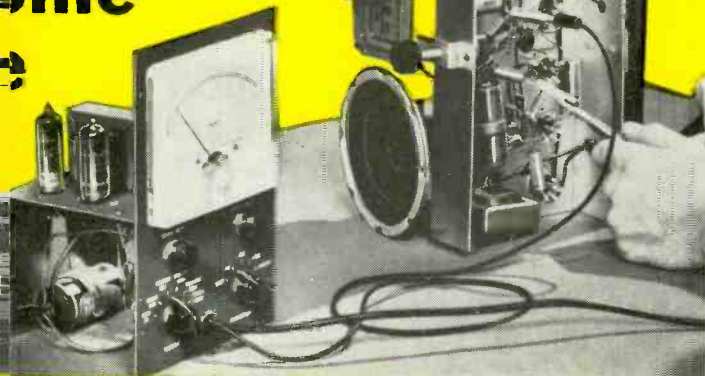


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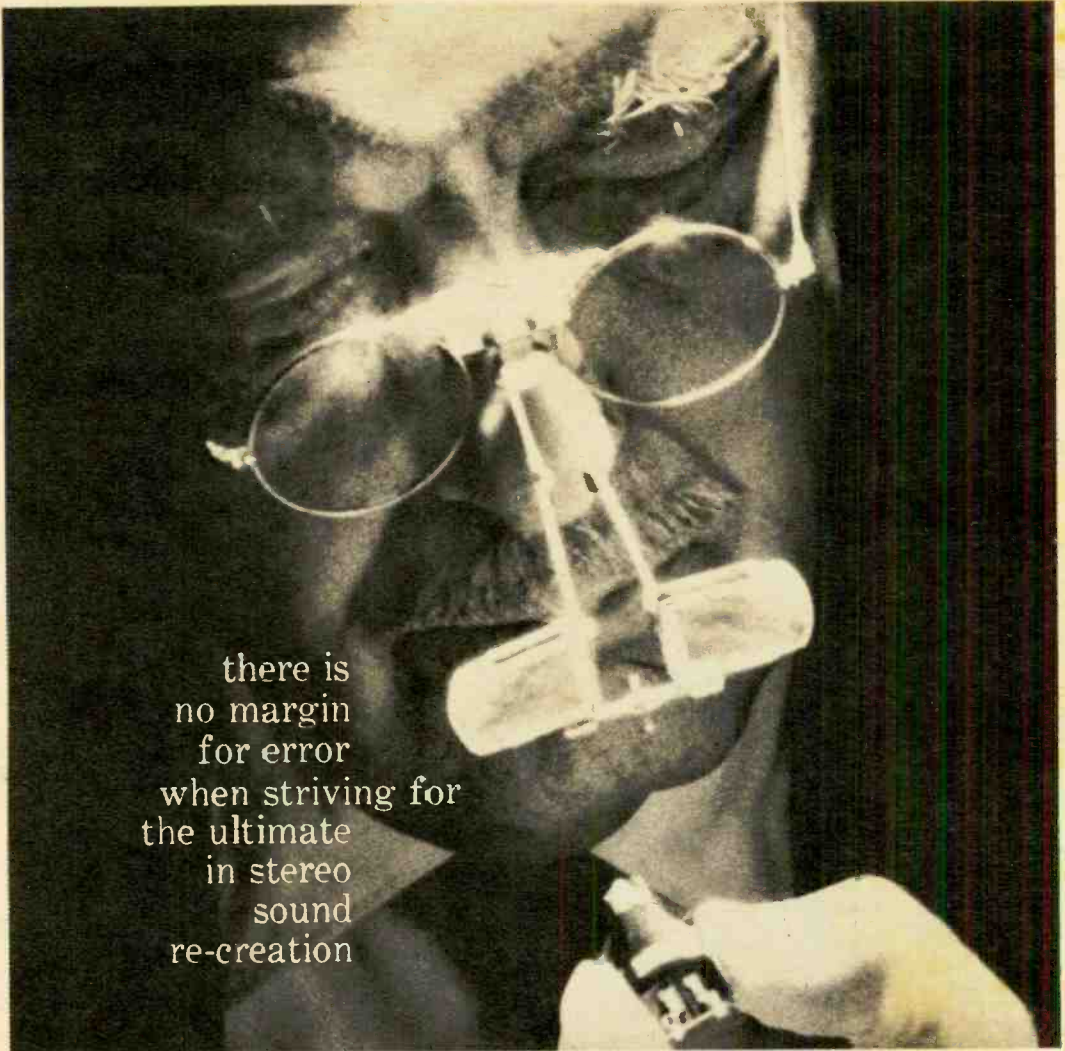
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ELECTRONICS ILLUSTRATED

October, 1960

Vol. 3, No. 10

A Fawcett Publication

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
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A Message From the Editor

THIS time of year is a very busy one in our editorial offices. Build-it-yourselfers stay home more in the fall than in summer and they stock up on projects in anticipation of long cold winter evenings. This means that we have to work up more ambitious projects for you at this time of year. Actually, we have discovered that *EI* readers are interested in do-it-yourself projects all through the year, including summer. But this should come as no surprise, air conditioning and outdoor living have made it easier for people to ignore energy-sapping heat and keep their vitality throughout the year. In our summer issues we present projects

of value for that season. Yes, there still are important seasonal variations in living habits and this brings me to the first topic of discussion—the hi-fi shows. Although hi-fi components are sold throughout the summer, there is no question but that the fall and winter are best for sales. To kick off the sales season, hi-fi manufacturers will show their new lines at the various hi-fi shows throughout the country. The first is the New York City High Fidelity Show. We will give you a complete report on the new products and ideas demonstrated there in our earliest possible issue.

If you are a hi-fi buff and are especially interested in loudspeaker enclosures, our next issue will have just what you need, a 16 page special section on stereo and monophonic hi-fi speaker enclosures. This will include a discussion of why they are needed, how they work and plans for building some well designed, *EI*-tested cabinets. As a special bonus we will present, for the first time anywhere, a tuned *front loaded* cabinet designed by *EI*. Don't miss this!

As a general rule, we report to you in depth on new important developments in electronics *as they occur*. However,

you may have noticed that we have not as yet had what we consider a definitive article on tunnel diodes. This is the little semiconductor device that can operate at higher frequencies than conventional transistors. We have seen many articles on the tunnel diode but none have explained just how they work in clear easy-to-grasp terms. We think we're on the track of such an article now and even more important, we will have several useful circuits that you can build using them. This should be especially interesting in view of the fact that General Electric has just announced a drastic slash in price for their gallium arsonide units. Further reductions are promised.

There are times when the editors of *EI* must use a great deal of ingenuity to get the

[Continued on page 10]



One of the speaker enclosure designs in Nov. *EI*.

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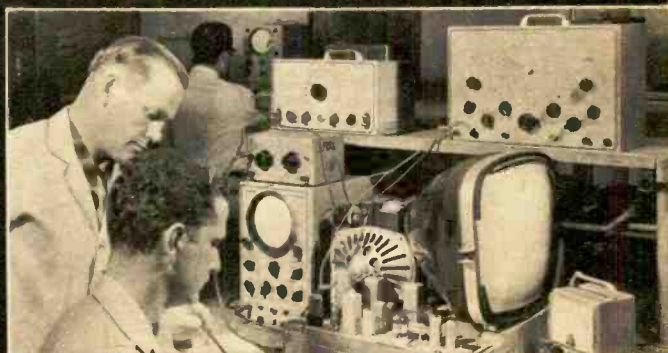
(Shown at left—Instructor explaining operation and testing of a large Motor Generator in our A.C. Department.)

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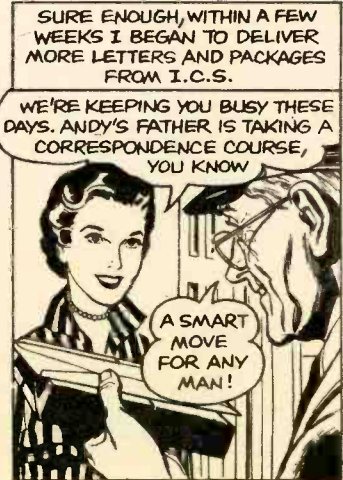
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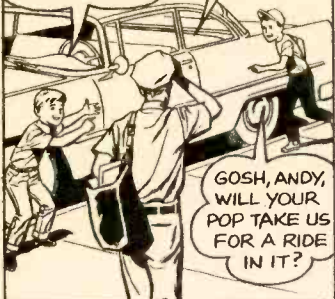
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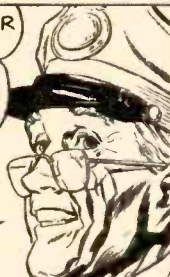


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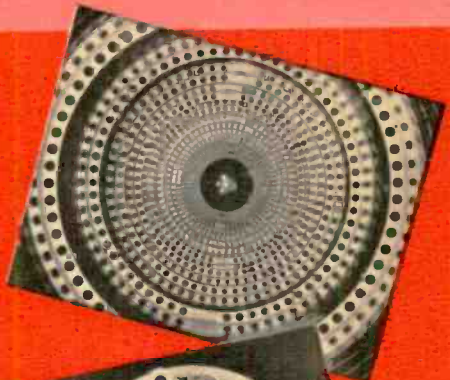
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The author of the lead story in this issue ("How To Win Science Fairs") knows what he is talking about. He won second prize at the National Science Fair in 1958. He is now studying electronic engineering at MIT and is also a regular contributor to *EI*. If you are interested in science fairs, read this article carefully. It's full of hard-to-get authoritative information. Incidentally, there is really no special trick to win science

[Continued on page 12]

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4B7A	6AV6	6J4	7B7	7B7	50L6GT
5AS8	6AW6	6J5	7C4	7C4	50X6
5AT8	6AX6GT	6J7	7C8	7C8	56
5AT8	6AX6GT	6K7	7C8	7C8	57
5AW4	6B8	6K7	7C8	7C8	57A
5BK7	6B8	6K7	7C8	7C8	57B
5L6	6BC8	6K8	7E6	7E6	57C
5T8	6BC8	6L7	7E7	7E7	57D
5U4C	6BD8	6NF	7F7	7F7	57E
5V4G	6BF5	6Q7	7F8	7F8	57F
5V6GT	6BF5	6S4	7M7	7M7	57G
	6BF6	6S6GT	7N7	7N7	57H
	6BC6C	6S7	7Q7	7Q7	57I
		6S7	7X7/XXFM	7X7/XXFM	57J
			7Y4	7Y4	57K
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V. Dean DeVora, 309 Bess Street, Washington, Ill.	1st	16
Edward T. Wall, Box 184, Kenly, N. C.	1st	12
James W. Wranich, 4236 Michigan Street, Kansas City, Mo.	1st	26
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Nelson S. Kibler, 1413 Patrick Henry Dr., Falls Church, Va.	1st	18
Barry L. Ulrich, 1110 Chestnut Ave., Barnesboro, Pa.	1st	14
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fairs; what is needed is hard work and planning. So many winners have gone on to important careers in science as a result of their endeavors in the fairs that it behooves you to take up this challenge. The science project for this month is the "Reaction Timer." We will have another for you next month and we welcome your comments on our new policy of encouraging electronics projects for science fairs.

"Since land-based missile stations in Europe would be notoriously easy prey for the enemy, we may do well to consider launching a massive building program of sea stations—submarines and surface ships—which could launch these IRBMs (Polaris and Regulus)."

The above quote is from the "Blueprint for Defense" article published in *Electronics Illustrated* on July 1958. In view of the common sense of such a concept for our defense it is strange that the highest priority was not assigned to its development. However, the newspapers recently announced in bold headlines that the Polaris missile has just been successfully test fired from two different atomic submarines. At last, more than two years after *EI* suggested this program for our defense, our Defense Department comes up with it. We feel it could have been done sooner with a crash program. We point this out to you to indicate that *EI* does not concern itself only with gadgets—we think big too!

Be with us next month for some interesting new build-it-yourself ideas including a 1-transistor pocket-sized Citizen's Band receiver.

Would you like a "Letters to the Editor" column? This would be turned over to you, our readers, to sound off at *EI*, or on anything electronic and of interest to other *Electronics Illustrated* readers. Let us know what you think of this idea.

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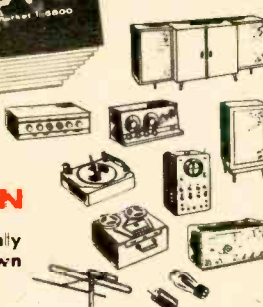


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..electronics in the news

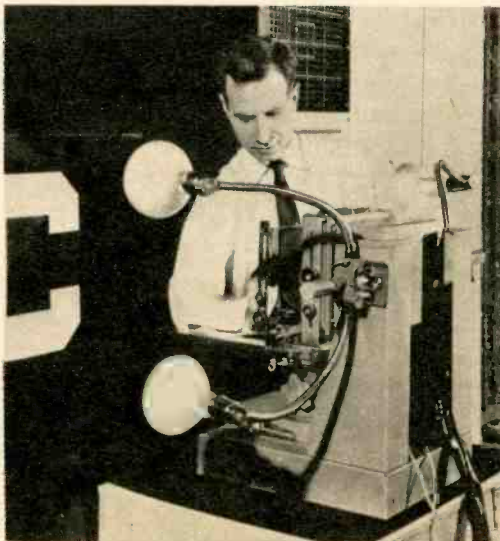
SKY EYE FOR TV: The Editors of Electronics Illustrated are accustomed to receiving photos of pretty girls holding things from the manufacturers of tubes and other electronic components. We thought



you would like to see this one because (look at the tube, now, lads) this one shows the RCA Vidicon television camera tube used in the TIROS weather satellites to take pictures of the Earth's cloud cover and weather patterns. By now the small size of "television tubes" creates no sensation, but there is no picture tube this small, and we fondly remember when a TV camera tube was big enough to smash over the bow of a battleship, leaving enough glass left over to christen a destroyer. The tiny "eye" is remarkable when you think of the thinness of the electron beam needed to scan its matrix, which is smaller than the cornea of your eye. Tube is ruggedized for launching....

• • • • •

True robots come a step closer with this machine that learns in a way very similar to that in which a human learns. The experimental Mark I "Perceptron," developed by the Cornell Aeronautical Laboratories, recognizes shapes, such as letters of the alphabet. Unlike other "reading machines," the Perceptron does not compare what it "sees" with a pre-stored set of samples. Its photocell sensing units have random connections to a set of "association units," which are roughly the equivalent of a memory. The association units feed "response units" which provide an output. In its present form, the machine tries to display what it "sees" on a lamp panel. If it has seen incorrectly, the human "teacher" corrects it. Gradually the machine "learns," so that it is not easily fooled by changing type faces, etc.



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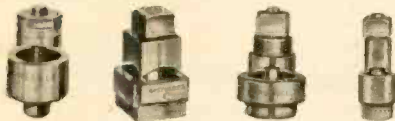
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...News

Handy . . . A self-reaching, self-feeling simulated human hand was announced by Czech researchers at the recent International Congress for Automatic Control in Moscow. In its foam-rubber "flesh" are carbon granules similar to those used in carbon microphones. Pressure on these granules results in changes in their total resistance, causing a varying signal to be delivered to a control device. Signal strength is proportional to the area and pressure of the rubber "skin" in contact with the subject, and the control device can "decide" on the amount of pressure needed to perform a task.

Also reported at the Congress were Norwegian and British optical flame cutters which could cut a ship's plates directly from plan drawings. An optical system follows lines on the drawing, and servos guide the cutting flames along the corresponding paths on the metal material.

American experts at the Congress were impressed by strides made by Iron Curtain Countries.

Space Race . . . Ground-control equipment for the recovery of space vehicles has already been developed, it has been announced by Sperry Phoenix Company, a division of Sperry Rand. Called MAN for "microwave aerospace navigation," the system enables a ground computer to take control of the space craft, calculate and maneuver a smooth approach, slow the vehicle down and land it. The MAN system uses a single ground-control radar housed in a highway van, and transponder equipment aboard the spacecraft. If the re-entry path length is greater than 350 miles, more MAN trucks can be added, and the control of the spacecraft then "handed" over to second, third, etc. MAN units as the spacecraft enters their range. Each MAN unit tracks the spacecraft by radar, "asks questions" and "issues commands" over the same radar frequency band. Human operators can override MAN's automatic features at any time.



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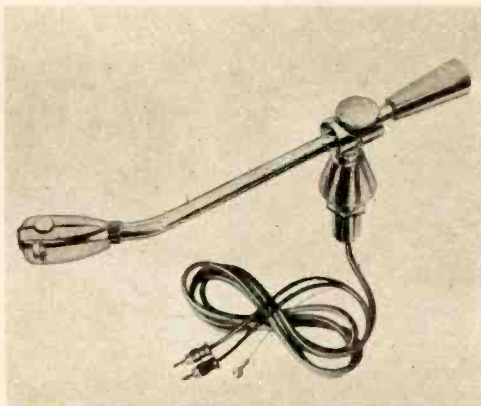
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... News

Fisher Radio announces the **Dynamic Spacexpander**, a unit designed to improve the sound from your hi-fi system using the reverberation technique. The model K-10 can be used with all high fidelity systems using separate preamplifiers or having tape monitoring facilities. Priced at \$59.50, from Fisher Radio at 21-21 44th Drive, Long Island City 1, New York.



Micropoise, Rek-O-Kut's new stereo tone arm, features a single cable which terminates in two color-coded leads, ready to plug into the amplifier, and a ground wire. Both the 12" and 16" models can be calibrated to track at from 0-6 grams. The 12" arm, model S-220, is priced at \$29.95 and the 16", model S-260, at \$34.95. Rek-O-Kut is in Corona, N. Y.

H. H. Scott has introduced a redesigned model of their **299 stereo amplifier** equipped for higher output wattage. Complete specifications on the 299B are available from H. H. Scott, Department P, 111 Powdermill Road, Maynard, Mass. \$209.95.

Sonotone has a **crystal cartridge** priced at \$6.45 with two sapphire styli. Mounting brackets provide for snap-in installation. Specs on the "12" series are available from Sonotone, Elmsford, New York.



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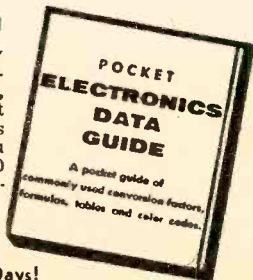


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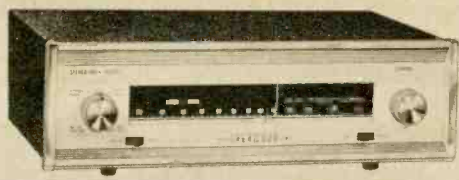
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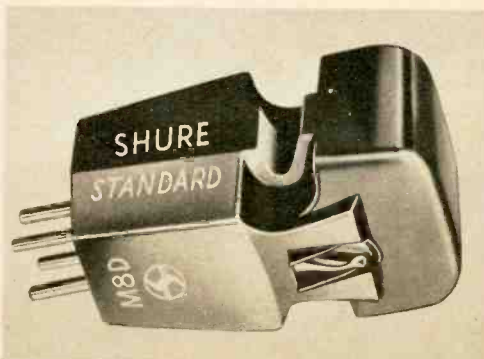


...News



An FM/Multiplex stereo tuner incorporating an inverse feedback circuit which the manufacturer says will improve response, lower distortion and control program frequency deviation has been announced by Sherwood Electronic Laboratories. Model S-3000 III is designed to accommodate the Sherwood model AMX multiplex adapter. Priced at \$110.50 from 4300 N. California Avenue, Chicago, Illinois.

A lightweight, low-cost "bookshelf" speaker system, the **Troubadour**, has been added to the Madison Fielding line of Crosby Electronics, Inc. The enclosure measures 9x9x14" and can be used as a portable extension speaker or permanently positioned. This unit comes in hand-rubbed walnut, mahogany and black ebony. Price, \$29.95. 135 Eileen Way, Syosset, N. Y.



A new Shure Brothers magnetic stereo cartridge designed for use with record changers has been put on the hi-fi market. The M8D is priced at \$16.50 including a 7 mil diamond stylus. Further information available from Shure, 222 Hartrey Ave., Evanston, Ill.



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

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

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J. Stataitis, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself. I was ready to spend \$240 for a Course, but I found your ad and sent for your Kit."

FROM OUR MAIL BAG

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

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

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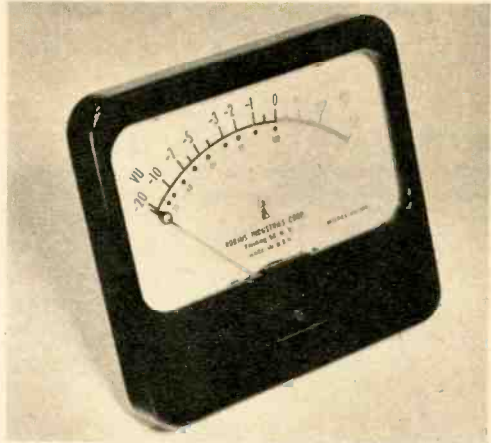
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...News



Maximum signal-to-noise ratio and precise level control are promised by a new **VU meter**, the model VU-100 "Gibson Girl" by Robins Industries Corp. It is designed to enable a tape recordist to establish balance and then repeat the identical value, and to help prevent tape saturation beyond the erase capabilities of the recorder. The 4½" meter mounts in a 2¾" hole, is 1½" deep, has 2-color scale, modulation and VU calibrations, dual impedance units and other features. A recorder's modulation indicator or integral meter may be calibrated against this precision device. Price: \$22.00, from Robins, 36-27 Prince St., Flushing, N. Y.

A new electronic sequence timer for such things as automatic washing machines was recently demonstrated by P. R. Mallory & Co. The timer has no moving parts. Instead it uses semiconductor switching modules triggered by an electronic "clock," and transistor amplifiers to control the mechanical cycles. In the demonstration washer, no changes were made in the ordinary fill, agitate, spin-rinse and spin-dry mechanisms. The electronic timer is not commercially available but was installed in the washer to demonstrate timing and control techniques Mallory expects to come into wide use in the next several years. First uses will be in industrial equipment and processes, by adapting timer to existing machines.

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... News



The "Petite," a compact new extension telephone with illuminated dial, has been introduced by Stromberg-Carlson Division of General Dynamics for the independent telephone industry. The dial light glows dimly when the 'phone is not in use, lights up brightly for dialing when the handset is picked up. Subscriber can turn off the light entirely by a switch in the base. Although the "Petite" has no built-in ringer, a compact wall-type bell box is available so that it can be used as a primary telephone instead of as an extension. The new narrow shape is intended to make the instrument more convenient for bedside table and other applications.



A new wide-angle TV picture tube, only 8 7/8" deep, has been demonstrated by Philco Corp. An experimental 18-inch tube with 122° deflection, it was shown at a recent engineering conference. It is flatter-faced than the familiar 17-inch, 110-degree picture tubes. The newly-developed deflection system is applicable to any size tube, and requires less deflection power in both horizontal and vertical circuits. Commercial production is expected to begin soon, but no date was given for use in TV sets.

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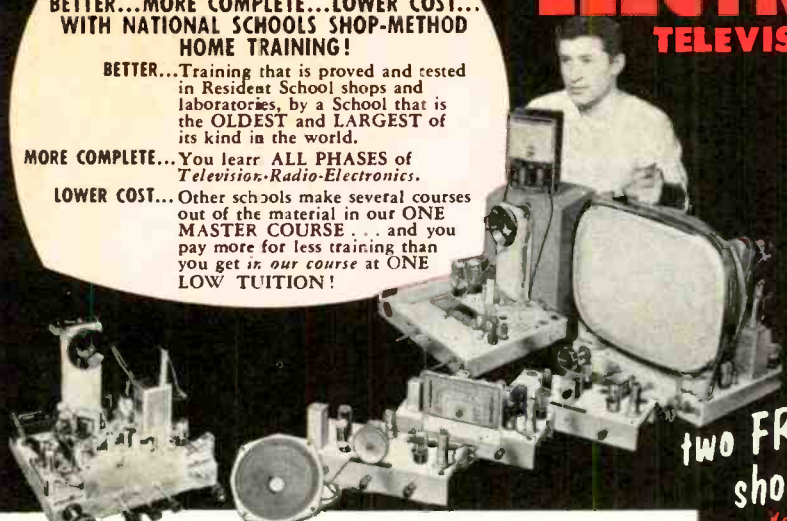
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Rev. Enoch P. Sanford



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Louis A. Tabat

I have a TV-Radio shop in Yorkville, Illinois, about 4 miles from my home, and it

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	6BH6	.51		6C7	.54
	6BJ6	.51		12AT6	.37
	6BK5	.75		12AT7	.71
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	6BN6	.90		12AV7	.73
	6BQ6	.83		12AX4	.60
	6BQ7	.85		12AX7	.61
	6BY8	.75		12AZ7	.65
	6BZ6	.45		12B4	.52
	6C27	.35		12BA6	.46
	6CA	.41		12BE6	.46
	6CB6	.51		12BQ7	.61
	6CD6	1.63		12BQ6	.63
	6CS	.59		12BY7	.65
	6CF6	.45		12C6	.63
	6CG7	.44		12DQ6	.66
	6CM7	.44		12SA7	.48
	6CM8	.59		12SK7	.48
	6CQ6	.35		12SN7	.56
	6CQ7	.35		12SQ7	.38
	6CQ8	.59		17AX4	.50
	6DQ6	.89		17D4	.50
	6E5	.49		17DQ6	.58
	6E6	.61		19BQ6	1.48
	6K6	.39		25BQ/6	.82
	6K7	.41		25C6	1.19
	6SA7	.45		25CUE	.82
	6SA8	.45		25L6	.41
	6AQ5	.48		35C5	.48
	6AS5	.52		65L7	.60
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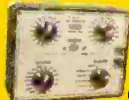


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How To Win At Science Fairs

by Ronald Benrey

YOU CAN WIN at a Science Fair as long as one thing interests you more than winning does. This is your project itself. It is going to be judged on *scientific thought, creative ability, and presentation*. You will really have to know the field your project is concerned with. This takes effort. Since you lack the means of a professional laboratory, you will have to do much with little. This takes trial and error and just plain work. Your presentation must be attractive and clear. This means good workmanship, which takes time and care.

You are going to have to show some originality.

After all, there is no use doing what everybody else is doing: be *different*. For this, you have to have the

other three under control.

By the way, the "laymen" who see your exhibit will ask all kinds of questions.

Have good answers at your fingertips. The judges won't be laymen, and any double-talk will scream to them that you don't know your subject. It may also make them suspect that the best parts of your project are not your work. This would be unjust, perhaps, but deadly. Now, whether your entry covers a large table top or can just be tucked under your arm, it is going to be a big job. It can't be left for a "crash program" in the last few weeks before the Fair. It is going to eat up big portions of your time, energy, and spending money for the next several months. All this demands your interest. But it isn't simply a matter of "fun."

Licking this challenge may be a turning point in your life. With or without a scholarship prize, your career may begin with it.



The author shown with his Fair winning project.

P lanning

As a reader of *Electronics Illustrated* your project will probably deal with electronics or applied physics rather than with biological or earth sciences. Select your topic carefully from a broad subject that really interests you.

A massive effort in the direction of a passing fancy will result in a mediocre project at best. Take a limited subtopic that you think worth investigating and that you feel able to handle. To ease financial strain, plan now to build your project over a long period of time, say six months, on a pay-as-you-build basis. Once you have a rough idea of your project's general form, don't dash into construction. Visit technical libraries and learn all you can about current professional work in the field, and its technical jargon. This will give you much important information and helpful hints, and when you finally face the judges, you will know your subject.



Prize-winning electron microscope: big or small, project needs careful planning.

A bility

Here is a prickly question. It is up to you to be realistic and honest with yourself when you choose a topic. Your science teachers and advisers will certainly be helpful, but the final decision must be yours. In other words, if you have never handled a soldering iron before, don't take on a project requiring elaborate electronic instrumentation. If you have enough time you can work up to a complex project by building a few simpler devices, like many described in *EI*. This is another reason for starting NOW. Why not get your feet wet by assembling some test equipment from kits? You will certainly need a multimeter anyway, for any project, and it will be something you can use "forever."

IS YOUR WINNING PROJECT HERE?

- RADIO TELESCOPE:** Home-built sensitive low-noise receiver, simple antenna system. Try to make simple "radio map."
- GUIDANCE SYSTEM:** For model car. Can be programmed to run around science fair grounds without hitting anything, or to reach pre-chosen destination.
- SOLAR CELLS:** Home-built unit as part of demonstration of basic physics of solar cells; display on recent professional research results; off-beat practical applications (eyeglass type hearing aid?).
- MOON MOUSE:** "To be landed on the Moon." Self-propelled, radio controlled from Earth, instrumented and transmitter equipped. Some functions solar powered?

