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8 January 2007

The Comptroller
The Patent Office
Patents Directorate
Concept House
Cardiff Road, Newport
South Wales NP10 8QQ

My reference: ACS/THERMAL

Dear Comptroller,

Application No: GB 0511424.4 - Thermonuclear power generation

I apply for substantive examination of the above application. I enclose Form 10/77, fee sheet and payment.

This letter is my initial reply to your research report of 2 September 2005. I do not think the prior art which has been cited is relevant for reasons which I explain in detail below.

One reason why the process of the invention may seem a little unfamiliar is that it applies the method of chemical kinetics, as used in industrial processes such as oil refining, to nuclear processes which are conventionally considered either as nuclear reactions reduced to simple equations used by physicists or as the massive installations of nuclear engineers. By contrast, the process which I am describing is a sort of composite technology, a nuclear Bunsen burner, if you like.

The process of combustion of even the simplest gases in fact consists of the collision of molecules at velocities high enough to overcome the activation energy of reaction with oxygen, and as Faraday showed, involves many different transient radical species en route to the final exhaust gases, which are carbon dioxide and water plus heated air. In a chemical burner the combustion process is initiated by a lighted match, which causes an explosion reaching back to the ignition front at the burner. The ignition front is stable because the design of the burner separates and controls the flow of input gas and air. The process can be terminated immediately by switching off the gas.

In the nuclear process the activation energy is much higher, and so in the process of the invention it has to be supplied by collisions that take place at nearly the speed of light, simply to produce enough momentum to generate the necessary energy. To reach such velocities requires near vacuum in the accelerator, as is well known to those skilled in the art. The conditions produced by collision are transient. The product is composed of very energetically vibrating individual and separated nuclear species rather than the sort of bulk heat that comes from air, which is by definition required for chemical combustion. The nuclear reaction can be switched off by turning off the flow of input nuclei. I add nothing new to what is already disclosed in the description. I am trying to convey the full implication of the terms which I have already used. This approach, or what I call methodology, is more analogous to, say, oil refinery processes than it is to conventional nuclear engineering.

I begin by defining the fundamental processes of nuclear fission, fusion and collision according to the invention. I need also to distinguish between temperature and heat. I attach a paper which I have written and submitted for publication to indicate the physical model that I am using.

Temperature and heat

Heat is normally considered to be the kinetic energy of atoms or molecules in a solid, liquid or gas, and it is conveyed from particle to particle by their structures of orbiting electrons. Heat is therefore a bulk property. The temperature of the bulk material is the average kinetic energy of the particles of which it is composed relative to a thermometer.

However, I am using the term temperature to describe the state of vibration of a nuclear entity which is isolated from other particles in a near vacuum. Vibration is also a form of kinetic energy, but the nuclear entity has no orbital electrons to spread the “heat”. Thus such an entity may have a very high effective temperature but very little heat. Heat is released only when the vibration of the nucleus is conveyed to other particles which have atomic structures complete with orbital electrons, or when the nucleus pulls an electron from another source into orbit around itself and becomes an atom in its own right. The nucleus does not need to come into direct contact with other particles; its positive charge is enough to disturb their motion at a distance, which is the process of transfer of heat. The distinction is fine but important in discussing the engineering processes of the invention.

Fission of nuclei

Fission of a nucleus occurs when it is caused to split into two fragments with comparable masses, which releases heat in the form of kinetic energy of particles. The process of nuclear fission is a special type of low temperature nuclear reaction, in which fission occurs when neutrons are used to bombard materials containing atoms with large unstable nuclei, such as U-235 i.e. complete with atomic orbital electrons. This is possible because neutrons as uncharged particles can penetrate the shells of orbital electrons and reach the nucleus. The temperature of reaction is low, which is an advantage in maintaining the integrity of engineering structures.

