PHYSICS

Uncle Sam's House of Science

One of many advances made by National Bureau of Standards is a device that shows the inside of an automobile or airplane engine as it operates.

By ANN EWING

➤ FOR THE first time, the inside of an automobile or airplane engine can now be seen and studied as it operates. The instrument for doing this was developed by the National Bureau of Standards, Uncle Sam's house of science.

It is the most recent example of the many very important contributions to national progress made by the Bureau since it was established in 1901.

X-rays changed into light by an inch-thick crystal show the moving parts within the engine. The crystal is made of sodium iodide, a close relative of common table salt, which is sodium chloride. The crystal, however, is a solid, one inch thick. It looks much like a highly polished hand mirror without a handle.

The visible light emitted by one side of this crystal faithfully reproduces the X-ray pattern hitting the other of its two flat surfaces. The X-rays are produced when electrons, speeded up to an energy of 50 million electron volts, are aimed at a metal target. The X-rays emitted by the target are beamed through the engine.

Used for Flaw Inspection

The visual image issuing from the crystal can be detected in several ways. It can be seen by eye, if proper precautions against radiation are taken. It can be photographed with an ordinary camera. Or the image can be viewed on a remote television screen, transmitted there by a TV camera, thus eliminating danger from radiation.

Using this TV arrangement, scientists can make a rapid inspection for flaws as the engine operates. With a suitable timing mechanism, the system can be hooked up for stroboscopic studies of moving engines, "stopping" them at any point in their cycle.

The technique was devised by Dr. John S. Pruitt of the Bureau of Standards staff. Using it, X-ray images seen through as much as 18 inches of steel, or seven and a half feet of concrete, can be continuously displayed.

To develop the accurate standards of measurement required by modern science and industry, the Bureau is exploring many frontier areas of science.

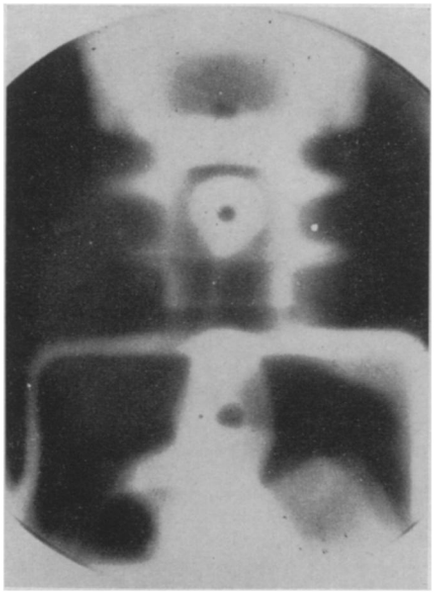
These include a "magic" liquid that flows up hill at temperatures near the lowest ever reached, atomic flames that may make possible new types of jet engines, and devices to speed up operation of giant "brains," the electronic calculators coming into wide use.

Demonstrations of work in these fields and such other recent developments as a radiation monitor for atomic blasts that operates over continental distances were on view at the Bureau's first Open House in 17 years.

Dr. Allen V. Astin, director of the National Bureau of Standards, gave the first public demonstration of a remotely-controlled radiation detector. Developed for the Atomic Energy Commission, the system was used during the recent tests of nuclear devices in Nevada, but only within an area of 250 miles from the explosions.

Instruments smaller than a table model TV set register radiation intensities, then transmit the information to any desired point by direct wire, radio or long-distance telephone. Readings from the remote station are printed on adding machine tape.

The "magic" fluid being studied by the Bureau is liquid helium, which becomes fluid only when its temperature is brought close to absolute zero, or minus 459.7 degrees Fahrenheit.



ENGINE "STOPPED" IN ACTION —This picture shows a one-cylinder engine in actual operation. X-rays from the National Bureau of Standards 50-million electron-volt betatron passed through the engine and were converted into visible light, then photographed by a television camera.

Near absolute zero the normal dancing motion of atoms and molecules is greatly slowed down, and the properties of matter undergo extraordinary changes.

Liquid helium at such very low temperatures shows characteristics of all three states of matter: solid, liquid and gas. It can pass through air-tight seals without resistance. It flows up the side of a containing vessel, in seeming defiance of the law of gravity.

At the other end of the temperature scale, Bureau scientists are investigating flames produced by the direct combination of atoms and molecules at very low pressures.

Oxygen atoms combining with acetylene gas at pressures less than one-thousandth the normal pressure of the atmosphere give a weird bluish-green flame. No one knows what the actual temperature of this flame is. It measures from 1,200 to 20,000 degrees Fahrenheit depending upon the type of thermometer used.

Flame's Temperature Studied

Dr. H. P. Broida and other Bureau scientists are trying to find out exactly what the flame's temperature is.

Their studies may give information that will make possible new types of jet engines and rockets for operation at very high altitudes. A pressure one-thousandth that at sea level is equivalent to an altitude of 200,000 feet, or about 38 miles.

