

WO 02/31833 A1

NUCLEAR TRANSMUTATIONAL PROCESSES

Background

5 The background of this invention relates to a nuclear transmutational process powered by an altered state hydrogen process.

 The invention is based on mostly astronomical observations, some of which are of the last few decades. It has been noted that when looking at the Abundancy Curve of the elements, which are known to exist in our universe, that the elements *Li*, *Be* and *B*
10 are very scarce in relation to their location in the Periodical System. (See Fig. 1; the Abundancy Curve of the elements). There must be reasons for this. The factors: pressure, temperature and other parameters e.g. certain configurations in their respective nuclei, whereby these named elements are being converted, apparently are occurring rather frequently in many locations in the universe, wherefore we can assume
15 that the values of the factors which allow conversions of these elements, either 'upwardly' via nucleosynthesis processes into heavier elements, or 'downwardly' by means of fission to hydrogen or helium or isotopes thereof ($He_2^4, He_2^3, H_1^3, H_1^2, H_1^1$) are favorable for such conversions to take place. Also it became clear to Inventor that certain isotopes of *Li*, *Be* and *B* can act as catalysts in certain processes. Whereas
20 these elements carry few electrons, their nuclei are easily approachable by elementary "particles", e.g. protons. In this Invention use is made of the properties of certain isotopes of *Li*, *Be* and *B*, which carry an extra neutron, in a function as "nucleonic catalysts" and "transmutational elements". This is a new concept; so far catalysts always only referred to actions by electrons in the outer shell of atoms.

25 Furthermore in a different category of astronomical observations in deep space, (in numerous locations by now) but also in solar flares in the corona of the sun, spectral lines were found which can be attributed to hydrogen in the extreme left UV and in the Soft X-ray areas. These lines correspond with photon energies, which are greater than those we are familiar with in the Lyman series. We hereby refer to observations which
30 were made by Labov and Bowyer and by Golub and Pasachoff; (See: Labov, S., Bowyer, S., 1991, "Spectral Observations in the extreme Ultra-Violet background", The Astrophysical Journal, 371, pp. 810-819) and also: Golub, L., Pasachoff, J.M., 1997, "The Solar Corona", Chapter 9.3 and in particular p. 294 (Table 9.4), The

Cambridge University Press, all of which corroborate hydrogen lines in the extreme UV and Soft X-ray areas. Insertion of these newly found energy data into the Rydberg formula, show correspondence with values for “ n ”, which are to be fractions instead of whole numbers (n is the quantum level number). The Rydberg formula is shown herewith:

$$\nu = \frac{E - E_2}{h} = \frac{me^4 Z^2}{8\epsilon_0^2 h^3} \left(\frac{1}{n_2^2} - \frac{1}{n_1^2} \right), \quad (1) \quad \text{or} \quad \bar{\nu} = R \left(\frac{1}{n_f^2} - \frac{1}{n_g^2} \right), \quad (2), \quad \text{wherein}$$

$R = 109.7 \text{ cm}^{-1}$ and $n_f > n_g$, whereby $n = \frac{1}{p}$, wherein $p = 1, 2, 3, \dots$ (p is in whole

numbers). In this formula $m = 9.1 \times 10^{-31} \text{ kg}$, $e = 1.6 \times 10^{-19} \text{ Coulomb}$, $Z = \text{atomic nr.}$ ($=1$ for hydrogen), $\epsilon_0 = 8.85 \times 10^{-12} \text{ Farad/m}$ and $h = \text{Planck's const.} =$

6.62 $\times 10^{-34} \text{ Joule sec}$

The fractions correspond with quantum-levels below the so called “ground-state” and for the forms of hydrogen whereby its electron is at quantum-levels below the “ground-state” a new name has come into place for the whole group, namely “fractional hydrogen”. See inventor’s book Fluidum Continuum Universalis, Part I, Chapter 4, which is being, publicized by www.greatunpublished.com # 270. The energies of the

$$\text{electron of hydrogen are given by the Bohr equation: } E_{\text{electr.}} = -\frac{Z^2 e^2}{8\pi\epsilon_0 a_H n^2} \quad (3),$$

$$\text{wherein } a_H = \text{Bohr radius. } E_{\text{electr.}} = -\frac{Z^2}{n^2} \times 2.18 \times 10^{-18} \text{ Joule, } E_{\text{electr.}} = -\frac{13.6}{n^2} \text{ eV} \quad (4).$$

For the “fractional states”, $n = \frac{1}{p}$, whereby $p = 1, 2, 3, \text{etc.}$ (whole numbers).

For the electron-proton distance as function of the quantum-level is valid:

$a_H = .053 \times n^2 \times 10^{-9} \text{ m}$ and for the orbit velocity as function of the quantum-level

$$\text{we have: } v_{(n)} = \frac{e^2}{2h\epsilon_0} \frac{1}{n} = 2.2 \times 10^6 \times \frac{1}{n} \text{ m.sec}^{-1}. \quad (5)$$

It is an object of the present invention to provide a method of generating energy which does not employ chemical reactions or fission processes.

It is another object of the present invention to provide a method generating energy, which is cheap, reliant and which produces no undesired waste products.

It is again an object of the present invention to provide an energy generation method, which uses a material which is present in abundance.

Summary of the invention

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Thereto, the method according to the present invention comprises the steps of:

- a. introducing hydrogen in a reactor vessel, the vessel comprising a cathode, an anode and an ionization element, the cathode comprising a primary and a secondary transmutational element, the transmutational elements having in their

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nucleus a number of neutrons which is larger than the number of protons, and wherein at least one neutron has a preferred orientation;
- b. Ionizing at least a part of the hydrogen with the ionization element to form a plasma,
- c. Applying a voltage differential across the cathode and the anode, causing protons

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to travel to the cathode and to induce a transmutation of the transmutational elements which combine to form an element of higher mass number than the mass number of said transmutational elements under the release of energy;
- d. collecting heat and/or on other energy formed in step c.

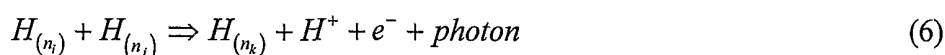
Suitable primary transmutational elements comprise an element of the group

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consisting of Li_3^7 , Be_4^9 , B_5^{11} . The secondary transmutational elements may be chosen from the group consisting of Al_{13}^{27} , Mg_{12}^{24} , In_{49}^{115} or any combinations thereof.

Laboratory runs with the processes, which are the subject of this Invention indicate that a mixture of various "fractional states" is simultaneously being formed and also that those states appear to be very stable. This was proven in many lab

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experiments during the second half of the year 2000. Therefore we can say that the "ground-state" is that stable state with the highest possible energy. (The "excited states" have still more energy, but they are not stable). If various "fractional states" exist together or are brought together in process, then reactions between those states can occur, which result in further ionisation and further lowering of quantum-level,

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while photons are being produced. The following general formulation for these reactions is:



wherein $n_i \neq n_j$ and $n_k < n_i$ and $n_k < n_j$

The phenomena of these processes as are described above and of the processes under this invention in general, are novel. Neither fission, nor chemical reactions take place. This Invention shows the formation of photon energy in a frequency range, which is safe for all biological life forms, including for humans. The processes involve conversions of hydrogen, whereby in ultimo the net produced photon energy comes at the expense of the 'constitutional energy' of the electron itself. The 'constitutional energy' of the electron in the "ground-state" is about 511,000 eV. For the "fractional states" this energy becomes less as the state is a lower one. (See book: Fluidum Continuum Universalis, Part I, Chapter 4). At this time numerous laboratory runs have been made (more than 1,000 hours), during which "fractional hydrogen", and photon energy were being produced and in which Al_{13}^{27} , Mg_{12}^{24} , In_{49}^{115} as secondary transmutational elements were transmuted into S_{16}^{32} , K_{19}^{40} and Sb_{51}^{123} respectively. To date, neither Gamma rays, nor Beta radiation, nor Alpha particles were ever observed with running these processes. The produced radiation in its totality is from Blue-Violet to Extreme UV-Soft X-ray. This process technology has been certified by the well known national laboratory: Applied Technical Services Inc., address: 1280 Field Parkway, Marietta, Ga., 30066, USA. The report number is M14343 and is dated March 01, 2001. This report is made part of this patent application as Exhibit A. The composition of the totality of the radiation depends on the various parameters to the process, including materials compositions of certain parts of the apparatus. Inside the enclosed reactor system, which contains hydrogen at pressures generally lower than atmospheric pressure, plasma is being formed, preferably in the presence of Tungsten (W) after the establishment of a certain electrostatic and electromagnetic field combination between the cathode and the anode. The Tungsten, which is being applied as a catalytic item, can have a variety of shapes: e.g screen, (either length-wise or cylindrically length-wise), or as a plurality of strips, or as in the shape of a coil, which gave the best results. The plasma in the reactor tends to mostly stay within the coil. Better ionisation can be obtained by applying a high frequency AC voltage of minute power to the Tungsten coiling. However in the second half of the year 2000 it became clear that by placing the ends of the coiling close to the cathode and anode, there was sufficient induction in the coiling (caused by the electromagnetic field component), that

