. When the beam reaches the extreme right-hand side of the screen, it is quickly brought back to the left-hand side and then the slower left-to-right motion is resumed. A sawtooth wave is

Electronics Illustrated
employed because it provides the beam with a uniform left-to-right motion. This horizontal movement usually represents the time axis.

For example, consider the sine wave shown in Fig. 4. This wave is to be reproduced on the face of an oscilloscope screen. It starts from zero, increases until it comes to a positive peak, gradually decreases when it comes to zero, reverses itself until it comes to a negative peak, then gradually moves back to zero.

However, these variations do not all occur at the same time; rather, they occur in sequence, one after the other. Hence, when we apply this voltage to an oscilloscope, we must not only have the beam move up and down, but also horizontally to show that one part of the wave occurs before another.

To produce the up-and-down motion, the sine voltage is applied to the vertical deflection system. At the same time, a sawtooth voltage, is applied to the horizontal deflection system. The result is the sine-wave pattern. Failure to provide this sawtooth voltage will produce a vertical line. Here the beam is moving up and down all right, but it has no horizontal spread.

In most of the applications where the oscilloscope is employed, this same type of time base or steady horizontal motion from left-to-right is required. That is why the sweep generator is built into the instrument.

A second control associated with the sweep generator is the one labeled "Sync Amp." Its purpose is to take a small portion of the input voltage being applied to the vertical system and use it to synchronize the sweep generator so that the sawtooth voltage moves in step with the applied signal. It locks the sweep generator in with the frequency of the applied signal (or a multiple of it) in order to produce a stationary pattern on the screen. If such synchronization were not employed, the pattern would drift across the screen and be in constant motion. This would make it difficult for the user to observe and also difficult to use in the event he wished to measure the amplitude of the applied signal.

Next month we'll consider each of the oscilloscope's controls in detail.

Antennas For Citizens Radio

Continued from page 43

tion is on the rear trunk deck. Here, the whip encounters the least metallic obstruction.

One trick, used by hams, is to remove a back-up light and install the antenna base there. When the car is sold, the light and lens are re-installed. In mobile installations always ground the tailpipe to the body and tighten all bolts to eliminate interference and noise caused by loose body parts.

Fixed station antennas may be installed with the same techniques used in TV antenna work. The large ground plane shown in the photo was mounted on a 5-foot TV mast, secured with vent mounts on a 4-inch pipe. Use guy wires if mast sections rise over ten feet.

The leadin wire called for in virtually all current Citizens Radio gear is 52 ohm coaxial cable. Various TV stand-offs may be used to bring it from the antenna to the transmitter. Unlike twin-lead (300 ohm) the jacket on the cable may touch metal without signal loss.

Selecting an antenna is apparently a compromise between physical size and range. The clip-on is inexpensive, easy to install, but most limited in range. Tests at EI have shown that a clip-on mounted on a car gave good results over two miles of obstructed terrain. The fixed location transmitter used a short whip atop a 200-foot building.

If maximum range is needed, a full ground plane (as high as possible) should be used for the fixed station with an 8½-foot whip for mobile use.

Hi-Fi Clinic

Continued from page 66

third harmonic will occur at 3,000 cps. The fundamental tone is considered the first harmonic.

All natural sounds contain at least a few harmonics, and it is differences between the relative strengths and distribution of these harmonics which make two instruments sound different even though both may be sounding the same fundamental pitch.
subjective group of listeners. But by using a representative group of listeners, we believe that we came more directly at the actual impact of wear on the record user than any rating number could, even if it were possible to produce one.

Admittedly, too, extremely finicky listeners might find our categories a bit too generous to the records. The evaluating equipment used was top high fidelity, with pickups and amplifiers in the best class and wide-range speakers. Everything considered, we believe that our tests were definitely on the "tough" side, as far as most listeners are concerned.

Another vital point is that records recover. A record played once and then put away for a day or a week will last better than one played over and over continuously, as they were in these tests. This recovery ability has to do with cold flow of the record material and its "memory" for its original shape; pushed out of shape, the groove tends to come back almost to normal in a few hours or a day. The effect was demonstrated several times in the course of the tests when a record was evaluated immediately after the run, and then again some time later.

Another important point: serious noise was produced by multiple playings at the point where the descending stylus hit the record. This "impact noise," of course, does not apply to normal use in which the stylus is put down on the outside edge of the record.

The basic test material was supplied by a number of copies of Stravinsky's "Petrushka," London CS-6009. This is a magnificent recording, with plenty of soft passages and sudden fortissimos.