These are only suggestions. You may come up with ideas regarding fuel cells, space communications, navigation, etc.

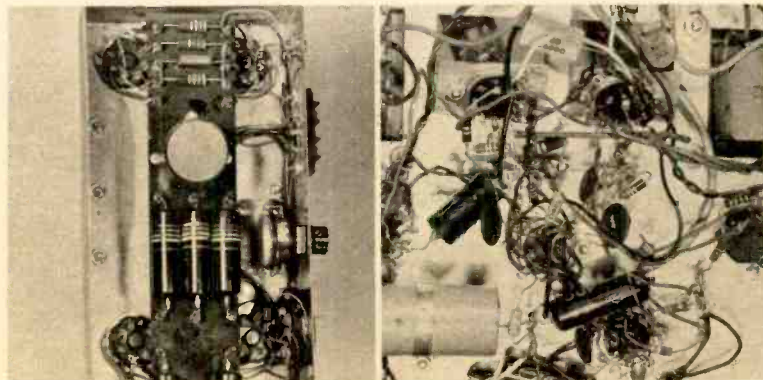
Originality

Another touchy subject: discussion of this often scares off good potential science fairers. Nobody requires or expects a science fair project to produce a radical new scientific discovery. However, this does not imply that an entrant can't find a new angle on an old problem. Merely duplicating a project described in a magazine shows the judges only one thing: the builder can follow directions. The main benefit of entering a science fair is the challenge of thinking a real problem out, all the way through. Your project can be for "demonstration" rather than "research," but make sure you come up with fresh, clear, meaningful ways to present your material. Stay away from last year's winning project: it was good last year. Avoid "staples" (like Tesla coils) unless they are only part of a wider original project.

Construction

Your project should be well presented and look impressive, but impressive need not mean expensive. Judges seldom look twice at an exhibit loaded down with excess and borrowed equipment when the same results could have been obtained more economically and without false show. Novel use of common materials shows creative ability, and this is an important judging criterion. Remember, *how* you solved your problem is what counts at a science fair, and not merely that you solved it. Also, neatness counts! Aside from being impossible to troubleshoot, a rat's nest of wiring is typical of *losing* projects. Time spent color-coding leads, installing wire harness and cable clamps will result in a much more attractive and more reliable project. But know what you are doing! Don't harness leads in a circuit that demands point-to-point wiring, or cable grid and plate leads together in an amplifier circuit. Read up on layout and construction techniques, and allow yourself time to make and correct mistakes. Prior planning will

also pay off in dollars and cents, since you can save by purchasing some components (like resistors) in quantity, and if you live near a big city you can shop around for some items in the military surplus stores, modifying your design if necessary to take odd-value components. Now, sit back and start your thinking. The time to start is right now.



Well-wired device (left) was winner; scramble-wired unit never reached Fair.

your high school CAN produce
Science Fair Winners

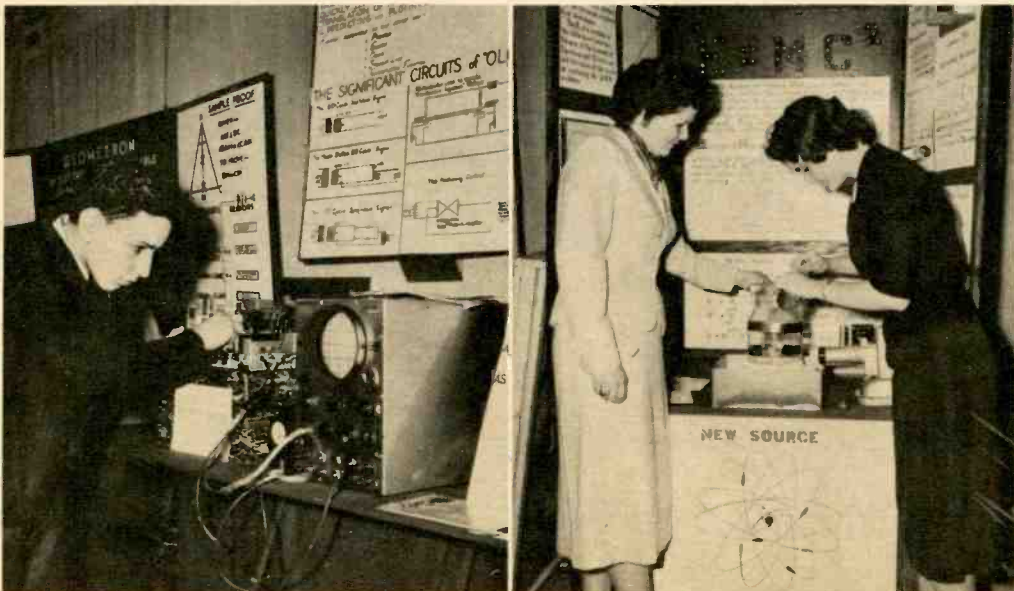
There is a secret to the pace-setting science high school. Your school may have it; you need it yourself.

By Ken Gilmore

NEW YORK's celebrated Bronx High School of Science has a spanking new modern building, well equipped laboratories, 2500 pre-selected, scientifically inclined students (each of whom has won out in fiercely competitive entrance examinations), and one out of five teachers is a Ph.D. It would be surprising if "Science," as its students call it, didn't send finalists to the National Science Fair and the Westinghouse Talent Search, and if its students didn't win Armed Services scientific awards, scholarships, and honors of all kinds by the hundreds. It is, in a word, one of the finest scientific training grounds in the country.

Bledsoe County High School in Pikeville, Tennessee (Pop. 1000) has a building erected in 1927, practically no laboratory equipment, not even one Ph.D., and 400 students selected only by the fact that they live in the area. Yet from an almost standing start five years ago Bledsoe's science program has expanded so

Bronx Science High produced Robert Strom, left, whose analogue computer took him to National Science Fair in 1960. Bledsoe High in Tennessee numbers among its 400 pupils Sandra Sanders, right. Her exhibit at the Fair illustrated Einstein's $E=mc^2$. Her teacher (left) helps test cloud chamber.





Mrs. Thelma Boynton, above, lectures science class at tiny Bledsoe County High. When she is finished, class converts classroom into laboratory, works on experiments. Enthusiasm of teacher, students makes up for shortage of equipment.





Bledsoe County High uses this small building in Pikeville. Its vigorous science interest has spread to nearby towns and to Pikeville's elementary and Junior High schools, Tennessee.



After 20 years in an antiquated building, Bronx's "Science" now has these modern facilities. Note observatory dome on wing at left. Labs allow advanced experiments.



Electronics students at Bronx Science High build projects of increasing complexity, learning proper layout and wiring techniques directly. Projects supplement theoretical study.



Expert instructors supervise and criticise the work of "Science's" students, explaining the "why" as well as the "how" of laboratory work. Students assemble their kits in school.

Bronx "Science" was dream of Dr. Morris Meister, first principal, now college president.



Dr. Alexander Taffel, present principal, credits Bronx's success to dedication of staff, pupils.



rapidly that already the school has to its credit one Navy Science Cruise Award winner, one Air Force Award for an outstanding science project, and one National Science Fair finalist. This year it swept the Regional Science Fair in competition with 15 other schools, taking 26 of 45 prizes, including all of those offered in physics. Many of its students spend more time working on outside science projects than they do talking on the telephone, going to the movies, driving hot-rods, or doing any of the other things in which teenagers are supposed to be so interested. Pikeville, Tennessee, has become a hotbed of scientific enthusiasm.

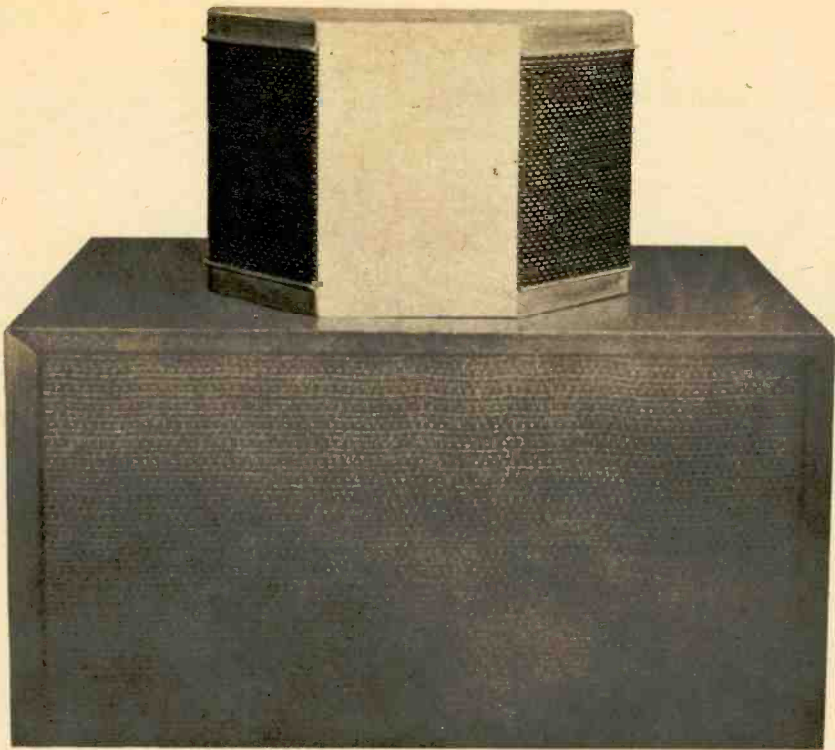
Each of these schools—Bledsoe County and Bronx Science—in spite of the vast differences between them—has been outstandingly successful in firing the scientific zeal of its students. *Electronics Illustrated* set out to learn what they had in common—why each is able to guide its students into scientific pursuits far more effectively than most American high schools. Surprisingly enough, the one vital secret of success

turned out to be the same in each case.

Behind each school stands one enthusiastic, dedicated teacher who had the vision, the energy, and the determination to make science vital and exciting to the students. And in each case, this contagious enthusiasm has spread throughout the faculty and student body until the whole school is bursting at the seams with it.

When Mrs. Thelma Boynton, an attractive mother of three boys, began to teach at Bledsoe five years ago, there had never been a science fair in the region, the school had no laboratory equipment to speak of, textbooks had not yet recognized the birth of the atomic age, and the students could not have been less interested. Mrs. Boynton realized that the first step was to make the students—and the town's people, too—science conscious.

A trip to the Tennessee Junior Academy of Science for 140 students was the first step in her well-planned campaign. Next came a tour of the Oak Ridge atomic [Continued on page 96]



A Stereo Add-On Speaker System

By Norman H. Crowhurst

Simply constructed unit adapts your present hi-fi speaker system for stereophonic reproduction

THE conflict between living room decor and space for a stereo speaker system can be resolved once and for all by the stereo Add-On system. All you have to do is place this neat looking little box on top of your present monophonic speaker system, connect up the leads and presto—you've a stereo speaker system. Of course, you will still need a stereo amplifier and program source.

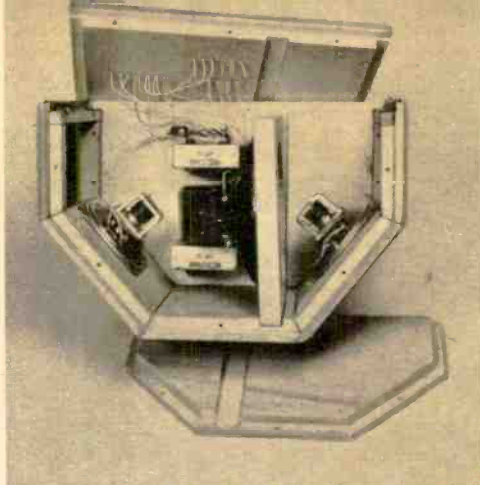
The enclosure for the stereo Add-On may be constructed of pine, plywood or scrap lumber. Since the enclosure makes no acoustic contribution to the sound, neither its dimensions nor method of construction are critical. But make sure that the front and back of the 6" speaker (SP3) mounted on the center board are sealed off from each other by installing the center panel so that it is flush on the top, bottom and sides. Note that the speaker cone faces the smaller of the enclosure's two internal compartments. The unit shown in the photos was constructed on the

author's new radial arm power saw and the jointing is a little complex. However, the assembly detailed in Fig. 1 will serve as well and can be constructed with hand tools.

Transformers T1 and T2 are mounted with wood screws and color-coded leads are soldered to the transformer lugs. The leads should be long enough to allow some slack when connected to the terminal blocks. As you fit the back panel, push the leads through the holes drilled for the terminal block lugs and connect them as shown in Fig. 2. The speakers are mounted with wood screws.

If you get stereo right away without further adjustments, you are in luck. Hook up your amplifier outputs and main speaker as in Fig. 4. If the phasing is wrong, your main speaker will lack bass. Switch a lead to an opposite polarity terminal on TS2 as shown.

Once the phasing is correct, adjust the balance on your amplifier so that each channel sounds equally loud when



Completed unit with top and rear panels removed to show internal assembly. The speakers and transformers mount with wood screws.

Fig. 1. Specific method of constructing the cabinet is up to the builder. One possible plan is below. Note that both sides are open and that the center baffle fits flush on all sides.

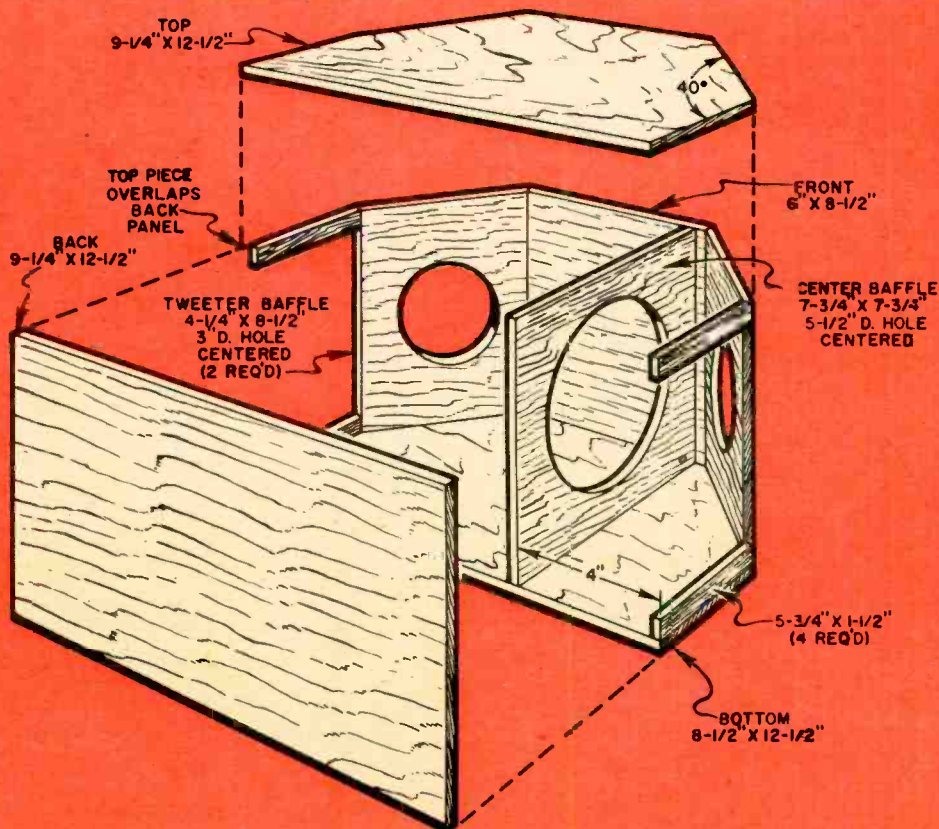
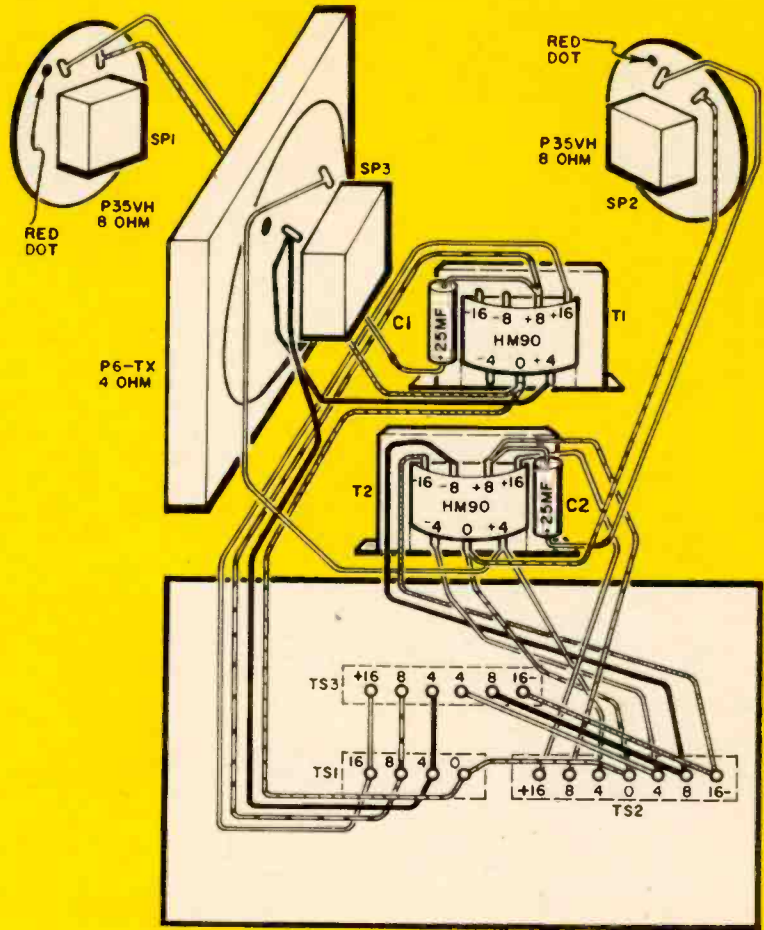


Fig. 2. Interconnections of the components inside the cabinet. Note that the rear panel is shown upside-down and from the interior of the cabinet. See Fig. 4 for exterior view of the terminals.



the other is switched off. Now you have to get the level between the main speaker and the stereo Add-On unit right. If your main speaker is a low efficiency type, you may have no problem. But if your speaker is a high efficiency model, you'll need to cut down its level with the circuit of Fig. 4. The 25-ohm wirewound potentiometer sets the relative level of the main speaker. If you turn down the main speaker and turn up the amplifier gain, the increased output from the stereo Add-On will increase separation. The 500 mf capacitor serves to boost the bass of the main speaker.

When the system is correctly hooked up, all the bass comes from the main speakers and there is no definite cross-

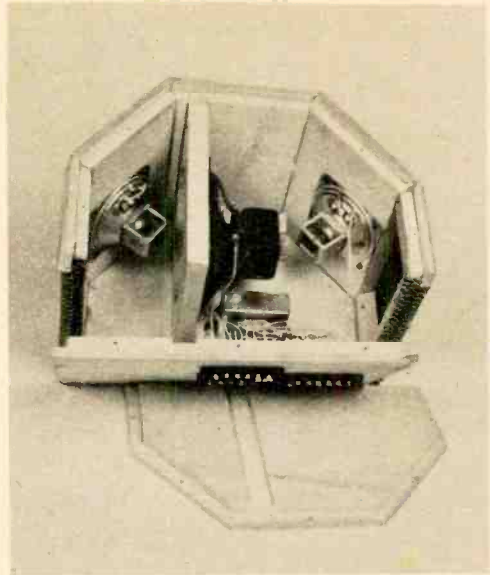
over from bass to mid-range; this is rather determined by the stereo properties of the program played. The signal from both the right and left (sum) amplifiers are mixed by transformers T1 and T2 and fed to the main speaker. What happens at the mid-range speaker SP3 is somewhat more complex.

SP3 is connected to the transformers so as to reproduce a signal developed by "subtracting" the sound of one channel from the sound of the other. What remains is known as the *difference* signal and could be considered as carrying the stereo "information." SP3 heard alone presents only a partial picture.

The 6" speaker operates from around 500 cycles, where stereo effects begin to be appreciable, up to about 1500 or 2000

cycles. From here on up, the tweeters SP1 and SP2 come into play, each connected to its own amplifier through a high pass filter (a single 25 mf electrolytic capacitor). The tweeters are angled outward to concentrate these higher frequencies in a way that utilizes the "proximity" effect. If you sit to the left you hear the left tweeter directly, so its sounds are on "your side," while sounds from the right tweeter sound remote. Similarly with the other side, you reverse the situation. If you are used to separate speakers and sitting in that one magic spot where stereo "clicks," this system may at first disappoint you. But after a while you'll realize you don't have to be "dead in front" of the unit to get stereo. You get broader separation by being closer to it and the spread diminishes as you move back. But this can be adjusted to the area in which you do your listening. To get the "breadth" further back, the level of the stereo unit should be raised by turning the main speaker down, and turning up the amplifier volume.

If your main speaker system was previously located in a corner, it may be necessary to relocate it slightly. If the stereo Add-On is situated with its tweeters within two or three feet of an angled wall, the highs will bounce off
[Continued on page 109]



Interior view of the unit from another angle.

PARTS LIST

- SP1, SP2—8-ohm tweeter units (Jensen P35VH)
- SP3—1-6" extended range speaker unit (Jensen P6-TX)
- T1, T2—matrixing transformers (Microtran HM-90), available for \$6.33 each from electronic parts stores or Microtran Inc., 145 E. Mineola Av., Valley Stream, L. I., N. Y.
- C1, C2—25 mf @ 25 V electrolytic capacitors
- TS1—4-screw terminal strip
- TS2—7-screw terminal strip
- TS3—6-screw terminal strip
- I—500 mf, 15 volt electrolytic capacitor (see text)
- 25 ohm, 4-watt wirewound potentiometer
- Wood screws, lumber, glue, wire, etc.

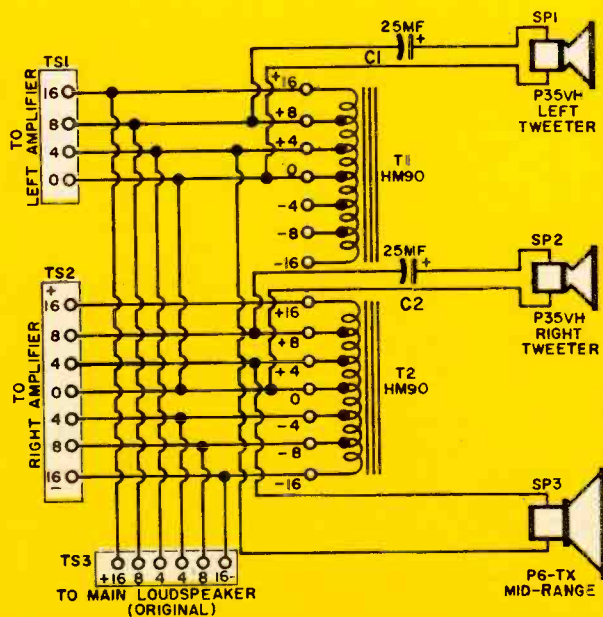


Fig. 3 Schematic of complete unit. Special transformers T1 and T2 serve as phase changers and mixers for input signals.

What You Can Do About



By Donald A. Smith, W3UZN

IF the screen on your television set looks as if it had a bad case of worms wiggling through the picture, chances are there is nothing wrong with your set—it's interference.

Such interference can be caused by a number of things. It could be due to amateur transmitters, local FM radio stations or miscellaneous other RF devices. For this is not a problem of random noise or diathermy interference; either the interfering signal is near the RF picture frequency of a particular TV channel, or it may be forcing its way through the TV set's front end and beating against the set's picture IF frequency.

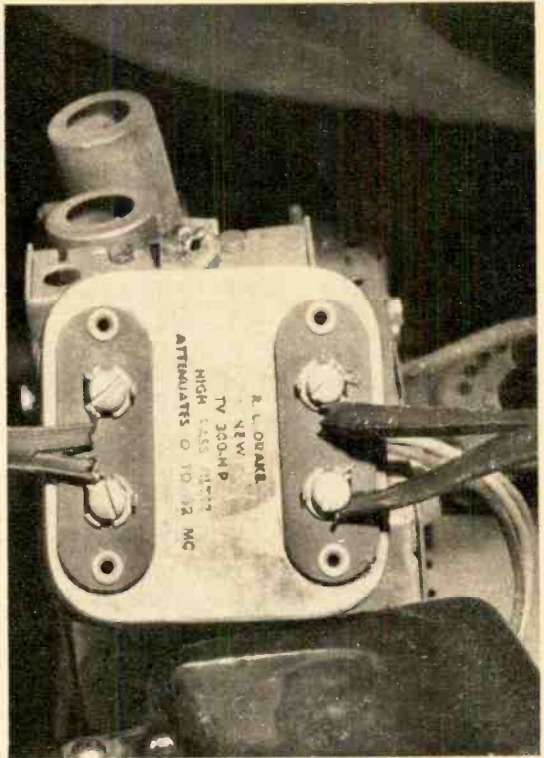
Amateur and other signals may affect the television set without being on the same frequency. For example: if an amateur is operating on 6 meters (50 to 54 megacycles), his signal may be strong enough at the antenna terminals of your television set that it will come right in despite the fact that the front end or tuner of your set is not tuned to its frequency. This problem exists because the selectivity of the average TV is not good enough to reject strong signals.

The way to reduce or eliminate this interference, is to stop it before it gets into the TV's circuitry. One good method is the use of a selective trap, resonant to the interfering frequency and connected *before* the TV tuner. The interfering signal will then be "dropped" across the trap and can't pass into the tuner.

There are several types of traps which might be of help. The simplest is made of standard 300-ohm flat twin-lead. Cut a

Recommended commercial high-pass filter effectively attenuates all frequencies below 52 megacycles. Unit is connected at TV end of antenna transmission line.

Simple homemade trap below can be constructed of 300-ohm flatline and connected in parallel with the existing 300-ohm antenna lead-in.



piece of twin-lead to a length of about 60". Without disconnecting your antenna, connect this 60" lead in parallel with it at your television set's two screw input terminal.

Now tune your set to the channel which has the worst interference. With a pair of cutters snip off about $\frac{1}{4}$ " of the lead at a time, while watching the picture on the set. As you approach the frequency of the interference, the picture will begin to clear up. Then snip about $\frac{1}{8}$ " at a time. Depending on the interference frequency, you may have to clip the twin-lead down to a length of 30" or so, before having success.

If this device does not lower the interference enough, you may have to use a commercially-built filter such as the Drake TV 300-HP. This high pass type of filter passes the TV frequencies (54 megacycles and up), but will reject all interference frequencies below 52 mc. This is probably one of the best traps for eliminating amateur and other types of RF interference.