satisfactory ionisation resulted. The application of coiled Tungsten also eliminated the need for electromagnetic focusing by means of so called Helmholtz pairs. The start-up of the discharge through the reactor requires a voltage which is higher than the voltage which is in existence during normal operation. When more plasma gets formed (this takes only seconds in case of applying Be_4^9 as “nucleonic catalyst”, but many minutes if B_5^{11} is used for the same function in the cathode assembly), then the voltage differential is lowered to a level, which is just sufficient to maintain a continuous discharge, which means continuous operation of the reactor. As temperatures rise in the reactor system and all processes run easier, then a further gradual decline of the voltage differential is possible; this calls for a voltage control, primarily based on temperature. In common ‘discharge tubes’ the protons travel to the cathode where they pick up free electrons at the cathode surface by which atoms of “ground-state” hydrogen are being formed again, or even “excited-states” ($n > 1$) in case of plentiful available energy (high temperatures and or high voltage differentials within such ‘discharge tubes’). However if: (a) a more or less pulsed DC voltage is being applied, the character time-function of which is important and (b) an additional component is made part of the cathode or is at least present in the surface of the cathode and which component causes so called “electronegative” areas, which attracts protons (provided that they are at close proximity) without the need of an electric field whatsoever, then a totally different course of events takes place. If ‘bonding’ to the “electronegative” areas, which are an inherent part of the additional component in the cathode, takes place by a certain percentage of the protons, which arrived at close proximity of the cathode surface, then after the point in time when the voltage differential is minimal or zero (which is caused by the intermittently existing electrostatic/electromagnetic field) when the field returns in full force, it will take more energy for free electrons to bond with those protons which are held by the “electronegative” areas of the additional component.

To ‘free’ these protons more attractive force needs to be exerted by the free electrons, which can only be achieved by moving in closer to those protons (the force increases with the reciprocal of the square of the distance between electron and proton) then the orbit of the “ground-state”. Therefore the electrons must ‘fall’ through one or more quantum-levels. The energy conversions which take place correspond with the Rydberg formula, whereby then “fractions” e.g. $n = \frac{1}{2}, \frac{1}{3}, \dots$ etc are to be inserted in

this formula in order to find the photon energy levels. This 'falling' through quantum-levels produces energy levels of the photons which correspond with the 'depth' of the 'fall'.

When "fractional hydrogen" is being formed then this mostly occurs as a simultaneous formation of various states.

Brief description of the drawings

The invention will be described in detail with reference to the accompanying drawings. In the drawings:

Fig. 1 shows the abundance curve of the elements in space;

Fig. 2 shows a schematic view of the structure of the neutron;

Fig. 3a, 3b and 3c show the electronegative areas of the nucleus of Li_3^7 , Be_4^9 and B_5^{11} respectively;

Fig. 4 shows the double-vortex-ring structure of the proton;

Fig. 5 shows the double-vortex-ring structure of the electron;

Fig. 6 shows a schematic detail of a proton being in a bound states to an electronegative end of a neutron and being bound to a free electron;

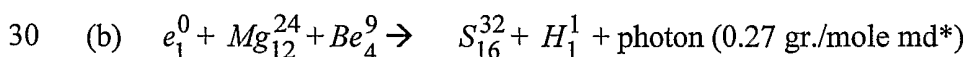
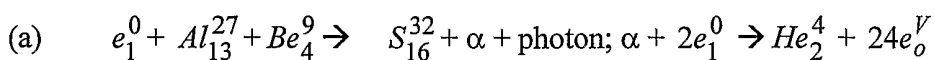
Fig. 7 shows a first embodiment of an apparatus for carrying out the transmutational process according to the present invention; and

Fig. 8 shows a second embodiment of an apparatus for carrying out the transmutational process according to the present invention.

Detailed description of the present invention

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Besides the primary process in which "fractional hydrogen" and "bi-electronic hydrogen" are being formed, this present invention utilises several transmutational processes including:





The purpose of the reactions b, c and d is the production of H_1^1 , which is the fuel component for the "fractional" and "bi-electronic" hydrogen formation processes.

- 5 *) md = mass defect; the mass defects here given are only approximate; e.g. said transmutation of Al_{13}^{27} providing photo-electricity of substance (extreme UV photons \approx 120 nm); said transmutation of Mg_{12}^{24} providing a large amount of heat (photons with longer wavelengths > 500 nm).

- 10 In the transmutational processes as described above, energy is generated from (1) the formation of fractional hydrogen, (2) the reaction of different fractional hydrogen states with each other and (3) by the transmutational process.

A number of "fractional states" together with their energy levels and energy differentials between the states as well as the corresponding wavelengths has been taken up herein and is shown in Table I.

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Table I:
Fractional states of hydrogen

n_{Rydberg}	$E \rightarrow \text{Gr.St.}$ (eV)	$E \rightarrow \infty$ (eV)	ΔE (eV)	λ (Å)
1 "Ground State"	0	-13.6	$n_i \rightarrow n_f$	912.0
$\frac{1}{2}$	-40.8	-54.4	$1 \rightarrow \frac{1}{2}$ 40.8	303.9
$\frac{1}{3}$	-108.8	-122.4	$\frac{1}{2} \rightarrow \frac{1}{3}$ 68.0	182.4
$\frac{1}{4}$	-204.0	-217.6	$\frac{1}{3} \rightarrow \frac{1}{4}$ 95.2	130.2

$\frac{1}{5}$	-326.4	-340.0	$\frac{1}{4} \rightarrow \frac{1}{5}$ 122.4	101.3
$\frac{1}{6}$	-476.0	-489.6	$\frac{1}{5} \rightarrow \frac{1}{6}$ 149.6	82.9
$\frac{1}{7}$	-652.8	-666.4	$\frac{1}{6} \rightarrow \frac{1}{7}$ 176.8	70.1

Reactions between “fractional states” also occur simultaneous with first time formation of “fractional states” out of protons, whereby further ionisation, photon emission and “lower” “fractional states” result. The related formulation is equation (6). If for instance a reaction between “fractional states” takes place, whereby one “fractional

state” is $H_{\left(\frac{1}{n}\right)}$, then the wavelengths as function of ΔE are: $\lambda_{(Angstrom)} = \frac{1.24 \times 10^{-4}}{\Delta E(eV)}$ (7)

For all practical purposes “fractional hydrogen” is inert and cannot react with Oxygen anymore. It has been observed that when an electron ‘falls’ to a lower quantum-level, sometimes a second electron can attach to the same proton, but then at a different quantum-level (to satisfy the “Pauli exclusion principle”). In this manner “Bi-electronic hydrogen” is being formed, the ions of which are negatively charged $H^{-}\left(\frac{1}{p}\right)$ (8)

See: Fluidum Continuum Universalis, Part I, Chapter 4.2. According to the website of Blacklight power Inc. of Cranbury, N.J., this firm is active in the research and development of new materials, which are based on negatively charged hydrogen ions, which this firm obtains via a different process method. The discovery of “Bi-electronic hydrogen” might also become a matter of major advance in chemistry.

The negative hydrogen ion is presently subject to research in a number of labs around the world (e.g. reporting about ‘Vacuum-UV spectroscopy of the negative hydrogen ion’, refs.: P. Balling et al., Phys. Rev. Lett. 77, 2905 (1996); H. H. Andersen et al., Phys. Rev. Lett. 79, 4770 (1997)). Inventor expects that as result of the launching of the FUSE satellite, which occurred on June 24, 1999 (FUSE stands for: Far Ultraviolet Spectroscopic Explorer) much insight will be obtained with regard to the occurrence and frequency levels, which go with these occurrences of the high energy lines in the

spectrum of hydrogen, which have been called herein: “fractional hydrogen” lines. A report on the mission of the FUSE program and description of the IDS Computer which commands the FUSE instruments, has recently been given by B. K. Heggstad and R. C. Moore of Johns Hopkins University, Applied Physics Lab., Laurel, Maryland, 20723-6099. Other institutes involved in FUSE related research are: Center for Astrophysics and Space Astronomy, University of Colorado, Boulder, Co., 80304 and Space Sciences Lab of University of California, Berkeley, Ca., 94720. Inventor expects that after practical applications of the process(es) as described in this Invention, which center on “fractional hydrogen”, will be publicly known, there will be frantic research relative to “fractional hydrogen” by labs worldwide. Inventor has indicated in FCU, Part I, Chapter 4, that theoretically 83 quantum-levels or states of “fractional hydrogen” are possible. However, the reaching of very low quantum levels with terrestrial experiments is unlikely; very low states are being reached in certain locations in the cosmos.

