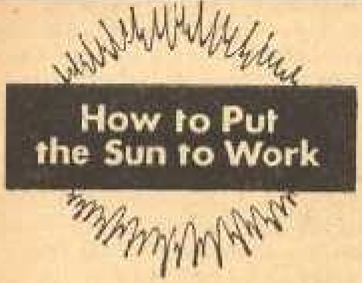


The radio set described below is only the first in a series of projects which will show you how to have fun tapping power from the sun. Also in this issue are plans for building a sun battery, which can be used to power a small motor. Subsequent issues will show you how to construct and use other solar-powered projects, such as a sun-controlled relay or light switch and perhaps a more powerful radio.

If you want to carry your experiments with sun-power still further, let us know what projects you would like to see, and we'll try to develop and publish them for you.

Sun-Powered RADIO

By
HAROLD P. STRAND

Testing the completed receiver, under (1) sunlight and (2) a 100 watt lamp. Direct sunlight naturally gives you much stronger reception.

Craft Print Project No. 248

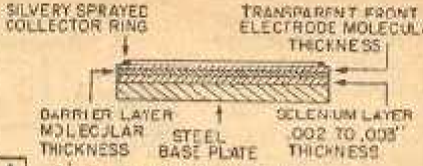
IF WE can make the air we breathe carry radio programs to us, why not let sunlight power the receiver which captures those radio waves for our entertainment? Research laboratories have originated and developed radio receivers which operate on sunlight. Now, at last, you can do the same, without being an engineering genius or having a miniature fortune to spend.

For example, you can build the radio set shown in Fig. 1 for about $11-12 in materials—a small investment considering the fun you will get from it. It is a pocket-size portable, requires no conventional dry cells for power, and it doesn't even need an On-Off switch. Simply holding your hand over the selenium photocells which capture the sunpower, will shut off or tone way down

How Selenium Photocells Convert Sun Power

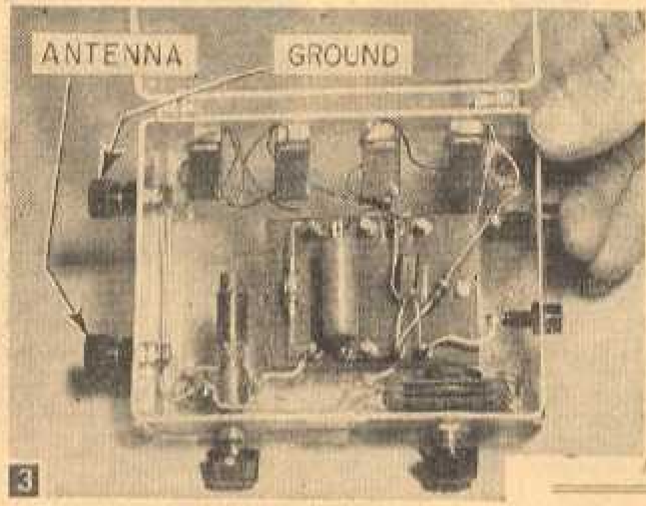
IN DESIGNING sun-powered projects like the radio shown in Fig. 1, you can convert sunlight into electricity using selenium photocells. These are relatively low cost and easy to obtain, but convert at best only about 1% of the light striking them into electrical power. Another method would be to use silicon cells, which are somewhat costly. Their advantage is that they are about 11% efficient. Bell Telephone Labs, for instance, uses 400 silicon cells mounted in a glass-covered case on a telephone pole, to power an experimental telephone line in Georgia.

For this radio project we used selenium cells, because they will do the job nicely and you can get them easily at a moderate price. Fig. A shows a simplified sectional view of one of these cells, correctly called selenium barrier-layer, self-generating photoelectric cells. The light which hits it penetrates the transparent front electrode and causes the selenium to release electrons. These released electrons travel across the barrier layer and are trapped on the front electrode to form a negative charge. (The unilateral conductivity of the barrier layer prevents the electrons from returning except for some small leakage.) The negative charge on the front electrode is in turn transmitted to the collector ring. This ring then becomes the negative, and the base plate the positive terminal of the cell.



A SECTIONAL VIEW OF SELENIUM CELL

When these two terminals are connected to the actuating device or amplifier, current of about 600 microamps per lumen will flow, at an external resistance of 100 ohms. Therefore, in such a cell, we have a source of d-c current similar to a dry cell, which can be connected in groups with other similar cells in series, parallel, or series-parallel, to obtain the desired voltage and current output.