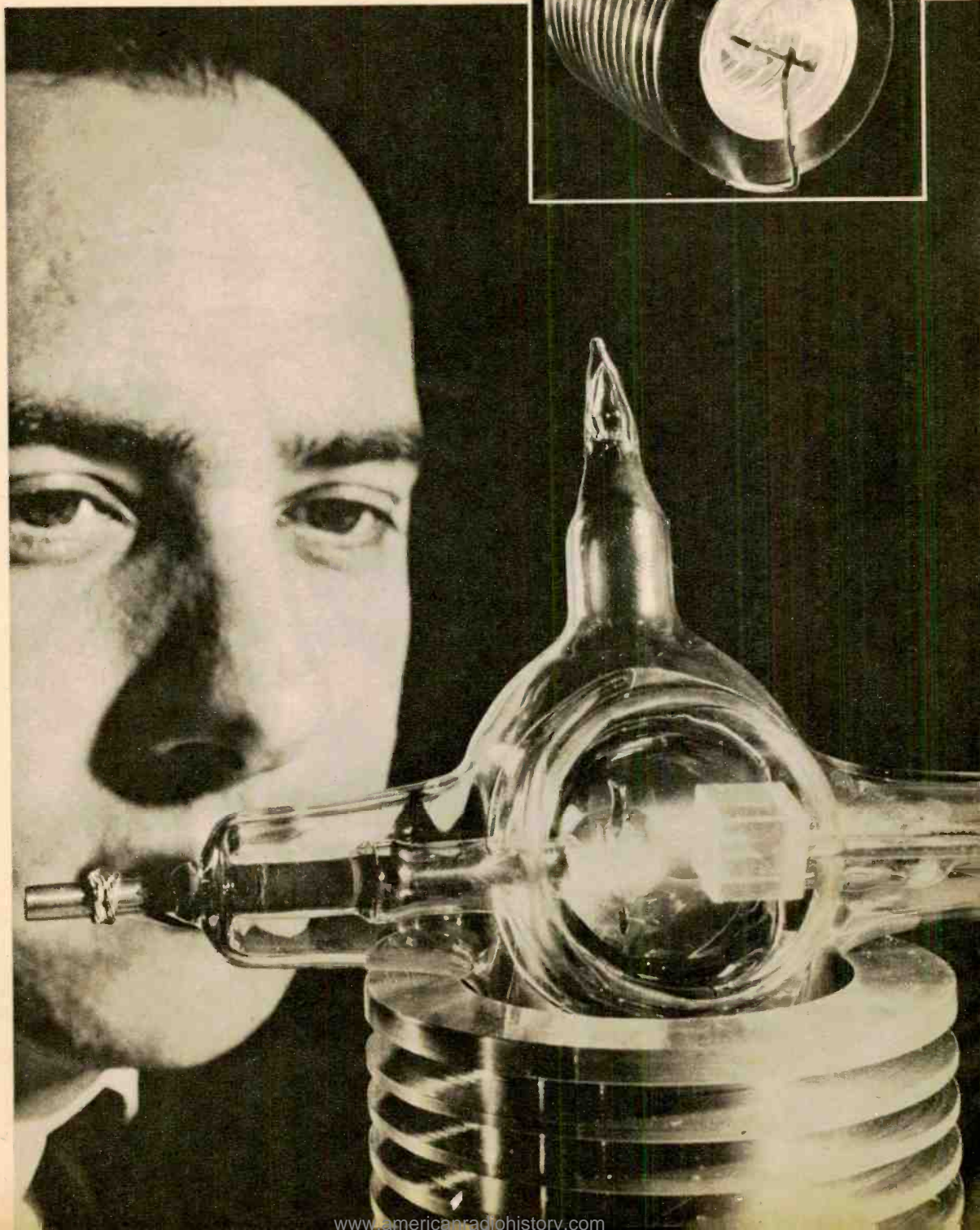
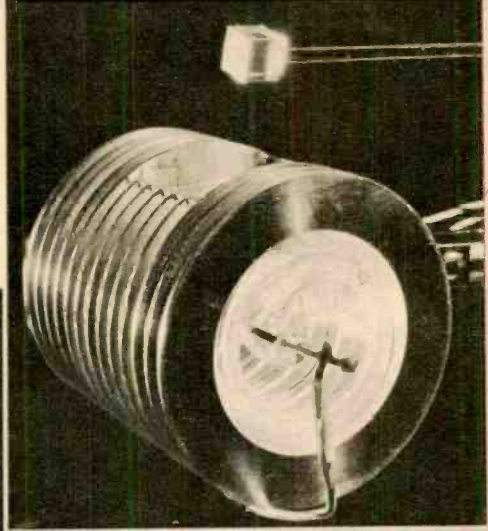
Helical neon tube-like light exciter surrounds rod of synthetic ruby. This is the heart of the Laser light amplifier. No magnetic field is necessary.

A True Light Amplifier

UNTIL now, no one has been able to take a light ray and amplify it thousands of times as we can with radio waves. Some attempts have been made using photomultiplier tubes and similar means, but the success has been limited and the amount of amplification possible by these methods small. Now, by modifying the Maser (see "The Amazing Masers" February, 1959 issue of *Electronics Illustrated*), Hughes Aircraft Company scientists have been able to produce an experimental light amplifier that treats light as if it were just a radio wave, which it really is.

The new amplifier is called a "Laser" and it operates something like this: A light source (helical gas tube with green glow) irradiates a synthetic ruby crystal which absorbs energy from this light. This energy excites the atoms of the ruby into an agitated condition from which they would like to calm down but the constant irradiation keeps them there. Now, the light to be amplified is shot in. This is just too much for the ruby atoms and they all let go *together*. This is called "coherent radiation" and an important effect is that the light comes out in a parallel beam and, of course, the light is amplified because all of the energy coming out is triggered by a small amount of energy going in. The light output is equivalent to that of thousands of Kliegl lights. This output beam, no larger than a pin's point, could be used as a light radar. *EI* is investigating reports of gas type light amplifiers. ●

The photo at right shows how ruby cube glows in excited state from light stimulation. The metal case is for cooling, no high temperature is needed. Below, Dr. Maiman inspects his baby.



the swing to
Single Sideband

Why do hams seem to be doing things the hard way?

What's all that quacking on the ham phone bands?

By Bill Leonard, W2SKE

HAVE you tuned across one of those ham bands lately? If so you could hardly help being assaulted by a cacophony of wild gulps and gurgles—a great deal of noise, apparently making no sense at all. Somewhere in the band, perhaps, a normal voice or two may be heard, calling the normal CQ. But even a once-over-lightly with the receiver tuned in the conventional manner is quite enough to show that something drastic has happened to amateur radio.

That something, of course, is Single Sideband, sometimes called

The author, of CBS TV fame, tests Collins KWM2 transceiver, to be installed in his car. Roundtable QSO featured long range, no QRM.





The amateurs aren't alone. Left, Air Force radiomen man Strategic Air Command's "Short Order" world-wide all-SSB bomber control network. At far right of page, Lt. Gen. Francis H. Griswold, KØDWC, SSB old-timer.

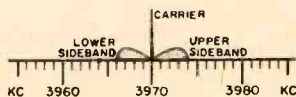
just plain "sideband," often abbreviated SSB, and occasionally fancied up as Single Sideband Suppressed Carrier, or SSSC—but by any name the most important development in amateur radio in the past quarter of a century.

"Sideband" has virtues by no means limited to amateur communications (the Armed Forces have spent hundreds of millions converting long distance facilities to SSB) but for the estimated 25,000 ham operators who have swung over to SSB it has meant:

An eight-fold increase in the ease of working DX (long distance communication) (a 9 db advantage of SSB over AM);

A fifty percent decrease in the size of the average transmitter;

Twice as many stations able to operate in any one band without interference (QRM);



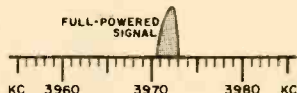
Here is an ordinary AM signal "on your dial." It has carrier, two identical voice sidebands.



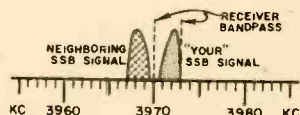
If we can eliminate the carrier, the sidebands still carry voice. But each carries the same thing.



We can just as well use one sideband alone, saving power, spectrum "space."



Why not put original carrier power into this single sideband? Now voice has punch.



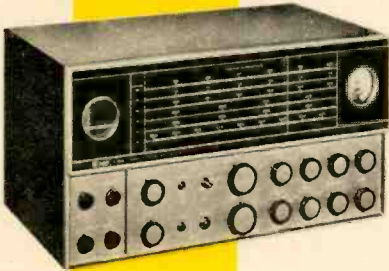
And two SSB signals can ride where one AM signal was before without QRM.



Hammarlund HX-500



Hallicrafters HT-32 A



Knight-Kit Model T-400

Transmitters. Table-top units deliver more power than bigger AM rigs. All power goes into voice envelope; none is wasted on heavy modulator or blank carrier. Power supply is much smaller, most tubes are receiver types.

Elimination of the annoying whistles and beats that once made the ham bands a kind of audio nightmare during crowded evening hours.

Last, but by no means least, a smaller chance of interfering with the neighbor's TV set.

How is all this accomplished? Look at the diagrams on page 45. It shows a radio signal as if you could see it through your tuning dial. As you know, an AM signal does not take up a "point" in the radio spectrum. It occupies a *channel*. The width of this channel varies according to what audio frequencies are present in the modulation. Here we show a signal 8 kc wide—two sidebands

carrying speech energy with components up to 4000 cycles (4 kc).

These sidebands are mirror-images of each other; they both carry the same information. And they carry *all* the information. It comes as a surprise to many people to learn that the carrier in an "amplitude modulated" signal is not modulated! That is, its amplitude or strength does not really go up and down at an audio rate. The *total* energy in the entire signal—carrier and sidebands—varies at this rate.

Newer-model receivers all have refinements for best reception of SSB, though any BFO-equipped set does very well. These feature selection of upper or lower sideband, stable oscillators, slow tuning rates, filters, etc.



Heathkit "Mohawk" RX-1



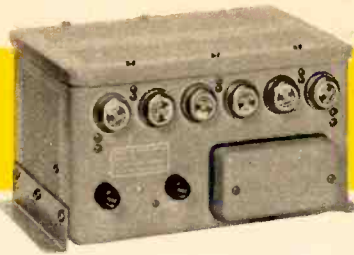
National NC-270



Hammarlund HQ-170



Heathkit DX-10 SB



Collins Transistor Power Supply



Central Electronics Model B

Accessories. Left, adapter converts AM transmitter to SSB. Center, mobile power supply for transceiver. Right, receiver adapter for improved SSB.

Look again. The height of our carrier "spike" is four times the height of the sideband "envelopes." To plate-modulate an AM transmitter, you need additional audio power equal to 50% of the carrier power. (A 100-watt transmitter needs a 50-watt modulator.) This extra power divides equally between the sidebands—so each has one quarter as much power as the carrier.

Now, if you can find a way to send the sidebands alone, you can save two thirds of your power! Oh, you do need a carrier. The receiver's detector stage can not use the sidebands alone. But you can reinsert that at the receiver with its BFO (beat frequency oscillator).

Now, since the sidebands are identical, you only need one. Send that one with the carrier, and the receiver doesn't know the difference. You get clear AM-type audio. Send it *without* the carrier, and you have saved five sixths of your power.

How about putting the power of both sidebands into that single sideband? That gives you a louder signal. Why stop there? Why not pour all the power you *might* have used for your carrier into *one voice-carrying sideband*? Your 100- or 150-watt transmitter now puts all its power into *voice*, and if you run the legal limit of 1000 watts, you have a kilowatt of voice power, not a kilowatt of blank carrier plus five hundred watts in two identical sidebands.

A low-power SSB exciter will feed an

antenna, and deliver at the receiving end the impact of an AM transmitter several times the nominal power.

Notice our diagram shows, at the last, "your" SSB signal, and a neighboring SSB signal, both inside the channel formerly taken up by the ordinary AM signal. Because you are interested in only one sideband you can narrow down the receiver passband by more than half. (Now you get your money's worth out of that crystal filter!) This means the receiver excludes not only the unwanted signal, but cuts down on the random noise it inevitably picks up.

Since there are no carriers to beat together, there are no heterodyne whistles. Since the output stage of an SSB transmitter is "linear," it does not generate harmonics—hence the reduced chance of TVI. [Continued on page 97]

Linear amplifiers provide compact high-power final amplifiers needing no modulator as they take signal from any transmitter or exciter.



Gonset GSB-101

Electronic Brain

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

Panoramic Adaptor

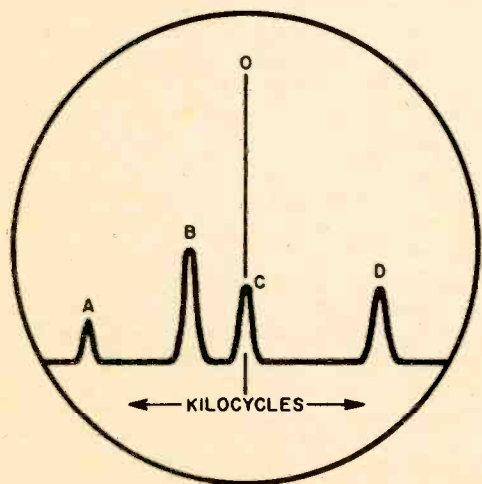
What is a Panoramic Adaptor and how is it used?

Steven Genex, Columbus, Ohio

A Panoramic Adaptor is an accessory that is used with superheterodyne communication receivers. Its main panel feature is an oscilloscope screen which, in the absence of radio signals, shows a horizontal line near the bottom of the screen. When connected to an operating receiver, pips become visible on both sides of the center zero. Each of these pips indicates the presence of a transmitting station; the amplitude of the pip shows the strength of the received signal while the horizontal displacement of the pip from the zero center indicates how far from the frequency to which the re-

ter on the screen. Stations A and B are higher in frequency than C, while B is the strongest of the group. Station D is also quite strong but is located lower in frequency than any of the others. As the receiver is tuned, say to higher frequencies, the pips drift across the screen to the right; as soon as the pip appears on the center line, the station is heard.

The Panoramic Adaptor is an ideal monitoring device, since it permits an operator to work a given frequency while monitoring the rest of the band visually. An operator can also tell instantaneously whether the signal is CW (code) or radiotelephony. A CW signal grows and shrinks to zero while the transmitter is keyed, and a voice transmission appears as a more or less steady pip on the baseline.



ceiver is tuned the "pip station" is located.

For example, referring to the diagram, the four pips indicate that there are four stations being picked up by the receiver within the sweep range (horizontal base line) of the particular adaptor used. Station C is the one being listened to since it appears at zero cen-

Electronic Stroboscope

What is the principle of operation of electronic stroboscopes and what are they used for?

Carl Millet, St. Augustine, Calif.

A stroboscope is a tool for visually "freezing" rapidly vibrating or rotating motion for close study without having to interfere with operation of the moving device. Stroboscopes make fine safe tachometers since no mechanical contact need be made between the strobe and the moving object.

In principle, the stroboscope consists of a flashing light with an on-time duration of a small fraction of a second for each flash. If a rotating wheel is thus illuminated once at the same point in every revolution, it will appear to be perfectly stationary under such a light source. Most stroboscopes of the electronic variety utilize a neon tube because such tubes can ionize and de-ionize very quickly. Unfortunately, neon tubes have a low light output, usually making it necessary to use such stroboscopes in a darkened room.

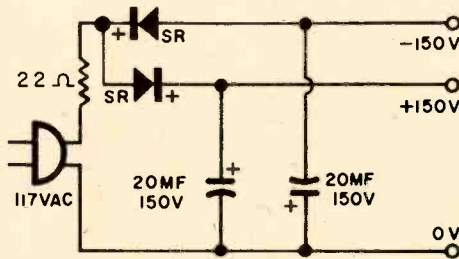
Transformerless Power Supply

Can you provide a circuit for a transformerless power supply that will provide about 150 volts positive and 150 volts negative with respect to common ground?

Raoul Cameron, Saskatchewan, Canada

The circuit you want is given in the accompanying diagram. Since you did not specify the current requirements, we are merely indicating selenium rectifiers without stating their current ratings. Select these on the basis of the maximum current to be drawn by the load, allowing a safety factor of about 50%. For example, if the load is to draw 100 ma through a given rectifier, use a unit rated at 150 ma.

Please note that the "common



ground" wire is not to be connected to an earth ground. Transformerless power supplies can produce nasty shocks unless care is taken to keep them well isolated from other ground points.

We have shown 20 mf filter capacitors. The hum level will be low enough for operating power amplifiers but not for high gain stages of any type. Should better filtering be desired, any standard pi-network filter may be added in the usual manner.

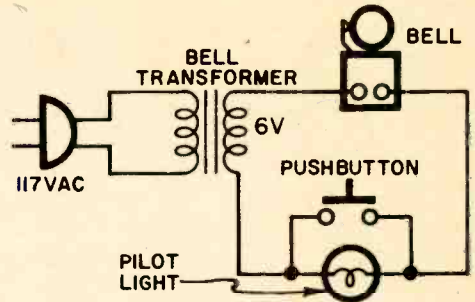
Bell Light

We have a new bell pushbutton on our front door that has a perpetual light in it, making it easier to locate in the dark. When the button is pressed, however, the light goes out. How does it work?

Arthur Richter, Plainfield, Ill.

The accompanying diagram shows the connections to the pushbutton light. If the bell transformer is a 12-volt type, the lamp is generally rated at 10 volts so that it will light with normal intensity despite the voltage drop across the bell.

Note that the transformer, light and bell coils are all in series while the pushbutton is connected directly across the light. With the pushbutton open, enough current flows through the series circuit



to make the light glow, but not enough to make the bell ring. Pressing the button causes a low resistance bridge across the light terminals, thereby cutting its resistance out of the circuit. The bell coils then receive the full transformer voltage and the bell rings.

TV Contrast

I have just purchased a new television portable receiver. I notice that the contrast is good on some scenes, but when a night scene is being shot, the dark background becomes grey and the normal contrast is lost. Why does this happen?

Carl Lummer, Richmond, Virginia

Many of the new television receivers, particularly those of the portable variety, are designed without DC restorer circuits. It is felt that the DC restorer is not necessary since the change in background quality is not usually serious enough to bother the viewer. The fact that this characteristic has annoyed you indicates that you have a more discriminating eye than most people, and that you are not satisfied with half-measures. On the other hand, economy design has made possible the sale of generally excellent television sets at prices that would have been considered ridiculous a few years ago.

As time goes on, you will unquestionably adapt yourself to the changing contrast you describe. It is felt that no harm is done if the average viewer is not affected by the loss in performance that results from their omission.



build a

Reaction Time Tester

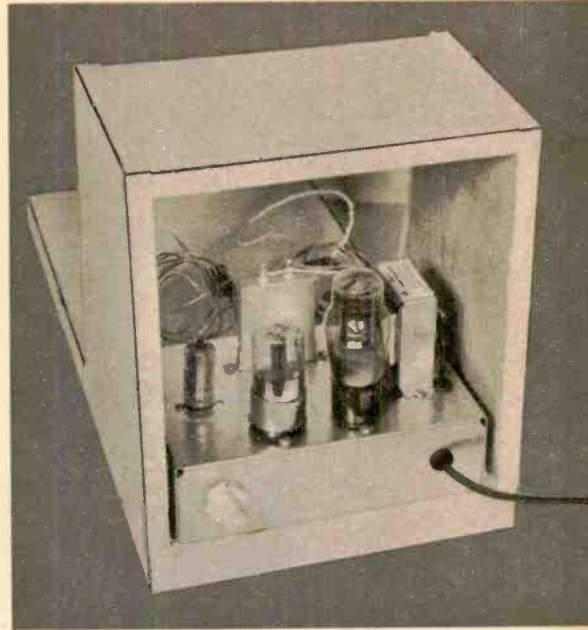
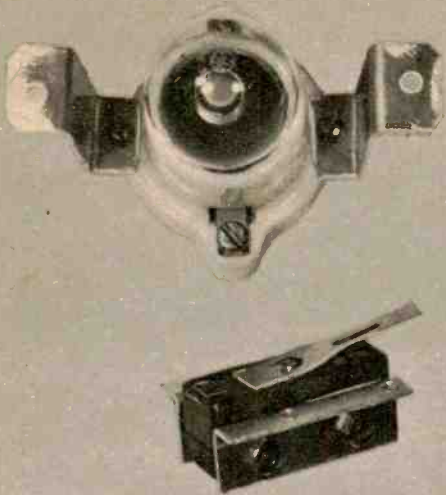
for an electronic check of your reflexes.

By Harvey Pollack

HOW fast are you? If you were around at the time of Billy the Kid would you dare challenge him to a draw? In modern terms, how fast can you get your foot on the brake pedal when a child suddenly darts in front of your car? Or what are the chances of your ever becoming a jet pilot?

The *EI* Reaction Timer can't answer these questions directly for you, but it will provide an excellent idea of how an individual rates in comparative reaction time. If you pre-





Brackets for neon socket and Micro-Switch (PB1) should be dimensioned so that: (a) neon tube projects slightly through panel hole to permit mounting of escutcheon; (b) PB1 must be made flush with base. Rear knob is R3.

cisely calibrate the R-T, you have an excellent laboratory instrument for psychological testing.

Using the R-T

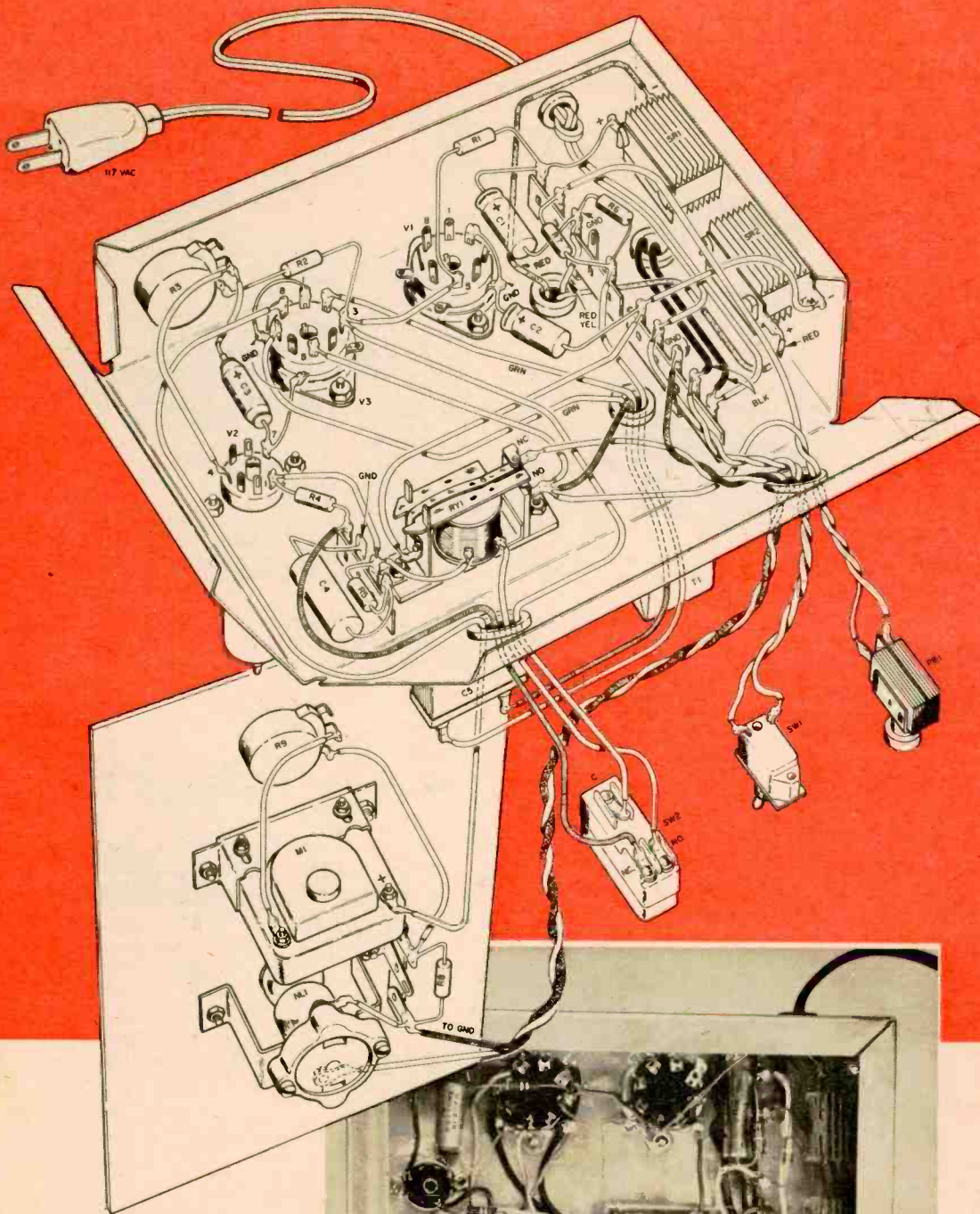
The subject sits comfortably in front of the R-T. On the panel is a neon lamp (NL1), an edgewise mounted meter (M1), and a knob (on R9). On the base is a lever-type Microswitch (SW2), an on-off toggle switch (SW1) and a reset pushbutton PB1. After the R-T has warmed up for five minutes or so, the panel knob (on R9) under the meter is adjusted for full-scale (1 ma) meter reading. The subject then presses the lever of Microswitch SW2 and watches the neon lamp; at the instant the neon lamp goes out, he is to release SW2 as quickly as possible.

Since the neon lamp extinguishes automatically and at random, you can't beat the machine by counting seconds. (Potentiometer R3 can be set to put out the lamp after *any* interval from the time he pushes the lever up to about 25 seconds.)

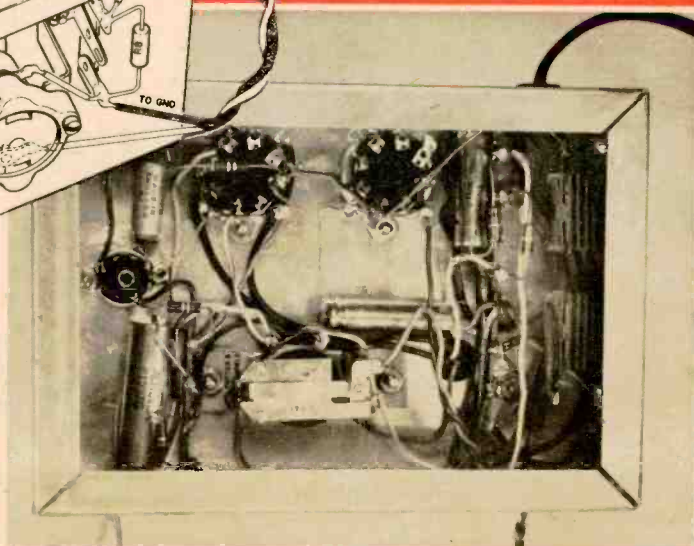
At the instant the lamp goes out, the meter needle starts to fall toward "0." Just how far it drops is determined by the subject's reaction time. If he's a slow starter, the meter needle may drop practically to zero; someone "quick on the draw" may stop it about 6 or 7 on the scale.

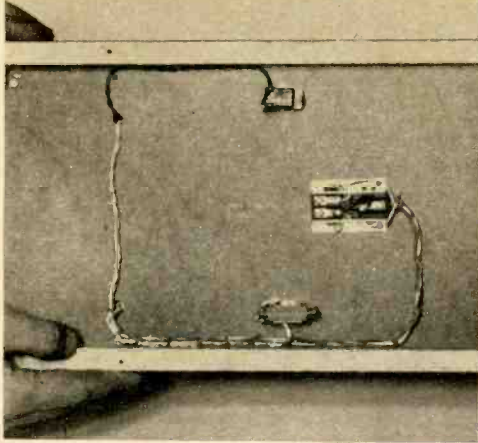
Construction

A wood frame and Masonite panel and base give the Reaction Timer an elegant, professional look. Cut a piece of $\frac{3}{16}$ " thick Masonite $8\frac{1}{2}$ " x 18 " for the base and glue and nail an apron of 1 " x 1 " molding all around it. Next cut the sides that hold the front panel,



Switches SW2, SW1 and PB1 mount beneath baseboard. Note rearward projection of M1 and NL1 on rear of front panel, bottom left. At right is chassis bottom.





Bottom view of baseboard shows the relative position of PB1 (bottom), SW2 (center) and switch SW1 (top). Note cabled wiring.

reading drop only a division or two, R6 should be made smaller. When you have arrived at a resistor value that achieves a final reading about 3 ma, be sure to record it in case you want to go through the precise calibration procedure.

Calibration

As mentioned earlier, you can calibrate the timer roughly by making a number of tests on many different people and thus establishing by experiment the various ranges of meter reading. For example, in the author's model, the following categories were printed on a card above the meter when it was used at a party:

RANGE	CATEGORY
1 - .8	GREASED LIGHTNING
.8- .6	PLAIN LIGHTNING
.6- .4	STILL GOOD
.4- .2	JUST AVERAGE
.2- 0	MOLASSES

A second rather easy alternative is to use the curve of Fig. 2 and assume a possible 10% error caused by variation of components and tubes.

Precise Calibration Procedure

Step 1: Determine the capacitance of timing capacitor (C5) to three significant figures by means of a capacitance bridge. This is C in the equations below.

Step 2: Determine the resistance of timing resistor R6 to three significant figures by means of a Wheatstone bridge. This will be R in the equations.

Step 3: With all tubes in place and the equipment warm, adjust the milliammeter to exactly full-scale. Connect a 15

or 20 volt battery, 5,000 ohm potentiometer, and an accurate voltmeter in the circuit shown in Fig. 1. With the potentiometer adjusted so that the voltage applied to the capacitor is zero volts, again trim the milliammeter to exactly full scale, using the 5,000 ohm pot, R9.

Step 4: Rotate the 5,000 ohm potentiometer until the meter reads exactly .9 ma and record the voltmeter reading. Again adjust the 5,000 ohm pot for .8 ma and record the voltmeter reading, etc., until the milliammeter is at "0" milliamperes.

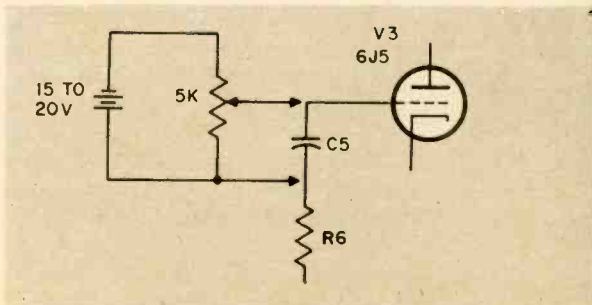
Step 5: Each of the voltage readings is a value for e in the equations that follow. Now measure the voltage across the illuminated neon lamp. This should be about 150 volts. Call this voltage E.