Protons can be bound to so called “electronegative areas” in or at the outer perimeter of nuclei. Neutrons, being “cigar-like” in shape are equally negative at one end as they are positive at the other end. Nearly always the neutrons have their negative end more or less pointed towards the “geographical center” of the nucleus, whereby this negative end functions in keeping two protons attracted and located in close proximity of this negative end, which means that two protons can be kept in close proximity of each other in a nucleus. No need for a “Strong Force”. This is the mechanism by which nuclei exist and whereby many positive charges/protons are kept together in a small location. The so called “Strong Force” is non-existing and is a physical artifact from the 1930-ties, which came into being by way of assumption and because of a lack of understanding of nuclear structure.

“Electro-negativity” is that characteristic of a nucleus of an atom, which expresses itself as a location at or in the nucleus where there is a need for fluid energy inflow.

According to Fluid-Mechanical Physics, the Introduction to which is described in Fluidum Continuum Universalis, Part I, which is a book written by Inventor (this book is available at www.greatunpublished.com # 270), electrons have a strong need for axial/polar fluid inflow. The electron is also part of the neutron, in that a neutron is composite entity, which consists of a proton at one end and an electron at the other end,

both of which are being kept apart as well as together by an anti-neutrino. Neutrons are quite unstable when on their own (11 minutes half-life), but when bound in nuclei, which is via their negative end, which can attract one or two protons simultaneously, neutrons are stable. All areas at or in nuclei which have an electronic end exposed, which is not supplied with fluid energy by a closely located proton are “electro-negative” areas. If these areas are accessible by protons then bonding with protons will occur. This process is one of the two which are active and responsible for nucleosynthesis. Particularly the isotopes Li_3^7, Be_4^9, B_5^{11} have extra neutrons to their nuclei, which provide for a greatly exposed negative end; these nuclei have few electrons attached and can easily be approached by protons. The elements: *Cd, In, As, Sb* have prevailing isotopes, which also have electronegative areas, however they are less exposed when compared with *Li, Be, B*; such is the case with the elements *Pd, Pt*, they have even more than one electronegative area in their nuclei, but they are not exposed.

“Electro-negative areas” are such areas in or at the perimeter of nuclei, where there is a need for energy inflow; this inflow can be provided by a proton or by the positive end of a neutron and if the scenario of this mechanism is enacted then the proton or the neutron (with its positive end) is more or less strongly bound to this electronegative area. See FCU, Part II, Chapter 10, ‘Nucleosynthesis and the Elements’. Part II will be published by www.greatunpublished.com during the winter of 2001-2002. In the event that a neutron is bound to an “electro-negative area” (which is with its positive end), then the negative end of said neutron points outwardly and away from the center of the nucleus. This negative end then can easily function as a proton catcher. Use is made of this characteristic for the workings of the process of this invention.

Furthermore for nuclei to be approached by protons, it is important that the element has as few electrons at its outside/perimeter as is possible. Logically the elements: *Li, Be, B* fulfill this requirement and these elements also have isotopes which have an extra neutron to their nuclei. These isotopes are resp. Li_3^7, Be_4^9, B_5^{11} and nature apparently agrees with the theory of nuclear structure as mentioned above, because it shows that these isotopes are the prevailing isotopes in the compositions of these

elements as they are found in nature. The respective prevalences are: $Li_3^7 - 92.6\%$; $Be_4^9 - \approx 96\%$; and $B_5^{11} - \approx 81.5\%$.

These isotopes have in fact the extra neutron attached so that the negative end is pointed outwardly, wherefore these elements react so easily with other protons or neutrons, which in turn explains the relative scarcity of these elements in our universe. For the better understanding of the fluid-mechanical structure of the neutron and of the nuclei of named isotopes Li_3^7, Be_4^9, B_5^{11} reference is made to Fig. 2 and Figs. 3a, 3b and 3c. The structures of these nuclei are also exhibited in Fluidum Continuum Universalis, Part II, Chapter 10 (www.greatunpublished.com).

These structures are logical results of fluid mechanical physics considerations. The likelihood of these structures are also indicated by A. G. Gulko in Vortex Theory (1980).

A number of analogies also exist in the work of M. Planck; (see: F. Winterberg, 1990 in Z. Naturforsch. 45: Planck Aether Model of a Unified Field Theory and Z. Naturforsch.

46: A Model of the Aether comprised of Dynamic, Toroidal Vortex Rings. There are also numerous publications, which carry elementary physics subject matters, which show some aspects, which relate to the theoretical work of this Inventor.

Reference be also made to publications by; T .H. Boyer (1975), M. B. King (1994), B. Haisch (1996) and R. N. Mills (1998) and others.

Inventor has greatly expanded Fluid Mechanical Physics and has been able to determine the dimensions and energies of the rotational, irrotational and helical component flows of the elementary "vortex toroid". The latter is the basic "Closed Vortex Entity". Composites thereof, which are known as the "particles", are built up and constituted by "vortex toroids". Also the dimensions, energies and other factors as charge and spin of the muon neutrino, electron, positron, proton, neutron and meson have been determined by Inventor. A listing of the energies, charge and spin characteristics of some of the here named "particles" is taken up herein and shown as Table II.

Table II:

	Fluid Dynamic "Mass"	Classical Physics Mass	Fluid Dynamic Energy Rate	Classical Physics Energy	Fluid Dynamic Charge Force	Fluid Dynamic Spin Energy Rate
			Potential Energy			Spin Velocity
Unit Expression	$\rho_o d^3$	kg	$\frac{\pi}{4} \rho_o d^2 c^{*3}$	Joule	$\rho_o d^2 c^{*2}$	$\rho_o d^2 c^{*3}$
			$\rho_o c^{*2}$	eV		c^*
Dimen- sionality	$N_{el.u.}$	kg	$N_{el.u.} L^2 T^{-3}$	$ML^2 T^{-2}$	$N_{el.u.} L T^{-2}$	$N_{el.u.} L^2 T^{-3}$
			$N_{el.u.} L^{-2} T^{-2}$			LT^{-1}
Electron- Neutrino/- Anti- Neutrino	$\approx 6 \times 10^{-3}$	$\approx 5 \times 10^{-36}$	≈ 1.1	$< 5 \text{ eV}$	N.A.	$\approx .1$
Muon- Neutrino	≈ 7.5	3.7×10^{-34}	≈ 2.0	207eV	N.A.	$\approx .18$
						.064
Proton/Anti -proton	≈ 60	1.67×10^{-27}	6.00	938MeV	≈ 3.0	$\approx .3$
			.40			.064

Electron Positron "at rest"	Pos. 2.73	9.1×10^{-31}	≈ 2.2	511KeV	.00128	$\approx .06$
	Neg. 2.70 Net .327					.064
Electron "in motion" $v = .99c^*$	≈ 59	$\approx 1.65 \times 10^{-27}$	≈ 5.9	$\approx 900 \text{MeV}$	≈ 2.9	$\approx .29$
						.064
Hydrogen Atom	≈ 60.03	$\approx 1.67 \times 10^{-27}$	≈ 8.2	$\approx 938.5 \text{MeV}$	N.A.	$4.4 \times 10^{-18} \text{J}$
						2.2×10^6 m.sec ⁻¹

Inventor also laid a "bridge" to some aspects of the (unnecessary) Quark Theory, which comprises other artificial conceptions.

Referring to Fig. 2: The neutron is a composite particle, consisting of a proton
 5 and an electron, which are held together and simultaneously kept apart by an anti-neutrino. More detailed description is in FCU, Part I, Chapter 4.3 and in Part II.

Referring to Figs. 3a, 3b and 3c, which show the nuclei of Li_3^7, Be_4^9, B_5^{11} , the
 reader note the positioning of the extra neutron to the nucleus; how it is attached and
 how it is pointed outwardly, so that a positively charged entity, as the proton and the
 10 positive end of the neutron, can be attracted. Referring to Figs. 4 and 5: these show the double-vortex-ring structures (or vortex pairs) of the proton and the electron. See FCU, Part I, Chapters 3.3 and 3.4.

Existing, accepted physics clearly has problems in certain areas of application of the

Bohr Theory and also with the Schrodinger equation. Sub. Bohr: With $\frac{mv^2}{2} = kT$, then

15 at $T = 0K$, the orbital energy would be 0 and the electron would spin into the proton and the charges would be annihilated. This does not happen; wherefore Bohr is certainly wrong in the low temperature range. Also citing a formulation as set up by

M. Planck: $U = \frac{h\nu}{e^{\frac{h\nu}{kT}} - 1} + \frac{h\nu}{2}$ we see that at $T = 0K$, that there is a remaining energy

being equal to $\frac{h\nu}{2}$. This is in full accordance with Inventor's work and this energy

equals the total of the rotational, irrotational and helical component flow energies of the electron, which is also its basic constitutional energy, which is $511KeV$.