A representative group of the most widely distributed pickup cartridges was evaluated in a number of tests. The most significant: with every condition as alike as possible, all set at 5 grams stylus force, the pickups were played 400 times each on separate records but on the same passage.

Least wear was produced by the Shure, with the Pickering very close behind. The wear with these two at 400 playings was definite but moderate, so they were pushed to 800. At this point, the records were still "playable," although approaching Class III.

Other pickups with outstandingly low wear were the Miratwin and the Electro-Voice 21MD. Most destructive was an imported ceramic. The ceramics as a group were somewhat more destructive than the magnetics.

A rule of thumb long applied has been: the louder a pickup "talks" in direct noise, the worse its effect on a record. This was confirmed, generally speaking. The "worst" pickup talked so loudly it could be cued, even in pianissimo passages, with the amplifier turned off. The best units were inaudible until the listening ear was practically wrapped around them.

Watch That Stylus Force!

Neither were there any big surprises in the results of varying the stylus force: just a hair-raising confirmation of the fact that this is far more critical on stereo records than it was on monophonic. A test was run with four of the pickups, ranging from "best" to "worst," set at 7½ grams rather than the standard 5 grams. The following table gives results, compared with the 5-gram test:

<table>
<thead>
<tr>
<th>Number of Plays for Roughly Equal Class II Wear</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
</tr>
<tr>
<td>7½</td>
</tr>
</tbody>
</table>

- **Pickup grams grams**
  - "Worst" 110 20 (Horribly wrecked at 65 plays)
  - "Medium" 300 90
  - "Best" 550 200

Early in the tests, a measuring error started the "best" pickup on a section of groove at 10 grams stylus force. A routine listening check at 5 plays revealed a groove murdered into mutilated death. The surface was pure Grade 3 sandpaper; the highs were all gone. Thereafter, measuring techniques were revised and force was checked at beginning, several times in the middle, and at the end of each test.

[Continued on page 100]
"bookshelf" 12 watt amplifier kit

COMBINES BEAUTY, STYLE AND QUALITY

Build this high quality amplifier in a few hours of your spare time and enjoy true high fidelity performance for years to come. Provides full range frequency response from 20 to 20,000 CPS within ±1 db, and has less than 1½% harmonic distortion at full 12 watt output over the entire range (20–20,000 CPS). Miniature tubes are used throughout the advanced circuitry, including EL84 output tubes in a push-pull tapped-screen output circuit. The special design output transformer has taps for 4, 8 and 16 ohm speakers. The model EA-2 has its own built-in preamplifier with provision for three separate inputs, mag phono, crystal phono and tuner. Features RIAA equalization, separate bass and treble tone controls, and a special hum-balance control. Complete with instructions for easy assembly.

MODEL EA-2
$28.95
SHPG. WT. 15 LBS.

Complete selection of Monophonic and Stereo Kits!

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listing over
100 high quality
dependable
Heathkits for you
to choose from.

HEATH COMPANY
BENTON HARBOR 39, MICH.

Send your latest Free Catalog.
Superior’s New Model 77

VACUUM TUBE VOLTMETER
WITH NEW 6" FULL-VIEW METER

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

- Model 77 completely wired and calibrated with accessories (including probe, test leads and portable carrying case) sells for only $42.50.
- 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 12A/D as D.C. amplifier and two 906’s as peak-to-peak voltage rectifiers to assure maximum stability.
- Model 77 uses a selenium-rectified power supply resulting in less heat and thus reducing possibility of damage or value changes of delicate components.
- Model 77 meter is virtually burn-out proof. The sensitive 400 microamphere meter is isolated from the measuring circuit by a balanced push-pull amplifier.
- Model 77 uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

Specifications:
- DC VOLTS — 0 to 3/15/75/150/300/510 volts at 1 megohms input resistance.
- AC VOLTS (RMS) — 0 to 3/15/75/150/300/510 volts. • AC VOLTS (Peak to Peak) — 0 to 8/80/200/400/900/2,000 volts. • ELECTRONIC OHMMETER — 0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm input resistance.
- VACUUM TUBE VOLTMETER — For discriminator alignment with full scale range of 0 to 1.5/7.5/31.5/150/375/750 volts at 11 megohms input resistance.

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

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

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

Model 77 — VACUUM TUBE VOLTMETER . . . Total Price $42.50 —
Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months.

Superior’s New Model TV-50A

GENOMETER
7 Signal Generators in One!