Step 6: In the equation $t = RC \log \frac{E}{E-e}$

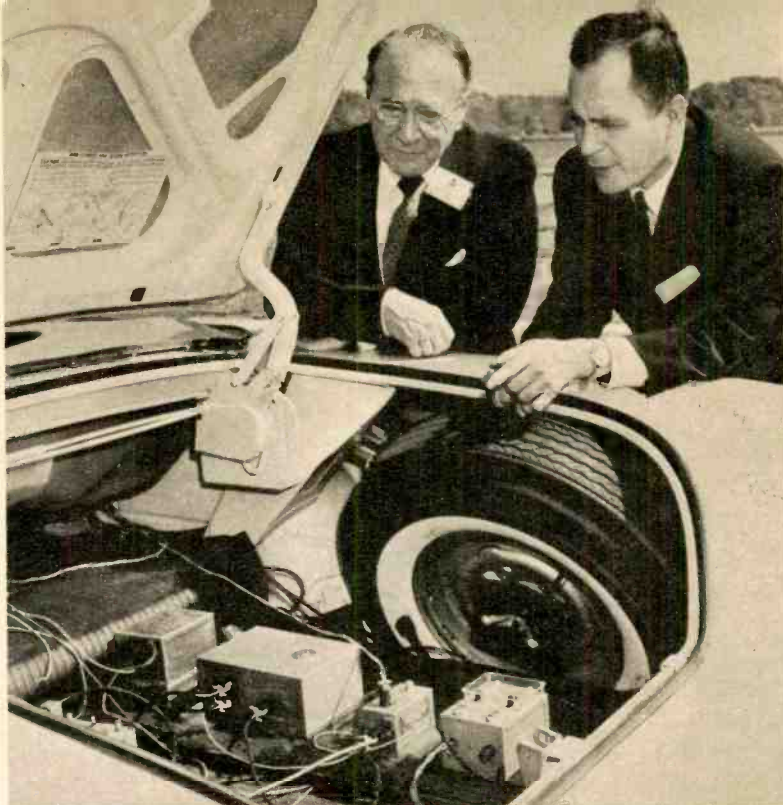
use the measured values (to 3 significant figures) of R, C, and E, substitute each value of e obtained in the Voltage-Current table and solve for t in each case. You will need a good table of natural logarithms (Public Library is an excellent source). C is in microfarads, R in megohms, E in volts. Now you have eleven values for reaction time (in seconds) associated with the milliammeter readings.

Step 7: Tabulate the values of plate current (ma) and the associated reaction times (convert seconds to milliseconds by moving the decimal three places to the right), then plot the calibration curve as in Fig. 2. This curve should closely approximate a straight line. [Continued on page 107]

Fig. 1. Setup used for precise calibration of instrument. Refer to procedure in step 3.



RCA's famous Dr. Vladimir Zworykin and *EI's* Feature Editor discuss electronic "brain" for new robot car.



EI brings you up to date on **Electronic Highways, Robot Cars**

IN our February issue, we brought you an exclusive *EI* report on the RCA experiments with automatic electronic highways. Since then, developments have been rapid, and *EI's* Feature Editor has not only taken a ride on a test-track "highway," but in a fully-automated car, developed jointly by General Motors and RCA.

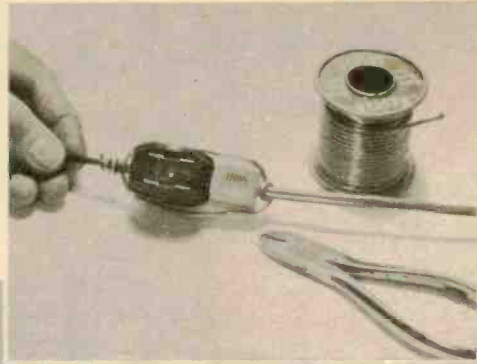
The "robot car" will drive itself only on the electronic highway, and is driven manually on ordinary roads. However, the electronic highway *does not* require robot cars, and benefits any vehicle on it, whether it has electronic controls or not.

This season, construction is in progress at a very busy highway intersection between Omaha and Boy's Town, Nebraska, where, for 1000 feet in each direction, the RCA detection loops are being installed in all lanes. By sensing each vehicle that passes over them, the loops will count cars, detect bunches of cars, measure the speed of individuals and groups, and pass the information on to a computer, which will constantly adjust the timing of traffic lights at the intersection and along its approaches. Since the system can "see" the entire traffic picture as no human could, it should keep traffic moving at an optimum rate, with a minimum of waiting time at red lights. A similar setup will be employed at New

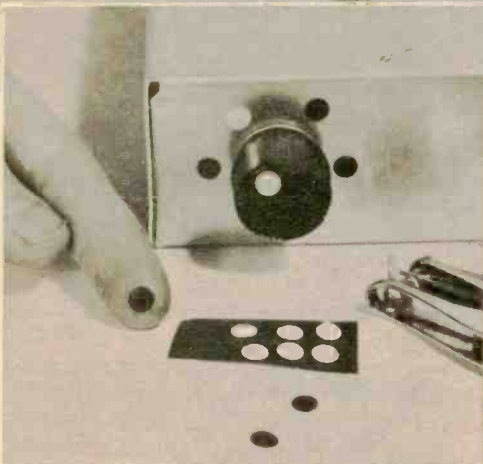
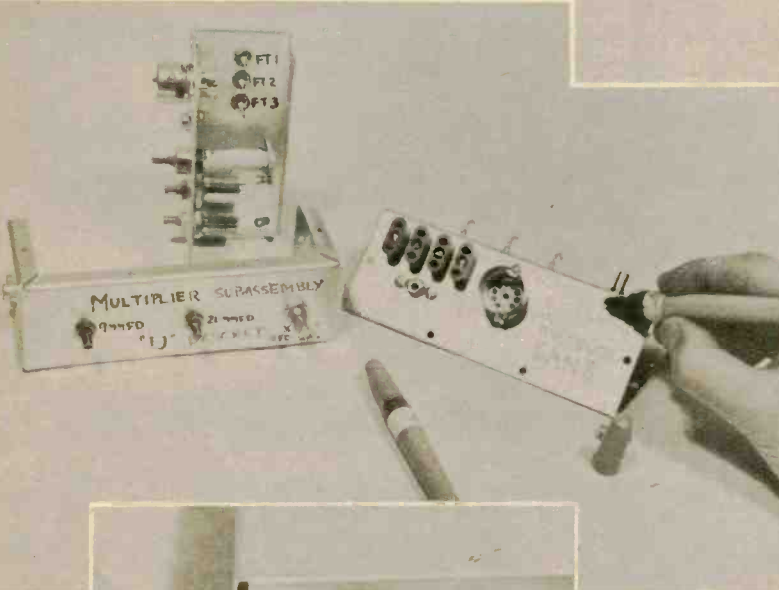
[Continued on page 104]

Try These

Solder wrapped around the cord of a socket and plug as shown, prevents the two connectors from pulling apart.



Use a felt tipped marking pen to mark tube sockets, capacitors, crystal positions, or sub-assemblies. Smear proof ink and variety of colors are features.



Small discs punched out from colored plastic tape are ideal markers for radio-electronic dials and switches. The self-adhering colored discs can also be used for color-coding parts. Iridescent tape can be used for non-illuminated dials and terminals.



A wide rubber band around the body of your electric drill makes a convenient holder for that easily misplaced chuck key. A heavy band can be cut from an old inner tube or glove.

Shopping for Hi-Fi

how much should you spend?

By Joseph Marshall



THE prudent purchase of high fidelity equipment needn't be any more difficult than the purchase of anything else. It may look that way sometimes, because the high fidelity industry provides a tremendous choice in its effort to satisfy the needs and preferences of everybody. However, if you follow a few guideposts you don't have to be an electronic engineer or an acoustic expert to spend your money wisely. The very diversity that seems so baffling at first glance makes it possible for you to get more satisfaction for your money than you can in most fields.

The trouble with most people who set out to buy something is that they rush to the store before they have determined what they really need. The only surer way I know to throw money away is to let yourself be talked into a friendly little game of poker by a trio of affable strangers.

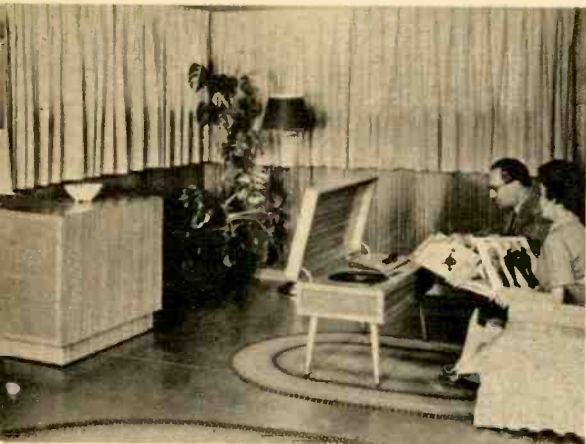
Before we drop in at the local hi-fi and stereo salon, let's look into our habits, our tastes, our homes and our wallets, and lay down the requirements a salesman needs to meet before we will give him any of our hard-earned money.

There are several factors that determine the kind of high fidelity system you actually need. To make things easy we



Electro-Voice

Do you lose yourself in Beethoven in his full symphonic glory? Or just relax now and then with mood music? Equipment needs differ.



You can have great enjoyment with a fairly simple system, like the fine unit at left, or you can gear your gracious living to music, with custom components.

have prepared a "quiz" table which takes the most important of these into account. The very process of filling it out will help clarify matters. When you finish and total up, you can get a pretty accurate idea of the general type of stuff that you will need, and how much it will hurt the family bankroll to fill the bill.

There is a pitfall in this quiz you should see and avoid at the outset. This is *not* a "How Cultured Are You" or other kind of snobbery quiz. *Don't* automatically give yourself "high scores" because you "know what the answers are supposed to be." This is a serious investigation of what you really want, what you need, and how much *you* should spend.

The application of our quiz table is fairly obvious, but we might briefly run over the reasoning behind it. For example, if all you want from music is that it provide a low background sound for conversation, reading, eating meals, or simply keeping a housewife company while her husband is at work and the children are in school, you need expensive true high fidelity about as much as a professional bathing beauty needs privacy.

For one thing, at low listening levels the brilliant highs and awesome bass that make music dramatic are lost to the normal ear. Your ears respond to the deep bass and super high notes only when they are fairly loud. The delicate

detail of music, which high fidelity is meant to preserve, is just lost in background noise. Furthermore, if that is how you feel about music you couldn't care less even if you *did* hear it all. The only "sensible" thing for you to do is to buy an ordinary FM radio.

This idea may dismay you. "Everybody" has high fidelity, and you want to be in style, which is a normal and understandable human desire. Well, stay with us. We'll help you stay in style without your paying through the nose.

On the other hand, if what you want is to hear Berlioz's *Requiem* played by a full symphony orchestra, two brass bands, and three mixed choirs, exactly as you would hear it if you took the trouble to go to Paris the year they played it in some cathedral, you're a darned fool if you think you can manage the trick with anything less than the best high fidelity system money can buy.

You need a lot better system if you listen attentively for long periods of time than if you play music only occasionally and for short periods. This is because of a very real factor called *listener fatigue*. A poor system causes a considerable amount of *distortion* of the musical material it is reproducing. You may not be conscious of distortion, but it is there, and affecting you all the time. It actually tends to tire people out, and make them irritable. This is why you hear shouts of "Turn that thing down!" in households

HOW TO RATE YOUR HI-FI NEEDS

In each "scoring" box, write the number corresponding to the proposition that most honestly reflects your own situation or preference. If more than one proposition seems to apply, choose the one with the highest number. Add your selected numbers up for the total, then consult the text. Total will affect your expenditure and choice of what you buy.

<p>I. YOU PLAN TO USE HI-FI FOR</p> <ol style="list-style-type: none"> 1. Background music. 2. Attentive Listening. 3. Concert-hall realism. <div style="text-align: center; border: 1px solid black; width: 80px; height: 20px; margin: 10px auto;"></div>	<p>V. SOUND PREFERENCES</p> <ol style="list-style-type: none"> 1. None whatever. 2. Reasonably undistorted. 3. Highest possible realism. <div style="text-align: center; border: 1px solid black; width: 80px; height: 20px; margin: 10px auto;"></div>
<p>II. LISTENING PERIODS</p> <ol style="list-style-type: none"> 1. Less than 1 hour at a time. 2. 1 to 3 hours at a time. 3. Periods of 3 hours or more. <div style="text-align: center; border: 1px solid black; width: 80px; height: 20px; margin: 10px auto;"></div>	<p>VI. BASS PREFERENCE</p> <ol style="list-style-type: none"> 1. Moderate bass. 2. Heavy bass. 3. Cleanest true bass. <div style="text-align: center; border: 1px solid black; width: 80px; height: 20px; margin: 10px auto;"></div>
<p>III. TYPE OF MUSIC</p> <ol style="list-style-type: none"> 1. Popular and "mood" music. 2. Jazz. 3. Classical music. <div style="text-align: center; border: 1px solid black; width: 80px; height: 20px; margin: 10px auto;"></div>	<p>VII. SIZE OF LISTENING ROOM</p> <ol style="list-style-type: none"> 1. Less than 225 sq. ft. 2. 225 to 400 sq. ft. 3. More than 400 sq. ft. <div style="text-align: center; border: 1px solid black; width: 80px; height: 20px; margin: 10px auto;"></div>
<p>IV. FAVORED SOURCE</p> <ol style="list-style-type: none"> 1. Mostly radio. 2. Radio, occasionally records. 3. Mostly records. <div style="text-align: center; border: 1px solid black; width: 80px; height: 20px; margin: 10px auto;"></div>	<p style="text-align: center;">TOTAL</p> <div style="text-align: center; border: 1px solid black; width: 120px; height: 40px; margin: 10px auto;"></div>

where a radio or phonograph isn't playing loudly at all. A poor system won't sound better when played infrequently, but then neither will it tire you out or drive your family to distraction. A really good system is always a pleasure to listen to, for any length of time.

By now you have probably looked at our table of requirements and may al-

ready have added up your "score." (Notice we label this a "total," because that is all that it is.) If your total is less than 10, your needs are not at all critical and you can meet them for as little as \$100, assuming that you will buy all ready-made components rather than kits (more about that in a moment), and assuming you want stereo.

Hi-Fi Clinic

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

Converting to Hi-Fi

I own an old console radio-phonograph with three speakers built-in. I would like to convert it to hi-fi and stereo. Can you send me plans on how to accomplish this?

Charles Hebb, Baxter, N. D.

This is typical of many inquiries received by *EI* every month, and while it would be encouraging to know that any cheap phonograph could be converted to hi-fi simply by changing a dingus and replacing a wotsit, this is unfortunately not the case. Simply stated, a low-fi phonograph can best be converted to high fidelity by replacing it with a high-fidelity system.

High fidelity is not a tangible thing like microgroove or stereo, so it isn't possible to convert to hi-fi as we might convert to LP or stereo operation. Fidelity is a function of quality, and low-fidelity phonographs rarely contain a single high-quality part. And the fact that most such phonographs are carefully balanced combinations of unbalanced components means that replacing a single item with a better one may well result in *worse* rather than better sound.

There is no short cut to high fidelity. A high-fidelity system must consist of high-quality components, so converting a low-fi phonograph to hi-fi by replacing its parts one by one will usually turn out to be far more trouble, and often more costly, than simply scrapping the whole thing and starting out with high-fidelity components.

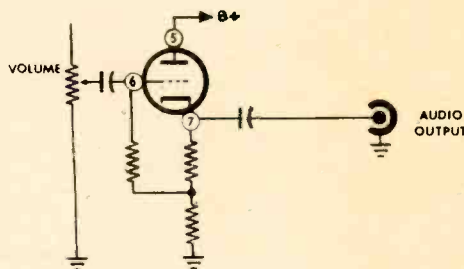
Cathode Followers

Some of the newer high fidelity equipment advertises cathode follower output and implies this is a virtue. Could you tell me what it is and why it is good?

J. Atkinson, Amenia, New York

In hi-fi equipment, the main advantage of a cathode follower is its low output impedance which allows long

lengths of shielded output cable to be used without loss of the higher frequencies and with minimum hum pick-up.



The name cathode follower is used because the output voltage is taken from the cathode (not the plate as is usually the case) and the voltage follows; that is, is in phase with the input voltage.

Soup Up A Recorder?

I recently purchased an inexpensive tape recorder. It sounds pretty good on voice, pretty awful on music. What can I do to improve its frequency response?

C. F. Cravens, Russell Springs, Ky.

I am afraid you just discovered the hard way why some tape recorders sell for less than a hundred dollars whereas others are \$200 and more.

Short of rebuilding the recorder's amplifier and replacing its heads, there is little you can do to improve the frequency response. If you are listening to the playback through the recorder's internal speaker, an external speaker connected in place of the recorder's internal speaker will probably result in some improvement.

However, even if you did soup up the electronic part of your recorder, the mechanical tape transport mechanism would still contribute a sort of vibrato effect to music (known as "flutter") which would prevent you from doing high quality recording with your machine.

El builds a Radio-Intercom Kit

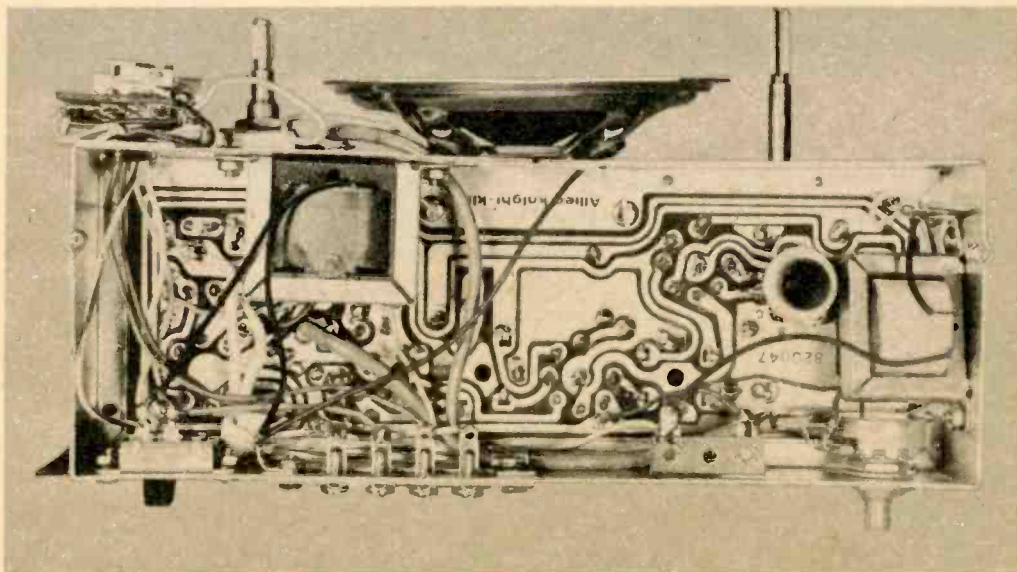
THE Allied Knight-kit "Ranger" is a table radio with a two-way intercom system. The radio, designed for normal household use, operates on 110-125 volts, 50-60 cycles, AC or DC. The circuit is a standard five tube superheterodyne, with two exceptions: the use of a new 50EH5 output tube provides very high gain without the need for an extra amplifier and secondly, a small selenium rectifier has been added to mute broadcast reception when the remote station calls in. A Hi-Q loop antenna does an effective pickup job in mid-town Manhattan, but can be easily supplemented (there's a screw terminal available) with an external antenna if necessary.

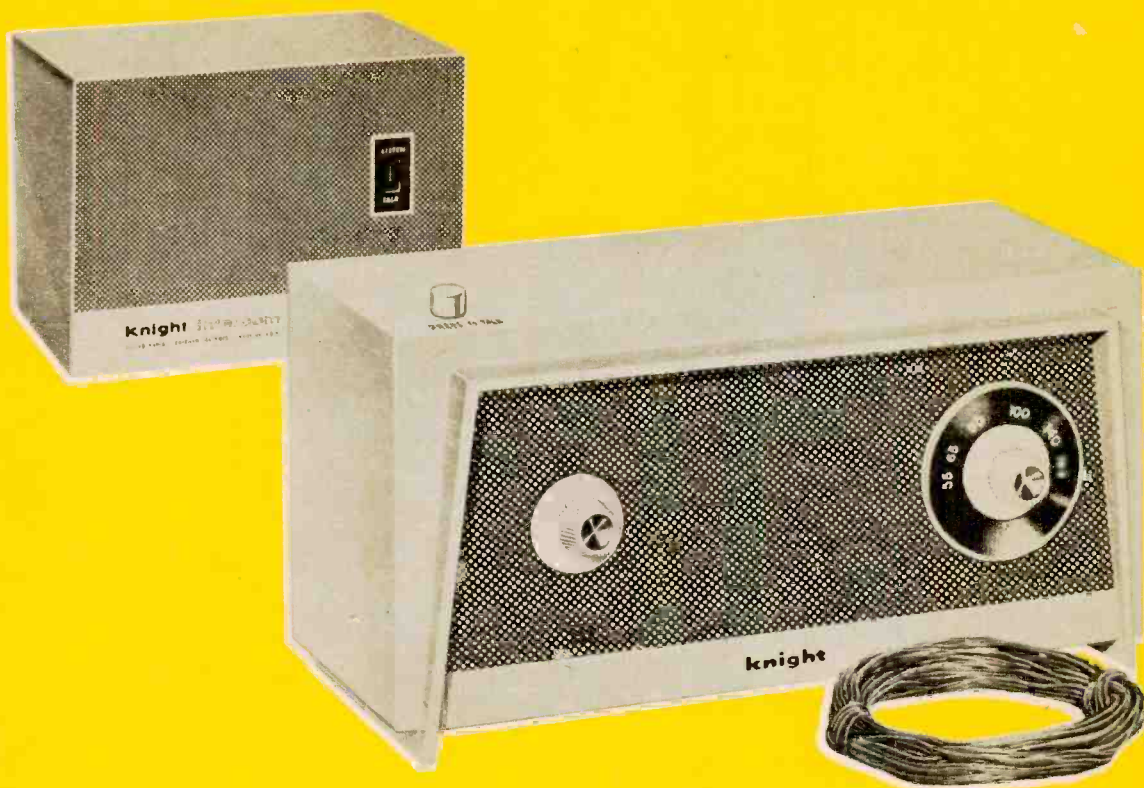
The remote station consists of a separate stamped metal cabinet painted to match the receiver, containing in addition to the speaker, a *Listen-Talk* switch. A fifty foot length of four-wire cable is provided for interconnecting the two units.

In use the radio works quite well—picking a wealth of AM stations with more than usual volume. The tuning, because of the small size of the dial knob and lack of vernier tuning is a trifle finicky, but a steady hand can turn the trick.

To use the intercom function from the Master unit, you merely depress the spring-loaded button on top of the receiver. This instantly mutes the broadcast, and you may speak to the remote station as long as you hold the button down. When you release the button, there is a momentary lag before the broadcast comes back on. The push-button switch has a positive action.

Bottom view of completed main chassis. Wiring has been greatly simplified by use of printed circuit board. Listen-Talk switch assembly is at upper left.

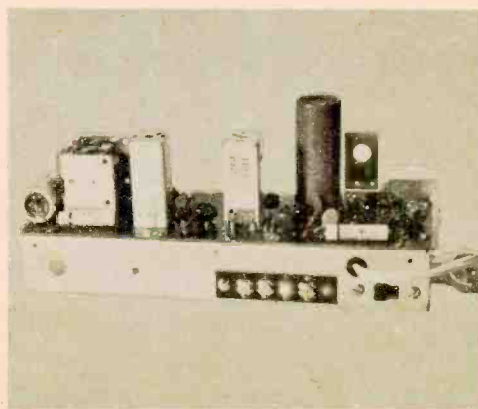




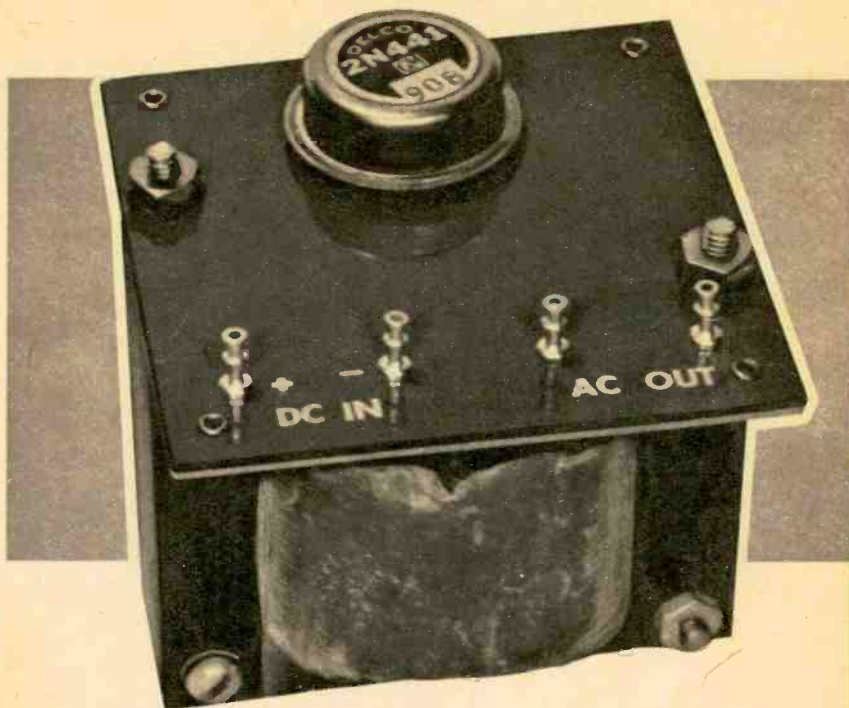
Assembled master radio-intercom unit and slave (rear) present a modern appearance.

From the Remote station, (which can be up to 50 feet away) you merely operate the *Talk-Listen* slide switch. To call the Master, you put the switch in the *Talk* position. This mutes the broadcast, and you speak into the little box. Slide the switch back to the *Listen* position, and you can receive messages, or, of course, listen to the radio station just as it is being received on the Master station. If you require your remote to be up to 200 feet away, #18 gauge wire is recommended.

The kit is very easy to build, being blessed with a better-than-average instruction manual, well-organized parts inventory and that wonderful helper—the extra large size wall chart to make page turning [Continued on page 110]



Four-wire terminal strip on rear of completed main chassis connects to remote units. Remote switch at right controls one or more units.



1-Transistor Power Supply/Converter

changes DC battery voltage to high voltage AC.

By R. L. Winklepleck

YOU may be interested in a portable power supply for high voltage insulation testing or for operating a geiger counter. If you're building an electronic photoflash outfit or modifying one to replace the old vibrator supply, this ultra-simple transistorized power supply may be just what you've been looking for.

When transistorized power supplies are mentioned one immediately thinks of the familiar two-transistor multi-vibrator circuit. This certainly is the most efficient circuit for steady loads, but it's not necessarily the best for all applications.

Let's consider the stripped-down Hartley oscillator shown in the schematic. It requires only one transistor, one resistor and one transformer. It doesn't even need a special transformer since almost any power or audio type will do. For top efficiency the base feedback portion of the tapped winding should match the low impedance of the transistor base and the other half should match the relatively high emitter-collector impedance. In practice, however, these values aren't critical and good results are possible using a transformer with a center-tapped 6.3-volt secondary winding such as the Stancor P-6134. The transistor (Q) can be a CBS 2N255 and the resistor (R) 68 ohms. With only a three-volt DC input the no-load AC output of the unit is approximately 500 volts.