5 Fig. 6 shows a detail drawing of a proton being in a "bound" status to an "electronegative end" of a neutron, while it is being approached by a "free electron".

Note the "fluid flows"; in order to overcome the "binding energy" with which the considered proton is bound to the "electro-negative end" of the extra neutron in Be_4^9 ; it must come closer to the proton than with the normal bonding in the "ground-state".

10 Therefore this electron must "cross" or "fall through" one or more quantum levels, which causes the creation of "fractional hydrogen" and a photon of related energy.

Since the "fractional hydrogen" atom has a smaller size, it is more difficult to contain; "Lower fractional states" can leak through certain energy barriers or "walls".

It was observed by inventor in lab runs with the process of this Invention, wherein

15 "fractional hydrogen" was being formed, that the pressure inside the totally sealed reactor lowered somewhat even while the temperature had increased. The possibility for "fractional hydrogen" to react with other elements e.g. O and N is virtually nill. For all practical purposes, the "fractional states" of hydrogen are inert.

However "fractional states" can react with each other, which is reflected in the

20 foregoing, by formula (6). Research and development is being done by Blacklight Power Inc., a New Jersey, US company, with regard to reactions involving "fractional states" as well as reactions with "Bi-electronic hydrogen, the ions of which were named hydrino's by Blacklight Power Inc. An invention, patented under US nr. 6,024,935 by R. N. Mills et al. shows that the invention and methods which are mentioned therein are

25 very different and in a different area when compared with this invention and this application for patent. Blacklight Power Inc.'s technology which is disclosed in US pat. nr. relates primarily to electro-chemistry and in particular to electrolytic processes with potassium complexes.

In lab runs with the process of our Invention it has been shown that "fractional

30 states" react with each other, which also results in further production of protons, which

in turn minimises the need for electric power for the purpose of ionisation, which is an objective and which makes that process “over-unity” is reached rather easily.

In the following there is a comparison of energy yields between the process of this invention with:

- a. Thermo-nuclear Fusion
- b. Conventional Combustion of hydrogen with oxygen.

Assume “fractional hydrogen” is being formed from the “ground-state” to “state”

$$n = \frac{1}{6};$$

then photon energy is emitted of about $\frac{1}{2} KeV$ and if the “state” of $n = \frac{1}{9}$ were reached

then about $1.1 KeV$ is emitted. E.g. if an electron were to go from $n = \frac{1}{2} \rightarrow n = \frac{1}{10}$ then

roughly $1 KeV = 1.6 \times 10^{-16} \text{ Joule}$ energy becomes available.

Considering: Thermo-nuclear Fusion in the sun: (See many publications on this subject matter, e.g. in Scientific American, by John Bahcall of Cal.Tech) reactions which likely take place are: $\text{proton} + \text{proton} \Rightarrow \text{deuterium} + \text{positron} + 420 KeV$,

$\text{proton} + \text{electron} + \text{proton} \Rightarrow \text{deuterium} + 1.44 MeV$.

This shows that the energy yield of the process of this Invention is in the $1/1000 \times$ category compared to the yield of thermo-nuclear fusion in the sun and which after many years of research and billions of dollars of expenses has never been copied on any sustainable basis on earth.

Considering: Conventional Combustion of hydrogen with oxygen.

The energy produced by molecular hydrogen combustion is $51,600 \text{ Btu/Lb}$, which is $118,700 \text{ kJ/kg}$. One mole of hydrogen contains 6×10^{23} molecules (Avogadro nr.); molecular weight of hydrogen being 2, means that that the energy per hydrogen atom is 118.7 kJ/gr , divided by 6×10^{23} , which is $1.2516 eV$ per hydrogen atom. The

conclusion is that the process of this Invention is in the category of producing $500 - 1000 \times$ more energy per atom of hydrogen than the combustion process can produce, wherefore the technology of this Invention provides for a ‘quantum leap’ in progress for the production of energy. Recent lab runs show substantial “overunity”. Outgoing electric power and heat together are substantially (e.g. $> 4 \times$) greater than the required

ingoing electric power. Two control mechanisms are desirable: a. The intermittent

addition of hydrogen be controlled by the pressure and possibly also by removal of “fractional and bi-electronic hydrogen” for temporary storage for later use purposes. b. The voltage differential between cathode and anode be controlled majorly by temperature and minorly by the pressure. In a newer further improved process version,
5 no addition of hydrogen during operations is needed, because of a secondary and simultaneously running nuclear transmutational process which produces protons. Also protons are produced if some “fractional states” convert into “lower fractional states” according to formula (6), although this last named process would not produce enough protons to keep the process continually going, wherefore the need for the nuclear
10 transmutational process.

In the event that “fractional and bi-electronic hydrogen” are removed during process operations, then a secondary evacuating pump and storage are needed. Such a sub-system is shown in Fig. 9. “Fractional hydrogen can react again with “ground-state” in a reactor with cathode and anode and having a voltage differential between
15 those and produce radiative energy. Bi-electronic hydrogen can (upon ionization to negatively charged hydrogen ions) form new molecules/materials hitherto unknown.

One can logically assume that process conditions vary widely as to which “nucleonic catalyst” is being used. Furthermore many dimensional parameters and alloy composition parameters greatly influence the energy production.

20 Energy is being produced in three locations:

- a. In the cathode area 40 – 80% of the total energy. Radiation is Soft X-ray, extreme UV and some violet to blue. This radiation can be directly converted into electrical power by using the photo-electric effect, wherefore there are a photo-cathode and a photo-anode around the cathode. The wavelengths of this radiation is
25 such that the “surface-exit-energy” (is the “workfunction”) of the electrons in certain metals, e.g. *Cs, Rb, Na, K, Ba, Sr* has been surpassed. The first and second “fractional series” radiation can also free electrons out e.g. *Cu* and *Zn*.
- b. In the ionization area 20 – 60% of the total energy. Radiation is from the blues to pink. This radiation is best used as heat, either directly or for powering a thermo-
30 dynamic cycle, including a Stirling cycle.
- c. In the ionization area in the central area next to the anode “bi-electronic” hydrogen is being formed after the process has matured and afterwards continually. This is an exothermal reaction and thus produces heat.

With reference to a., two modes of construction have proven to be possible. One is featuring a chamber around the cathode area from which it is separated by a radiation transmitting material, e.g. quartz. Inside the chamber are the photo-cathode as a shield against the outer wall of this chamber and the photo-anode, which can be either against the sides of said chamber or be a screen diametrically inside of the photo-cathode. The photo-anode be made of an electro-conductor. If the photo-cathode is covered with an element with a relatively low energy "workfunction", e.g. *Cs, Rb, Na, K, Ba, Sr*, then this chamber must be void of oxygen, wherefore it must be first evacuated and then filled with an inert gas, e.g. *Ar*. The second mode of construction, which was discovered in the fall of 2000 is by bringing the photo-cathode and photo-anode inside the reactor, but being electro-magnetically isolated from the electrostatic and electromagnetic fields which exist between the cathode and anode in the reactor. This isolation is established by constructing a so called "Cage of Faraday" around the cathode assembly, which allows sufficient space for the electrostatic and electromagnetic fields, so that protons can approach the cathode unhindered at all locations. The openings in the "Cage of Faraday" as well as the openings in the photo-anode are sufficiently large and best also aligned with each other, so as to allow that radiation from the cathode can easily reach the photo-cathode. In operation small voltage differentials are in effect between the photo-cathode and photo-anode, respectively "Cage of Faraday". Substantial electric currents then result if sufficient radiation of short enough wavelengths is available. This electric power is electronically converted to a DC status at a voltage level, so that it can be directly used for powering the primary electrical circuit (of which the cathode and anode are part) and/or be stored into the intermediate electric power storage (small battery). If the electric power production is greater than the electric power use ("overunity"), then the excess power is available for whatever use. Also electric power can be substantially produced from that part of the radiation in the ionization area, which is in the 400nm – 900nm range, by using *GaAs/Ge* photo-voltaic cells. The electrical output efficiency runs up to 20% of all radiation in the ionization area, which is in the 400nm – 900nm range. The remaining 80% becomes available as heat.

Some heat is produced in the cathode area, although most radiation in this location is of sufficiently short wave-lengths that direct photo-electric conversion can take place; the majority of the heat (80% plus) is produced in the ionization and anode areas.

This heat can be used either directly or for powering a cycle system (e.g. a Stirling system).

5

Process Description.

Fig. 7 shows a reactor system with an annular space surrounding its cathode area, from which photo-electricity is being produced and a jacket around the ionisation area for the collection of the convective heat, which is produced by this area.

Fig. 8 shows a reactor system, which has a diametrically enlarged cathode area in which the "Cage of Faraday" and photo-cathode and photo-anode are located and from which the photo-electricity is being produced as well as a jacket around the ionisation area for the collection of the convective heat, which is produced by this area.