✓ R.F. Signal Generator for A.M. ✓ Bar Generator
✓ R.F. Signal Generator for F.M. ✓ Cross Hatch Generator
✓ Audio Frequency Generator ✓ Color Dot Pattern Generator
✓ Marker Generator

This versatile All-Inclusive GENERATOR Provides ALL the Outputs for Servicing:

A.M. Radio • F.M. Radio • Amplifiers • Black and White TV

R. F. SIGNAL GENERATOR: The Model TV-50A Generator provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50A Genomer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

CROSS HATCH GENERATOR: The Model TV-50A Genomer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

DOT PATTERN GENERATOR (FOR COLOR TV)
Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a “must” is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

Model TV-50A GENOMETER . . .
Total Price $47.50—Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months.

BAR GENERATOR: The Model TV-50A projects an actual Bar Pattern on any TV Receiver Screen. Patterns will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

MARKER GENERATOR: The Model TV-50A includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 450 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency).

EXAMINE BEFORE YOU BUY!
USE APPROVAL FORM ON NEXT PAGE

Electronics Illustrated
Superior's New Model 70 UTILITY TESTER®
FOR REPAIRING ALL ELECTRICAL APPLIANCES
and AUTOMOBILE CIRCUITS

As an electrical trouble shooter the Model 70:

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

As an Automotive Tester the Model 70 will test:
- Both 6 Volt and 12 Volt Storage Batteries • Generators • Starters • Distributors
- Ignition Coils • Regulators • Relays • Circuit Breakers • Cigarette Lighters • Stop Lights • Condensers • Directional Signal Systems • All Lamps and Bulbs • Fuses
- Heating Systems • Horns • Also will locate poor grounds, breaks in wiring, poor connections, etc.

INCLUDED FREE This 64-page book—practically a condensed course in electricity. Learn by doing. Just read the following partial list of contents: What is electricity? • Simplified version of Ohms Law • What is wattage? • Simplified wattage chart • How to test all electrical appliances and motors using a simplified trouble-shooting technique • How to trace trouble in the electrical circuits and parts in automobiles and trucks.

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

Superior's New Model 82A A truly do-it-yourself type TUBE TESTER
TEST ANY TUBE IN 10 SECONDS FLAT!

FEATURES:
- Tests over 600 tube types. • Tests Q2X and other gas-filled tubes. • Employs new 6" meter with scaled air-damping chamber resulting in accurate vibrationless readings. • Use of 22 sockets permits testing all popular tube types and prevents possible damage to tubes. • Dual Scale meter permits testing of low current tubes. • 7 and 9 pin straighteners mounted on the 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. Didn't tell the low price-minded how! We claim Model 82A will outperform similar simplified tube testers. They'll sell for much more—and as proof, we offer to ship it on our examine before you buy policy.

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

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

SHIPPED ON APPROVAL
NO MONEY WITH ORDER—NO C.O.D.

MOSS ELECTRONIC, INC.
Dept. D-674, 3849 Tenth Ave., New York 34, N. Y.
Please send me the units checked on approval. If completely satisfied I will pay the amount specified with no interest or finance charges added. Otherwise, I will return within 10 day trial positively cancelling all further obligation.

Name
Address
City State

November, 1959

[Table with various options and prices]

www.americanradiohistory.com
Continued from page 96

In another of the several stylus force tests, the best and worst pickups were run on the same passage on different records, at gradually increasing stylus force. The results:

<table>
<thead>
<tr>
<th>Stylus Force</th>
<th>Best Pickup</th>
<th>Worst Pickup</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 grams</td>
<td>850 (still good)</td>
<td>Won’t track</td>
</tr>
<tr>
<td>4.75 grams</td>
<td>—</td>
<td>300</td>
</tr>
<tr>
<td>6 grams</td>
<td>550</td>
<td>60 (wrecked at 75)</td>
</tr>
<tr>
<td>8 grams</td>
<td>310</td>
<td>15 (wrecked at 30)</td>
</tr>
</tbody>
</table>

The “best” pickup at the 8 gram force did produce a curious “flattening” of the music, partly the reduction of highs, but very little increase in noise.

To make sure you are getting the stylus force set right, measure just off the edge of the turntable, with the stylus tip at the level of the top of the turntable. Move the gauge and the pickup with it up and down several times gently to be sure the vertical pivot in the arm is not sticking and giving a false reading. As you move, the inertia of the arm will naturally increase the reading; the opposite happens on the way down. Take an average reading, or the one with the gauge held steady at the turntable level, once you are convinced the arm is free.

