RADIO

Baby Rival to Vacuum Tube

A powerful midget of a device, made of a strange metal, can supplant the familiar electron tube. Transistors have military applications and help switch telephone calls.

By WATSON DAVIS

➤ TO OUR electronic age of radio, television, radar and a thousand other electrical applications, the familiar electron or vacuum tube is its heart. Millions upon millions of tubes are in use. Just look inside your radio.

Yet the vacuum tube has its first serious rival, a mite of a device without vacuum, glass, or lighted filament.

It is called the transistor. It is only a little over three years old, but it is already doing jobs for communication and the military that the tubes cannot do. It looks like a little cartridge and it does not even get hot in operation.

The essential stuff of this new wonder in electronics is a metal that almost no one knew about—germanium. And when the scientists who made it try to explain the transistor they talk about not only electrons but "holes" where the electrons have been driven out. Since electrons, which are the particles that make up electricity, are difficult to visualize, the holes that are where they were may defy imagination.

Has Corresponding Parts

What makes the tubes of a radio work does not seem so much of a mystery now. Thousands work with them every day. The transistor can be understood by comparing it with the continuously regulating electron valve which has made modern electronics possible.

The new electronic valve has what corresponds to hot lighted cathode, grid and plate (you can see these in a tube in your radio amplifier) all in a tiny bit of the metal germanium.

To the old-timers in radio who can remember back to the crystal set days, the transistor in one form will remind them of the crystal detectors with their cat whisker contacts. For the transistor first made has two cat whiskers, one input or emitter and the other collector or output. A connection to the base of the germanium crystal makes the triode, analogous to the familiar three-element electron tube. An even newer transistor does away with the whisker connections and leads are permanently attached to a bit of the metal and sealed in plastic.

What the transistor can do is important. Not only are they very small in size, but they operate on very little current. The latest junction transistor can be operated on about a millionth of a watt, which is pleasing to the telephone people, who are making first use of it, because a signal in a modern telephone takes about a millionth of a watt.

When a vacuum tube is used to amplify this millionth of a watt telephone signal, a full watt of current is consumed. This is like sending a freight train to deliver a pound of butter.

The first practical civilian job of the transistor is in helping to make it possible for you to dial any telephone anywhere in the nation from your own telephone. A bank of transistors will be used in an automatic device that will tell the telephone system's switching equipment how to route the call you are making over the toll lines between cities.

Fundamental Research Result

This amazing little transistor device came into existence because of a discovery that was made during fundamental research into the electrical properties of solids. The scientists were studying what they call semiconductors, that is materials that take on the properties of both metals and insulators depending upon the way in which they are treated.

Silicon and tellurium, which are metallic chemical elements related to germanium, have similar properties. They, too, may find use in even more advanced electronic devices of the future.

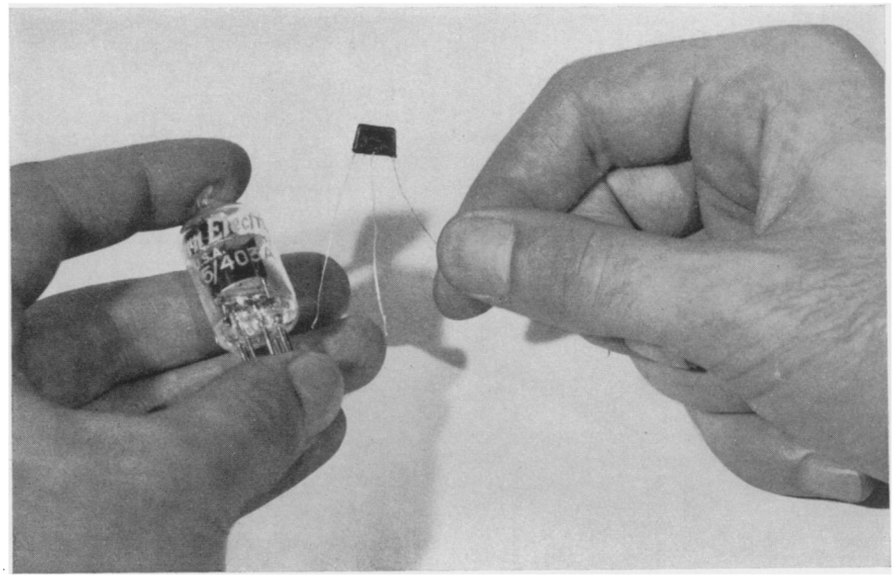
The principle of the transistor was discovered by the Bell Telephone Laboratories scientists, Drs. J. Bardeen, W. H. Brattain and William Shockley. They were studying the resistances of thin semiconductor layers when electric fields were applied to them. Drs. Bardeen and Brattain discovered that two contacts on the semiconductor surfaces and a connection to the crystal itself resulted in the arrangement being an amplifier. It acted very much like the highly useful triode vacuum tube.