Referring to the laboratory layout as shown in Fig. 7:

By means of variac (variable transformer) 1, transformer 2, bridge rectifier or 'half' rectifier (diodes) 3 and 'filter' 4, a wide range of more or less pulsed DC is available between cathode 8 and anode 5. The ionisation area 6 is shown with a Tungsten coil and high frequency power source 7. The latter feature is optional (if the ends of the Tungsten coil are placed close to anode and cathode, then electric induction takes place, which has proven to be sufficient for the further promotion of the ionisation of hydrogen).

Cathode 8 is surrounded by reactor tube section 9, which is preferably made of quartz, which allows high transmissivity for UV. The annular space around 9 is indicated by 10; inside, it has at its outer perimeter the photo-cathode 11, which may be made of *Cu* or *Cu/Zn*. These materials allow the 'photo-electric' effect to occur from the first "fractional series" of hydrogen on down. For better utilisation of some longer wavelengths in the UV an inner surface layer 11 made up of suitable element(s) e.g. *Ba, K, Rb, Cs* is applied. The photo-anode(s) 12 are shown imbedded in the sides of the annular space, but 12 can be placed as a concentric screen (inwardly from the photo-cathode) as well. Because of the low values for the "ionisation constant" of elements, like *Ba, K, Rb, Cs*, the annular space is filled with an inert gas e.g. *Ar*, after first having been evacuated. Both the reactor system 00 and annular space 10 are hooked up

to vacuum-pump system 13. The mV gauge 14; the mAmp gauge 15 and Watt-integrator 16 are part of the photo-electric circuit; the voltage for this circuit is being supplied by potentiometer 17; this voltage needs to be regular fairly constant DC, wherefore a 'filter' might be taken up in this circuit. Volt-meter 18, Watt-meter 19, recorder 19a and mAmp-meter 20 are part of the primary electrical circuit of reactor system 00. The pressure sensor-gauge and motorised valve 21 can cause hydrogen to be supplied to the reactor system at a controlled pressure level. This hydrogen can be supplied by either an electrolysis unit 22 or by a bottle 23.

However, if transmutational processes are being applied, e.g. process b, c or d (see pages 6 and 7) which produce protons, then no further hydrogen needs to be supplied for process runs of indefinite length.

Thermocouples 24 give read-outs at 25, which is also connected to voltage control 25a. A jacket type heat-exchanger is positioned around reactor system 00 and is indicated by 26. This jacket can be extended to include the anode area as well, so as to utilise most of the produced heat.

Operation.

The operation described below refers to the laboratory set-up as is shown in Fig. 7 and with the use of Be_4^9 as nucleonic catalyst.

After evacuation of the reactor system 00 and the multiple purgings with hydrogen, hydrogen is let into the reactor system at the 'early' operating pressure of 1000-1500 mT. Also the annular space is evacuated and then filled with Ar.

After applying a DC voltage differential of 500 – 550 Volts and a simultaneous super-positioned AC voltage of specific character of about 900 Volts, plasma is formed and shows in all sections of the reactor system. After a few minutes the Voltage can be regulated back by 50-100 Volts DC. After this, the pressure is allowed to increase to 2500-3000mT. A current establishes itself in the range of 2-5 mAmps. This means a power consumption of the reactor system of 1 – 3 Watts. In the ionisation area the plasma colors from deep pink, to light pink, light blue into violet. In the cathode area there is blue (and violet if the element Ti is part of the composition of the cathode),

furthermore in the (invisible for the eye) extreme left UV and soft X-ray there are the first and second “fractional series” ($n = \frac{1}{2}$ resp. $n = \frac{1}{3}$ in the Rydberg formula).

With output voltages of 2 – 4 Volt between photo-cathode and photo-anode and about 1.5 Volt between photo-cathode and “Cage of Faraday” and mAmps ranging from 3 – 20 mAmps, in total about 20 – 120 mW photo-electricity was produced in the test with ATS in Marietta, Ga. These results have been improved on in April 2001 by a factor 100% plus. (These results were obtained with a photo-cathode existing of Cu only).

With using elements on the photo-cathode surface, which have a much lower “ionisation constant”, the photo-electricity can greatly increase, e.g. a factor of 10×. Heat production in the ionisation and anode areas has been far “over-unity”. For a section of the ionisation area alone, a value from the test referred to, shows a 2.19 “over-unity” versus the power input as a whole. In a test in April, 2001, about 5/1 heat “over-unity” was measured. Total heat and electric “over-unity” with a newer test unit, which has several parameters substantially improved, should exceed 7/1.

Referring to the laboratory lay-out as is shown in Fig. 8: Better results were obtained with it. For the identification of the components of the layout of Fig. 8 the same reference numerals have been used for like sections as in Fig. 7. In Fig. 8, the photo conversion section is indicated at 29 with a cage 30 placed around the cathode 8. The photo-cathode and photo-anode are respectively indicated by 34 and 35.

32 indicates a secondary vacuum pump and 33 indicates a fractional hydrogen storage vessel for remove of fractional and bi-electronic hydrogen.

In Fig. 8 the photo-cathode and photo-anode have electric terminals indicated by 36 and 37. The cage of faraday 30 has a terminal 38.

Less power input is required with closer proximity of anode and cathode as well as with proper electric induction in the Tungsten coil, for the production of the same power output. It was recently established that after extending runs into many hours, the overall production of heat as well as of electricity increased substantially. The reason for this is that gradually more “fractional hydrogen” of the first “fractional series” reacts with “ground-state” hydrogen according to formula (6) and forms “fractional hydrogen” of the second and third “fractional series”. In these conversions there is much more photon energy becoming available: respectively 108.8 and 204.0 eV per

atom of hydrogen. Also "bi-electronic" hydrogen is being produced after maturing of the process. The latter process is exothermic and thus produces heat. For the further utilisation of heat produced in the ionisation area, particularly if the temperature difference over the reactor wall exceeds 20°C a special Stirling system can be employed (Rentz system), which is relatively quite effective if only low temperature differentials are available. This Stirling system then in turn provides for shaft power. Inventor however has opted for the utilization of *GaAs/Ge* cells instead, whereby a photo-electric conversion efficiency of 20% or better can be guaranteed. The Boeing, Spectrolab Division has already reached a maximum conversion efficiency level of 33.2%. Fig. 8 also shows a secondary vacuum pump system 32, which is there for the purpose of collecting samples of "fractional" hydrogen and or of "bi-electronic" hydrogen into storage tank 13, for the purpose of further testing, either for energy generation or for new materials research and development.

CLAIMS

1. Method of generating energy, comprising the steps of:
 - a. introducing hydrogen in a reactor vessel, the vessel comprising a cathode, an anode and an ionization element, the cathode comprising a primary and a secondary transmutational element, the transmutational elements having in their nucleus a number of neutrons which is larger than the number of protons, and wherein at least one neutron has a preferred orientation;
 - 10 b. Ionizing at least a part of the hydrogen with the ionization element to form a plasma,
 - c. Applying a voltage differential across the cathode and the anode, causing protons to travel to the cathode and to induce a transmutation of the transmutational elements which combine to form an element of higher mass number than the mass number of said transmutational elements under the release of energy;
 - 15 d. collecting heat and/or on other energy formed in step c.
- 20 2. Method according to claim 1, wherein the primary transmutational element comprises an element of the group consisting of Li_3^7 , Be_4^9 , B_5^{11} , As_{33}^{75} , Cd_{48}^{113} , In_{49}^{115} and Sb_{51}^{123} or any combination thereof.
3. Method according to claim 1 or 2, wherein the secondary transmutational element has a higher atomic number than the primary transmutational element.
- 25 4. Method according to claim 3, the secondary transmutational element comprising an element of the group consisting of Al_{13}^{27} , Mg_{12}^{24} , In_{49}^{115} or any combination thereof.
- 30 5. Method according to any of the preceding claims, wherein the cathode has a carrier comprising an element of the group consisting of Ti, Pt, Pd, Ag, Au and Al, or any combination thereof.

6. Method according to any of the preceding claims, hydrogen and/or helium being formed in the transmutation.
- 5 7. Method according to any of the preceding claims, wherein in the pressure in the vessel is reduced.
8. Method according to any of the preceding claims, the ionization element comprising a metal element.
- 10 9. Method according to claim 8, the metal element comprising W.
10. Method according to claim 8 or 9, a high frequency voltage being applied across the ionization elements.
- 15 11. Method according to claim 8,9 or 10, the ionization element being placed near cathode and the anode for causing self induction in the ionization element.
- 20 12. Method according to any of the preceding claims, a time-varying voltage being applied between the cathode and the anode.
13. Method according to claim 11, wherein the temperature in the reactor vessel is measured and the voltage between anode and cathode is controlled on the basis of the measured temperature.
- 25 14. Method according to claim 11, wherein the amperage is being controlled and kept between set boundaries by continuous adjustment of the voltage between cathode and anode.
- 30 15. Method according to any of the preceding claims, a convertor being provided near the cathode for collecting radiation produced at or near the cathode and for converting the collected radiation into electricity.