A more immediate purpose of such experiments is to learn more about how and why flames burn under ordinary conditions in order to increase the burning efficiency of industrial fuels.

The Bureau's new development in electronic computers is known as the diamp, short for diode amplifier. It is a substitute for the transistor, itself a post-war device.

Like the transistor, it makes possible a compact, rugged high-frequency amplifier, and it also requires much less power to operate than conventional vacuum tube systems.

"Brain" Speeds Increased

The diamp makes use of a previously unwanted characteristic of germanium and silicon crystal diodes. A crystal diode is a device similar to the transistor. However, instead of amplifying a current as transistors do, the diode operates as a gate. It either passes or stops the flow of current through it.

Important advantages of the diamp over the transistor are its higher operating rates, lower cost and commercial availability.

By combining the diamp with a prior Bureau invention for a very high-speed memory for computers, operating speed of giant "brains" can be increased by a factor of five to ten, scientists at Standards believe. Both inventions for speeding up

calculations with electronic "brains" were conceived by Arthur Holt of the Bureau.

Most of the work in electronic computers was originally supported by the armed services. They are particularly interested in higher speed machines, since computers are used for control of and defense against guided missiles.

Although present computers calculate with apparent lightning speed, there are many important problems for which they are still too slow. These include not only scientific problems such as found in nuclear physics but also those arising in business, in industry and even in handling the nation's growing traffic problems.

They are too slow despite the fact that SEAC (Standards Eastern Automatic Computer), for instance, can remember more than 1,000 numbers and has ready access to many thousands more by means of magnetic tape or wire, and can add more than 4,000 numbers per second and multiply or divide 400 per second.

Visitors at the Bureau's recent Open House also learned that scientists there have been developing brightness standards for color television. Color TV tubes contain red, green and blue fluorescent materials that, in combination, produce all the required colors in the image. For good pictures, the colors must measure up to certain standards.

The Bureau's radiation facilities include the betatron, synchrotron and gamma-ray laboratories, all of which make it possible for the Bureau to provide the standards, measurements and instruments required in the nation's expanding atomic energy program and in the field of multi-million volt X-rays.

Millions of everyday transactions depend upon the wide variety of standards provided by the Bureau. These range all the way from the wavelength of light measured in millionths of an inch to massive railroad track scale weights. Included are standard screw threads, standard isotopes, gage blocks used for mass production in industry, standard fuels for anti-knock ratings and chemical standards for process control in the steel industry.

In 1901, when the Bureau was established by Act of Congress, it had custody of two primary standards, the meter bar for length and the kilogram cylinder for mass, or weight.

With the phenomenal growth of science and technology over the past century, the Bureau has become a major research institution concerned not only with everyday weights and measures but also with hundreds of other scientific and engineering standards necessary to the industrial progress of the United States.

Science News Letter, June 11, 1955

MEDICINE

Frozen Sleep Surgery

➤ PATIENTS HAVING operations for removal of cancers may do better under frozen sleep than with other types of anesthesia. Some cancers that cannot be removed under ordinary anesthetics might be removed if the patient were in the frozen sleep stage.

Studies to explore the possibilities are under way at the University of Colorado School of Medicine in Denver. A report from the American Cancer Society which supports the studies states that preliminary observations already show many cancer patients will do better with the frozen sleep than with other types of anesthesia.

Hypothermia is the technical name for the frozen sleep state. The patient is cooled down to a temperature of about 75 degrees Fahrenheit, a little higher than the usual comfortable room temperature, and much below the 98.6 degrees which is normal temperature for the human body.

In the studies by Drs. Henry Swan, Robert W. Virtue and J. Cuthbert Owens the patient is prepared by first giving him enough anesthetic to keep him from feeling the cold. Then he is put into a tub of ice water and ice cubes to reduce his temperature.

At the low temperatures circulation is stopped and the heart can be isolated for operation for as long as nine minutes. The method has been used in many places for operations on the heart, because it lets the surgeon work on a temporarily bloodless heart. The studies are planned to show whether the method would permit operations to remove tumors that have grown into arteries and other vital organs. It would at least give surgeons a bloodless field to work in.

Science News Letter, June 11, 1955

MEDICINE

Tent Built in Lung To Cover Healthy Part

➤ A NEW kind of tent is giving help to patients who have to have a part of a lung removed because of tuberculosis or other lung disease. The tent is made from the lining of the chest wall and covers the healthy lung part left after the operation.

Good results with the tent in 89 patients ranging in age from 16 to 74 years were announced by Drs. Laurence Miscall and Robert W. Duffy of Triboro Hospital, New York, at the meeting of the National Tuberculosis Association in Milwaukee.

Empty space above the tent in the chest is filled with air to prevent its filling with fluid and to hold the tent in place. Complications and deformity which may accompany an operation for removal of part of the ribs and permanent collapse of the lung are not risked with the tent technique.

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