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UNITED STATES ATOMIC ENERGY COMMISSION

**A HOMOGENEOUS HIGH TEMPERATURE POWER
PILE UTILIZING GRAPHITE WHICH HAS BEEN
IMPREGNATED WITH URANIUM.**

By
Farrington Daniels

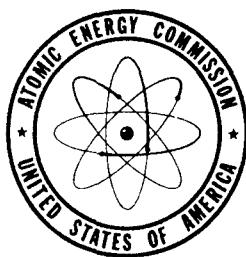
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Pile
No. 1

- Fissionable high Temperature Power File
utilizing Graphite which has been Impregnated with Uranium

8-23-46

Recent experiments at the Argonne National Laboratory, cooperating with the Clinton Laboratories, have shown that it is a simple matter to impregnate Sanford graphite with uranyl nitrate up to 4 or 5 percent by soaking with an ether solution of uranyl nitrate and evaporating the ether. The uranyl nitrate is then converted, by heating, into U_3O_8 which remains deposited in the voids. The experiments show further that the uranium is deposited uniformly throughout the graphite.

I propose the construction of a simple pile composed of large blocks of graphite impregnated with U_3O_8 (containing a high content of U^{235}) and cooled with an inert gas (such as helium or carbon dioxide) circulating through holes bored through the blocks. The pile will be operated at high temperatures, 800° to 1000° so that the graphite will be constantly annealed, thus minimising the effects produced by neutron bombardment.

For the first graphite pile I propose the following description:

Active pile, impregnated with Uranium
File with graphite reflector
Vertical holes

Diameter - 6 ft., Height 6.6 ft.
Planter - 3 ft., Height 3.3 ft.
5/8" (4 or 15 mm.) holes
spaced 6/8" between edges of
holes (i.e., 1-1/4" between
centers of holes). 5 holes
per foot, 31 holes per sq. ft.

Area of holes

0.315 sq. in. per hole or 26.8
sq. in. per sq. ft.

Percent of volume occupied by holes

10 percent.

Cooling gas

Helium

Pressure of gas

10 atmospheres

Circulation of gas

30,000 cu. ft. of helium per

minute measured at 10 atm.

Inlet Temperature

600°F

Outlet Temperature

1400°F

Construction

Sanford graphite in rectangular
blocks (rounded for outside
circular edge.) Less than
300 gram of U^{235} incorporated
into each block.

Impregnated graphite

0.6 to 1.5 percent by weight U_3O_8 .

Total weight of U^{235}

15 - 30 kilograms

Power output

60,000 kw of heat, or less

Total weight of graphite in active pile

5,350 kilograms

Removal of U^{235} for Chemical Processing:

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For The Atomic Energy Commission		
Chief, Declassification Branch		R. J. Carroll

The shut down and cooled and allowed to stand. Pressure reduced to 1 atm. Graphite blocks lifted upward, one at a time, with internal travelling cranes and transferred to small stainless steel furnaces where each block is burnt slowly with suitable stack ventilation. Ashes are dissolved in nitric acid and uranium extracted with borax (or other) and used for soaking and impregnating new graphite blocks which have been bored with holes.