16. Method according to any of the preceding claims, wherein a heat exchanger is provided at heat is extracted from the reactor vessel.
17. Method according to any of the preceding claim, wherein the pressure in the reactor vessel is reduced and is measured, and wherein the amount of hydrogen introduced into the vessel is controlled on the basis of the measured pressure.
18. Cathode for use in the method according to any of claims 1 to 16, comprising a primary and a secondary transmutational element having in their nucleus a number of neutrons that is larger than the number of protons, and wherein at least one neutron has a preferred orientation.
19. Cathode according to claim 18, the primary transmutational element comprising an element of the group consisting of Li_3^7 , Be_4^9 , B_5^{11} , As_{33}^{75} , Cd_{48}^{113} , In_{49}^{115} and Sb_{51}^{123} or any combination thereof.
20. Cathode according to claim 17, 18 or 19, the secondary transmutational element having a higher atomic number than the primary transmutational element.
21. Cathode according to claim 19 or 20, the secondary transmutational element comprising an element of the group Al, Mg, In or any combination thereof, in case of using either Li_3^7 , Be_4^9 or B_5^{11} or any combination thereof as primary transmutational element.
22. Cathode according to any of claims 17-21, having a carrier comprising an element of the group consisting of Ti, Pt, Pd, Ag, Au and Al, or any combination thereof.
23. Apparatus for generating energy, comprising
- a reactor vessel having a cathode, an anode spaced at a distance from the cathode and an ionization element between the cathode and the anode, wherein the cathode

comprises a primary and a secondary transmutational element, the transmutational elements having in their nucleus a number of neutrons that is larger than the number of protons, and wherein at least one neutron has a preferred orientation,

- a hydrogen inlet, and
- 5 - a heat and/or radiation collector device integral with or connected to the reactor vessel.

24. Apparatus according to claim 23, the the primary transmutational element comprising an element of the group consisting of Li_3^7 , Be_4^9 , B_5^{11} , As_{33}^{75} , Cd_{48}^{113} , In_{49}^{115}
10 and Sb_{51}^{123} or any combination thereof.

25. Apparatus according to claim 24, the secondary transmutational element having a higher atomic number than the primary transmutational element.

15 26. Apparatus according to claim 25, the secondary transmutational element comprising an element of the group Al, Mg, In or any combination thereof.

27. Apparatus according to any of claims 23-26, the cathode having a carrier comprising an element of the group consisting of Ti, Pt, Pd, Ag, Au and Al, or any
20 combination thereof.

28. Apparatus according to any of claims 23 to 27, the ionization element comprising a metal coil.

25 29. Apparatus according to claim 28, the ionization element comprising W.

30. Apparatus according to any of claims 23-29, a time dependent voltage being applied to the ionization element.

30 31. Apparatus according to claim 30, the ionization element being placed near cathode and the anode, for causing self-induction in the ionization element.

32. Apparatus according to any of claims 23-31, the reactor vessel comprising in the area of the cathode a window of radiation transmissive material, an annular chamber surrounding the cathode, and a radiation absorber located within the annular chamber.
- 5 33. Apparatus according to claim 32, the radiation absorber comprising a photo-cathode, which together with a photo-anode are part of a photo-electric power circuit.
34. Apparatus according to claim 30, the radiation in the ionization area being absorbed by absorbing material comprising a heat-absorbing material, being applied
10 either against the inside or outside of the reactor wall.
35. Apparatus according to claim 31, 32 or 33, the annular chamber being filled with a noble gas.
- 15 36. Apparatus according to any of claims 23-34, the reactor vessel comprising an outlet for removal of fractional hydrogen.
37. Apparatus according to any of claims 23-35, a heat exchanger being in heat conductive contact with the reactor vessel or being applied as a "jacket" around the
20 reactor vessel.
38. Apparatus according to any of the claims 23-31, having a photo-cathode and photo-anode placed within the reactor around the cathode.
- 25 39. Apparatus according to claim 38, a "cage of Faraday" being placed around the cathode for shielding the photo-electric field from the primary field between cathode and anode.

Fig 1

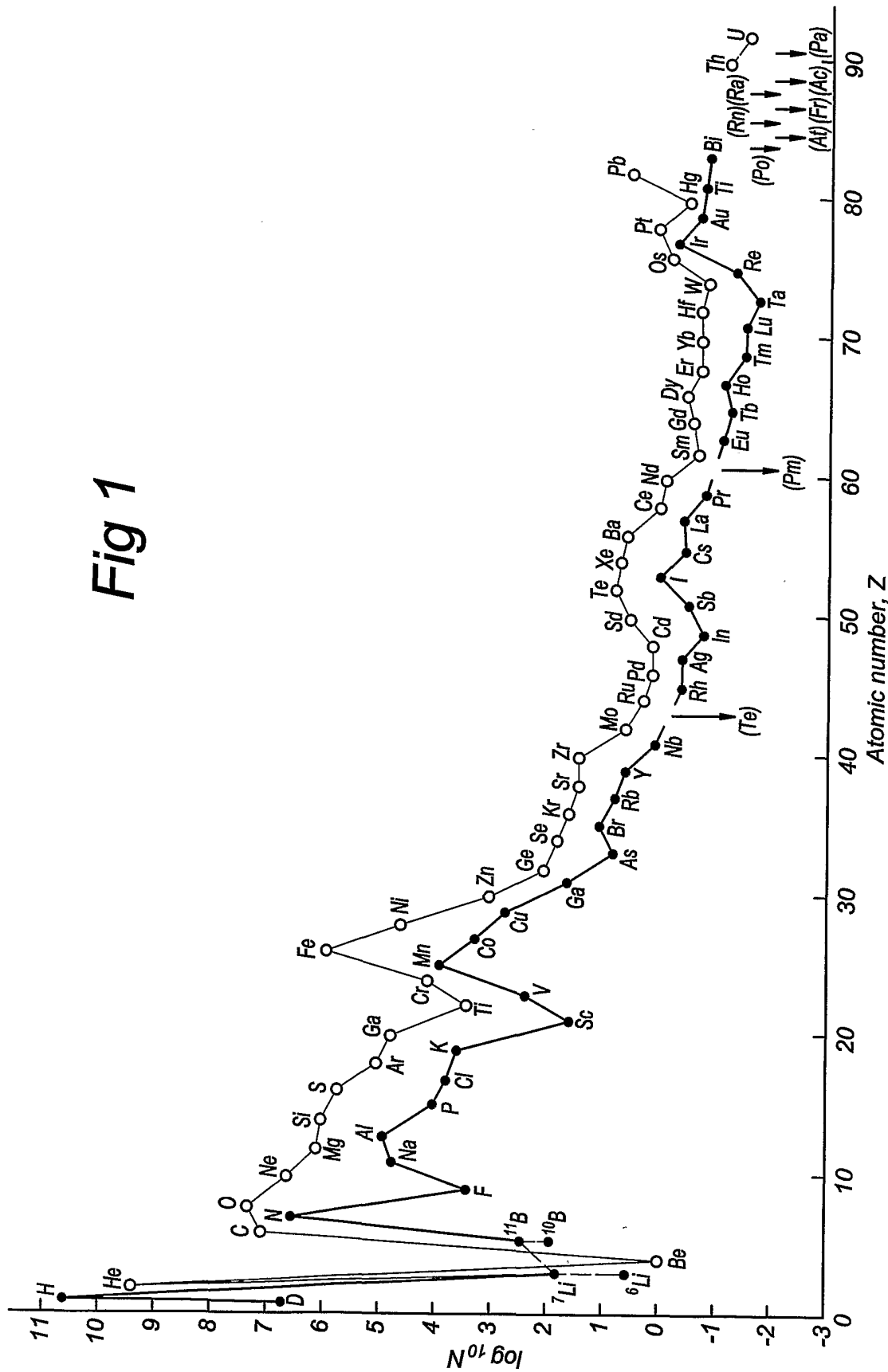


Fig 2

Half-life=700 sec
10-11 min

$$\frac{\text{Neutron}}{\text{UDD}} = Q_H$$

940 MeV
Spin = 1/2

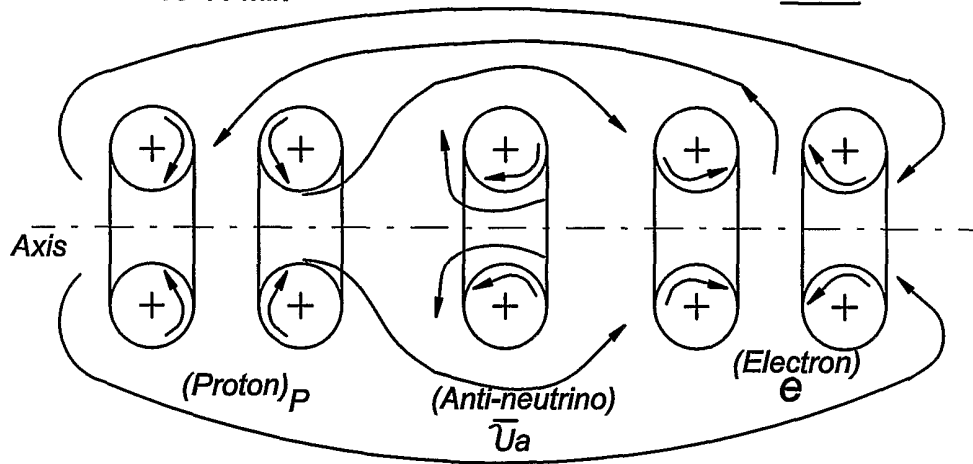


Fig 3a

↗= VALENCE ELECTRON
P=PROTRON
I=ANTI NEUTRINO
e=ELECTRON

$p \bigcirc p$ = HELIUM NUCLEUS

$$\begin{array}{c} (ENA) \\ e \\ p \bigcirc p - e/p \\ e \quad p - e \\ \underline{Li \ 7/3} \end{array}$$