Keep ‘Em Clean and They’ll Go Forever

The foregoing tests, and many variations, were made with records kept in jackets when not in use, but with no special effort to clean the surfaces. So a test was run with a “good” pickup, at 3.75 grams, on two records: one left out on a table face up for four days, the other washed in a detergent just before playing, and kept covered during the test. The results:

Washed record—833 plays—wear noticeable on careful listening, but sound still excellent.

Dirty record—135 plays—roughly the same wear; a fuzzier sound.

Excited by these results we then ran a test with every conceivable condition at optimum. The best pickup (Shure M3D), at 3.75 grams, was played on a record washed before each run in detergent. A Discharger was put on the pickup to keep the surface ionized. The changer was covered. The passage chosen had both soft and extremely loud music.

The tremendous result: the passage was played 1150 times and except for the “impact noise,” it still sounds marvelous.

To wash your records, use a good-grade detergent (never soap or any other gooey stuff, no matter how enthusiastically advertised) in lukewarm water. (Hot water will destroy a record.) Use a short rod through the center hole, and fill a pan with the water and detergent to about 4 inches depth. You can then hold the record vertically and revolve it in the water without getting the label wet. Slosh the water through the grooves with a soft cloth. Then rinse in lukewarm water and dry very gently with a lint-free cloth.

The principal makes of record on the market were compared with each other and with the London record. There were differences, but they were insignificant compared to the effects of pickup design, stylus force, and cleanliness.

Throughout the test, the condition of each stylus was carefully watched with a microscope giving 100 and 200 times magnification. All styli were diamonds. No significant wear occurred on any stylus. This is to be expected, because the actual total playing time with any stylus was very small. For instance, in the 1150-times test described, the stylus was on the record for only 18 seconds during each play, for a total of 345 minutes or about 12 to 15 LP sides.

Answers to Electronic Photoquiz

1. Open can of soldering paste.
2. Drill shavings from plastic coil form.
3. Record grooves.
4. Splatter of hot solder.
5. Selenium rectifier.
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Driveway Light Control

Continued from page 72

this. In the average lighted room it should be possible to adjust the balance pot so the relay is just on the verge of closing. The unit is at its most sensitive point, and the shadow of the hand over the top photocell should cause the relay to close. If the relay closes when the shadow is over the control photocell, reverse either the primary or secondary leads of transformer T, but not both. Remove the temporary shorts from the indoor switch terminals and RY2 and the unit is ready for installation.

The unit is mounted at headlight level in the driveway. The author's model utilizes a 1-inch pipe and an electrician was consulted to bring the AC wiring from the house to the unit. Wire the switch, lights and power line according to the diagrams.

At night, park your car with the headlights on at the point where the unit is to trigger. Adjust the balance pot until the relay just triggers and check the adjustment by turning the headlights on and off. Be sure to wait for the completion of the cycle before any changes in adjustment are made. Replace cover and check the manual switch by opening momentarily. Cycle should repeat.

Hamshack Goes Anywhere

Continued from page 75

Should the ham, or his collection of equipment be too large for a clothes closet, he shouldn't be discouraged. Many wives and mothers gladly consent to an out-of-sight basement spot. There the ham of the house can string wires, strew equipment, hang "picturesque" calendars, QSL cards, and scatter tools to his heart's content. Indeed, many a water meter reader and gas man has viewed such a scene.

Besides offering ample storage space and privacy, the coolness of a basement is perfect during summer "dog days," but there are a couple of disadvantages. Excess moisture in the air will quickly corrode and rust metal components if

[Continued on page 108]
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Hamshack Goes Anywhere

Continued from page 104

left exposed. This can generally be overcome by one or two applications of a sealing-type paint on walls and floor. A dehumidifier will generally solve the problem completely.

Another less obvious disadvantage of basement radio work is the danger of severe shock to a ham who must stand on the damp floor to repair or adjust equipment. Insulating rubber or plastic runner strips placed in front of work bench and equipment is a simple but worthwhile safety measure.

Amateur radio is by no means restricted to four walls. In fact, hundreds operate entirely from autos where they have installed receivers, transmitters and antenna systems. A complete station made up of compact units may be sandwiched beneath the dash panel. Another trick is to use the trunk compartment for bulky equipment with remote controls installed close to the driver.

Ham stations are on the wing, too. Contacts can be made with operators in a small aircraft out for a Sunday spin through the clouds, or with a jet bomber streaking toward Greenland working a kilowatt mobile aeronautical!