Many New Uses

Many things are possible with transistors that the conventional vacuum tubes cannot do. Their small size and low power requirements will allow them to be applied to controls, such as in telephone systems, computors and unmentionable military devices. Transistors will be used first for tasks that they alone can do effectively. Then, in a few years, they will begin to invade more conventional fields of electronics, such as radio and television.

About 20,000 or so transistors, mostly of the contact or Type A sort, are being made each month. They are going into commercial telephone switching service. The junction type, which is smaller and eventually may be simpler and cheaper, is still in the developmental stage.

The experts are frankly quietly excited about the future applications, but they also



MIDGET DEVICE—The transistor at the right can do the job of the larger electron tube (left). This model, made of germanium, is called a junction transistor, second and latest sort to be developed by Bell Telephone Laboratories.

recognize that they have much to learn about how this new device works and the possibilities that lie in the metal of which it is made.

Germanium is one of the purest of metals as it is used in these new electronic devices. There is not much of it available, as it has been a by-product of recovery of cadmium and zinc. It costs from $100 to $200 a pound.

Also Rectifies Current

Another property of germanium is that of rectifying electric current, that is, changing alternating to direct current. In this, processed germanium metal operates more efficiently than existing rectifiers of selenium and copper oxide. The General Electric Co. rates the germanium rectifier, made in a form not much larger than a thimble, as perhaps the best rectifying metal yet discovered.

When the transistors as they are developed in the future are combined with the printed wire circuits that replace wires with streaks of metallic ink or paint, the electronic devices of the future will be smaller and probably cheaper. With transistors, a two-stage amplifier can be fitted into a match box. The dream radios of fiction may not be too far in the future.

Science News Letter, March 1, 1952

MEDICINE

New Stomach Juice Test May Aid Cancer Diagnosis

➤ FINDINGS THAT may lead to a new aid for diagnosing cancer of the stomach are reported by three cancer researchers, Dr. Shields Warren of New England Deaconess Hospital and D. Rourke Gilligan, biochemist, and J. Rothwell Moor, research technician, of the Harvard Cancer Commission.

Cancer patients these researchers find, have in their stomach juices more free and peptide amino acids than normal persons or patients with ulcers.

The ulcer patients had the same amount and kind of amino acids as the normal persons. The amino acids are the building blocks of protein. The amounts and kinds in the stomach juices of the patients and normal persons after fasting were determined by paper-partition chromatography.

The stomach cancers in the patients in this study were far enough advanced so that they could be diagnosed by X-ray and clinical methods. In one case, however, it was not possible to tell by X-ray and other usual methods whether the patient had stomach ulcer or stomach cancer. In this patient, the chromatogram of the stomach juice resembled that of the other patients with stomach cancer.

Whether this method will prove an aid to early detection of stomach cancer can only be discovered by further studies, Dr. Warren and associates state in their report to the JOURNAL OF THE NATIONAL CANCER INSTITUTE (Dec. 1951).

Science News Letter, March 1, 1952

VETERINARY MEDICINE

Cattle Owners Underrate Need for Strict TB Control

➤ CATTLE OWNERS have been underrating the need for strict, continuing eradication measures against tuberculosis, the American Veterinary Medical Association in Chicago charged.

In a few sections of the country, bovine tuberculosis is definitely on the increase, although the overall U. S. rate for the disease in 1951 is the lowest since 1943.

The Association urged the cooperation of all farmers and veterinarians in continued testing of cattle and the elimination of all animals that react to the tuberculin test. Bovine tuberculosis is communicable to humans.

Science News Letter, March 1, 1952

The world's largest flesh-eating *mammal* is the Kodiak brown bear.