However, the bulk of material required to generate heat by nuclear fission in a sustained way involves a large quantity of heat. The reason is that critical masses of unstable elements are required in order to liberate more neutrons from fission of a nucleus than are used to cause its fission, which is the chain reaction. The actual bulk mass of material required to become critical depends on its geometry. When the operating temperature of the reactor has been reached, conditions are controlled to produce an equilibrium in which exactly one neutron is released in the bulk mass for each single neutron used in its bombardment. If the number of neutrons produced is less than that used in bombardment, the generation of heat fizzles out. If more neutrons are produced in the bulk mass than are used in its bombardment, the result is ever increasing quantities of heat in the bulk material per unit time, leading eventually to overheating and meltdown. The neutron balance is maintained by control rods of materials such as cadmium, which absorb excess neutrons. Moderator materials such as graphite or deuterated water are also used to reduce the speed of neutrons for bombardment of the bulk mass, so as to maximise their effectiveness in striking nuclei, or they simply speed past without causing fission.

Since nuclear fission requires free neutrons to act as missiles, radioactive waste is always produced in the process. Radioactive materials contain nuclei with imbalances of neutrons, and they emit hazardous particles and radiation as they adjust their structure or decay over time, both when the nuclei adopt new configurations and when their electrons accelerate back into new orbits.

Fusion of nuclei

Nuclear fusion is defined in the Encyclopaedia of Applied Physics as the amalgamation of a projectile and a target nucleus to form another nucleus. An alternative definition might be that fusion takes place when two light nuclei combine to form a bigger nucleus. The curve of average binding energy per nucleon against Mass number A shows that if two light nuclei are combined, the individual nucleons become more tightly bound, and so energy is released when nuclei move towards the peak in the middle of the curve. This takes the form of kinetic energy of particles.

Fusion is a high temperature process which requires very energetic motion of nuclei to force them together into more stable nuclear configurations. Available industrial processes also require a lot of bulk heat, as conventionally supplied by nuclear fission explosion. High temperature alone will not suffice, because heat needs to be sustained in bulk around the locus of fusion, or it dissipates too rapidly.

This combination of fission and fusion produces all the problems of both. Nuclear fusion weapons produce devastating radiation followed by radioactive fallout. Even if this sort of process could be used on a smaller and less destructive scale, these problems would remain. Hence the search for completely new approaches, such as plasma in toroids. However, the engineering problems of controlling significant quantities of materials at such process temperatures have all proved to be very difficult, even after long development.

Collision of nuclei

The collision process of the invention is different in kind. Energy for rearranging or destroying the structure of the nuclei is provided by the momentum of two heavy nuclei which collide at speeds comparable to the speed of light. Additional energy from missiles such as neutrons is not required i.e. the process does not rely on radioactivity. It is not therefore a nuclear fission process as defined above.

The collision of two heavy nuclei results in a transient entity that I have called a collision mass. A collision mass is devoid of nuclear structure, because this is destroyed by the collision, but it has some form while it lasts i.e. it is not mere shrapnel. My proposed structure depends on the analysis of nuclei given in the enclosed paper. The thesis is that neutrons, which are known to be unstable at low temperatures after ejection from a nucleus, are in fact associations of electrons with two or more protons inside the nucleus. Neutrons are known to be formed at very high temperatures, and I think pressures, which force the electrons to interact intimately with the protons. They orbit closely around and within the proton assemblies at close to the speed of light, thus binding them together while the positive charges on the protons naturally push them apart. These electrons stay with the nucleons in the nucleus. They are intranuclear electrons, as opposed to the extranuclear electrons which orbit the nucleus at a distance, take part in chemical bonding and have been calculated to orbit at about a third of the speed of light, which is slower because they are further away from the atomic centre.

(This is a variation on early models of the nucleus which was thought to contain electrons, cancelling out the positive charges of some of its protons. The model was rejected because relative masses of elements in the Periodic Table did not add up. It was followed by the theory that protons and neutrons in the nucleus continually change identity or exchange a third particle. My theory is much simpler in the Occam's razor sense. It proposes intranuclear electrons in very fast and close orbit around protons, the sort of model which is familiar in other spheres too. There are other reasons for the apparent discrepancies in the masses.)

