ENGINEERING

Mining Without Miners

Underground workers not required in relatively new method of getting energy from coal by burning it in its natural seams.

By A. C. MONAHAN

➤ THE ENERGY in deep underground coal seams, too thin to be mined by ordinary methods, is being captured and put to work by an underground burning process in Russia, Great Britain and the United States.

Crude petroleum was experimentally obtained in Sweden from deeply buried deposits of oil shale by applying electrical heat to the shale, the heat being applied in deep bore holes drilled down from the surface.

Most salt obtained from deep in the crust of the earth in America is captured and brought to the surface by high-pressure water forced down one pipe which comes back through another laden with the mineral. In many parts of the world, salt is mined by pick-and-shovel workers who work deep under the earth.

Sulfur in the natural deposits in Louisiana and Texas is brought to the surface melted in hot water which has been pumped down to it through a pipe. Super-heated steam is used. It has a temperature above 240 degrees Fahrenheit which is approximately the melting point of sulfur.

The light metal magnesium, now coming into wide use particularly in the aviation industry, can be recovered from seawater but much is obtained from underground salt beds by the water method, the magnesium salts being removed from the brine. Much iodine is now recovered from brine brought to the surface in oil fields.

No Underground Workers

These are all examples of mining without miners. At least, they do not employ underground workers. They do employ highly trained technical men and mechanics but these employees remain on the surface. In this they are like the employees of the oil industry. In ordinary language, oil is mined, but the operators are not miners in the usual sense of the word.

The process of burning coal underground in its natural seams to obtain combustible gases was first tried in Russia, it is claimed. Considerable work has been done in England with special emphasis being placed on it in the past few years. America's first "pilot-plant" attempt began about four years ago at Gorgas, Ala., in cooperation with the Alabama Power Company.

The experimental work is continuing—and at a stepped-up pace. By January 1951, about 8,000 tons of coal underlying between one and two acres of ground had been burned from a single initial passage prepared at the start of the work. It has been definitely proved that low-cost fuel for generating electric power can be obtained. A gas turbine engine driven by hot product gas was successfully run. In one section, operated for 16 months, the total heat of the gas reached a maximum for the eighth month of about 70% of the heating value of the coal consumed.

In the process of burning coal deep under the surface of the earth, at least two holes are sunk into the coal layer, and fire started in one. Gases of combustion pass through the coal to another hole and rise through it to the surface where they are captured in containers.

The actual process, however, is more complicated than that. Air or oxygen must be forced under pressure down the ignition hole to enable combustion to continue. The amount must be regulated. If too much oxygen is supplied to the fire a complete combustion takes place. Hot gases are obtained that might be used for heating but they would not be combustible. Burning the combustible gases from the coal is what provides the desired power.

Again, the process is complicated by the need of a man-made opening through the coal seam from the burning part to the gas-collecting pipe. The opening is a tiny tunnel bored from the bottom of a shaft extending down into the coal. The shaft must be large enough for a man to work in at its lower end.

What may well prove to be a more efficient and less expensive way of making a passage in the coal for aiding the combustion and permitting the gases of combustion to pass to the recovery hole received a recent patent from the U. S. Government. The inventor is Frederick Squires, Illinois State Geological Survey, Urbana, Ill., and in his process the clay under the coal is removed by water.

The process is quite simple. A hole is drilled through the coal seam into the underlying clay. A pipe is placed down the center of the hole and water under pressure forced down it. The water picks up the clay under the coal and returns to the surface bearing the clay with it. When enough clay has been removed, the formation is given time to dry. Then ignition of the coal is started. The fire burns along the exposed under side of the coal and the gases of combustion pass along the excavation to the outlet well.

Another method of gasifying coal under ground, developed by the Missouri School of Mines, uses high-voltage electricity. This

COMBUSTION'S START—An incendiary bomb, called a thermite grenade, is being tossed down a borehole to start combustion by U. S. Bureau of Mines' men in the second coal-gasification experiment at Gorgas, Ala.

is employed to heat the coal and produce gases in its early stages. After the coal has become sufficiently heated, the electric current is cut and air or oxygen pumped into the coal to cause combustion and the yield of additional gas.

In this process holes are drilled into the coal seams about 20 to 40 feet apart and pipes are inserted in the holes. These pipes act as electrodes. An electric current of considerable voltage is sent from one to another. The electricity has to pass through the coal itself, and much of it is turned into heat by the electrical resistance of the coal. The gases driven off from the coal come to the surface through the pipes that act as electrodes.

Method for Thin Seams

To some it may seem wasteful to burn coal under ground to obtain gases. But it must be remembered that the process at present is proposed only for seams too thin to be mined by ordinary methods. Miners will work in seams only some 30 inches thick but only with great difficulty in others of less thickness. These thin seams are plentiful in America, Great Britain, Russia and other parts of the world. Many of them are within a few hundred feet of the surface, a depth at which the burning method can be easily employed.

Again, it must be remembered that much of the artificial gas now used in great areas of the United States to which natural gas is not delivered is made from coal. Two types are used, often a mixture of the two. The first is water gas, made by reacting steam over coke. The second is coal gas made by distilling bituminous coal in a retort.

When the coal is heated in a closed retort, gases are driven off leaving coke and coal tar. The gases contain principally hydrogen, methane and carbon monoxide. Those obtained by burning coal underground are much the same. Any coke that may be formed remains, of course, in the earth. Instead of burning the gases produced in a furnace to develop power, they could be used to make synthetic liquid fuels such as gasoline and heating oil.

Electric Heat Tried

The Swedish experiment in getting petroleum vapor from underground oil shale by electric heat has been temporarily halted because the hydroelectric power available right after World War II is now needed for other purposes. In the immediate post-war years it was surplus and therefore inexpensive. Sweden's present industrial activities require all the electricity available.

Oil companies in Sweden are now said to be considering making their own electricity for the purpose. They would use for fuel the so-called spent shale, from which the primary crude oil had been extracted. This spent shale still has good fuel qualities.

In the work in Sweden, holes were drilled deep into the earth and into the underlying oil shale. Electric heating elements were lowered into the holes and the electric current turned on. It took weeks before the shale was sufficiently heated to give off vaporized crude oil. But the product finally came up the drill holes to the surface where it was captured and refined.

The process of obtaining crude oil from oil shale is one of heating. Basically it means heating the crushed shale in a retort until the oil is driven off. It is doubtful that the Swedish system of heating the shale in place will be used in America. One reason is that cheap electricity is not available. Another is that very much of America's oil shale is in Colorado mountains and can be mined by driving tunnels into the sides of the mountains.

This means that machine mining is easily carried out and the mined shale does not have to be drawn up to the surface through a shaft. In the shale mine in Colorado, trucks enter the mine and load up at the working faces. They carry their loads direct to the pilot plant.

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