

## SECTION G — PHYSICS

### G21 NUCLEAR PHYSICS; NUCLEAR ENGINEERING

#### G21B FUSION REACTORS (uncontrolled fusion, applications thereof G21J)

##### Subclass index

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<b>1/00</b>	<b>Thermonuclear fusion reactors [1, 2006.01]</b>	1/19	• • Targets for producing thermonuclear fusion reactions [2006.01]
1/01	• Hybrid fission-fusion nuclear reactors [2006.01]	1/21	• • Electric power supply systems, e.g. for magnet systems [2006.01]
1/03	• with inertial plasma confinement [2006.01]	1/23	• • Optical systems, e.g. for irradiating targets, for heating plasma or for plasma diagnostics [2006.01]
1/05	• with magnetic or electric plasma confinement [2006.01]	1/25	• Maintenance, e.g. repair or remote inspection [2006.01]
1/11	• Details [2006.01]		
1/13	• • First wall; Blanket; Divertor [2006.01]		
1/15	• • Particle injectors for producing thermonuclear fusion reactions, e.g. pellet injectors [2006.01]		
1/17	• • Vacuum chambers; Vacuum systems [2006.01]	<b>3/00</b>	<b>Low-temperature nuclear fusion reactors, e.g. alleged cold fusion reactors [2006.01]</b>

#### G21C NUCLEAR REACTORS (fusion reactors, hybrid fission-fusion reactors G21B; nuclear explosives G21J)

##### Subclass index

REACTORS.....	1/00
REACTOR ELEMENTS	
Fuel; moderator; cooling; containment; shielding.....	3/00, 5/00, 15/00, 13/00, 11/00
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MANUFACTURE.....	21/00
ADAPTATIONS OF REACTORS FOR EXPERIMENTATION OR IRRADIATION.....	23/00

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<b>1/00</b>	<b>Reactor types [1, 2006.01, 2018.01]</b>	1/12	• • • • • moderator being solid, e.g. Magnox reactor [1, 2006.01]
1/02	• Fast fission reactors, i.e. reactors not using a moderator [1, 2006.01]	1/14	• • • moderator being substantially not pressurised, e.g. swimming-pool reactor (G21C 1/22 takes precedence) [1, 2006.01]
1/03	• • cooled by a coolant not essentially pressurised, e.g. pool-type reactors [5, 2006.01]	1/16	• • • • • moderator and coolant being different or separated, e.g. sodium-graphite reactor [1, 2006.01]
1/04	• Thermal reactors [1, 2006.01]	1/18	• • • • • coolant being pressurised [1, 2006.01]
1/06	• • Heterogeneous reactors, i.e. in which fuel and moderator are separated [1, 2006.01]	1/20	• • • • • • moderator being liquid, e.g. pressure-tube reactor [1, 2006.01]
1/07	• • • Pebble-bed reactors; Reactors with granular fuel [5, 2006.01]	1/22	• • • using liquid or gaseous fuel [1, 2006.01]
1/08	• • • moderator being highly pressurised, e.g. boiling-water reactor, integral-superheat reactor, pressurised-water reactor (G21C 1/22 takes precedence) [1, 2006.01]	1/24	• • Homogeneous reactors, i.e. in which fuel and moderator present an effectively homogeneous medium to the neutrons [1, 2006.01]
1/09	• • • • Pressure regulating arrangements, i.e. pressurisers [5, 2006.01]	1/26	• • • Single-region reactors [1, 2006.01]
1/10	• • • • moderator and coolant being different or separated [1, 2006.01]	1/28	• • • Two-region reactors [1, 2006.01]
		1/30	• Subcritical reactors [1, 2006.01]