EXTRA NEUTRON

ENA=ELECTRO-NEGATIVE
AREA

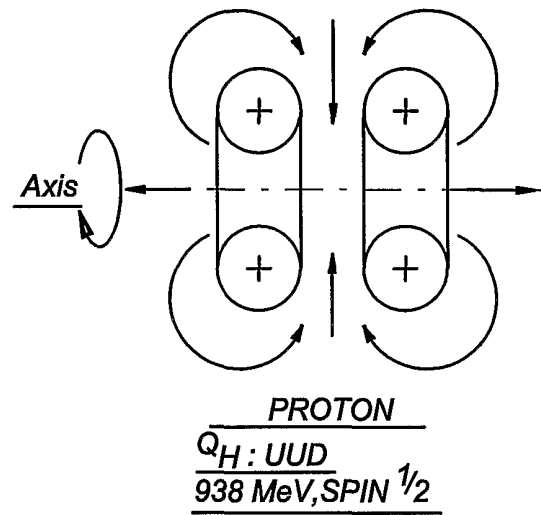
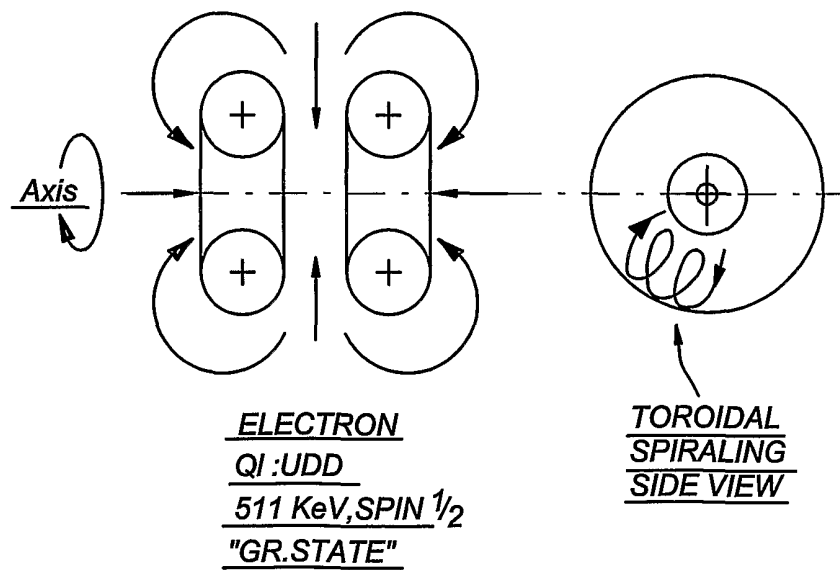
Fig 3b

Diagram illustrating the proposed mechanism for the formation of an extra neutron in the $\text{Be}^9\alpha$ reaction. The central circle represents the Be^9 nucleus. An incoming electron (e) from the ENA source is shown entering the nucleus. An outgoing electron (e) is shown leaving the nucleus. A proton (p) is shown entering the nucleus from the left, and another proton (p) is shown leaving the nucleus to the right. A third proton (p) is shown entering the nucleus from the right, and a fourth proton (p) is shown leaving the nucleus to the left. A dashed box below the nucleus contains a proton (p) and an electron (e), labeled "EXTRA NEUTRON".

Fig 3c

Fig 3c

The diagram shows a central circle representing a nucleus. It is surrounded by several particles: a vertical chain of five particles (e, p, e, p, e) above the circle; a vertical chain of two particles (p, e) below the circle, enclosed in a dashed rectangular box; and two triangular clusters of three particles each (one with p, p, e and one with p, p, e) to the left and right of the circle. A curved arrow points from the boxed particles to the text "EXTRA NEUTRON". To the left of the diagram is the label $B^{11/5}$.