Dropping down to lake or sea level, one finds a growing number of launches, liners, houseboats and yachts with hams at their helm. While a special FCC license is required for limited operation on marine frequencies, many sea-faring CQ’ers are heard on the higher ham band frequencies.

No matter what the situation, every amateur agrees “Where there’s a will, there’s a way.” Maybe that’s why hamshacks are everywhere.

Rebuilt TV Picture Tubes

Continued from page 60

tube manufacturers admitted that rebuilding is here to stay by going into the business themselves. Some of the important tube manufacturers actually rebuild in the same plants where their new picture tubes are made—and send them through the same rigid tests.
The rebuilding process is not much different from making new tubes, and local rebuilders can compete with the giant companies. For instance, La Salle Tube Manufacturing Co., one of the first rebuilders to open shop, services the Chicago area. Its trucks pick up duds and distribute rebuilt tubes within a 500 mile radius of its plant. Visitors to La Salle’s plant see workers, aided by several conveyors and automatic devices, turning out thousands of rebuilt tubes each month. The tubes are mainly used in home TV receivers, but some are for closed-circuit TV systems or cathode-ray oscilloscopes.

Although no two rebuilders follow exactly the same procedure, the steps taken at La Salle (see p. 60) are typical of quality workmanship.

The rise of tube rebuilding has allowed fraudulent operators to emerge. One type of fly-by-nighter has been selling “fake” rebuilds. Instead of going to the trouble of cutting open the bottle and replacing the screen and electron gun, they have been “hot-shotting” the original worn-out electron gun. This means giving the gun a heavy electrical shot, which temporarily revives it.

No reputable dealer will knowingly sell a hot-shotted tube because it would never last the one-year warranty period. To make sure that you don’t receive a hot-shotted tube, insist on seeing the warranty statement that goes with all new or rebuilt tubes. If any picture tube you buy doesn’t last one year from date of purchase or installation, don’t hesitate to take it back for a substitute.

Many companies insist that their rebuilt tubes are just as good as all-new tubes. Some say that rebuilds are even better because during the tube’s initial use, any moisture trapped in the glass has probably leaked out, molecule by molecule, resulting in “seasoned” glass envelopes that contain no moisture to damage the new elements.

Electronic Music

Continued from page 78

precisely the musical color he wants. Many challenges to the composer arise in the handling of distortion and
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- **BARGAINS—BARGAINS. Catalog 100, T-K Enterprises, 4526 So. 46 Ave., Omaha 7, Nebr.**

- **BUSINESS OPPORTUNITIES**
  - **GROW MUSHROOMS. Celler; shed and outdoor. S考上, full time, year round. We pay $4.50 lb. dried. We have 29,000 customers. Free Book. Mushrooms, Dept. 318, 2964 Admiral Way, Seattle, Wash.**

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

- **OPERATE PROFITABLE mail-order business!! Write: Bond, T-1637 West Vernon, Phoenix, Arizona.**

- **HI-FI**
  - **PHONOGRAPH RECORDS cheap, post-paid. Catalogue. Paramount, Box 2028-K, Pine Castle, Florida.**

**ELECTRONICS ILLUSTRATED**

**DIAGRAMS FOR repairing radios, amplifiers, $1.00; television $2.00. Give make, model. Diagram Service, Box 672-EI, Hartford 1, Conn.**

**WORLD’S SMALLEST Radio $1.00 and a—stamped addressed envelope to Ekeradio, 650 N. Fair Oaks, Pasadena, Calif.**

**NEW! "10 TESTED Crystal Set Plans"—25¢, with Transistor experiments, catalog. Laboratories, 1331-K Valoia, Redwood City, California.**

**STOP T.V. commercials, Control volume and Off-On Switch from your chair. Complete plans $1.00. Kitmymack, Box 34E, Monclova, O.**

**ELECTRICAL SUPPLIES & EQUIPMENT**

**AMAZE YOUR friends with simple to build binary device that will indicate their age. Plans and instructions 50¢. Kit $7.95, wired and tested $9.95. D & C Electronics, P. O. Box 934, Rome, N. Y.**

**INVENTIONS & INVENTORS**

**FOUND! YOUR "open sesame" to selective manufacturers interested in acquiring available inventions. Write: Willard Bott, 2106 Customhouse St., San Francisco 24, Calif.**