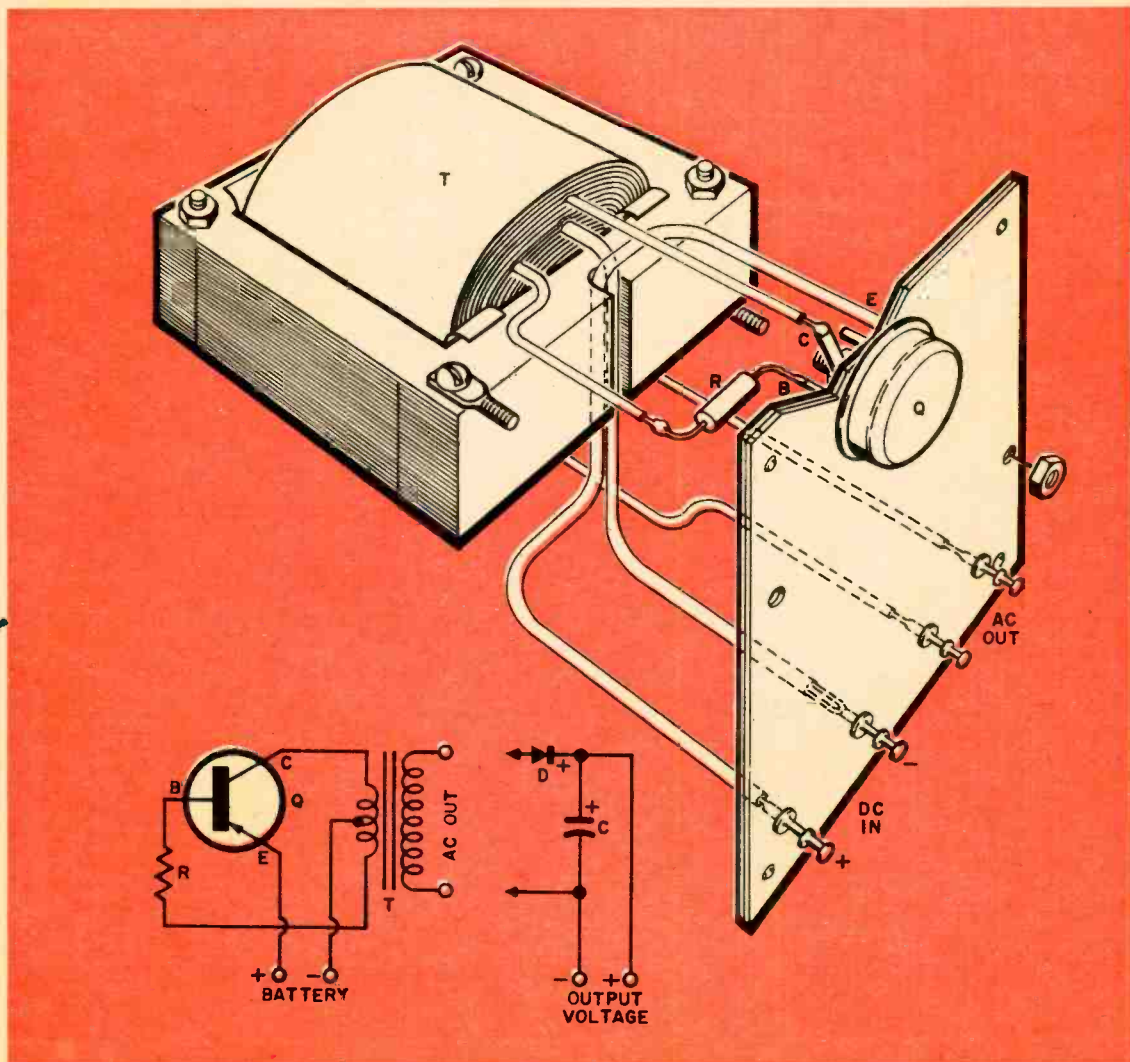
A 500 mf capacitor can be charged to 450 volts in less than thirty seconds. Only one ampere is drawn from the battery voltage supply.

For more power try a vibrator transformer such as a surplus Philco unit sold by Herbach & Rademan of Philadelphia for one dollar under catalog number TM-3011. Use a Delco 2N441 transistor as Q and a 47 ohm resistor as R. With a five-volt supply a 500 mf capacitor can be charged to 450 volts in ten seconds and it will climb slowly to 650

volts. The peak DC supply current drawn is only two amperes and as the load decreases the supply current will fall to less than one ampere.

The no-load output consists of spikes as shown in the oscilloscope pattern photo 1. Under load, these peaks broaden as shown in photo 2. Note that the output is electrically noisy and requires a lot of filtering if noise is important. It's not very efficient under steady load; but for an application where the load varies and a rather rough output can be tolerated,

Spade lugs are mounted on the transformer (T) to hold the insulated terminal plate. Use high voltage diode (D) and try connecting rectifier circuit across the AC OUT terminals both ways.



it's both good and quite inexpensive.

You must experiment a bit to find the combination of transformer, transistor, resistor and battery voltage which best fits your output voltage and current needs. It's important to stay within your transistor specifications to prevent their destruction. You'll find that with each component combination there is a definite maximum battery voltage beyond which an increase will do little or nothing for output performance. With a little cutting and fitting, however, on a trial and error basis the results can be gratifying and the cost insignificant.

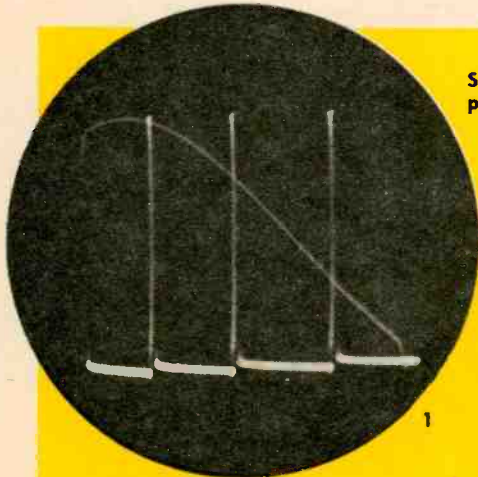
Hook in the rectifier and filter network with the orientation that provides the highest output voltage. In any case, make sure that the positive terminal of diode D is connected to the positive end of the filter capacitor C.

There is one very important point to keep in mind. The intense transient voltage peaks produced can and will puncture both transistors and rectifiers which seem to be well within the safety limits of the operating voltages. Use components which are quite obviously over-rated for the job so they can handle these peaks without difficulty.

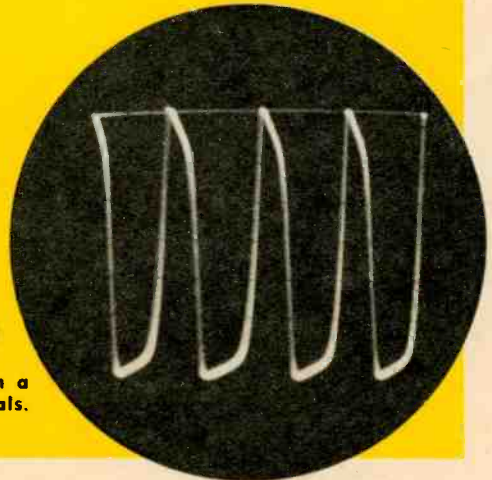
TRANSISTOR HARTLEY OSCILLATOR

This simplified, series-fed Hartley oscillator uses a 6.3 volt secondary as a type of auto-transformer. When power is supplied to the circuit, the combination of transistor leakage and the forward bias supplied the base (via the lower half of the transformer winding and R) causes the transistor Q to conduct. This flow of current through the upper half of the transformer winding induces a forward-biasing voltage in the lower half producing a rapidly increasing current which climbs to saturation. Resistor R serves to limit the base current to safe levels. At saturation, current ceases to rise and the transistor base current drops thereby reducing the emitter-collector current through the top half of the transformer regeneratively. The voltage in the lower half of the transformer reverses with the collapse of the field and the transistor cuts off completely. This cycle repeats itself at a frequency determined by transistor and transformer characteristics and the supply voltage.

The cycle of oscillation in the transformer primary induces a similar cycle in the secondary at a much higher voltage level than would be suggested by the turns ratio because of the intense flyback action. By orienting the rectifier to conduct with the collapse of the transformer field, amazingly high voltages can be achieved.



Scope traces of power supply. Left; sharp peaks produced when operating with no load.



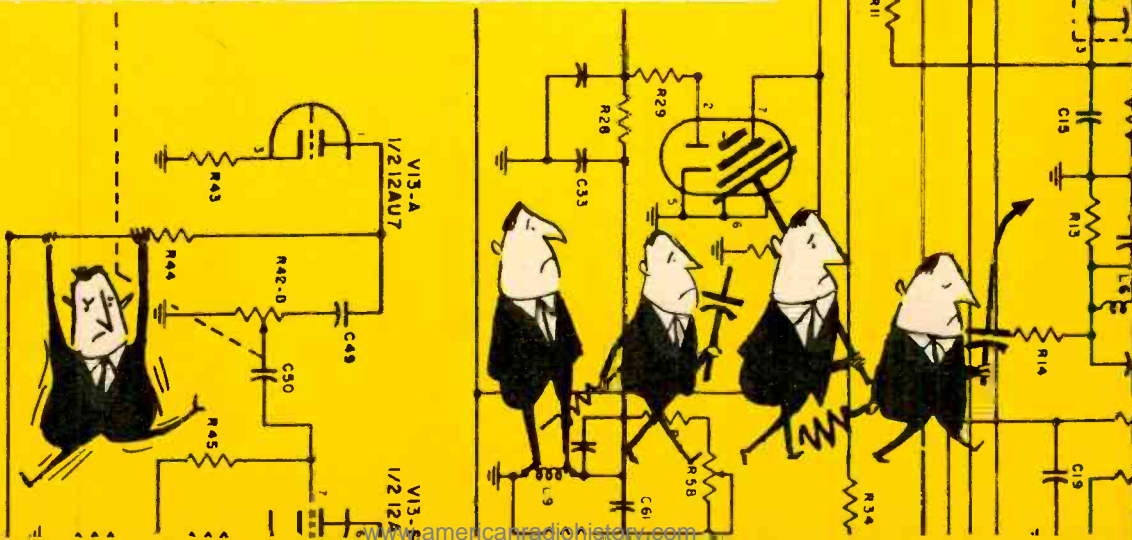
Distorted sine wave appears (right) when a load is placed across the AC OUT terminals.

How to Read Schematic Diagrams

By Harvey Pollack

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The Schematic

THE schematic diagram is a direct pipeline between the circuit designer and the experimenter or technician who puts the equipment to work. The schematic carries a wealth of vital information, succinctly and precisely expressed. And because it conveys virtually all the essential details that describe the interconnections between parts, their values, and their circuit relationships, an understanding of the schematic diagram

is basic if you want to advance in electronics.

As a first step in working with schematics, you must learn to translate the symbols on the diagram to the actual metal, paper and plastic components in an electronic device. Since it is essential that you recognize certain fundamental electrical linkages that appear most frequently in schematics, we have compiled a series of symbols and photographs which review the language of the schematic diagram in compact form. Look them over to be sure that they are all familiar. (Pages 78-82.)

Series Connection—

When the circuit elements such as resistors, capacitors, coils, transformer windings, etc. resemble a chain of sausage links, you have a series circuit. The electric current must flow through each part in turn before returning to the voltage source. (Fig. 1).

FIG. 1

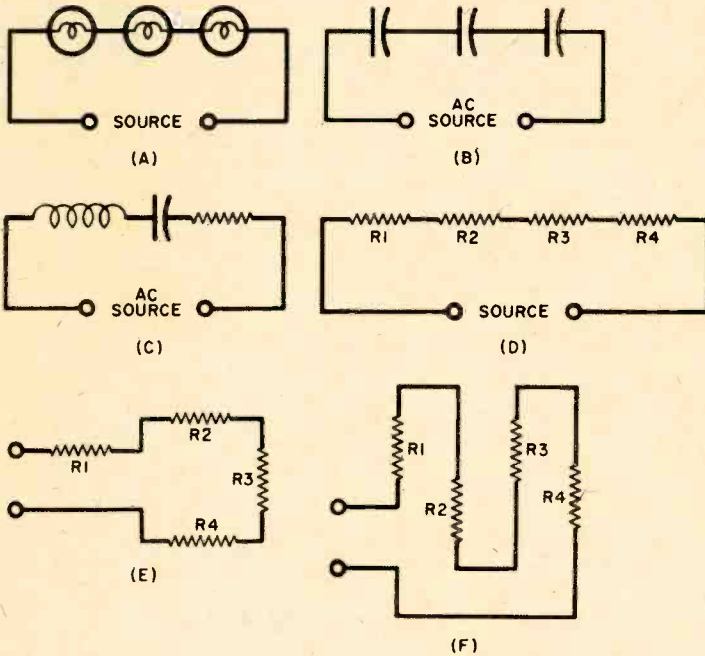
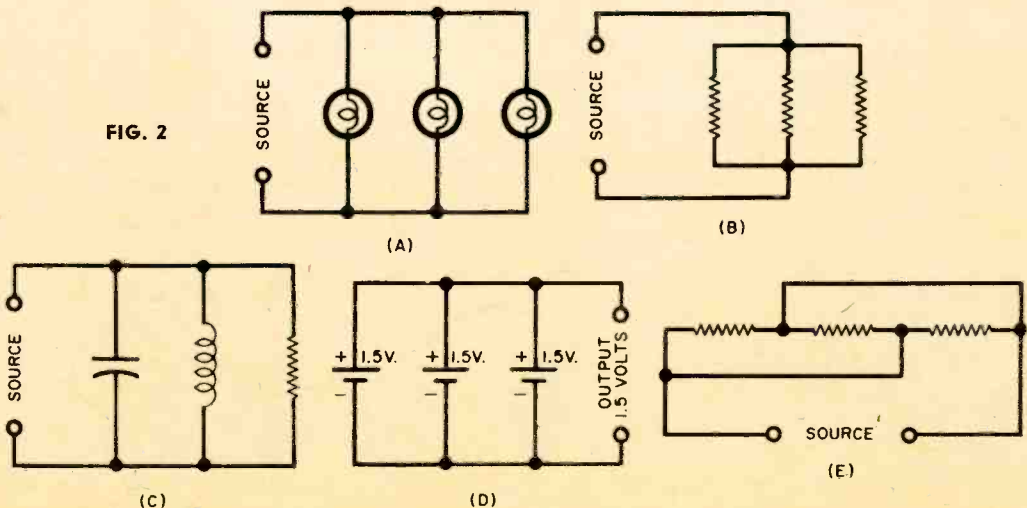


FIG. 2



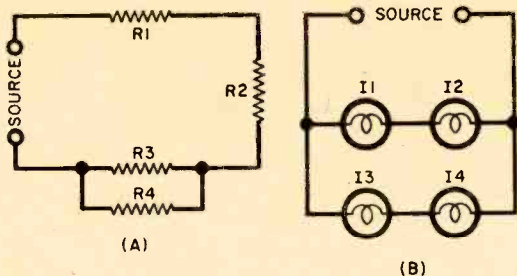


FIG. 3

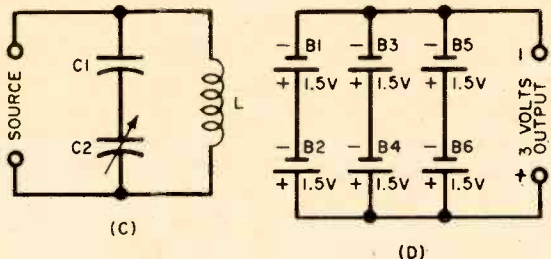


FIG. 4

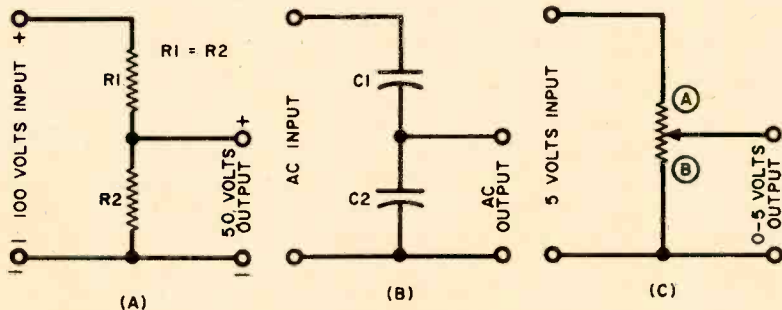
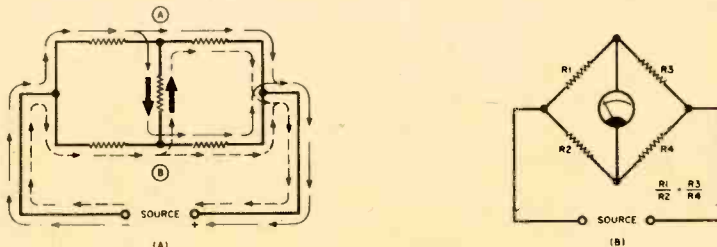


FIG. 5



Sources of voltage such as dry cells, generators, transformer secondaries, etc., are in series if the output voltage is the sum of all the individual voltages. A series voltage source will always have one free *minus* and one free *plus* terminal in DC circuits.

Parallel Connection—When the circuit elements are hooked up like rungs in a ladder, the circuit is a parallel one. Current flows through each one individually without going through the others. Each branch of a parallel circuit behaves as though the other branches were not there. When equal voltage sources are in parallel, the output is equal to the voltage of any one of the individual sources. (Fig. 2D).

Series-Parallel Connection—Components are in series-parallel when the functions described for both above cases are combined. Voltage

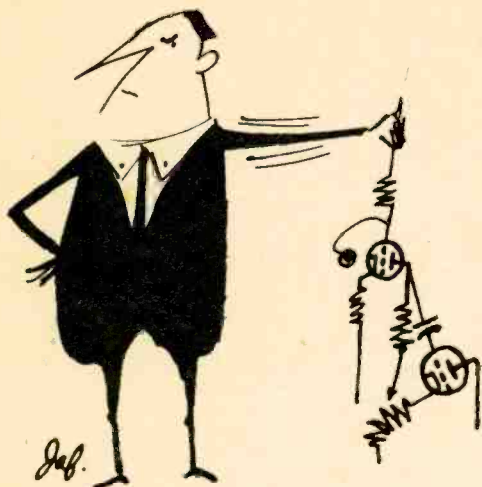
sources may also be combined in series-parallel arrangements. (Fig. 3). This type of circuit is often used to provide both higher voltage and higher current.

Voltage Dividers—A voltage divider is made up of a series of components connected across a voltage source. A portion of the voltage may be tapped off by connecting the output leads across one or more of the components. (Fig. 4).

Bridge Circuit—A circuit is bridge-connected if current from a single source can flow in opposite directions in at least one of its components. In an unbalanced bridge (Fig. 5A), current can flow from A to B and from B to A making the net current in the center resistance equal to the *difference* between the two currents. In a balanced bridge the components make the net current in the common load equal to zero. (Fig. 5B).

How To Analyze a Schematic

Suppose you wanted to analyze the photocell relay circuit shown in Fig. 6. (Incidentally, this is an excellent unit; the relay can be triggered by a 2-cell flashlight at a distance of 30 feet or more!) Your first move should be to break down the circuit into the common configurations. This does not mean that you must draw out the breakdown; you should, however, try to see what configurations are present.



There are several different ways of handling such an analysis. Let's run through one of them together.

We might first draw the photocell (PC1) connected to the 117 volt AC line through series components R1, R2, R3, and SW1 (Fig. 7). In this simple arrangement, when SW1 is closed, current will flow in the series circuit through each component before returning to the source. The amount of current will depend, of course, upon the size of the applied voltage and the total series resistance of PC1, R1, R2, and R3. When

this type of photocell has no light on it, its resistance is very high (in the megohms region) so that the current flowing through this series circuit will be tiny indeed. Note the R2 is variable and also controls the current.

In the next step (Fig. 8) we add a relay armature (RL1) and an AC receptacle (SO1) *in series* with each other, but *in parallel* with the series combination consisting of R1, PC1, R2, and R3. (Fig. 8). This new circuit is independent of the other components in the sense that it does not affect them, nor do they affect the new circuit. If the normally open (N.O.) relay contacts are closed by depressing the relay armature, 117 volts AC will appear across the terminals of SO1 and can serve to light a lamp or ring a bell. (We are assuming throughout that switch SW1 is closed.)

Fig. 9 shows another series group comprising the relay coil (RL1) and the 5823 tube V1 connected in parallel with the series combination of R1, PC1, and R2. Note that 117 volts AC is applied across the series circuit containing R3, the relay coil RL1 and the 5823 cold-cathode thyatron tube V1. As long as V1's grid is "floating" or unconnected, V1 cannot conduct, hence no current can flow in the R3-V1-RL1 circuit. Later, the photocell will make the grid of the tube go instantaneously positive so that the 5823 will conduct. Since the current

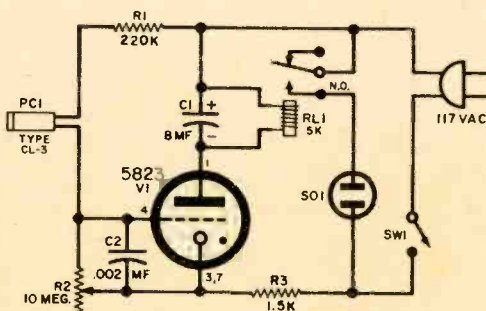
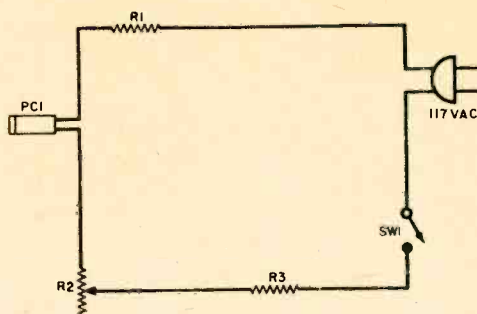


FIG. 6

FIG. 7

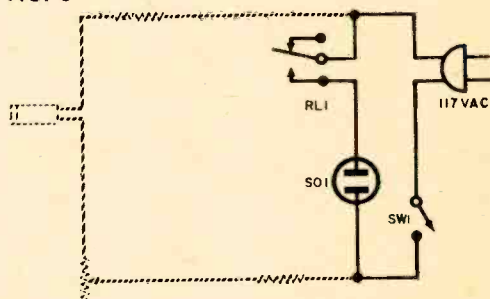


have added the following: a capacitor (C1) across the relay coil in parallel with it, a wire connection from pin #4 of V1 (the control grid) to the junction of PC1 and R2, and a capacitor (C2) from the grid of V1 to its cathode (pin #3 or #7). The photocell relay is now complete. Capacitor C1 smooths out the voltage drop across RL1 to prevent the relay from "chattering" when energized; the grid and cathode of the tube are now connected in parallel with the section of R2 included between its upper end and its wiper (middle contact). Thus, any voltage drop that appears across this portion of the resistor due to changing light conditions on PC1 will be applied between the grid and cathode of V1. Capacitor C2 stabilizes the voltage developed across the active part of R2 by the amount of light falling on PC1.

through this tube would be too high if the only load in its circuit were the resistance of RL1, the additional resistor (R3) is included to keep the current down to a safe level.

Referring once again to the complete schematic diagram (Fig. 6), we see that, in addition to the parts in Fig. 9, we

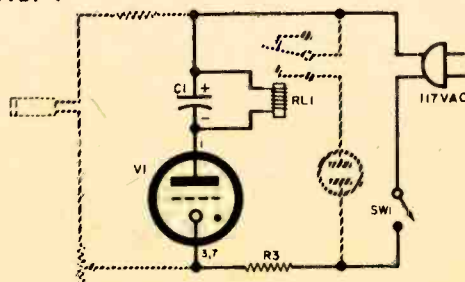
FIG. 8

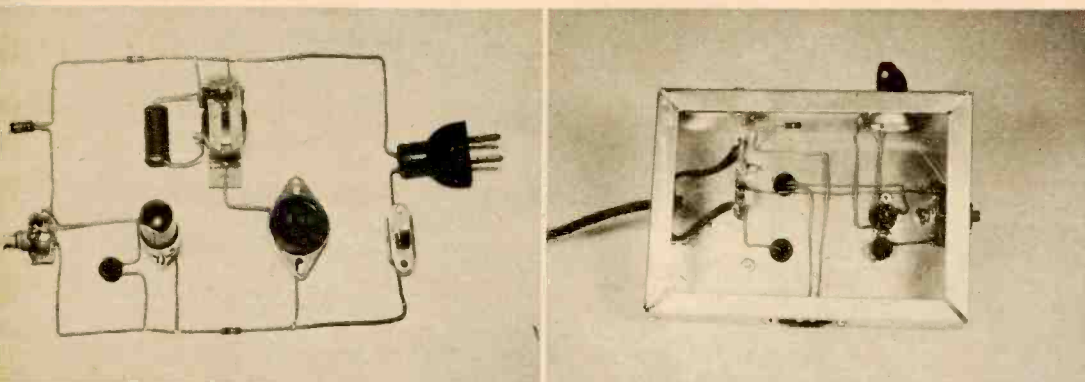


Laying Out A Chassis

Having built up the final schematic from its basic configurations, we will now consider the layout of the chassis on which the unit is to be built. The schematic offers no clue as to the best location of the components, where the holes should be drilled for the sockets, photocell, switch, line cord, components, where the relay should be placed. Since the actual layout is not critical in equipment of this

FIG. 9





At left, the components of the photo-relay are laid out as in schematic. Practical working layout at right is designed for convenient operation.

type, the layout used depends only upon convenience in use and appearance in its final state. The parts *might* be mounted in exactly the same positions as they occupy on the schematic diagram (see photo). But if a chassis is used, this layout is not logical since it makes no use whatever of the front, rear, and side of the chassis.

In planning your layout from a schematic, you should visualize the conditions you expect in the surrounding installation site so that you can locate important components conveniently.

(a) The switch and sensitivity control are probably the only components you will want on the front apron.

(b) The photocell should be placed on the apron that will face the light source in the final installation of the completed unit. In this model, the light was to come from the right side, hence the cell faces this way.

(c) An available source of AC to power the unit happened to be located to the left of the chassis; thus, the line cord emerges from this side.

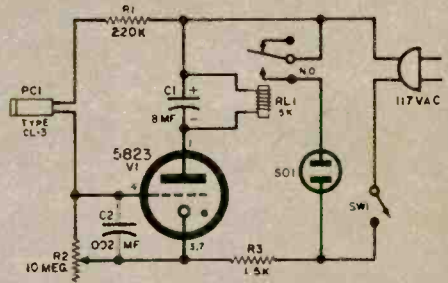
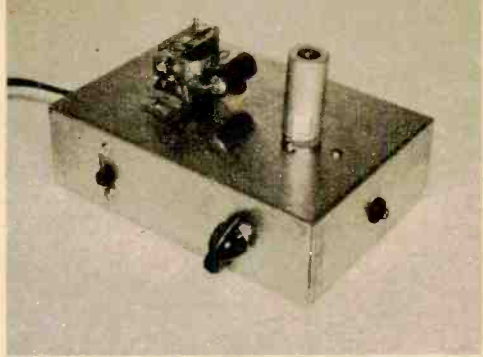
(d) Output receptacle SO1 could have been mounted anywhere. The rear panel was selected because the alarm bell plug that fits into SO1 should be at a location where it could not be easily dislodged.

Why was the tube placed on the right and the relay on the left of the chassis? If you'll check the schematic, you'll see that the tube is most closely associated with PC1 and sensitivity control R2, and that the relay is connected with the output socket SO1 and the line cord. The wiring is more direct this way, and the layout more logical. Although the relay could have been positioned under the chassis—which would have made the two feed-through grommets unnecessary—inexpensive types like this one are more reliable when mounted upright. Note that there is AC voltage on the relay contacts, so if the device is to be installed in an exposed position, a cover for the chassis would be desirable.

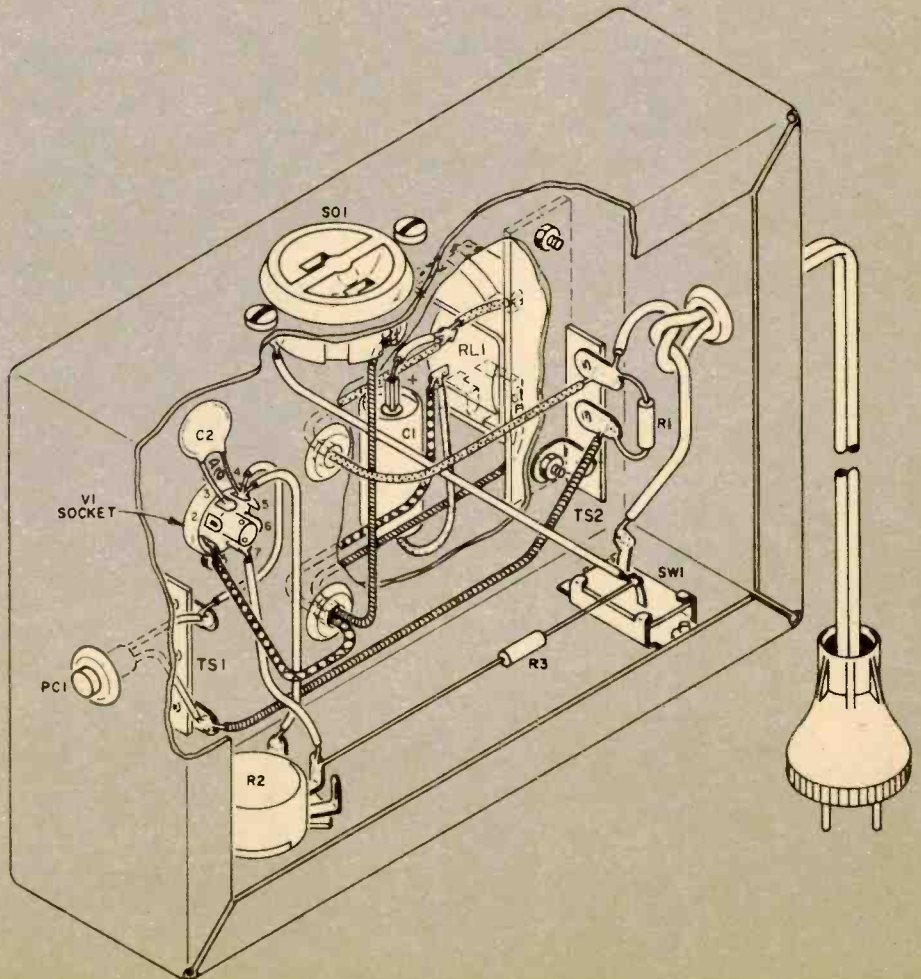
Looking under the chassis, we note several details that do not appear on the schematic diagram. Good construction practice does not permit small components or wires to be spliced in mid-

PARTS LIST FOR PHOTOCELL RELAY

- R1—220,000 ohms, 1/2-watt resistor
 - R2—10 megohm potentiometer
 - R3—1500 ohms, 1/2-watt resistor
 - C1—8 mf 150 V electrolytic capacitor
 - C2—.002 mf, 200 volts or higher disc capacitor
 - PC1—Photozell (Clairex CL-3)
 - RL1—Relay, 5000-ohm coil, SPDT contacts, upper contact not used (Potter and Brumfield type LB5)
 - SW1—SPST slide switch
 - V1—5823 cold-cathode thyratron tube
 - SO1—Chassis mounting AC receptacle
 - TS1, TS2—2-post terminal strip (neither post grounded)
 - Misc.—117 volt line cord and plug
- Parts not shown in Schematic Diagram*
 Aluminum chassis 5" x 7" x 2", 7-pin miniature socket with shield, four rubber grommets, knob, hardware (screws, nuts, etc.)



