MILITARY SCIENCE

Tiny Weapons Aid Fighter

Miniature weapons of all kinds are turning soldiers into supermen—By Jonathan Eberhart

➤ A SINGLE SOLDIER could carry a guided missile complete with launcher, a radar set, a secret code transmitter, a two-way radio and a gadget that would let him jump to the ground from tall trees or hovering helicopters —all together weighing no more than a portable television set.

Miniaturized electronic components, as well as weapons research spurred on by the pressure of Viet Nam, have made it possible for a man carrying less than 50 pounds of equipment to be prepared for virtually anything.

Newest of these James Bond devices is a two-pound radar set so compact that it can actually be mounted on a rifle barrel. Several versions of the device have been made with ranges up to 1,500 yards. The set, which will not detect a stationary object, indicates moving ones with a rising whine heard through earphones. Powered by an equally lightweight battery pack, it can distinguish between running, walking and crawling men, large and small vehicles, and even between sexes. A special built-in scrambler makes the radar beam appear like nothing but radio noise to any nearby detection instruments. The Radio Corporation of America said the units could be mass-produced for under $1,000.

A code transmitter no bigger than a canteen can send detailed combat information in half a second by using 22 switches to represent a prearranged piece of data. The operator sets each switch to a certain number, according to a code card taped to the lid of the transmitter, and pushes a button. The message is sent out at high speed and unscrambled at decoder stations. Built by Litton Industries, Beverly Hills, Calif., the coder weighs less than four pounds.

Part of the super-soldier's equipment can be used only once. General Dynamics Corporation's Redeye guided missile, fired bazooka-style from a disposable fiber glass tube, can knock down a plane by homing on the heat of its engine.

Perhaps the smallest two-way radio in the world has been built by Westinghouse, although only for experimental purposes. Each transmitter-receiver is only slightly larger than a domino, including power supply. Needless to say, weight is hardly a problem.

If the bearer of all this gear is parachuted into a tree, or if he is set down by helicopter on one of the Army's new treetop landing mats, he may soon be able to reach into his pack and strap onto his feet a pair of Lockheed "Dynasorbs." These are like simple pieces of pipe, each notched on the bottom end. The soldier just steps off into space and the force of landing splits the pipes into segments which curl up on impact, absorbing most of the shock.

Other strange devices could provide a man with everything from night vision to death rays. A guided missile called the Condor can travel up to 50 miles sending continuous television pictures of what it sees back to the plane from which it was launched. The pilot can use the pictures to make corrections in the missile's flight path.

An amazing kind of aerial camera developed by Fairchild Instrument Corporation takes color pictures of the terrain below—but not the usual kind of color. Everything in the picture will appear, for example, as a light blue, while a concealed tank may show up shocking pink.

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TECHNOLOGY

Diodes From Thin Film

➤ A TINY ELECTRONIC device known as a tunnel diode has been made to operate at room temperature when built by thin-film methods.

Tunnel diodes, once hailed as "wonders" in the electronics field, have already replaced transistors for such uses as amplifiers, oscillators and in the logic circuits of computers.

Making tunnel diodes by thin-film techniques means they can be turned out on a mass-production basis, instead of the more laborious hand-controlled methods now required to fabricate single-crystal semiconducting transistors.

Semiconductors are made of materials that conduct electricity better than insulators but not as well as metals. The so-called "negative resistance" tunnel diodes are made from MOS, which stands for Metal-Oxide-Semiconductor.

The new type of tunnel diode was discovered by Drs. Leo Esaki, P. J. Stiles and W. E. Howard of International Business Machines Corporation in the MOS junction of aluminum, aluminum oxide and tin telluride. They later found the same effect in another compound that was like it, except germanium replaced tin.

The negative-resistance effect is less pronounced in the new types than in a conventional tunnel diode, but other combinations of materials should increase the effect substantially.

The original tunnel diode was discovered in 1958 by Dr. Esaki, a young Japanese physicist then at the University of Tokyo. A tunnel diode does not have a visible tunnel. The name is derived from the remarkable way that electrons, under proper conditions, pass through the potential barrier existing between the positive and negative sides of a semiconductor diode. The electrons behave as if there were a tunnel between the two sides.

The tunnel diode's value lies in the small range in which increasing voltage results in a decreasing current. This occurs because the resistance becomes smaller with increased voltage, an effect termed "negative resistance."

Experimental details and a theoretical discussion of the negative-resistance effect are reported in Physical Review Letters, 16:1108, 1966.

The new types of tunnel diodes are made by depositing a thin strip of aluminum onto a glass substrate. The aluminum is then exposed to oxygen, in order to form a thin insulating layer of oxide on top. A strip of semiconducting material is deposited across the top of the aluminum strip.

The tunnel diode junction occurs at the intersection of the two strips.

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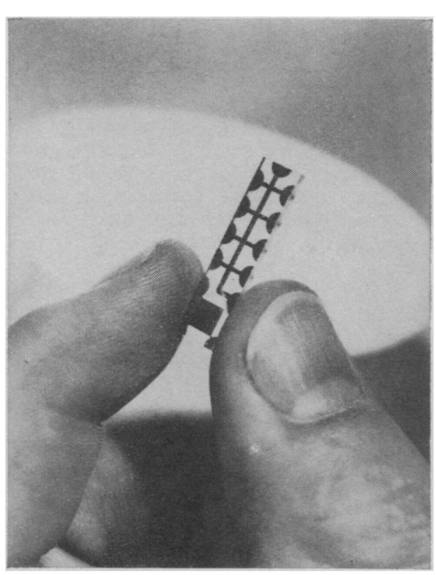

IBM

EXPERIMENTAL DIODES—Scientists at International Business Machines Corporation have discovered a new type of tunnel diode having "negative resistance." An array of experimental MOS tunnel diodes is shown. The longitudinal line is an oxidized aluminum strip and the perpendicular lines are strips of tin telluride. Each intersection forms an MOS tunnel diode junction.