- 1/32 • Integral reactors, i.e. reactors wherein parts functionally associated with the reactor but not essential to the reaction, e.g. heat exchangers, are disposed inside the enclosure with the core (G21C 1/02-G21C 1/30 take precedence) [3, 2006.01]
- 3/00 Reactor fuel elements or their assemblies; Selection of substances for use as reactor fuel elements [1, 2006.01]**
- 3/02 • Fuel elements [1, 2006.01]
- 3/04 • • Constructional details [1, 2006.01]
- 3/06 • • • Casings; Jackets [1, 2006.01]
- 3/07 • • • • characterised by their material, e.g. alloys [5, 2006.01]
- 3/08 • • • • provided with external means to promote heat-transfer, e.g. fins, baffles, corrugations [1, 2006.01]
- 3/10 • • • • End closures [1, 2006.01]
- 3/12 • • • • Means forming part of the element for locating it within the reactor core; External spacers for this purpose [1, 2006.01]
- 3/14 • • • • Means forming part of the element for inserting it into, or removing it from, the core; Means for coupling adjacent elements [1, 2006.01]
- 3/16 • • • Details of the construction within the casing [1, 2006.01]
- 3/17 • • • • Means for storage or immobilisation of gases in fuel elements [5, 2006.01]
- 3/18 • • • • Internal spacers or other non-active material within the casing, e.g. compensating for expansion of fuel rods or for compensating excess reactivity (interlayers G21C 3/20) [1, 2006.01]
- 3/20 • • • • with coating on fuel or on inside of casing; with non-active interlayer between casing and active material [1, 2006.01]
- 3/22 • • with fissile or breeder material in contact with coolant [1, 2006.01]
- 3/24 • • with fissile or breeder material in fluid form within a non-active casing [1, 2006.01]
- 3/26 • • with fissile or breeder material in powder form within a non-active casing [1, 2006.01]
- 3/28 • • with fissile or breeder material in solid form within a non-active casing [1, 2006.01]
- 3/30 • Assemblies of a number of fuel elements in the form of a rigid unit [1, 2006.01]
- 3/32 • • Bundles of parallel pin-, rod-, or tube-shaped fuel elements [1, 2006.01]
- 3/322 • • • Means to influence the coolant flow through or around the bundles [5, 2006.01]
- 3/324 • • • Coats or envelopes for the bundles [5, 2006.01]
- 3/326 • • • comprising fuel elements of different composition; Comprising, in addition to the fuel elements, other pin-, rod-, or tube-shaped elements, e.g. control rods, grid support rods, fertile rods, poison rods or dummy rods [5, 2006.01]
- 3/328 • • • • Relative disposition of the elements in the bundle lattice [5, 2006.01]
- 3/33 • • • Supporting or hanging of elements in the bundle (spacer grids G21C 3/34); Means forming part of the bundle for inserting it into, or removing it from, the core; Means for coupling adjacent bundles [5, 2006.01]
- 3/332 • • • • Supports for spacer grids [5, 2006.01]
- 3/334 • • • Assembling the bundles [5, 2006.01]
- 3/335 • • • Exchanging elements in irradiated bundles [5, 2006.01]
- 3/336 • • • Spacer elements for fuel rods in the bundle (spacer grids G21C 3/34) [5, 2006.01]
- 3/338 • • • • Helicoidal spacer elements [5, 2006.01]
- 3/34 • • • Spacer grids [1, 2006.01]
- 3/344 • • • • formed of assembled tubular elements [5, 2006.01]
- 3/348 • • • • formed of assembled non-intersecting strips [5, 2006.01]
- 3/352 • • • • formed of assembled intersecting strips [5, 2006.01]
- 3/356 • • • • being provided with fuel element supporting members [5, 2006.01]
- 3/36 • • Assemblies of plate-shaped fuel elements or coaxial tubes [1, 2006.01]
- 3/38 • Fuel units consisting of a single fuel element in a supporting sleeve [1, 2006.01]
- 3/40 • Structural combination of fuel element with thermoelectric element for direct production of electric energy from fission heat (structural combination of fuel element with instruments for temperature measurement G21C 17/112) [1, 2006.01]
- 3/42 • Selection of substances for use as reactor fuel [1, 2006.01]
- 3/44 • • Fluid or fluent reactor fuel [1, 2006.01]
- 3/46 • • • Aqueous compositions [1, 2006.01]
- 3/48 • • • • True or colloidal solutions of the active constituent [1, 2006.01]
- 3/50 • • • • Suspensions of the active constituent; Slurries [1, 2006.01]
- 3/52 • • • Liquid metal compositions [1, 2006.01]
- 3/54 • • • Fused salt, oxide, or hydroxide compositions [1, 2006.01]
- 3/56 • • • Gaseous compositions; Suspensions in a gaseous carrier [1, 2006.01]
- 3/58 • • Solid reactor fuel [1, 2006.01]
- 3/60 • • • Metallic fuel; Intermetallic dispersions [1, 2006.01]
- 3/62 • • • Ceramic fuel [1, 2006.01]
- 3/64 • • • • Ceramic dispersion fuel, e.g. cermet [1, 2006.01]
- 5/00 Moderator or core structure; Selection of materials for use as moderator [1, 2006.01]**
- 5/02 • Details [1, 2006.01]
- 5/04 • • Spatial arrangements allowing for Wigner growth [1, 2006.01]
- 5/06 • • Means for locating or supporting fuel elements [1, 2006.01]
- 5/08 • • Means for preventing undesired asymmetric expansion of the complete structure [1, 2006.01]
- 5/10 • • Means for supporting the complete structure [1, 2006.01]
- 5/12 • characterised by composition, e.g. the moderator containing additional substances which ensure improved heat resistance of the moderator [1, 2006.01]
- 5/14 • characterised by shape [1, 2006.01]
- 5/16 • • Shape of its constituent parts [1, 2006.01]
- 5/18 • characterised by the provision of more than one active zone [1, 2006.01]
- 5/20 • • wherein one zone contains fissile material and another zone contains breeder material [1, 2006.01]
- 5/22 • • wherein one zone is a superheating zone [1, 2006.01]