Three different modes of presenting the photocell relay; each showing some aspects of the device which is implied, but not shown, in the other views. An experienced technician who is aware of the practical problems of construction can build directly from the schematic.

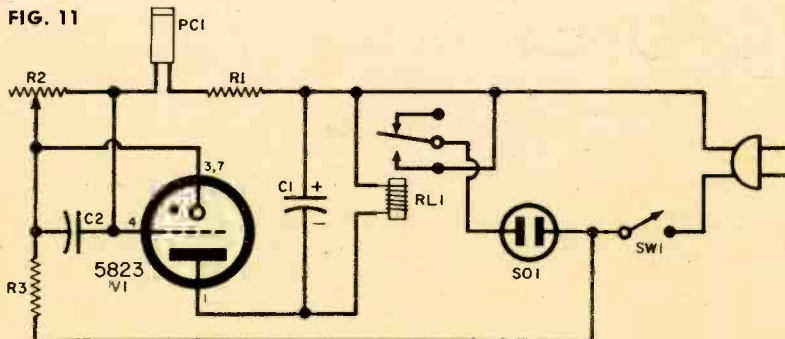
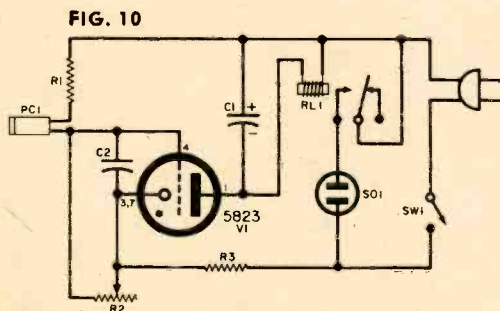


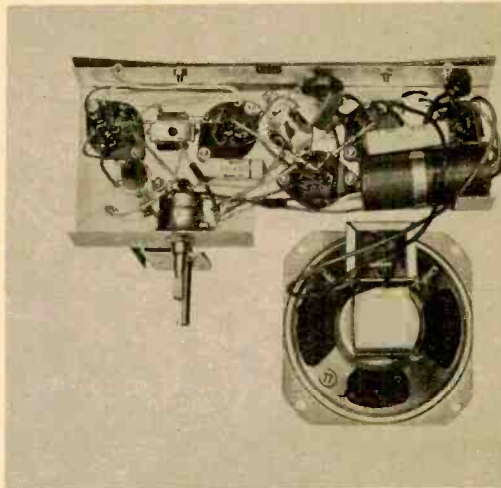
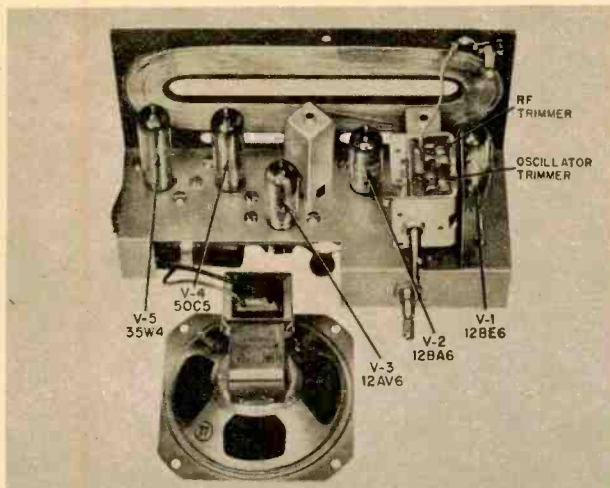
air so that parts "float" on the ends of long leads. Hence, two terminal strips (TS1 and TS2) are employed. One of these provides termination for one line cord wire and both pigtailed of R1. The other terminal strip supports the leads of photocell PC1 whose window peers through the rubber grommeted hole on the right side of the chassis. The ends of R3 are held by one terminal of switch SW1 and the wiper (center) terminal of R2; C2 is supported by connecting its pigtail leads directly to pins #3 and #4 of the tube socket. Similarly, capacitor C1 is secured by its leads directly to the coil terminals of RL1. Note that C1 is an electrolytic capacitor, so indicated by the + and - markings on the schematic. This capacitor *must* be connected with the polarities as shown; the same is not true of C2, a ceramic disc type.

Alternative Schematics

Beginners are often bewildered by the fact that a given circuit may be drawn schematically in several different ways without changing the electrical nature of the circuit. Tubes are shown inverted or lying on their sides, relays are vertical or horizontal, resistors and capacitors are moved from vertical to horizontal legs, and relay contacts are interchanged. Figures 10 and 11 are examples of the variations possible for the same circuit we have discussed above. In general, one can say that the best schematic is the one that's easiest to follow. A good draftsman will plan his work so that the finished diagram will appear to be as simple as possible, with as few cross-overs as he can manage. On this basis, the schematic of Fig. 6 is the best because it has no cross-over connections and does give the impression of simplicity. Fig. 11 does have one cross-over, while the drawing in Fig. 10 somehow makes one feel that the circuit is more complex than it actually

is. In any case, all three drawings yield identical electrical information and should be viewed merely as different means of expression depending upon the draftsman's whims.





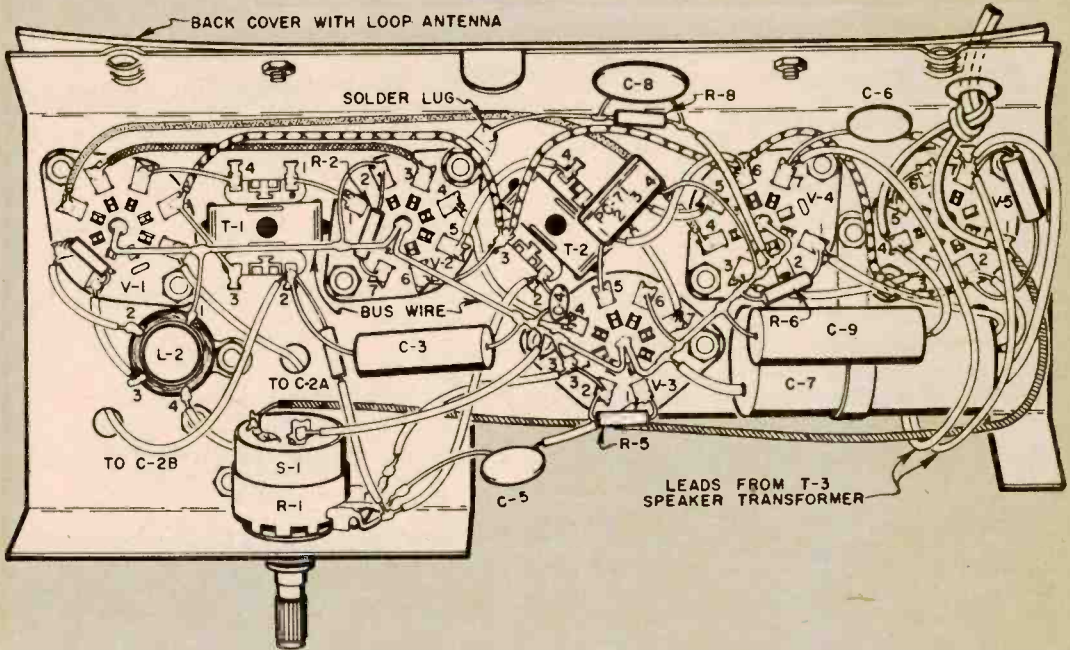
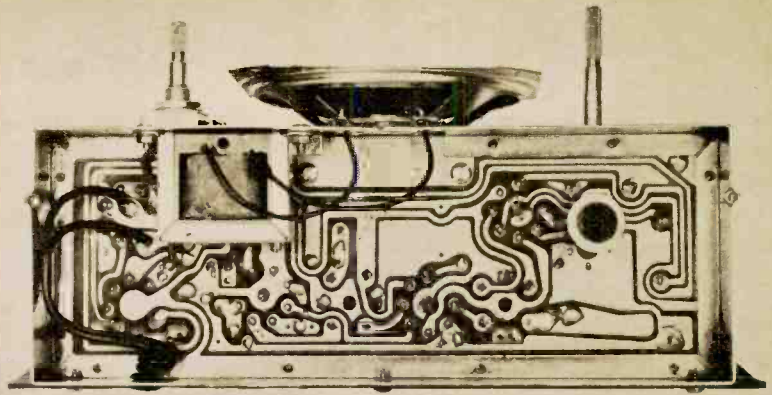
Top and underside views of a standard five tube AC-DC radio. See pictorial diagram on page 77 for closeup view of its component layout and wiring.

Schematic of an AC-DC Radio

Facility in working with schematics can be developed only through practice. Learning the symbols and studying examples, such as the preceding circuits, are but first steps on a long road. Before you start planning a chassis of your own, let's take a look at how the professional engineers do it by checking the construction of a typical AC-DC radio.

From left to right along the row of tubes, see p. 76, are a 12BE6 converter stage, then a 12BA6 intermediate frequency (IF) amplifier, followed by a 12AV6 detector-audio amplifier, and finally a 50C5 audio power output stage. Immediately below the 12BA6 is the rectifier tube, a 35W4. In operation, the rectifier together with its filter network, two sections of C7 and R7, provides DC plate and screen power for the tubes. The amplitude-modulated signal is picked up by the antenna loop, L1, and is fed to the 12BE6 at pin 7. Due to the circuit involving L2, C2B and C2D connected to pin 1, a part of the 12BE6 oscillates, causing a heterodyne or mixing action to occur within the tube. The broadcast signal emerges at the plate (pin 5) of the 12BE6 converted to the IF of the receiver, 455 kc. The signal is then amplified by the 12BA6, detected by the diode part (pin 5) of the 12AV6, and the resulting de-modulated audio is fed to pin 1 for further amplification by the triode section of the same tube. Power amplification, sufficient to operate the loudspeaker, is accomplished in the 50C5 circuit.

The stage-by-stage layout of the schematic diagram suggests a possible chassis layout to some extent. The logical place for the 12BA6 would be at the rear of the chassis near the main variable capacitor C2A/C2B. Hence the tube line-up begins with the 12BE6 in the right, rear corner. Next to the tube is T1, the first IF transformer, and immediately adjacent to this component is the 12BA6. Continuing leftward, we find the second IF transformer T2 followed by the 12AV6 detector-audio amplifier. As you can see, chassis layout follows the schematic closely right up to the

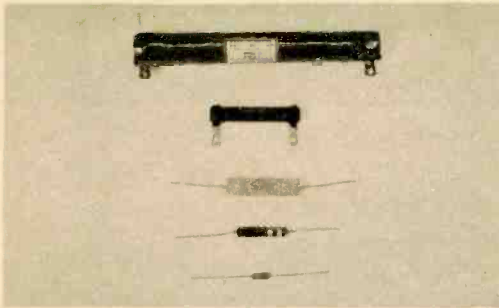


Pictorial diagram of AC-DC receiver whose schematic is shown on opposite page. The printed circuit receiver shown in inset has identical circuit.

50C5 which is mounted close to the output transformer, T3 and the speaker. The 35W4 is mounted at the far left.

Wiring is always most effective, and performance most trouble-free when interconnections are made as short and direct as possible. Thus, tube sockets are mounted so that the tube element lugs are sensibly placed for good wiring. Terminal strips are positioned to support small components in the best places, and plan for outside leads such as line cord and antenna in advance.

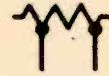
As you probably now appreciate, reading schematics means something more than understanding that a "sawtooth" symbolizes a resistor and a series of loops means a coil. To truly "read" a schematic one must be able to analyze a circuit, break it down into its component elements and understand the interaction of the "sub-circuits" upon each other. The photo-electric circuit we examined earlier illustrates the problems involved. More importantly, it illustrates the approach and analysis techniques you can use to understand and design circuits. On the following five pages are most of the electronic symbols you will encounter in schematics.



RESISTORS



FIXED

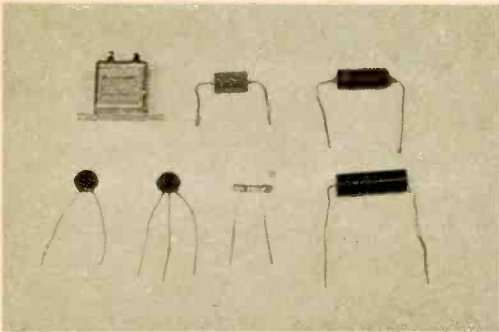
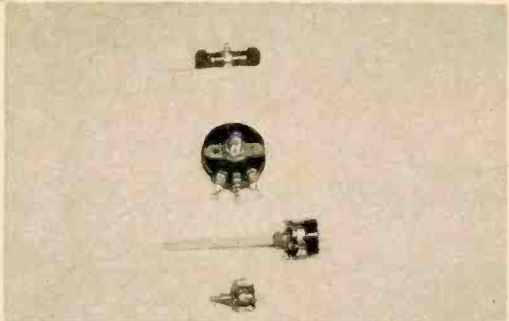


TAPPED

RESISTOR (Potentiometer)



VARIABLE

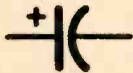


CAPACITOR

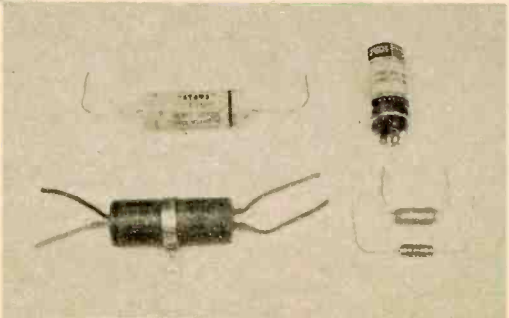


FIXED

CAPACITOR



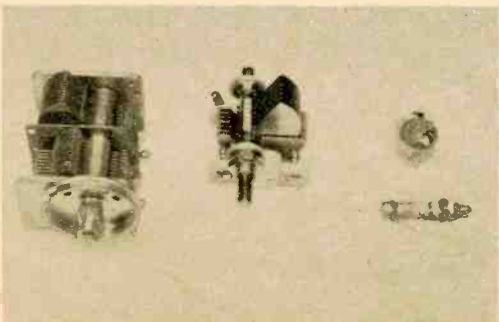
ELECTROLYTIC

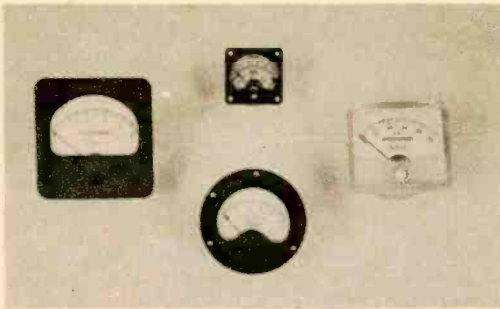


CAPACITOR



VARIABLE





METER



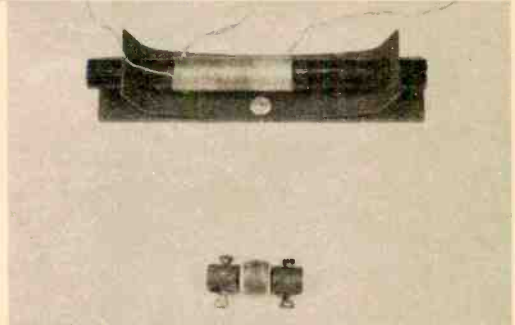
COILS OR CHOKES



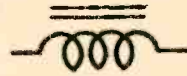
SLUG TUNED



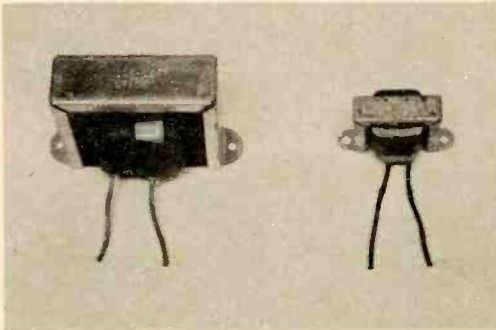
TAPPED



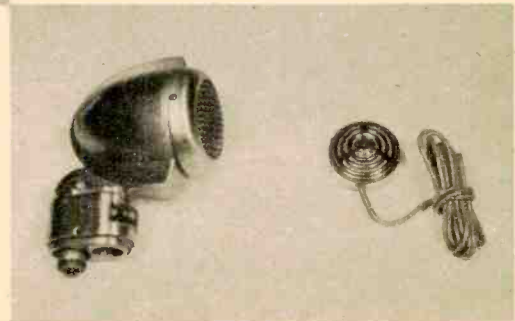
CHOKES



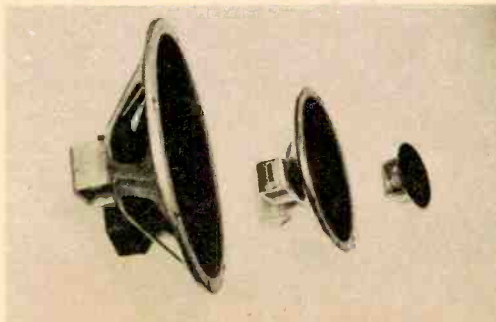
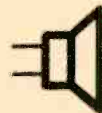
IRON CORE



MICROPHONES



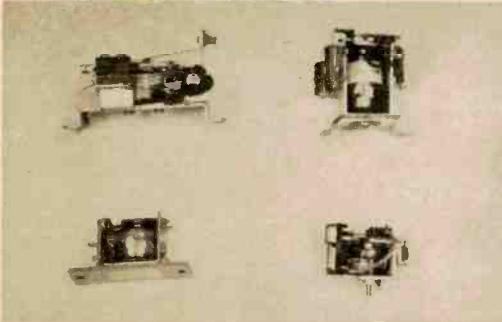
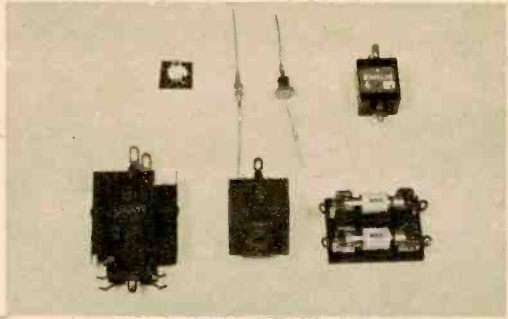
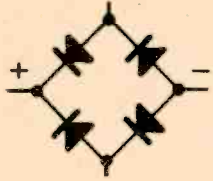
SPEAKER



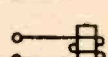
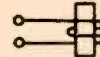
RECTIFIER



BRIDGE



RELAYS



SPST
NORMALLY
OPEN

SPST
NORMALLY
CLOSED

SPDT

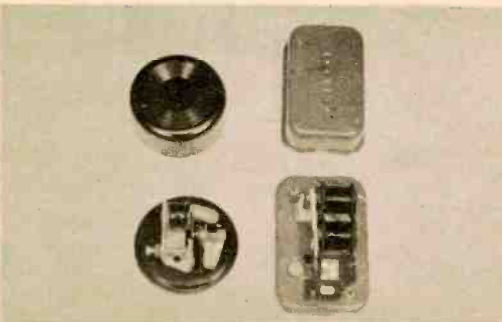
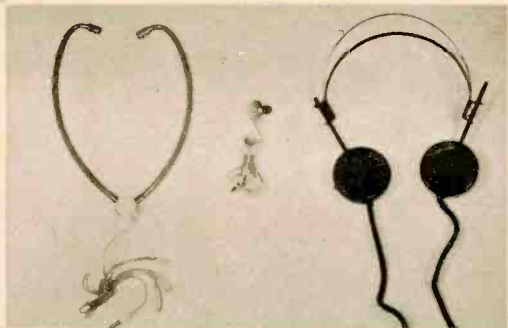
HEADPHONES



DOUBLE



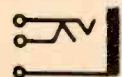
SINGLE



BELL



BUZZER

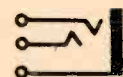


SHORTING
TYPE



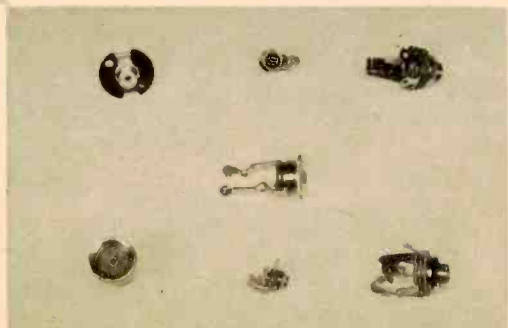
OPEN
CIRCUIT

JACKS

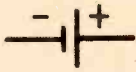


2 CIRCUIT

PHONO



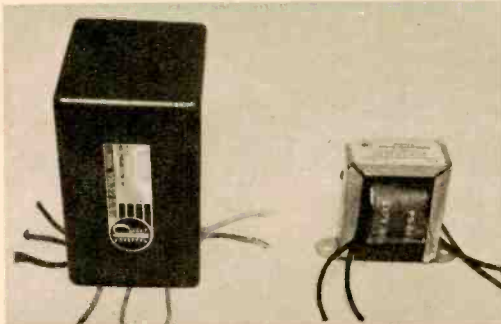
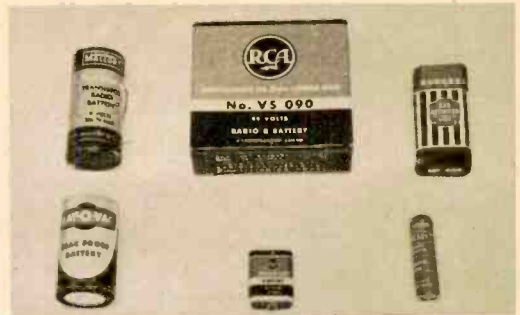
BATTERIES



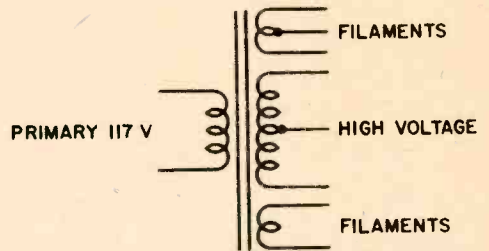
SINGLE CELL



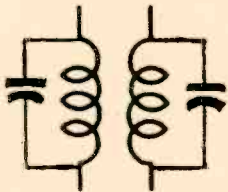
MULTI-CELL



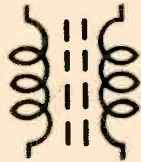
POWER TRANSFORMER



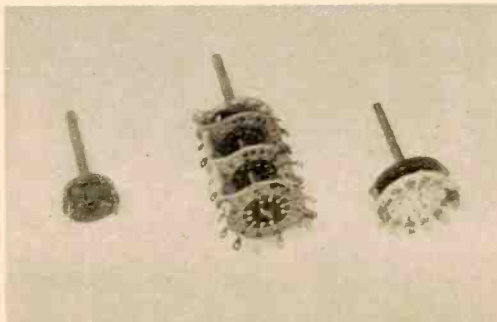
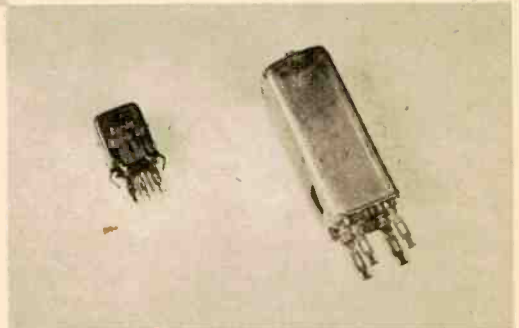
TRANSFORMERS



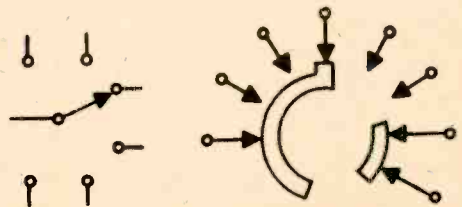
AIR CORE



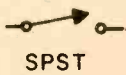
POWDERED IRON CORE



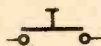
SWITCHES



SWITCHES



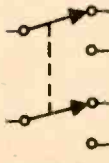
SPST



MOMENTARY PUSH BUTTON



SPDT



DPDT



PHOTOCELL



WIRES



CONNECTION



NO CONNECTION

GROUNDS



WIRING



CHASSIS

PILOT LIGHT



FUSE



117 V CONNECTORS



RECEPTACLE



PLUG

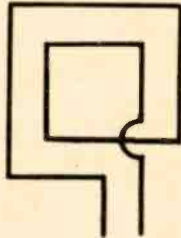
ANTENNAS



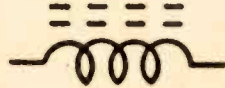
GENERAL



DIPOLE

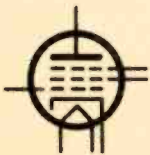


LOOP



FERRITE TYPE

VACUUM TUBES



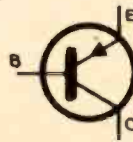
HEATER TYPE



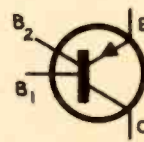
COLD CATHODE



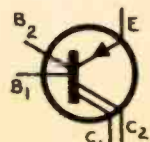
PHOTOTUBE



TRIODE



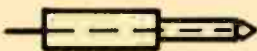
TETRODE



PENTODE

TRANSISTORS

PHONE PLUG



MAGNETIC RECORDING HEAD



TELEGRAPH KEY

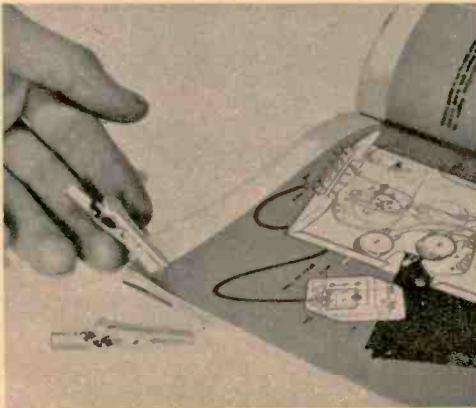




Clip Tricks and Tips

By John Comstock

Mark the pages of your favorite electronics magazine with an alligator clip when you want to return to a certain article quickly.



A clip force-fit into a hole drilled in a corner of your bench or set in vise makes a good miniature soldering vise and small parts holder.



Restringing a radio's dial cord is easier with a tool made of an alligator clip slipped over the tip of a small screwdriver and crimped.



Clips that are used to grip tiny wires should either have their teeth filled with solder or completely filed down for a sure grip.



a real QSL catch

DX from the Real "Treasure Island"

It's no "pirate," but logging it is a real challenge.

By C. M. Stanbury, II



IN the fall of 1958, DX listeners were searching for the island of Nibi Nibi. This island, immortalized in the book *Penguin Island*, was supposed to have both a short wave and a broadcast-band station. Of course there was no such station and just to make the hoax complete, nobody is certain which island in the Society group the author intended. Thus for practical purposes Nibi Nibi didn't even exist.