All the extranuclear electrons have been stripped off heavy atoms as part of the preparation for acceleration to such high velocities in the accelerator. When the heavy nuclei collide, the bonds which hold them together are broken, nucleons become free and the electrons which bound them together are liberated. Since they have much smaller mass, the electrons are pushed to the outside, which is sorting by mass, but they are restrained by the large positive charge of the protons and more fundamental particles which may be derived from protons. The resulting entity is therefore composed of a core of positively charged particles having considerable kinetic energy, surrounded by the electrons derived from the original "neutrons". This is what I have called a collision mass.

A collision mass is stationary in the collision zone or at least has much lower velocity than the heavy nuclei of which it is formed, because of the cancellation of opposing momenta. Such an entity has extremely high gravitational attraction because of its large mass, which is the sum of the masses of the heavy nuclei. It may then suck in lighter nuclei which are in its vicinity. This absorption tends to cool the collision mass, but under suitable conditions the high "temperature" or energy of vibration is sufficient to cause rearrangement or fusion of light nuclei with the release of more heat and more vibration. Successive absorptions and fusions result in an increasing mass of high temperature, vibrating matter.

Expansion of the collision mass into the vacuum results in isolated particles in the form of electrons, protons and possibly helium nuclei, which are particularly stable structures. The protons and helium nuclei associate with electrons because of opposite charges, or pick up electrons from surfaces etc, and the result is hydrogen and helium atoms. Low pressure and the separation between particles mean there is virtually zero chance that electrons will resume their close orbiting of protons to form neutrons. Thus there is little likelihood of the formation of higher atomic numbers. By the same token there is little likelihood of radioactivity. The materials have been reduced to the fundamental building blocks.

All the particles produced by collision are decelerating rather than accelerating through space. This includes the intranuclear electrons which were orbiting protons at close to the speed of light. Only the acceleration of particles through the medium of space produces radiation, according to the physical model which I am using. Decelerating particles do not produce radiation, and so there is no production of hazardous radiation.

Accelerators operating under high vacuum and arranged to produce collision of nuclei are well known to those skilled in the art. Since nuclei are such small entities, it is not possible to arrange individual collisions. Instead billions of nuclei are fired at each other in streams to produce millions of collisions. The problem in research is to identify and characterise the particles which result from collision, hopefully the fundamental building blocks of matter, and so the process is kept as simple and uncluttered as possible.

This is of no importance in the process of this invention, because the sole intention is to reduce all materials eventually to hydrogen or helium. Much greater concentrations of particles can therefore be used to increase the probability of collision. One way of achieving this is by using magnetic fields to “pinch” the flows in the collision zone. The “pinch” effect was discovered in 1907, and so it is well known to those skilled in the art. The process of generating industrial power requires the sustained production of many millions of collision masses, the number of which can be controlled by switching off the accelerator. As collision masses complete their job and evaporate, they are replaced continually through new collisions.

The corollary of the preceding discussion is that there is no heating of any of the entire apparatus until the hydrogen and helium nuclei come into contact with materials in the form of gases, liquids or solids. The positive charges of the nuclei then disturb the motion of the orbital electrons of the atoms of which these materials are composed, which is heat transfer. Eventually the nuclei pick up electrons from other sources themselves, and become atoms complete with extranuclear electrons, albeit in somewhat erratic, heated orbits. These are extranuclear electrons because, as described above, the conditions are such that there is no possibility of forcing them into nuclei, which would be the reformation of neutrons. Thus the hydrogen nuclei i.e. protons become hydrogen atoms complete with extranuclear electrons, and these combine to form very hot hydrogen gas.