3 Closeup of radio with lid of plastic case up.

these objectionable commercials. On cloudy days or at night, you can operate the set by shining a 100 to 150 watt light bulb on the photocells—thanks to the low load requirements of the tiny transistor used in this set. However, do not allow temperature in excess of 185°F on the cells or they may be damaged. In other words keep light bulb back a foot or more for prolonged operation. An explanation of why we chose the B2M type photocells for this project, and how they convert sunlight into electrical power is given in the box copy at the top of this page.

Constructing the Radio. As Figs. 3-6 show, this pocket-size radio has a diode detector and transistor amplifier built into a standard plastic case. In place of the dry cell usually used for power, four B2M photocells which will not need replacing are mounted on the back side of the case. Drill all the mounting holes in the plastic case as shown in Fig. 7, and in turn, mount the diode, capacitor, resistor and transistor to the terminal board.

Mount phone jacks and ground and antenna terminals, as well as the #MS215 miniature tuning condenser, and the ferrite-core tuned antenna coil, into their respective positions in the plastic case as shown in Figs. 3 through 8.

For the next step, attach the cell brackets to the back of the case with machine screws and nuts as shown in Figs. 6 through 8.

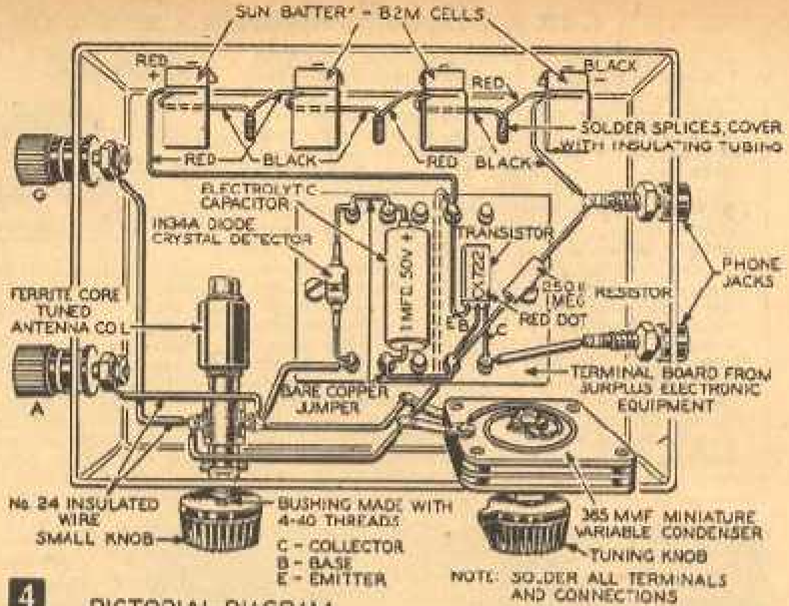
These B2M cells cost from $1.47 to $2.50 each (depending on where you buy them). They measure .040 x .443 x .724 in., have an active area of .25 in., and are rated at .5 volt open-circuit voltage, 2 milliamperes with

MATERIALS LIST—SUN RADIO

1 plastic case with hinged cover 1¼ x 2⅝/16 x 4⅝/16" inside measurements (Lafayette Radio, 110 Federal Street, Boston Mass., or 100 Sixth Avenue, New York, N. Y. Cat. #MS 162, $0.32).
4 International Rectifier Corp. B2M photocell sun batteries (Lafayette Radio or Allied Radio, 100 N. Western Avenue, Chicago 80, Illinois. About $1.47 each).
1 antenna coil with adjustable high Q core for broadcast range 540-1700 kc. (Lafayette or Allied Radio).
1 Sylvania crystal diode 1N34A (Lafayette or Allied Radio).
1 1-mfd. electrolytic condenser 50 volt, Cornell-Dubilier BBR-1-50 or equivalent. (Allied Radio.)
1 250,000, 1 meg. ½ watt resistor (Lafayette or Allied Radio).
1 Raytheon CK 722 transistor (Lafayette or Allied Radio).
1 365 miniature tuning condenser (Lafayette Radio Cat. #MS 215, $0.69).
2 phone tip jacks (Allied Radio Cat. #41 H 115, $0.12 each).
2 insulated binding posts (Allied Radio Cat. #41 H 350 Eby Type 33, each $0.21).
4 rubber feet knobs ½" diameter, no screws (any local radio supply store).
1 terminal board with 5 terminals for solder (take from old electronic surplus equipment or make up).
1 small Bakelite knob to fit condenser shaft.
1 small Bakelite knob that can be bushed and threaded to fit coil shaft. (Lafayette Radio MS-185 $0.07)
#24 hook-up insulated wire, screws, nuts, etc.

a 10 ohm load, and a power output of .3 milliwatts with a 100 ohm load, when used in average sunlight. Under artificial light or with lower intensity natural daylight, the ratings will of course be lower, though the set will still work well if other conditions are favorable.