You can make up for all that lost DX hunting time. Go after Treasure Island. That's right, Robert Louis Stevenson's *Treasure Island*, far more famous than Nibi Nibi ever was.

Treasure Island is actually Isla de Pinos, a Cuban possession 100 miles South of Havana and legally a part of the province of Havana. Before the Castro regime came to power, a group of

businessmen capitalizing on Stevenson's classic attempted to turn the island into a tourist center. The project included a broadcast station, CMBN, at Nueva Gerona, largest and most modern town on Isla de Pinos. Although CMBN was a BCB operation (1370 kc), it operated all night. After 0300 EST Mondays, with the channel clear, it was frequently heard throughout the U. S. While transmitting entirely in Spanish, QSL letters were issued to many DXers in English. CMBN represented a golden opportunity to bag Treasure Island, but with the coming of Fidel Castro, the tourist business dropped off drastically and CMBN ceased all night broadcasting.

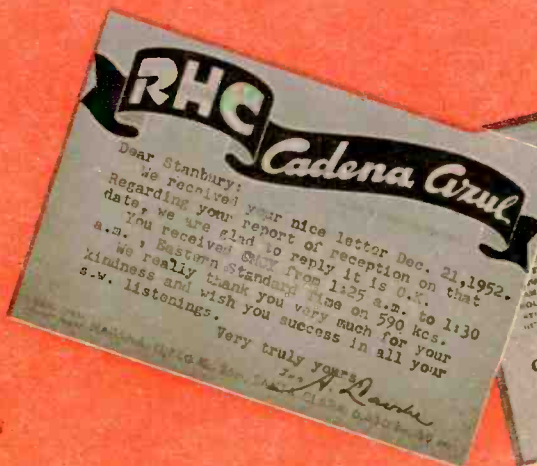
Can Treasure Island be heard today? Yes. Almost any SWL with a reasonable amount of patience will even now be able to catch this rare DX. But instead of the BCBer, the Utility listener has the edge. New target station is COL9 operated by the Cuban Air Force at Coronel Martin Marrero Aerodromo just outside Nueva Gerona.

During daylight hours the Cuban Air Force transmits on 9018 kc (just below the 31 Meter SWBC band). In the East this is certainly an easy channel to locate as it is a mere 9 kc above the widely heard Voice of Zion (4XB31 at Jerusalem). The latter will not be so consistent in the West, and without a crystal calibrator you will have to hunt a little. [Continued on page 104]

TREASURE ISLAND TRANSMITTERS
(all located at or near Nova Gerona)

FREQ. KC	CALL	TYPE
315	CIP	Air Force Beacon
1370	CMBN	Standard Broadcast
2760	CLB	Navy
3035	COL9	Air Force (night)
5718	COL9	Air Force (dusk-dawn)
9018	COL9	Air Force (day)

Pre-Castro Cuban QSL's. For "Treasure Island" you may have to make up your own card, but the author tells you how to get authorities to sign it.

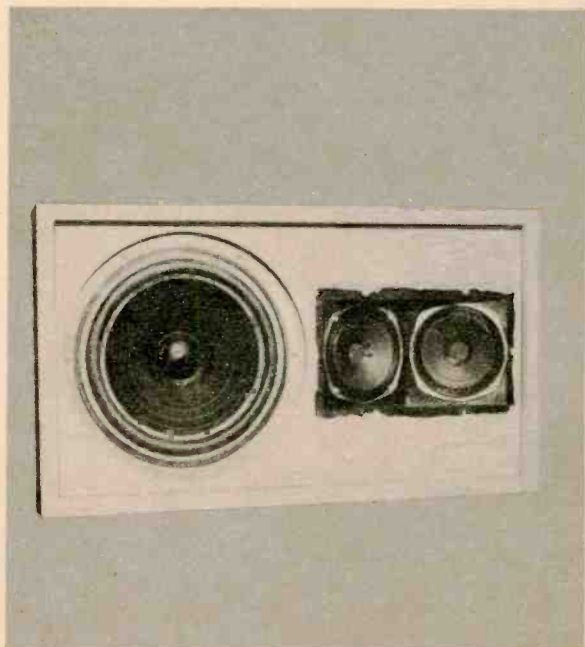




E I builds a
Wide Range Speaker Kit



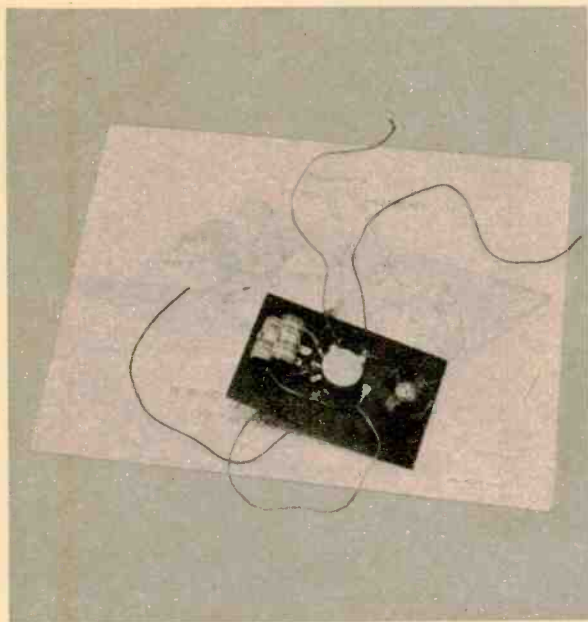
All parts furnished with the AS-2 kit. Gloves on instruction manual are for handling glass wool, use them. Keep cabinet in plastic bag until you are ready to mount the crossover.



Front view of speaker system with all speakers in place. Note putty calking around plastic tweeter housing and woofer frame. This serves as airtight seal for infinite baffle cabinet.

Crossover network for separating highs from lows and feeding each to the right speaker. Note large clear wiring guide furnished, follow it exactly. Balance control is adjusted on back.

Bring wires from crossover to speakers out of enclosure and tape them temporarily to front while filling cabinet with glass wool. Rip the latter into wads to fill enclosure completely.



BOOKSHELF size speakers (which almost no one ever puts on a bookshelf, they are so good looking) are among the best selling speaker systems. Furthermore, among bookshelf speakers, the low-efficiency type has become justly popular for its clean bass response. The Heathkit AS-2 series are such systems; in particular, they use the acoustic suspension principle under license from Acoustic Research, Inc. Although the entire system is highly scientific in concept, the only critical manufacturing aspect is the making of the "floppy" speaker suspension and voice coil assembly. Heath furnishes the complete speaker as a unit, all the builder need do is assemble the crossover network, mount it in the cabinet, fill the cabinet with sound absorbent material (this is an infinite baffle enclosure, all the backwave of the woofer is absorbed in the cabinet), mount the woofer and tweeter speakers to the face of the enclosure, and finally, put the grill cloth board in place.

Be careful when inserting fiberglass pieces in the tweeter frame, don't push too hard on the tweeter cone. Don't throw away any of these fiberglass pieces, no matter how small, you will need all of them. Screw the tweeters securely to their plastic housing but not so tight as to bend their frames. This enclosure must be airtight; use all the putty calking that comes with the kit. And, very important, do use the plastic gloves furnished when handling the glass wool for the enclosure—you will itch for days if you don't.

After extensive music listening and laboratory tests, the Heathkit AS-2 speaker system at \$69.95 for the ready-to-stain model and \$79.95 in mahogany or birch is a Good Buy —

Play It Safe

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

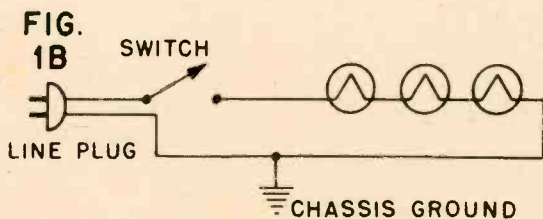
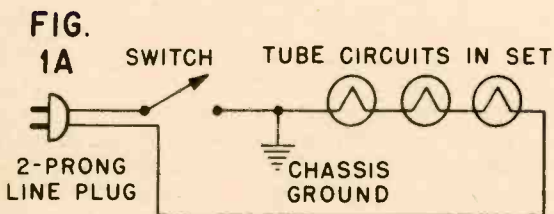
Robert Hertzberg



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

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

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



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

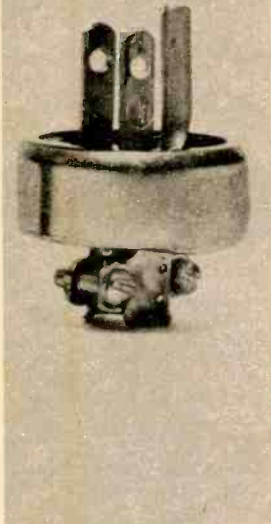
Without question, the worst offenders are transformerless radio and TV sets of the AC/DC "hot chassis" type, which have been sold by the million.

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

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

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

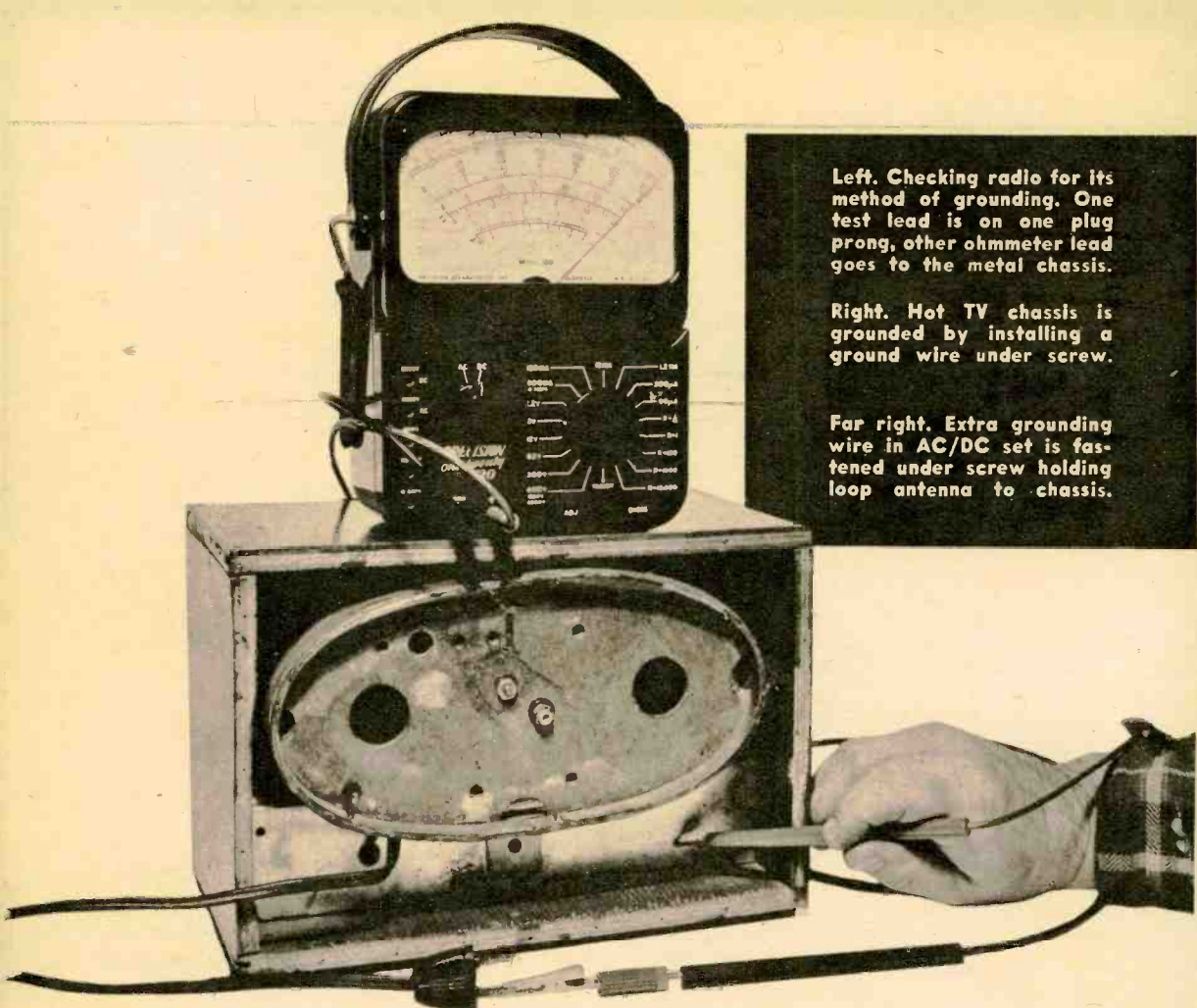
Now close the switch, and if there's still a light left working in the room, trace the Fig. 2A circuit, or rather the dead short circuit, that results: hot side of power line, through switch, right



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

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





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

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

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

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

Suppose the other combination of plug connections exists, as in Fig. 2B. With the switch off, you insert the plug in the power outlet. To your surprise,

the filaments light up and the set starts working in normal fashion . . . *with the switch off*. How come? Easy: hot side of power line to far end of tube circuits, left end of tube circuits to center ground lead, and back through ground side of power line.

With sets of the Fig. 1B variety, the

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

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

FIG. 2A

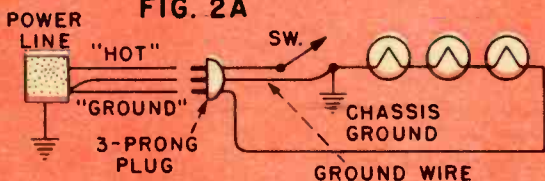
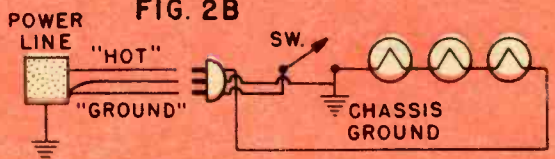
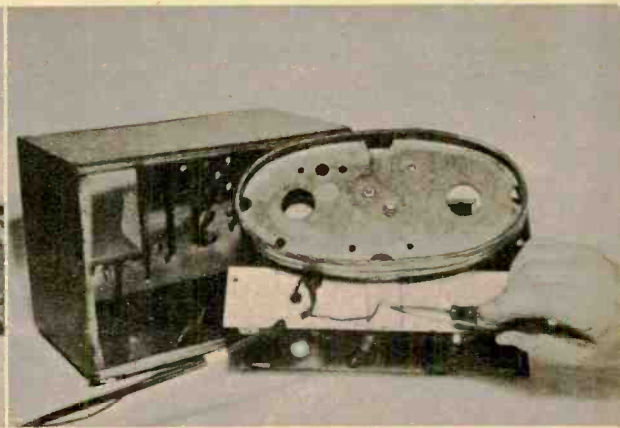
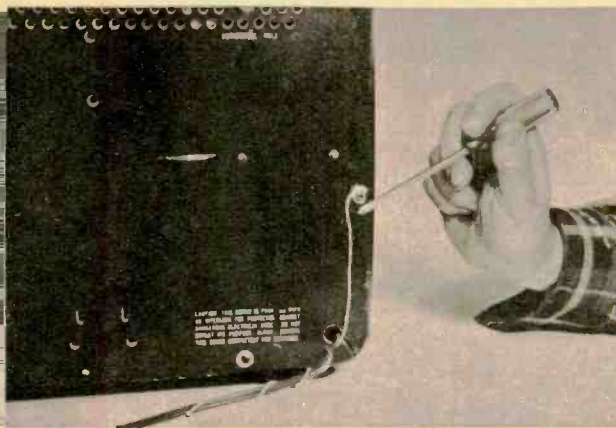


FIG. 2B





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

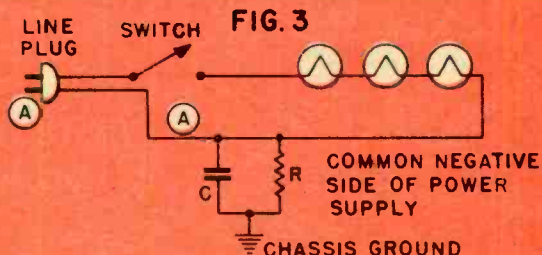
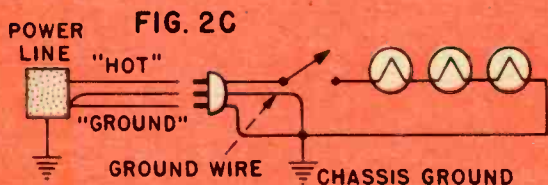
You are probably wondering why a special three-prong plug should be needed at all. Why not simply use a

polarized two-prong plug, having prongs of unequal size to match the unequal slots in power outlets? Connect the set chassis to the wide prong, which fits only into the grounded leg of the power line, and the set is safely grounded. This would be easy except for the fact that polarized two-prong plugs to fit common two-slot outlets are extremely difficult to obtain.

Sets using the arrangement of Fig. 1A are real stinkers, because the chassis ground must remain isolated electrically from the power line ground, unless you want to rewire the power circuit. To make them safe, make sure that the chassis is isolated physically. Examine the bottoms for protruding screw heads, and tape them over. Also check the control knobs, and if they have set screws cover them with narrow strips of tape. One particularly bad case of the electrocution of a child in a bathtub was traced to [Continued on page 108]

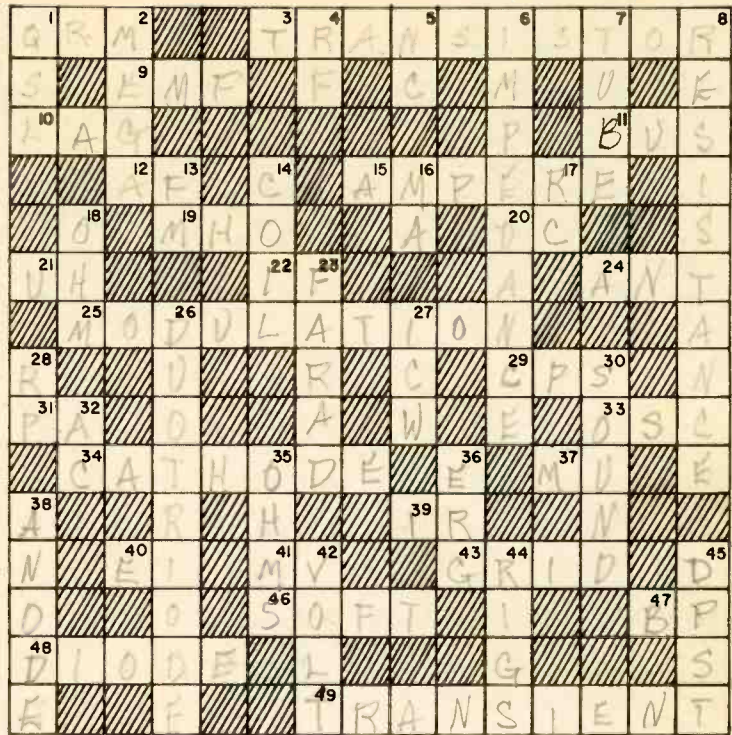
Complete protection against chassis shock is obtained with this variation of Fig. 1B circuit.

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



Electronic Crossword

By
Dahrl C. Stultz



[See November issue for solution]

ACROSS

1. International radio "Q" signal for "interference."
3. A semi-conductor device.
9. Electromotive force.
10. With an inductive component in a circuit the current will _____ the voltage.
11. An uninsulated conductor.
12. Audio frequency. 15. Unit of current.
19. Unit of conductance. 20. Direct current.
21. Ultra high (frequency).
22. Intermediate frequency.
24. Abbreviation of antenna
25. Placing intelligence on a carrier
29. Cycles per second. 31. Power amplifier.
33. Oscillator (abbreviated).
34. The electron source in a vacuum tube.
37. Amplification factor.
39. Ohm's Law: $E = \text{_____}$
40. Ohm's Law: $P = \text{_____}$
41. Millivolts.
43. The vacuum tube element that controls the flow of electrons from cathode to anode.
46. A vacuum tube that has not been fully evacuated is called a _____ tube.
47. Band pass. 48. Two-element vacuum tube.
49. A temporary component of current in a circuit during adjustment to a changed load, different source voltage, or line impulse.

DOWN

1. A card exchanged between radio amateurs to confirm radio communication with each other.
2. Prefix meaning one million.
4. Radio frequency. 5. No connection.
6. Opposition to alternating current.
7. The English call this a "valve."
8. The opposition to current flow in a DC circuit.
13. Frequency modulation.
14. A component made of turns of wire around a form.
16. Milliampere.
17. A circuit made up of resistors and capacitors. 18. Unit of resistance.
23. Unit of capacitance.
26. A tube with two triodes in it.
27. Interrupted continuous waves.
28. Plate resistance.
30. Vibration of a body at a rate which can be detected by human ears.
32. Alternating current.
35. A resistance marked "1 k" is equal to 1,000 _____.
36. The absolute CGS unit of energy.
38. The electron collecting electrode in a vacuum tube.
42. Unit of electromotive force.
44. Amateur term for complete ham station.
45. Double pole, single throw switch.

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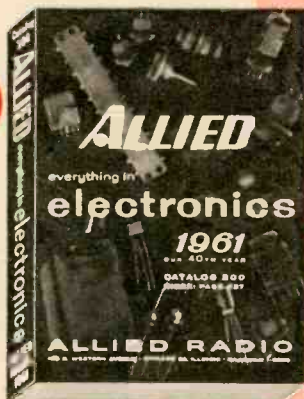
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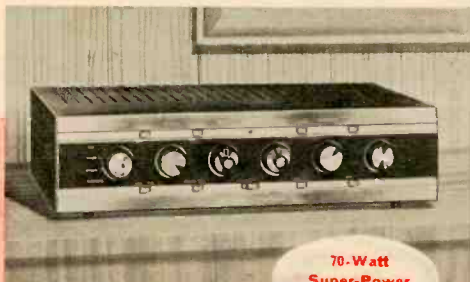
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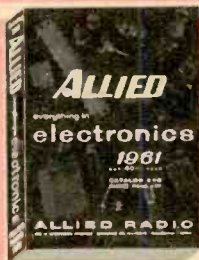
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Science Fair Winners

Continued from page 35

facilities. In the meantime, Mrs. Boynton began to bring the science courses up to date and transfer to her students some of her own excitement over recent scientific developments. Soon, some students began to start small science projects, and Mrs. Boynton began to lay plans for a local science fair.

To let Pikeville know what was going on, Mrs. Boynton arranged for her students with projects to appear on a Chattanooga television program. A local furniture store set up receivers in the school so that those remaining behind could see their classmates on TV. Excitement among the students began to mount.

The town was beginning to take pride in its young scientists, too. And everyone began to look forward to the first science fair. Business firms, civic groups, and individuals chipped in to raise the more than \$100 needed for prizes and expenses connected with the fair. And finally, with 188 exhibits, Pikeville's first science fair, held on Saturday, April 5, 1958, was a huge success.

Mrs. Boynton took some 30 of the local winners on to the Regional Fair, where Bledsoe County's students took no top award, but did place in some divisions. After the Regional, they went back home fired with determination to do better next year. In the spring of 1959, 210 students entered the Pikeville local fair, and of those who went on to the Regional, Bledsoe County's Billy Redmond won a Navy Science Cruise Award with his home-made meteorological station. To help keep interest high, Mrs. Boynton arranged another TV appearance.

"The regional fairs did us a lot of good," said Mrs. Boynton. "Our exhibits were getting better each year as our students saw what other schools were doing." By the fall of 1959, Bledsoe students proved her right by sweeping all awards at the Regional Tennessee Junior Academy of Science. They went on to capture several places at the State Junior Academy meet.

One of the big problems through the past few years has been money—or rather, the lack of it. Transportation to and from fairs, equipment and materials for projects, prizes for winners, special books and reference materials—all cost money. Although the town's people, civic clubs, and businesses all helped to support the work of the town's young scientists, there was still a

shortage of funds. In some cases, the teachers made up the difference out of their own pockets—one fair cost Mrs. Boynton a month's pay before it was over.

The students decided on a do-it-yourself project to raise money. Their first idea: talk to the basketball coach and get permission to operate a soft drink concession. Then someone suggested that the science club might become a kind of collective correspondent for the Chattanooga News Free Press.

The students went at these new projects with their usual enthusiasm and soon the results began to show. Said Mrs. Boynton, reporting on the fund-raising project recently, "We made \$92 at the basketball tournament last Spring, and our check from the paper has ranged from \$6 to \$16 a week ever since we started."

The most pressing problem now is the lack of scientific equipment in the school laboratory. Commercial scientific equipment is expensive, and the entire science department has a budget of only \$200-\$300 a year. This takes care of everything from chemical and biological supplies to physics equipment to pencil sharpeners.

Again the students decided on a do-it-yourself approach. They solicited old radios from the people in Pikeville, dismantling them and used the parts in electronic experiments. Many students who have built science fair projects that would be useful as laboratory equipment have donated them after exhibition.

Impressed by the activity in the science department, the Bledsoe County School Board recently managed to spearhead an effort to raise enough money, under a joint City-State-Federal program, to buy a microscope and sixteen modern laboratory desks with facilities for gas and water.

A lack of materials and facilities fails to dampen the teacher's or the class members' enthusiasm for science. Sandra Sanders, for example, a pretty, 17-year-old junior at Bledsoe, read a biography of Albert Einstein for a book report in English last year. Fascinated by the great theorist's ideas, Sandra read everything that she could find on the subject. When it came time to pick a science fair project this year, she chose an exhibit explaining the mathematical derivation of Einstein's ideas on matter and energy as summarized by his famous equation, $E=mc^2$.

To illustrate the interchangeability of matter and energy, she built a cloud chamber, showing the radioactive decay of radium. Short of equipment and standard parts, Sandra set out last August to gather

the necessary materials. She collected a large pickle jar from a local restaurant, an aluminum dish pan, copper strips cut from a moonshine still (which had been raided by "revenooers," confiscated, hacked to pieces, and left in a junk yard), and a little pile of radium salts scraped from luminous clock hands. These basic ingredients, combined with a few miscellaneous parts and a generous dash of ingenuity, won for her the local and regional fairs and a trip to Indianapolis as Bledsoe High's first National Science Fair finalist.

With everything going at top speed, Mrs. Boynton really has only one problem now—finding more hours in the day. In addition to teaching chemistry, physics, and biology, and studying for advanced degrees at Tennessee Polytechnic, she is a busy homemaker. She also finds time to pay scores of calls on her students in their homes to help with their out-of-class science projects. When the contestants are getting ready for a fair, she rarely manages to get home before 11:00 at night.

Why is Mrs. Boynton not only willing, but eager to put in so many hours of hard work for her teacher's paycheck? "When you see that sparkle in the eye and know you've rung a bell, there's nothing in the world like it," she said.

N. Y. City's Bronx High School of Science is different in almost every way from Bledsoe County High. Yet this celebrated institution also owes its outstanding performance to the vision and enthusiasm of one dedicated teacher. Dr. Morris Meister began to dream back in the 1930's of a school to teach and guide gifted, scientifically inclined youngsters who were interested in science. In 1938 he convinced the New York school board that his idea would work, but there was still one big problem. There was no school building available.

Dr. Meister looked around, found an old building in the Bronx that had been tried and abandoned as unusable by three other schools. Convinced that the building wasn't the important thing, Dr. Meister thought it just fine. For the first few years, Science High was propelled by little other than this educator's personal enthusiasm and drive, but soon his results began to be known. Then it was only a few years until "Science" was recognized as one of the outstanding schools of its kind in the country. That "unusable" building, by the way, was its home for 20 years.

Dr. Meister left "Science" three years ago to become President of Bronx Community College, but his place was taken by another outstanding educator, Alexander

Taffel. Dr. Taffel, a physicist by training, shares Dr. Meister's ideals, and is carrying on in the same tradition. Two years ago, the Science faculty realized a long-standing dream when it moved into a new home: a handsome new building with lots of laboratory space, an astronomical observatory, greenhouses, and other facilities befitting a school of its stature. But as fine as these things are, Dr. Taffel rates them second in importance to an intangible asset, the zeal of "Science's" teachers—and students.

Take Robert Strom, for example, Bronx Science's 1960 finalist at the National Science Fair. Robert, a 13-year-old sophomore, conceived, designed, and built at home an analogue computer that predicts astronomical events and solves parametric equations, presenting its solutions in the form of a series of curves on an oscilloscope face. This was in addition to his required research project at school.

Electronics Illustrated asked Dr. Taffel how Science managed to keep its students at such a high level of accomplishment. "The most important ingredient in 'Science's' success," he said, "is the tremendous power of enthusiasm of our teachers for the subjects they're teaching. Modern buildings and well-equipped laboratories are a great help, but we could get along without them if we had to. What we couldn't do without is our teachers who, themselves, are excited by the challenge of science and scientific education."