**MISCELLANEOUS**

**HAVE FUN: comic postcards. 25 different $1.00. Bradley Variety, P. O. Box 281, McGregor, Iowa.**

**CHEMICALS AND Apparatus Catalog 25¢. No-Age Laboratories, Box 232, Bellmore, N. Y.**

**DETECTIVES**

**DETECTIVES—WORK Home—Travel. Experience unnecessary. Detective Particulars free. Write: Wagner, 8-125 West 86th, New York 24.**

**MUSIC**

**SONGPOEMS AND Lyrics Wanted! Mail to: Tin Pan Alley, Inc., 1650 Broadway, New York 19, N. Y.**

*Electronics Illustrated*
every effort is made to turn unavoidable distortion into musically acceptable sounds. All the various processes of timbre-modification must become an integral part of the general plan of the composition. Mixing often requires considerable experimentation to achieve proper balance of unusual sound materials and to avoid undesirable masking. Synchronization is another difficulty if precision is required in the final composition. Synchronous motors are a must, and starting and stopping the recorders often requires more than one pair of hands.

What is the future of electronic music or of tape music as it has been called in the United States? First of all, it will never replace the more conventional methods of musical composition. However, inasmuch as it permits composers to do things which are impossible to accomplish with conventional instruments, it offers a new field of exploration which is not likely to be soon exhausted. Movies, television, and radio have begun to make use of this new music, and it also has been heard in the concert hall. A new bond between composer and engineer appears to be in the making.

*Ameco AC-IT Ham Transmitter*

Continued from page 87

the plastic will solidify it into its original position.

No meter is used in the circuit but tune-up may be done with a small pilot lamp. If the builder has a DC milliammeter, it is inserted in series with a key lead. The plate tuning capacitor is rotated for a dip in current and the antenna loading capacitor brings the current up to its rated value. As customary with pi-network outputs of this type, the final step is to dip the plate current.

A 65-foot antenna of the single-wire type was strung up to check the rig's on-the-air performance. Five contacts on the 80 meter CW band were logged, each yielding a report of good signal strength and quality. EI rates AC-IT for $18.70 as an easily-assembled unit for the beginner and a Good Buy.
EMC MODEL 801
RC BRIDGE AND IN-CIRCUIT CAPACITY CHECKER
A new comprehensive resistance and capacity checker. It measures condensers for actual value, leakage, and power factor. In addition it measures condensers while still connected in their original circuits for opens, shorts or intermittents.

MODEL 801 WIRED $38.95
MODEL 801 KIT 24.95

EMC MODEL 802
SIGNAL TRACER AND GENERATOR
Generates its own audio, IF and RF signal for tracing. Uses both a magic eye tube and a speaker for signal detection. Checks noisy components. Checks and compares magnetic, ceramic and crystal cartridges. Supplied with two shielded audio probes and RF crystal demodulation probe.

MODEL 802 WIRED $38.95
MODEL 802 KIT 24.95

Build-It Course
Continued from page 51

network. Apply a frequency to a capacitor and it opposes it with capacitive reactance. But, as the signal goes up in frequency, the opposition decreases. In the higher treble ranges, the capacitor is virtually a short circuit. The low-frequency bass notes encounter great resistance—an open circuit.

It is the varying degree of opposition between highs and lows that enables the equalizer, or tone control, to yield the desired response curve.

The design of this preamplifier is basic. It is a workable unit capable of good performance in conjunction with the other plug-in projects in this series. An important consideration in its construction is avoiding hum. Be certain that all grounds are secure and well-soldered. Try a ground lead between chassis, at various points, if hum level in the completed unit is objectionable.

Next month an AM tuner will be added to this series.

Add A Tuning Eye
Continued from page 63

Refer to a schematic drawing of your set for a point to obtain B+ from 220-360 volts DC. This is most readily available at the large filter capacitors in the power supply section.

An Amphenol Magic Eye assembly contains a hood-type escutcheon made of plastic, a metal support bracket and socket with leads. The only additional part required is a 3,300 ohm, 1 watt resistor.

A special procedure must be followed with a tuner that has a ratio detector such as the Heathkit. Pins 1, 5 and 6 are connected to ground and the output from the ratio detector is connected to pin 4 of the 6AL7. The negative end of the 10 mfd 50 volt capacitor is suitable. Target areas A, C and D will not change size during tuning. Area B will vary and should be tuned for smallest size.

The Amphenol kit cost $1.50 and the 6AL7 tube $3.
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National's NC-188—new general coverage receiver—a truly great value. Designed for Short Wave Listeners and for new Hams, it covers AM broadcast and all popular SWL and amateur bands. Continuous coverage: 540 kc to 40 mc in 4 bands, plus all the latest engineering features.

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