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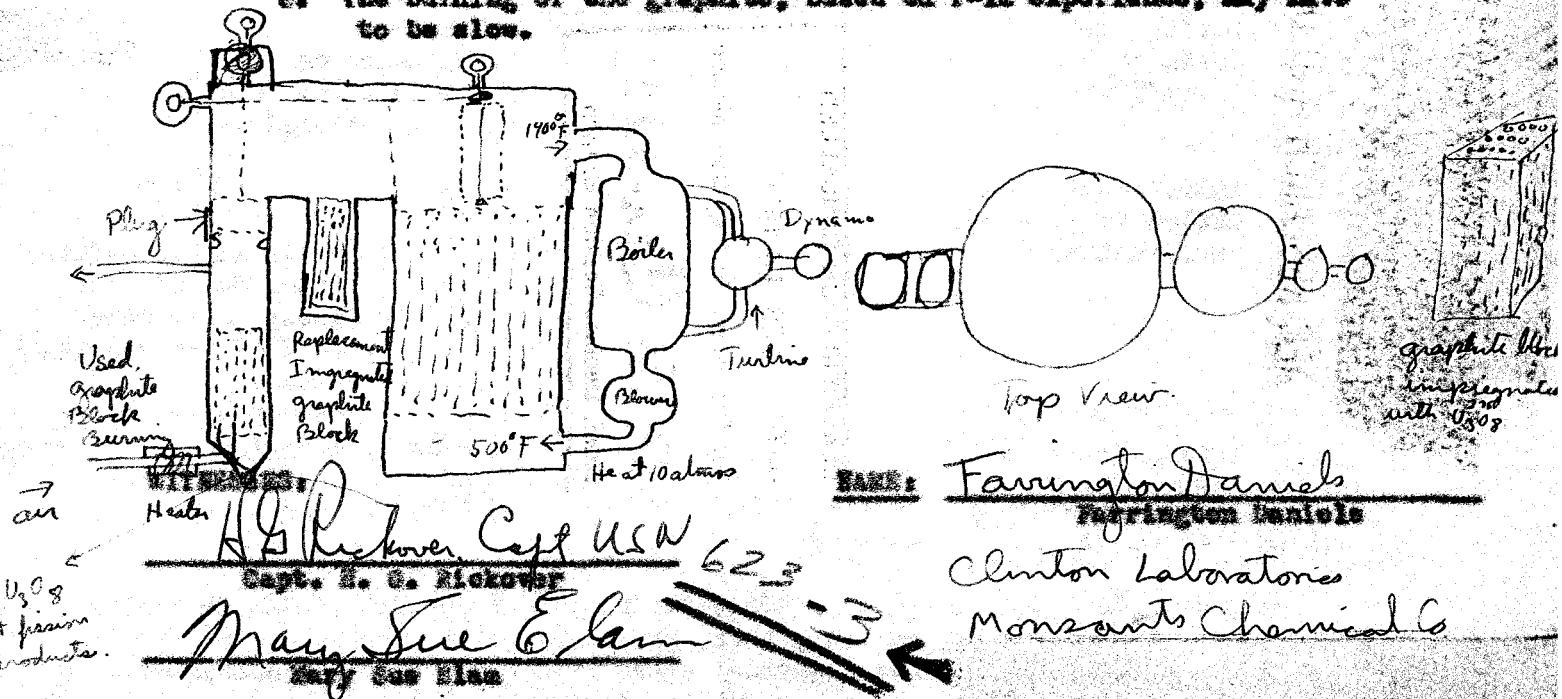
These calculations are based on an assumption that the critical size for graphite would be about 1.5 times that for BeO using the old constants without a reflector. They are of the same order of magnitude as the corrected values for BeO using a reflector.

Advantages:

1. All materials immediately available and cheap.
2. Construction on pile could be started almost immediately.
3. All accessories and equipment and buildings same as planned for BeO pile and could be used interchangeably (if not contaminated.)
4. Heat is spread uniformly throughout whole mass instead of in fuel rods, thus reducing concentration of U^{235} and the heat evolved per cubic centimeter. Better control because larger heat capacity for active fuel.
5. The impregnation of graphite or BeO either in thin homogeneous, graphite pile or in the fuel rod type offers distinct advantages in chemical reprocessing. Other impregnation involves few chemical operations and can be done by semi-remote control.
6. Conversion of thorium to U^{233} can probably be accomplished by impregnating some of the reflector blanket graphite blocks with thorium oxide.
7. The constants for graphite are so well known that few new nuclear measurements will be necessary, except for the temperature variable.
8. Simplification by omitting operation for loading and unloading fuel while operating.

Disadvantages:

1. It is necessary to shut down the pile for reprocessing.
2. There is very little opportunity for experimentation and change of variables.
3. The burning of the graphite, based on T-12 experience, may have to be slow.



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