Battery Runs Small Electric Devices on Light From the Sun
BY VINTON McVICKER Staff Reporter of THE WALL STREET JOURNAL
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Latest Product of Bell Telephone Laboratories Is Little Enough To Be Held in a Hand

By Vinton McVicker
Staff Reporter of The Wall Street Journal

NEW YORK—A battery that converts sunlight into usable electric current is the newest product of Bell Telephone Laboratories.

It will have its first public demonstration today in Washington before the National Academy of Sciences.

In a press preview at the Bell System's Murray Hill, N. J., laboratory, the solar battery showed its ability to generate enough current to operate a variety of devices with relatively low power requirements, as in the telephone field.

Small enough to be held easily in the palm of a hand, it provided ample current—even under an overcast sky—for clear voice communication from a pocket-size FM radio transmitter 100 feet outside the building to a receiver indoors. That was without an antenna. With an antenna, according to the experts who developed the device, the range would be at least a half-mile.

Indoors, hooked up to a similar transmitter and illuminated by an electric light bulb pinch-hitting for the sun, it powered the radio sending of recorded music the length of a 50-foot room. When a sheet of cardboard was held so as to shade the battery from the light, the music stopped.

Light From a Bulb

In another demonstration, again with light from an electric bulb, the battery operated a miniature motor that turned a toy ferris wheel.

The battery is simple in construction—10 metal wafers, of specially treated silicon, each 2¼ inches by a half-inch in size, placed side by side in a transparent plate, wired together and to terminals from which it can be connected like any other battery to the current-consuming device

The same course of research at Bell Laboratories that brought the transistor into being in 1948 has produced the solar battery as its latest result That study, in progress since 1930 explored the properties and electrical uses of the so-called semi-conductors.

Germanium was the first semi-conductor put to practical use. It is the essental element of the transistor, a tiny substitute for the vacuum tube, which uses far less current than the vacuum tube.

Laboratory studies continued with silicon, one of the commonest elements in nature and more satisfactory than germanium in some respects, including the fact that its electric properties are not seriously affected by high temperatures, as germanium is affected.

A Big Step Forward

A big step forward in this research in semi-conductors was the discovery of what the scientists termed the "p-n junction"—"p" for positive, "n" for negative. Essentially this means that when minute amounts of the correct impurities are introduced into chemically pure silicon, then under the impact of light an electric potential is created at the point, the "p-n junction," where these impurities come together. That can be harnessed like any other electricity for practical use.

Practical application of this new scientific knowledge posed two problems, both of which have been solved, according to Dr. James B. Fisk, vice president in charge of research of Bell Laboratories, by physicists, chemists and metallurgists in teamwork.

One was the extraction of chemically pure silicon, for which "a relatively simple method" has been developed that leaves only one atom of impurity in 100 million atoms of silicon. The other was a way to deposit the needed impurities—boron and arsenic are examples—in the exact amounts and at the precise places needed; that is being done by exposing the pure silicon wafers to vapors containing the desired mixtures.

Status Called Promising

Once those hurdles were cleared, production of the battery on a laboratory basis was possible. Dr. Fisk describes the present status as "still experimental but very promising indeed, even though there is much work yet to be done."

Says an official statement from Bell Laboratories:

"Although work is still in the laboratory stage, actual use of the solar battery in the telephone business is a strong possibility. For example, silicon solar batteries might be used as power supplies for low-power mobile equipment, or as sun-powered battery chargers which could be used at amplifier stations along a rural telephone system."

Interested primarily in low-power uses in telephone operation, Bell scientists will make no forecasts of the extent to which the solar battery could be applied where power requirements are higher—as, for example, in lighting a house.

A square foot of silicon-wafer surface, they

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say. under sunlight will generate about five watts of current. But because in practical use the generating battery has to be connected to storage batteries to supply current on cloudy days and at night, they say a better rule of thumb is about one watt to one square foot for use around the clock.

No Theoretical Limit

Theoretically there is no limit, according to the scientists, to the size to which a battery might be built, although the silicon strips have to be kept to about a half-inch width. But they view that further development as a question for engineers, rather than for themselves.

According to their figures, it would take about 100 square feet of silicon wafer surface —equal to a plate 10 feet square—to keep a 100-watt lamp burning all day.

At present, according to Bell's researchers, the solar battery has about 6% efficiency—that is, it converts 6% of the solar energy that strikes it into electricity. That rate, they say, compares favorably with the efficiency of most engines now in use. They also see a step-up to 10% efficiency as attainable without great difficulty, but add that unavoidable limitations set an absolute ceiling of 22% on efficiency, since the battery reacts to only a part of the total solar spectrum.

Researchers credited by Bell Laboratories with the invention of the solar battery are Gerald L. Pearson, Calvin S. Fuller and Daryl M. Chapin, who had help from many other members of the staff at various stages of the development.