What makes an outstanding science high school? Be it in the Bronx or in Pikeville, the answer is the same: teachers who think the greatest, most wonderful job in the world is teaching science, and guiding and inspiring youngsters toward science careers. The lesson is obvious: the money we must spend to keep our nation strong scientifically must go to train and keep outstanding science teachers.

Swing to Single Sideband

Continued from page 47

So many hams have been convinced that the pros far outweigh the cons that retailers dealing with ham equipment report *ninety-five percent* of transmitter sales to hams beyond the novice class these days are for SSB gear. Many foresee the day—and not too far distant—when "sideband" will be *required* on all phone bands from 10 to 160 meters.

"Sideband," in short, is not only here to stay, it is almost without question here to take over!

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Made by famous Garrard of England to superb specifications. "Plug-in" cartridge feature. Rubber matted heavy turntable is shock-mounted, and idler wheels retract when turned off to prevent flat spots. Powered by a line-filtered, four-pole induction motor at 16, 33 $\frac{1}{3}$, 45 and 78 rpm. Supplied with Sonotone STA4-SD ceramic stereo turnover cartridge with .7 mil diamond and 3 mil sapphire styli. Assembles in minutes; mechanism and vinyl covered mounting base pre-assembled, arm pre-wired. With 12" record on table, requires approximately 15" W. x 13" D. x 6" H. Color styled in cocoa brown and beige. 10 lbs.

Mechanism Only: Less cartridge, base and cables. Model AD-30, 8 lbs., . . . \$22.95



AA-50 \$79.95

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A complete 25/25 watt stereo power and control center (50 watts mono) . . . 5 switch-selected inputs for each channel . . . new mixed center speaker output . . . stereo reverse and balance controls . . . special channel separation control . . . separate tone controls for each channel with ganged volume controls . . . all of these deluxe features in a single, compact and handsomely styled unit! Five inputs for each 25 watt channel are provided: stereo channel for magnetic phono cartridge (RIAA equalized); tape head input; three high level auxiliary inputs for tuners, TV, etc. There is also an input for monophonic magnetic phono cartridge, so switched that monophonic records can be played through either or both amplifiers. The automatically mixed center speaker output lets you fill in the "hole-in-the-middle" found in some stereo recordings, or add extra monophonic speakers in other locations. Nearly all of the components are mounted on two circuit boards, simplifying assembly and minimizing possibility of wiring errors. Handsome cabinet features new "visor" effect, with vinyl-clad steel cover in black leather-like texture with gold design. 30 lbs.



AA-20
\$34.95



AA-30 \$45.95

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HI-FI RATED 14/14 WATT BASIC STEREO AMPLIFIER KIT (AA-30)

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HW-19 (10 meter)

HW-29 (6 meter)

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The problem in SSB generation is how to get rid of one sideband, how to suppress the carrier in the transmitter, and, above all, how to reinsert a carrier in the receiver in exactly the right relationship to the received sideband.

The carrier is suppressed (if never absolutely eliminated) by a *balanced modulator*, which is simply a mixer which "passes" the sum and difference frequencies of an AM signal generated at a low level, but does not reflect the original carrier frequency in its output.

This is a simple device. Schematically, at first glance it looks like any push-pull amplifier.

Now comes the problem of getting rid of the unwanted sideband. There are two basic methods, the *phasing* and the *filter* methods. Generally speaking the phasing method is a little easier, a little cheaper, and not quite so stable. It works on the old principle that two signals of equal level fed 180 degrees out of phase cancel each other, while signals in phase reinforce each other. Special combinations of resistors and capacitors are capable of producing the proper phase shift.

The filter method simply slams the radio door in the face of the unwanted sideband. Suppose we wanted to pass the *upper* of two sidebands on a 500 kc signal. We have our choice of two kinds of filters (crystal or coil-capacitor combinations). A filter may pass a narrow band of frequencies between 500 and 503 kc. This is a *band-pass* filter. Or it may simply reject all frequencies not as high as 500 kc, making it a *high-pass* filter.

SSB offers the choice of *either* one of the two sidebands, and it is not at all difficult to switch from one to the other at either the receiving or transmitting end. A custom has grown up among amateurs to use *upper* sideband in the 10, 15 and 20 meter bands, *lower* sideband on 40, and *either* sideband on 80 meters.

Of course, if the receiver is tuned to receive upper sideband, a lower sideband signal will be unintelligible, and vice versa. But shifting the receiver from "upper" to "lower" can often be done with the BFO knob alone.

It is easiest to generate SSB signal at low power levels and at low frequencies, and then, when the signal is small but "complete," so to speak, multiplying power and frequency to the desired output level. Signal frequencies are raised by the heterodyne method. If we have created our SSB signal at 500 kc and wish to transmit

at 14300 kc we simply mix it with signal at, say, 13800 and pick off the 14300 kc sum frequency output.

We must then amplify this signal to the desired level with a *linear amplifier*—one in which the output signal is an exact (or nearly exact) replica of the input signal, for remember, all the audio is already part of the signal, and any distortion of the waveform in a later amplifier shows up on the air. (With AM, the audio power is not impressed on the carrier until the carrier is raised to its highest power level, so any method of raising that power level before audio is added is all right. A non-linear amplifier may be used.)

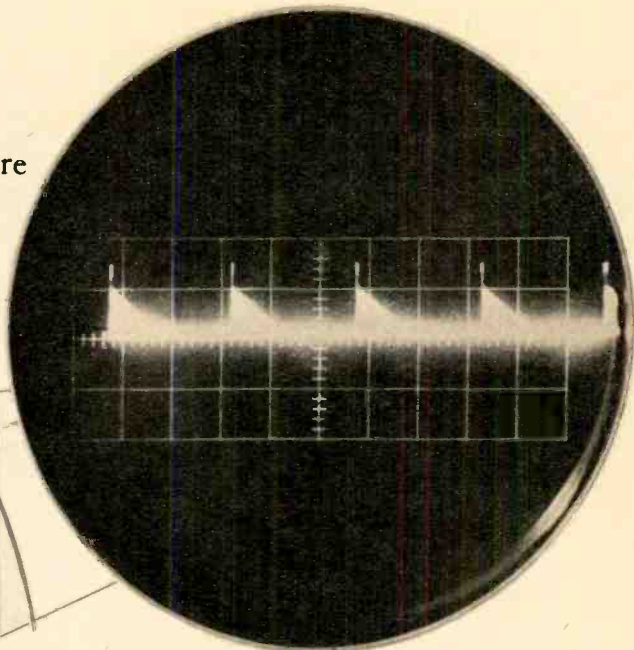
So now we have generated a clean Single Sideband signal. The air is full of them these days. They work so well that when conditions are good, "roundtables" can involve stations in every continent in the world. Transoceanic contacts are so common on SSB that they are no longer regarded as DX. Once the miracle of DX was not that one did it well, but that one did it at all. Nowadays the sidebander finds he has a chance really to talk to his friends overseas. He gets to know them, because he can hear them and they can hear him. Annoying interference from other stations is not entirely eliminated but is greatly reduced. So is voice-distorting selective fading, so common over long distances on straight AM when one sideband fades at a different rate from the other sideband.

The author remembers contacting a South African station, ZS6KD, while operating from his car, parked in Times Square, New York City! Not only was the contact "100% solid" at both ends, but ZS6KD recorded my signal, played it back to me immediately, and I never missed a word!

Getting the knack of tuning SSB isn't nearly as difficult as it is made out to be. With a little practice SSB can be tuned in with any receiver that has a BFO. In fact, it's very much like tuning in CW. Of course, modern, stable receivers designed with SSB in mind make the job easier. Happily, the swing to "Sideband" has been so great that no manufacturer today would think of bringing out a new receiver in anything but the cheapest category that isn't capable of good SSB performance. This requires high stability and a slow tuning rate—things you need anyway.

The next time you turn on your receiver, why not join SSB instead of trying to fight it? Let the receiver warm up for half an hour, so it will be stable. You should do this for AM and CW reception, anyway.

“Phase detector of the Moving Target Indicator receiver misaligned on the FPS-3... realignment procedure must be followed.”



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Turn the BFO *on*, and the AVC *off* (if there is an AVC switch). Advance the audio gain control almost all the way—then forget it. Use the RF gain control to adjust the set's sensitivity. This automatically adjusts the loudness of signals. Tune in a convenient CW or AM signal and adjust the BFO until the "whistle" sounds right.

Then tune for an SSB signal—I suggest around 14300 kc. If you have both main tuning and vernier bandspread dials, set the main dial at 14300 and tune with the vernier until a signal peaks up loud. It probably won't be quite readable—it will sound as if the operator had swallowed Donald Duck. Slowly adjust the BFO until the voice sounds natural. (Adjusting the BFO amounts to tuning the "local carrier" you are restoring to the lone sideband. Sideband signal and BFO signal are mixed in your receiver's second detector just the way the carrier and sidebands of an AM signal are, to produce an audio output. When the BFO signal is in the same relationship to the sideband as the original carrier was, the voice becomes "real.")

Then sit back and enjoy the QSO. Keep the RF or "Sensitivity" control just high enough for comfortable volume, so that you don't overload the receiver. With a little practice you'll be tuning in SSB signals even more quickly than you could AM signals, and enjoying it to the hilt.

Electronic Highways

Continued from page 55

York City's Holland Tunnel approaches.

In February, the automated cars for the electronic highway were not ready, but now General Motors has completed pilot models that perform very well. We rode in a sedan and a convertible that not only steered themselves, but stopped to avoid ramming a "stalled" standard car ahead, adjusted themselves to the prevailing traffic speed, and successfully fought off our efforts to throw them off course on a curve.

The robot cars steer themselves by means of a pair of pickup coils mounted athwart the centerline at the front of the car. Buried in the roadway, in the center of the lane, was a continuous wire carrying a weak low-frequency RF signal. The car's "brain" controlled the steering so that the energy pickup in the two coils was always equal. The car therefore followed the wire wherever it went.

Each detection loop is accompanied by a light, which can be installed either on a

standard alongside the road, or in the pavement itself. Not only do the buried detection loops provide that "flying tail" of radio energy, they light a train of warning lights behind each car. Thus a driver of a standard vehicle, manually controlled and without electronic aids, is warned by the lights (near or in the road) of moving or stopped cars ahead, or even of cars in the *opposite* lane coming around a curve. This would be most welcome for driving through fog.

We couldn't determine whether the detection loops could sense the presence of a human (or a deer) on the highway, and bring a robot car to a halt in time, or warn a human driver to stop. We didn't volunteer to stand in the road while the electronic cars bore down on us, and we couldn't find a deer, but we asked the question. Engineers replied that a child or a deer might be conductive enough, because of blood and tissue salinity, to trigger a warning, but thought it doubtful. Both RCA and General Motors officials stressed, however, that the electronic highway and the automated car are not intended to replace human responsibility and judgment. They are designed only as aids to safer and more efficient driving. Even with your car on "autopilot" you will be expected to remain in command.

A Real QSL Catch

Continued from page 85

COL9 transmits entirely in Spanish but the voice identification "Marrerro" is not difficult to pick out especially as none of the other stations in this circuit have names resembling it. The best time to listen would be between 0700 and 1200 EST but they can frequently be heard after 1600 EST. During this latter period you might monitor 5718 kc and that applies to the early morning hours too.

Cuban broadcast stations, in general, have never been noted as good verifiers, but before Castro many did verify. After the revolution and subsequent waves of anti-American sentiment, the situation has become increasingly bad.

So what chance does an American DXer have to verify a government station and a military outlet at that? We won't kid you, it's not easy but there is one way of turning the trick. Regardless the policies put into effect by the Castro administration, the Cuban government is also anxious to create favorable world opinion. Thus when Neuris E. Vernier C., director of communi-



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1DN5	.55	4DK6	.60	6AX7	.84	6DT5	.66	12AJ6	.46	12CX6	.54	17W6	.70
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1K3	.73	5AN8	.86	6EC7	.94	6EA8	.79	12AQ5	.52	12DL6	.85	19T8	.80
1L6	1.05	5AQ5	.52	6CC8	.97	6H6GT	.58	12AT6	.43	12DM7	.67	2-EX6	1.49
1LN5	.59	5AT8	.80	6BD6	.58	6J5GT	.51	12AT7	.76	12DQ6	1.04	25BQ6	1.11
1R5	.62	5BK7A	.82	6E6	.55	6J6	.67	12AUG	.50	12DS7	.79	25C5	.53
1S5	.51	5BQ7	.97	6BF6	.44	6K6	.63	12AU7	.60	12DZ6	.56	25CA5	.59
1T4	.58	5BR8	.79	6B66	1.66	6S4	.48	12AV5	.97	12ZE6	.50	25CD6	1.44
1U4	.57	5C68	.76	6PH6	.65	6SA7GT	.76	12AV6	.41	12EG6	.54	25CU6	1.11
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		5J6	.68	6BL7	1.00	6SQ7	.73	12AZ7	.86	12FM3	.45	25W4	.68
3AL5	.42	5T8	.81	6BN4	.57	6T4	.99	12B4	.63	12K5	.65	25Z6	.66
3AU6	.51	5U4	.60	6BN6	.74	6U8	.78	12BA6	.50	12SA7M	.86	35C5	.51
3AV6	.41	5U8	.81	6BQ5	.65	6V6GT	.54	12BD6	.50	12SK7GT	.74	35L6	.57
3BA6	.51	5V6	.56	6BQ6GT	1.05	6W4	.57	12BE6	.53	12SN7	.67	35W4	.52
3BC5	.54	5X8	.78	6BQ7	.95	6W6	.69	12BF6	.44	12SQ7M	.73	35Z5GT	.60
3BE6	.52	5Y3	.46	6BR8	.78	6X4	.39	12BH7	.73	12U7	.62	50B5	.60
3BN6	.76	6AB4	.46	6BU8	.70	6X5GT	.53	12BL6	.56	12V6GT	.53	50C5	.53
3BU8	.78	6AC7	.96	6BY6	.54	6X8	.77	12BQ6	1.06	12W6	.69	50DC4	.37
3BY6	.55	6AF3	.73	6BZ6	.54	7AU7	.61	12BY7	.74	12X4	.38	5JEH5	.55
3BZ6	.55	6AF4	.97	6BZ7	.97	7A8	.68	12BZ7	.75	17AX4	.67	5JL6	.61
3CB6	.54	6AG5	.65	6C4	.43	7B6	.69	12C5	.56	17BQ6	1.09	117Z3	.61
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cations for the Cuban Air Force in the Province of Havana received a DX report along with a prepared QSL card, he not only signed the card but wrote a letter along with it. At the bottom of his letter is typed NUESTRA REVOLUCION ES HUMANISTA NO COMUNISTA (which of course translates "Our revolution is humanistic not communistic").

Getting down to a concrete approach, we suggest you report first with the Spanish language form shown in italics below and include a self-prepared QSL card.

Your address and date go in the upper right hand corner, of course, and you head off the letter with the call and address of the station or verifier. The Spanish text will translate as follows: DEAR SIR: HERE IS A REPORT OF RECEPTION OF YOUR TRANSMITTER (station identification) ON (date) AT (time) IN THE TIME OF (time zone or country), CALLING "ATTENTION" (station called) ON (frequency) KC . . . I HAVE BEEN HEARING AND REPORTING TO COMMUNICATIONS STATIONS SINCE (date you began DXing utility stations) AND HAVE RECEIVED CONFIRMATION FROM (number of utility stations verified in country) STATIONS IN (country) . . . ENCLOSED IS A CARD, ALREADY PREPARED, AND IT WOULD BE MUCH APPRECIATED IF YOU WOULD SIGN IT AND RETURN IT FOR MY COLLECTION . . . MANY THANKS . . . VERY TRULY YOURS, . . . (your signature).

The Spanish text: *Muy Senor Mio: Sigue un enforma sobre recepcion de su emisora (STATION) en (DATE) a (TIME) la hora de (ZONE), anuncio "Attention (STATION CALLED)" en (FREQUENCY) kc . . . Soy radioyante de estaciones comunicaciones como efincado desde (DATE YOU BEGAN DIXING UTILITIES) y ha recibido confirmaciones de (NUMBER OF UTILITIES VERIFIED) estaciones en (NAME OF COUNTRY) . . . Una tarjeta debidamente preparada fue incluida y se apreciara mucha si fuese firmada y devuelta para coleccion mio . . . Muchas gracias . . . Atto y S.S. (YOUR SIGNATURE).*

Type the letter in neat business-letter form. Where paragraphs begin should be obvious. Your prefabricated card can be run off on a typewriter or you can get adhesive letters at a stationery store to make up a card suitable for display. Another big help in encouraging return of the card is to pre-stamp it with the stamps of the country. Uncanceled foreign stamps can be had from a dealer.

Reaction Time Tester

Continued from page 54

line over most of its length, but should show a definite tendency to hook as tube V3 approaches cut-off. If all measurements were made to three significant figures, then your reaction-time values will be precise to the nearest millisecond.

Circuit Design

There are three distinct circuits in the R/T: (1) the power supply, (2) the stimulus-oscillator, and (3) the time-measurement circuit.

At first glance, the power supply appears to be a full-wave rectifier, however, note the connections of selenium rectifiers (SR1, SR2) and their polarities. In this arrangement, two voltages are available +150 volts and -150 volts with respect to the grounded centertap of T1. The positive voltage is regulated by V1.

The stimulus-oscillator uses a cold-cathode thyratron V2 in a novel relaxation circuit. With SW2 in its normally-closed position, tube V2 is set by means of R3, to fire once every 10-15 seconds.

When SW2 is depressed to the N.O. position, the next time V2 fires, it energizes

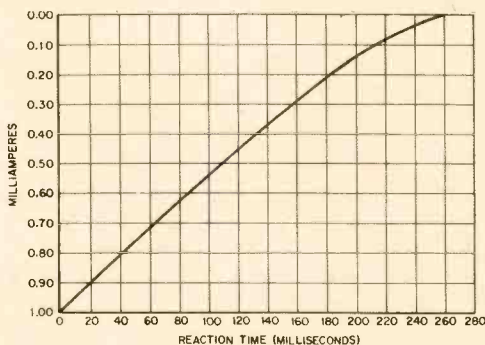
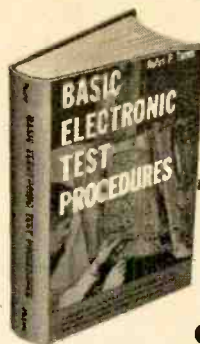


Fig. 2

relay (RY1) closing the circuit to the time-measurement section and opening the circuit to NL1. Reaction timing begins at the instant RY1 pulls in. Capacitor C5 begins to charge through R6 from the -150 volt line. The increasing negative grid bias on V3 causes its plate current to diminish rapidly. When the lever of SW2 is released, RY1 drops back to the N.C. position and the charging circuit is opened. V3 now serves as a VTVM and measures the voltage charge which accumulated on C5 between the time V2 fired and SW2 was released. Pushbutton switch PB1, resets the unit by discharging C5 through R7.

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Play It Safe

Continued from page 91

contact between her wet, soapy fingers and an exposed screw in a tuning dial. Is the set's back open? A cover of perforated hardboard is called for.

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

In some sets made by manufacturers who like to see their customers remain alive, the bite is taken out of the power circuit by what is called the "floating ground" circuit. This is shown in Fig. 3. The unswitched common negative side of the power supply in the receiver, instead of going directly to the metal chassis, connects to it through either a fixed capacitor C alone or a combination of a capacitor and a fixed resistor R. C should be no larger than .02 mf and R about 200,000 ohms. If C is bigger (some manufacturers use .1 or .2 mf) it should be replaced. The wire marked "A" should go to the prong of the line plug that fits the grounded side "A" of the power line. Then, if capacitor C should develop an internal short circuit (unlikely, but always a possibility),

you have the same grounded chassis protection afforded by the circuit of Fig. 2C.

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

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

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

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

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

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

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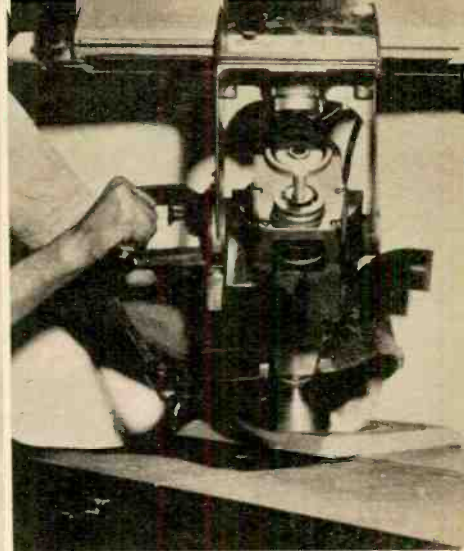
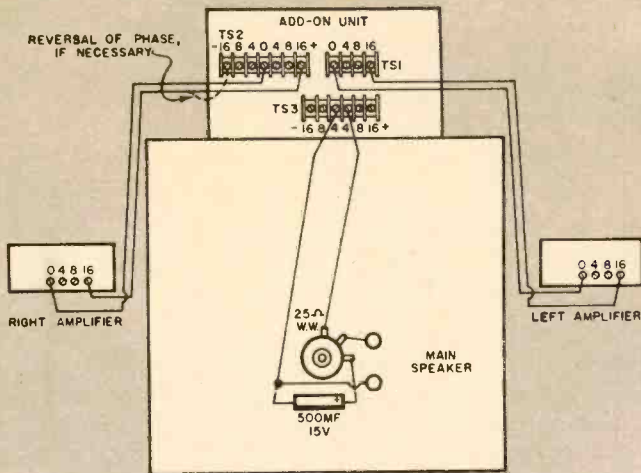


Fig. 4. For more bass, connect the main speaker across the two 8 or 16 ohm screw connections.

Author's radial arm saw served to make the compound joints in the original Add-On unit.

Stereo Add-On Speaker

Continued from page 39

toward the listener and the audio perspective will be shifted.

As a closing observation, this system gives the lie to the theory that some magic separation in feet is necessary to "get" stereo. In this system, its compactness is an asset to performance, not a disadvantage to be camouflaged.

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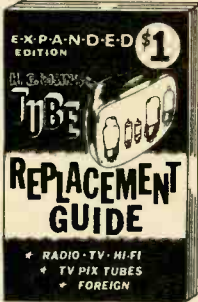
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Radio-Intercom Kit

Continued from page 63

for a needed diagram far less frequent.

The tools required are simple, and likely to be in most every home. The manual lists long-nose pliers, diagonal cutters, a screwdriver and a soldering iron. To these I would add a wire stripper, a 1/4" nut driver and if possible, a female assistant with long slender fingers.

To make parts list checking easier, Allied has packed the various items in little plastic bags. They have also picked up a fine habit—they place all the resistors on a card, marked with their proper values. See, there's no need to learn the color code! The parts list checked out down to the last nut and bolt, and I strongly urge that the careful parts list check be mandatory at the start of every attempt at kit building.

Since the kit uses a printed circuit board, the entire construction took less than four and a half hours.

There were very few complaints. The part number was missing on some of the switches, which caused some delay. Most of the resistors are positioned right on the circuit board, but some just have numbered holes.

Another thing, coil L-2 in this reviewer's kit has such short mounting terminals that they cannot be crimped to insure a tight mechanical contact, and by their nature they must be held by the merest touches of solder (these were the connections I found faulty later). The cable clamp on TS-3 might be big enough to hold the two cables plus two leads as directed, but I doubt it. This is one place where the slim-fingered helper would have come in handy. Allied Radio has informed us that they have taken steps to correct the above criticisms.

All in all, we can give this kit extremely high marks for clear instructions, extreme ease of building, and above all, remarkably fine performance. This one was so easy it can be recommended as a Good Buy for anyone who'd like to try his hand at kit building without making a major investment, and still end up with a very useful product. Its cost is \$27.50, which includes one remote unit. Extra remote stations in kit form are \$3.95.

subscribe to EI NOW!

Shopping for Hi-Fi

Continued from page 60

If you live in or near Washington, New York, Philadelphia, Boston, Chicago, Los Angeles or other city where there are 6 to 20 FM stations on the air, you will always be able to find music you like, and can do without a record player for awhile.

On the other hand, if there aren't many FM stations in your area, or you prefer your own records anyway, you can save by omitting the tuner.

You can save about 40 percent by assembling kits. The several lines of hi-fi kits include every grade from the very finest on down. They also include just about every component from turntables to speaker systems.

Kit manufacturers have become extremely clever in making their kits easy to put together. Many people who couldn't tell a resistor from a juvenile delinquent have successfully assembled hi-fi kits. Of course it helps a lot if you have a kindergarten-level knowledge of electronics and can use a soldering iron, or if you have a friend or relative who can bail you out if you're puzzled or in trouble. Nothing, however, could be clearer than the step-by-step instructions of the major kit producers.

How about "package" units, which give hi-fi in one hunk of furniture? This is probably what your wife will want. The decibels and the watts and all that are for *men*—tinkerers at heart—and they scare or annoy her. The package unit is recognizable as *furniture* to her, and she will welcome it in her living room without argument even if it turns out to have as many knobs and switches under its lid as separate components have.

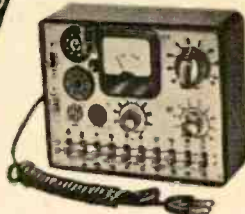
There are some very good "package" units, but generally, dollar for dollar, you do far better from the quality standpoint by selecting components. The really good "furniture" is very expensive, because engineering and production money must be put into solving the troublesome acoustical problems posed by putting speakers and phono pickups, etc., all in the same box.

The mail-order catalogues can help you greatly, because they introduce you to what is available at different price levels, and very often the mail-order concern will put up component groupings which, if bought together, can be had for less than the total cost of the components bought separately. (The "hi-fi salon" you buy from, if you don't buy by mail order, may

[Continued on page 113]

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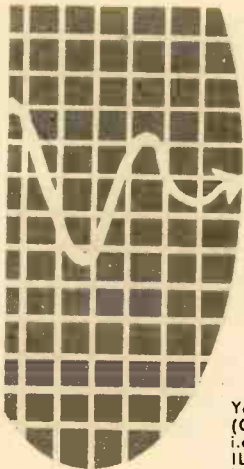
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• • • MUSIC

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

Continued from page 111

be the showroom of a mail-order house anyway.) Catalogue descriptions of each component will help familiarize you with typical sets of specifications. This will help you understand a live salesman's jargon, or even challenge him if he avoids coming down to cases about specifications.

Now, let's get down to cases about your needs.

Your total: 6 to 9. Your needs are not critical and just about any set will serve them. A monophonic system ought to please you as much as stereo. \$150 may fill your needs amply. Try to fulfil the following specifications: Overall response, including speakers: 50 to 12,000 cycles. Amplifier power output: 10 to 15 rated watts. If you listen mostly to radio, the lowest-priced tuner-preamp-amplifier combination will do the job. Phono player: changer or low-priced turntable with inexpensive stereo pickup. Tuner: to suit location; sensitive for fringe areas, medium or low-priced for local areas.

Total: 10 to 14. You need a pretty good system that will cost you from \$250 up. Specifications: Overall response including speakers: 40 to 15,000 cycles. Amplifier: integrated preamp-amplifier with 15 to 20 watts rated output, or a higher-priced tuner-preamp-amplifier combination. Phono: high-quality, low-rumble changer, or moderate-priced (around \$60) turntable; good magnetic pickup. Tuner: moderately priced to suit location.

Total: 15 or over. The best you can afford, and let's hope you can afford at least \$400. Where stereo is marginal for the other two groups, it will probably mean a lot to you. Specifications: Overall response including speakers: 35 to 18,000 cycles. Amplifier: 25 to 35 watts, integrated or separate preamps. Phono: top quality minimum-rumble turntable and top-quality pickup arm and cartridge. Tuner: wide-band detector in FM tuner, low-distortion detector in AM tuner.

You may do well at *less* than our suggested minimums if you familiarize yourself with the field and shop carefully, whether you buy factory-assembled components or kits. If you have to economize, *do not skimp on speaker or amplifier.* (The speaker system should take at least one-third your outlay.) Leave out either the tuner or the phono feature, or buy "half a stereo system" (mono), or use kits. A combination of these money-saving steps can cut your expenditure drastically with no sacrifice in quality and a high dividend in enjoyment

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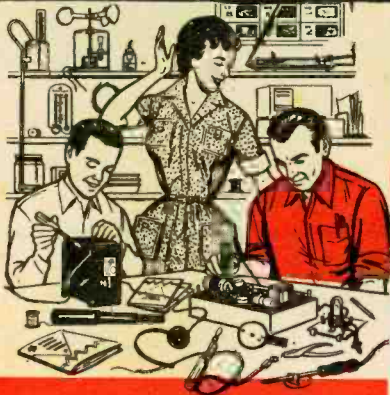
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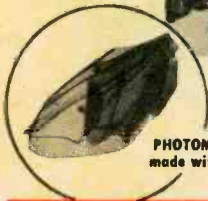
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