Fig 4*Fig 5*

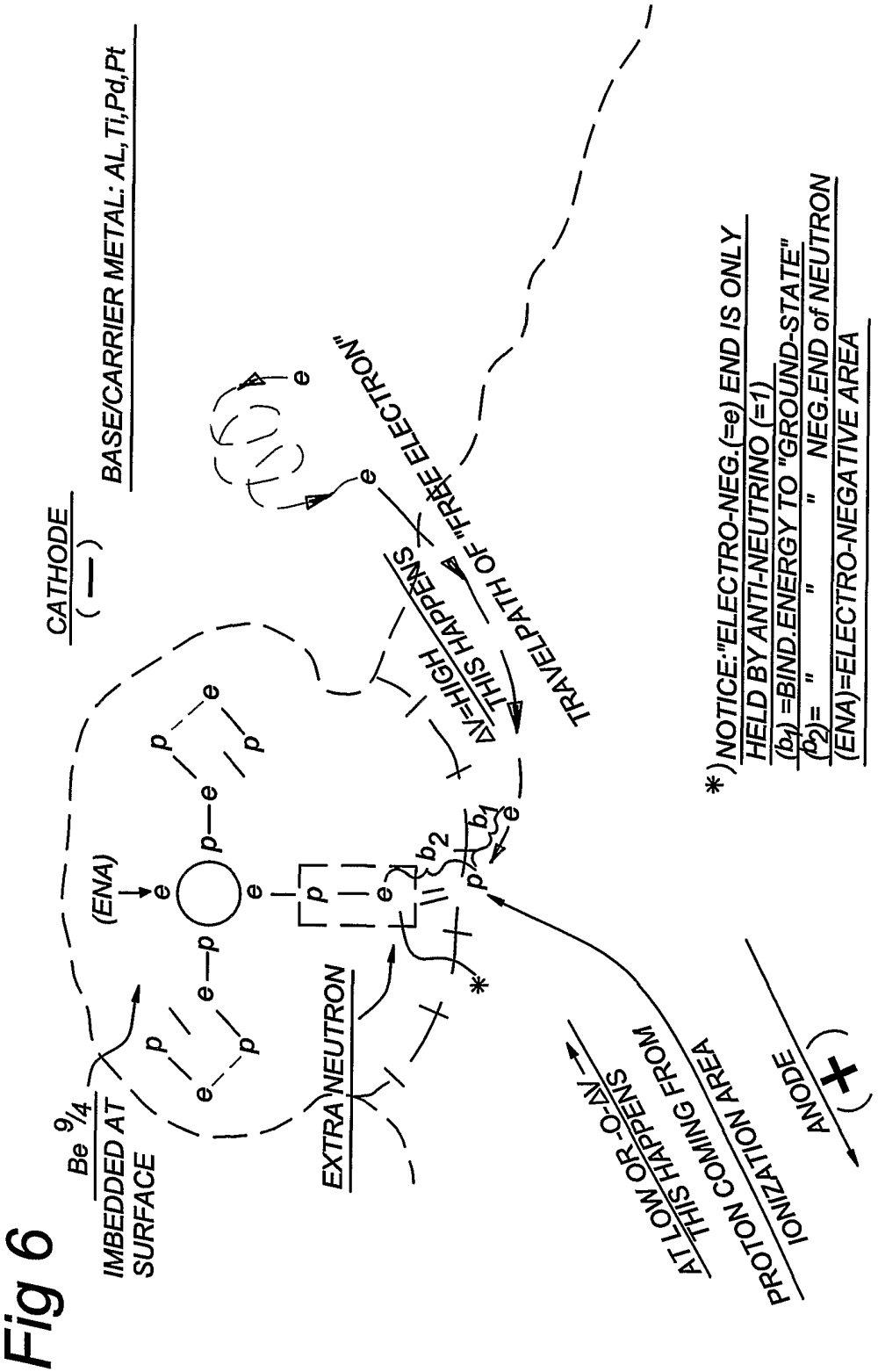


Fig 7

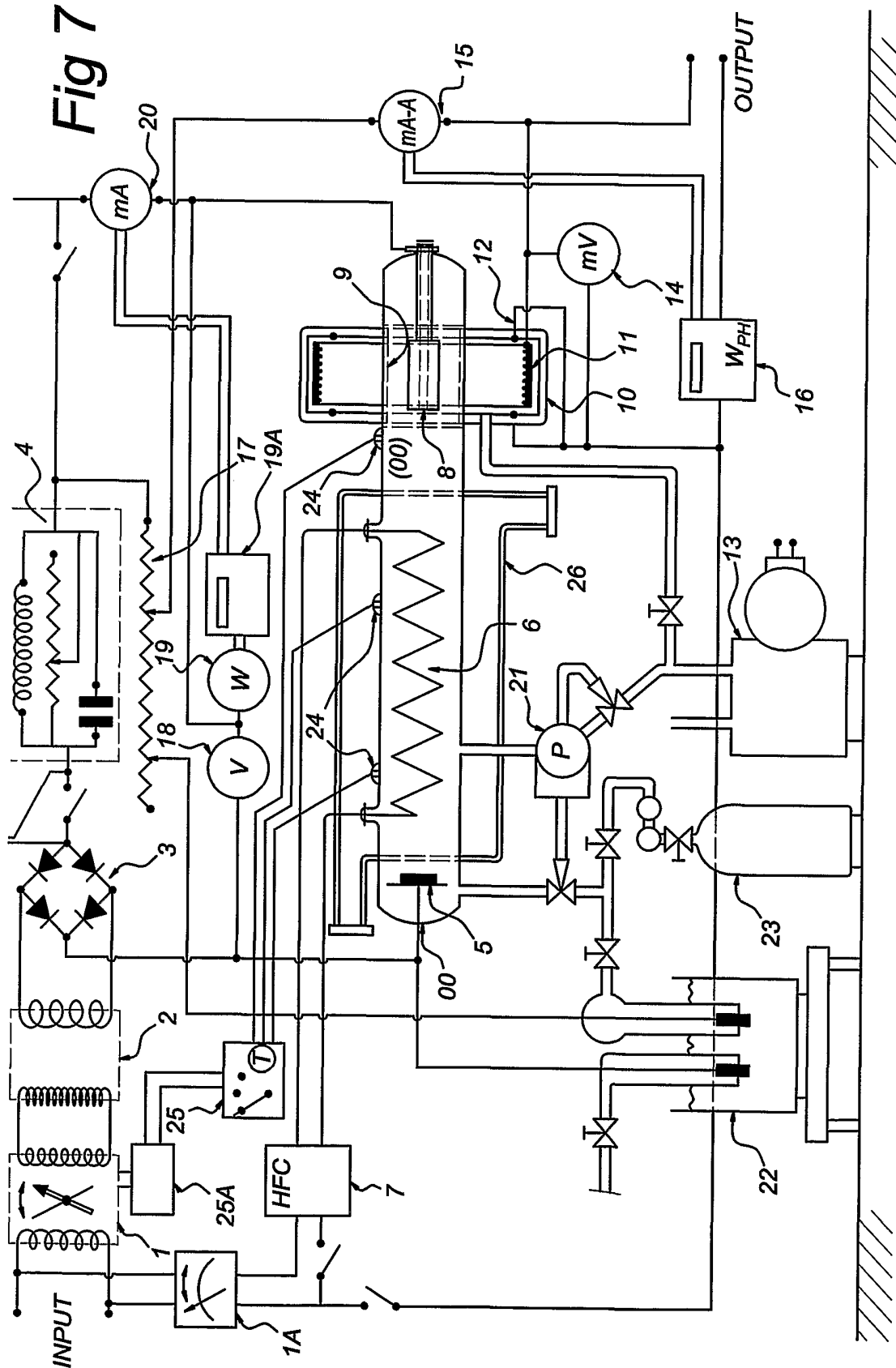
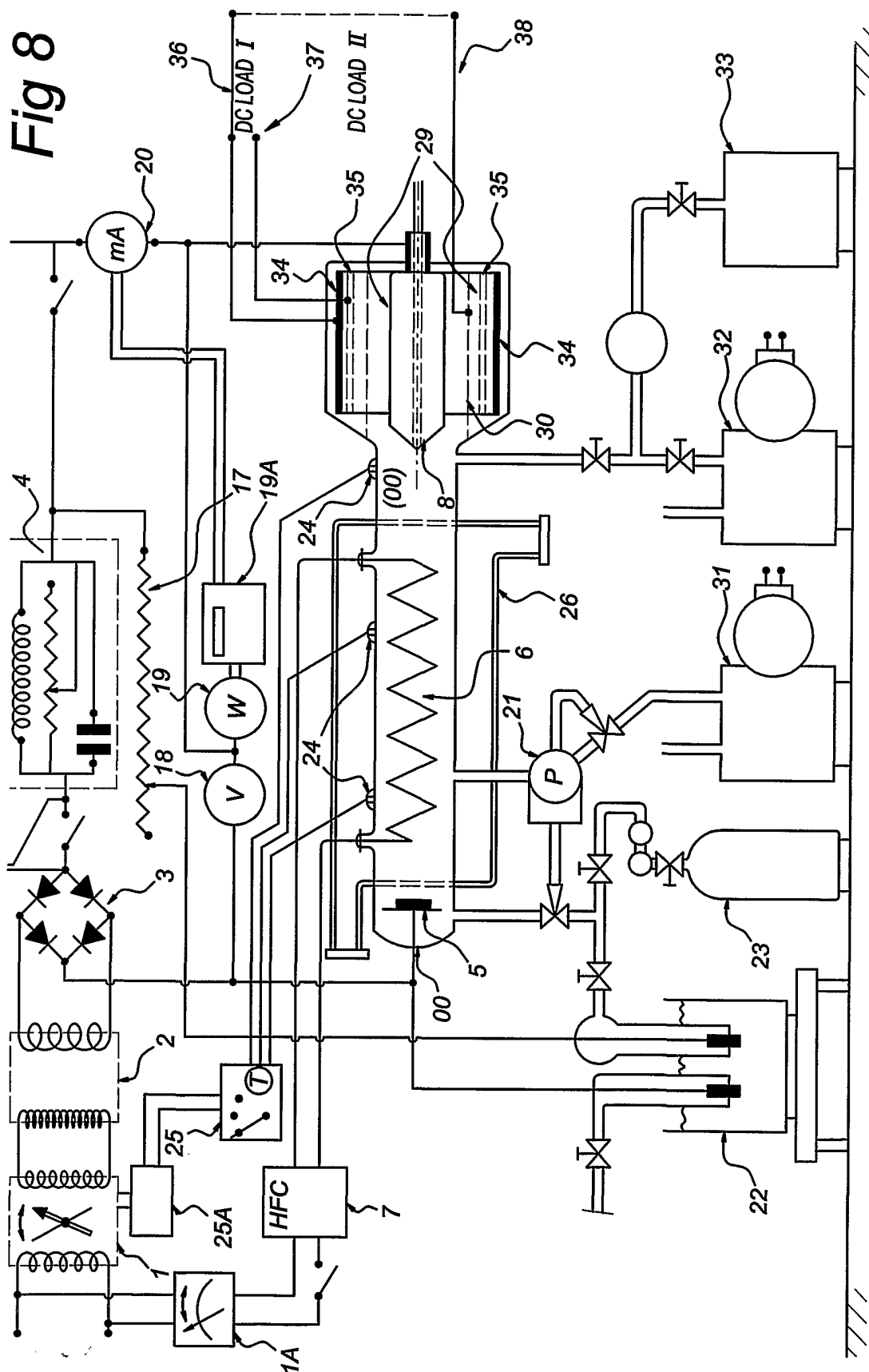


Fig 8



INTERNATIONAL SEARCH REPORT

ii , Application No
PCT/NL 01/00710

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G21B1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

INSPEC, WPI Data, PAJ, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 395 066 A (MATSUSHITA ELECTRIC IND CO LTD) 31 October 1990 (1990-10-31) page 3, line 40 - line 55 page 5, line 52 - line 58 page 7, line 44 - line 49	1-6, 18-27
A	page 12, line 13 - line 22 figure 7	10, 12, 30
A	EP 0 461 690 A (BOEING CO) 18 December 1991 (1991-12-18) the whole document	2, 6, 16, 19, 24, 34, 36, 37
	--- -/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

22 March 2002

Date of mailing of the international search report

02/04/2002

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Capostagno, E

INTERNATIONAL SEARCH REPORT

International Application No
PCT/NL 01/00710

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 024 935 A (PHILLIPS JONATHAN ET AL) 15 February 2000 (2000-02-15) cited in the application column 2, line 40 - line 48 column 41, line 45 -column 42, line 11 figure 5 -----	7-14, 17, 28-31, 34, 37

INTERNATIONAL SEARCH REPORT

Information on patent family members

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