This is analogous to the use of ionisation trails to track the progress of individual particles for research purposes, which must all eventually result in heat. The differences are that the heat generation process of the invention requires myriads of nuclei to shed their vibration per second, and there is no interest in their tracks provided they result in hot materials which can ultimately be used to produce power. This is a much simpler and therefore cheaper process than detection. The limit to the concentration of nuclei which can be handled in this way is likely to be the erosion of materials of construction of pipes, blades etc by the high temperature particles.

On the basis of this analysis I now refer to the cited prior art.

1. GB1446671 A (WINTERBERG)

The invention is a controlled nuclear fission process comprising the steps of subjecting a non-critical mass of heavy fissionable nuclei including material capable of releasing energy by a fusion process to an imploding pulse of radiation or magnetic field whereby the mass increases in density, exceeds the critical mass and so initiates a fast neutron fission divergent chain reaction.. The term “heavy fissionable nuclei” is defined as fissionable nuclei having a mass number greater than 200. The non-critical mass may typically comprise a compressed pellet. So

- Conventional use of the term “fissionable” i.e. U235, U233 and Pu239 i.e. radioactivity.
- Conventional fission reaction – use of the term “non-critical mass” and fast neutrons.
- Critical mass of the fissionable material achieved by striking a pellet of fissionable material which is just below critical level with a pulse of radiation or magnetic field, which brings it into the critical mass range.
- The pellet may have shell like structure or just be a mixture i.e. bulk, macroscopic.
- The mass of the pellet has to be sufficient both to reach critical mass and to develop enough concentrated, bulk heat to initiate fusion reaction.

2. DE2430312 A (KUNERT)

- This appears to be a sort of light bulb filled with helium which is subjected to quantum radiation to form a plasma and initiate fusion of light elements and form electricity directly, a sort of compact toroid. This seems to have no bearing on my invention.

3. RU2212064 C1 (MOTORIN)

- This involves two simultaneous reactions of induced fission of heavy nuclei and fusion of hydrogen isotopes in the form of a metal hydride.
- The heavy nuclei are radioactive materials, that is conventional fission.
- The hydride is in powdered form , mixed with the radioactive materials.
- The result is a reaction in bulk from which heat has to be removed through heat sinks and heat conducting materials.
- It seems likely to produce all the problems of nuclear waste mentioned above.

4. JP09072979 A (SUEO)

- This is incorporation of lithium deuteride in the fuel of a nuclear reactor of the thermal neutron or fast breeder type

- The aim is to reduce fuel used and radioactive waste produced.
- The lithium deuteride can be circulated through the core of the reactor.
- Conventional nuclear engineering.

5. GB1432896 A (FISCHER)

- A nuclear reaction plasma is created and contained within a mass comprising molten lithium deuteride etc i.e. reaction in bulk material.
- The plasma is created by discharge of a capacitor between electrodes in the mass.
- It talks of the production of primary neutrons i.e. radioactivity in the reactants and the vessel containing them.
- No advantage or relevance.

6. RU2176114 C2 (EVSJUKOV)

- Nuclear reactor divided into two regions.
- First region is designed for heavy nuclear fission i.e. conventional fission.
- Second region is designed for "low temperature nuclear fusion" (sic).
- Power is controlled by inflow and outflow of heavy water i.e. conventional bulk material engineering.
- Advantages reduced cost of nuclear fuels, reduced amount of radioactive waste.
- Variation on conventional nuclear reactors.

The model of physics on which I have based the invention is not that conventionally used, but it is at least as valid an analysis of the observations, and it has the advantage of simplicity. However, knowledge of the model is not itself necessary to carry out the process. Just follow the instructions! I have included it to save later misunderstandings. I might point out that my model of physics has been argued through in respect of the Theory of Relativity (which I reject), and has resulted in two patents granted:

1. GB 2 405 225 B Radioactive timekeeping

2. GB 2 407 225 B Measurement of velocity through space

The prior art which has been cited does not seem to me to bear any relationship to the process described in my application.

Yours sincerely,

A.C. Sturt

Enclosure:
Neutrons in the Structure of Atomic Nuclei by A.C. Sturt 29 November 2006.