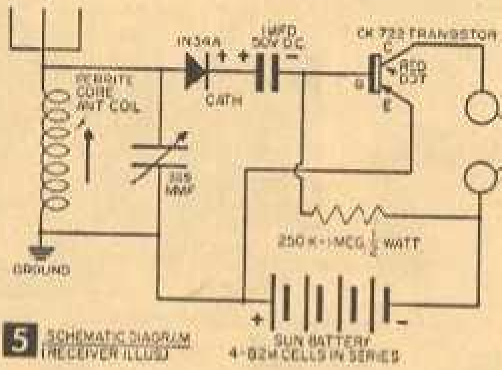
Complete the wiring of the mounted components as shown in Figs. 3 through 5, soldering all connections and keeping the leads as short as possible. Cementing four rubber knobs to the bottom of the case at the four corners will raise the case up enough to provide clearance for the nuts securing the terminal board.



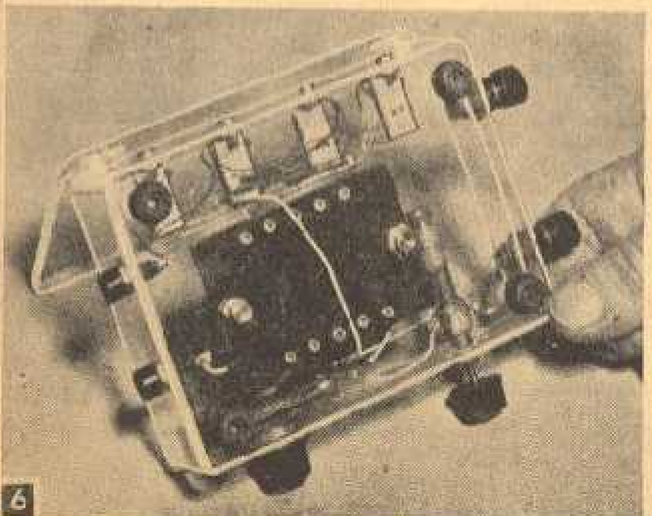
4 PICTORIAL DIAGRAM

Testing the Receiver. With the wiring completed, attach an antenna wire about 25 ft. long, and clip a ground wire to a grounded light fixture, heating pipe, radiator, plate screw on a wall outlet, or finger clip on a dial phone. In some rural areas far removed from radio stations, an outside antenna about 100 ft. long may be needed to bring the stations in well. For headphones, use the common magnetic type of 2,000 ohm or higher resistance.

Plug in earphone jacks and hold radio so strong sunlight shines on photoelectric cells. Reception should start immediately and you can tune radio by turning both the tuning condenser knob and antenna coil knob to get the strongest



5 SCHEMATIC DIAGRAM (RECEIVER ILLUS)



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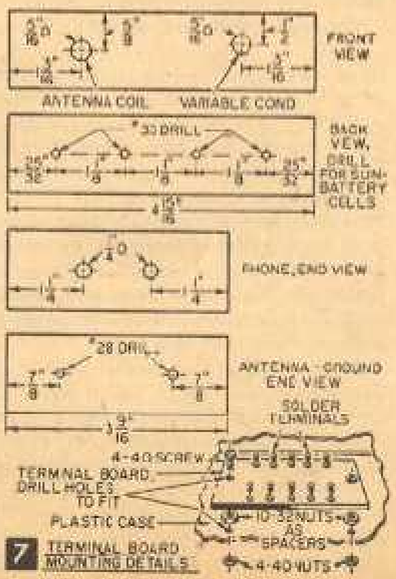
View from underside of terminal board. Note mounting of four cells with the brackets furnished against back of plastic case.



7 TERMINAL BOARD MOUNTING DETAILS

and clearest signals, and seperate the stations.

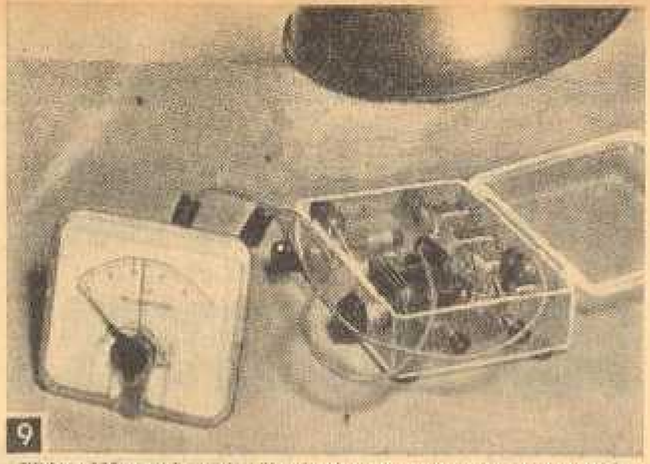
If you are located in a steel-framed building in a large city close to the broadcasting stations, don't expect top-notch performance from this set. Like the crystal set designs from which this is adapted, you won't get the maximum sensitivity and selectivity under such conditions. So take the set out to your Cousin Emma's house in the suburbs if you really want to see what it will do.

Indoor Light Test. As Fig. 9 shows, we conducted a test of current output with a 0-1 milliameter under a 100-watt lamp. Clip leads attached to the battery terminals show a .5 milliampere current, with the light source about 8-10 in. above the cells. Under sunlight, this reading would be around 2 milliamperes. (When using a lamp to activate the cells, remember not to let the hot bulb stay close to cells for long periods of time, since heating cells over 185°F will injure them).

Figure 10 shows a test of the radio, using a high resistance voltmeter (20,000 ohms per volt), which places a very light load on the cells. With this setup, and still using a 100 watt light bulb, we get a reading of about 1.4 volts across the battery.

The circuit shown is only one of many you could use—just so long as your circuit does not require more than 1½-3 volts normally from a dry cell. Figure 11 shows another type of circuit you might want to try out—if you are in an experimenting mood.

Some other circuits can be tried that might prove to be more selective and sensitive for areas where this may be desirable. If you have luck in developing them, let us hear about it.



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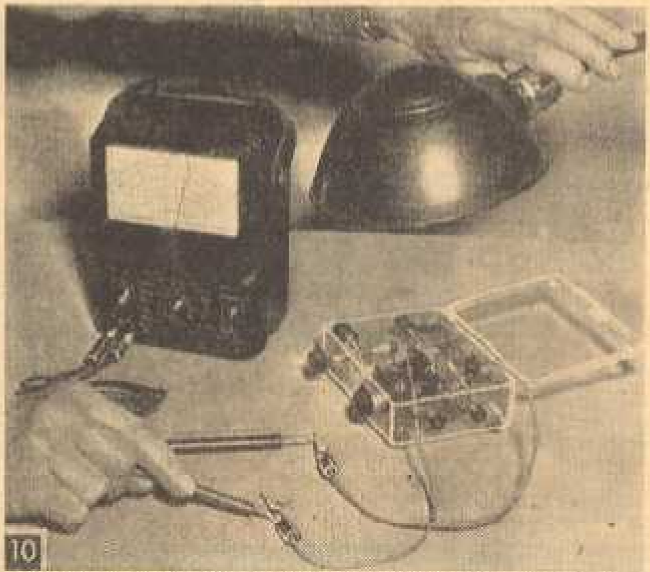
With a 100 watt lamp for illumination, a current of .5 milliamperes was generated by the photocells. In good sunlight, this would be around 2 ma. more or less, depending on the individual cells.



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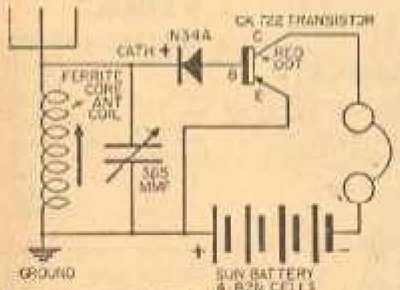
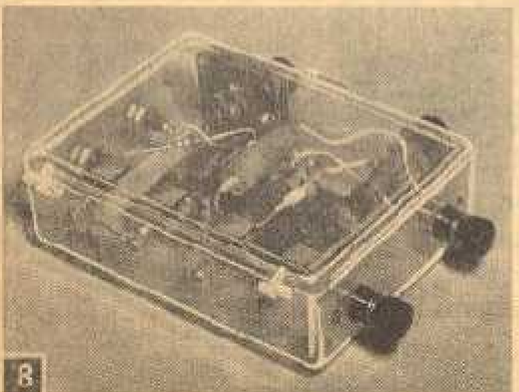
Voltage across the cells in a test with a high resistance voltmeter was 1.4 volts.



11 ALTERNATE CIRCUIT FOR EXPERIMENT



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View from rear with plastic lid closed. Insulated terminal posts are used for the antenna and ground

● Craft Prints in enlarged size for building sun-power radios are available at 50¢ each. Order by print number, enclosing remittance (no C.O.D.'s or stamps) from Craft Print Dept., SCIENCE AND MECHANICS, 450 East Ohio Street, Chicago 11, Illinois.