**7/00 Control of nuclear reaction [1, 2006.01]**

- 7/02 • by using self-regulating properties of reactor materials (arrangements that involve temperature stability G21C 7/32) [1, 2006.01]
- 7/04 • • of burnable poisons (burnable poisons in fuel rods G21C 3/326) [1, 5, 2006.01]
- 7/06 • by application of neutron-absorbing material, i.e. material with absorption cross-section very much in excess of reflection cross-section [1, 2006.01]
- 7/08 • • by displacement of solid control elements, e.g. control rods [1, 2006.01]
- 7/10 • • • Construction of control elements [1, 2006.01]
- 7/103 • • • • Control assemblies containing one or more absorbants as well as other elements, e.g. fuel or moderator elements [5, 2006.01]
- 7/107 • • • • Control elements adapted for pebble-bed reactors [5, 2006.01]
- 7/11 • • • • Deformable control elements, e.g. flexible, telescopic, articulated [5, 2006.01]
- 7/113 • • • • Control elements made of flat elements; Control elements having cruciform cross-section [5, 2006.01]
- 7/117 • • • • Clusters of control rods; Spider construction [5, 2006.01]
- 7/12 • • • Means for moving control elements to desired position (dropping control rods into the reactor core in an emergency G21C 9/02) [1, 2006.01]
- 7/14 • • • • Mechanical drive arrangements [1, 2006.01]
- 7/16 • • • • Hydraulic or pneumatic drive arrangements [1, 2006.01]
- 7/18 • • • Means for obtaining differential movement of control elements [1, 2006.01]
- 7/20 • • • Disposition of shock-absorbing devices [1, 2006.01]
- 7/22 • • by displacement of a fluid or fluent neutron-absorbing material [1, 2006.01]
- 7/24 • • Selection of substances for use as neutron-absorbing material [1, 2006.01]
- 7/26 • by displacement of the moderator or parts thereof [1, 2006.01]
- 7/27 • • Spectral shift control [5, 2006.01]
- 7/28 • by displacement of the reflector or parts thereof [1, 2006.01]
- 7/30 • by displacement of reactor fuel or fuel elements [1, 2006.01]
- 7/32 • by varying flow of coolant through the core [1, 2006.01]
- 7/34 • by utilisation of a primary neutron source [1, 2006.01]
- 7/36 • Control circuits [1, 2006.01]

**9/00 Emergency protection arrangements structurally associated with the reactor (emergency cooling arrangements G21C 15/18) [1, 2006.01]**

- 9/004 • Pressure suppression [5, 2006.01]
- 9/008 • • by rupture-discs or -diaphragms [5, 2006.01]
- 9/012 • • by thermal accumulation or by steam condensation, e.g. ice condensers [5, 2006.01]
- 9/016 • Core catchers [5, 2006.01]
- 9/02 • Means for effecting very rapid reduction of the reactivity factor under fault conditions, e.g. reactor fuse [1, 2006.01]
- 9/027 • • by fast movement of a solid, e.g. pebbles [5, 2006.01]
- 9/033 • • by an absorbent fluid [5, 2006.01]
- 9/04 • Means for suppressing fires [1, 2006.01]

- 9/06 • • Means for preventing accumulation of explosives gases, e.g. recombiners [5, 2006.01]

**11/00 Shielding structurally associated with the reactor [1, 2006.01]**

- 11/02 • Biological shielding [1, 2006.01]
- 11/04 • • on waterborne craft [1, 2006.01]
- 11/06 • Reflecting shields, i.e. for minimising loss of neutrons [1, 2006.01]
- 11/08 • Thermal shields; Thermal linings, i.e. for dissipating heat from gamma radiation which would otherwise heat an outer biological shield [1, 2006.01]

**13/00 Pressure vessels; Containment vessels; Containment in general [1, 2006.01]**

- 13/02 • Details [1, 2006.01]
- 13/024 • • Supporting constructions for pressure vessels or containment vessels [5, 2006.01]
- 13/028 • • Seals, e.g. for pressure vessels or containment vessels [5, 2006.01]
- 13/032 • • Joints between tubes and vessel walls, e.g. taking into account thermal stresses [5, 2006.01]
- 13/036 • • • the tube passing through the vessel wall, i.e. continuing on both sides of the wall [5, 2006.01]
- 13/04 • • Arrangements for expansion and contraction [1, 2006.01]
- 13/06 • • Sealing-plugs [1, 2006.01]
- 13/067 • • • for tubes, e.g. standpipes; Locking devices for plugs [5, 2006.01]
- 13/073 • • • Closures for reactor-vessels, e.g. rotatable [5, 2006.01]
- 13/08 • Vessels characterised by the material; Selection of materials for pressure vessels [1, 2006.01]
- 13/087 • • Metallic vessels [5, 2006.01]
- 13/093 • • Concrete vessels [5, 2006.01]
- 13/10 • Means for preventing contamination in event of leakage [1, 2006.01]

**15/00 Cooling arrangements within the pressure vessel containing the core; Selection of specific coolants [1, 2006.01]**

- 15/02 • Arrangement or disposition of passages in which heat is transferred to the coolant, e.g. for coolant circulation through the supports of the fuel elements [1, 2006.01]
- 15/04 • • from fissile or breeder material [1, 2006.01]
- 15/06 • • • in fuel elements [1, 2006.01]
- 15/08 • • from moderating material [1, 2006.01]
- 15/10 • • from reflector or thermal shield [1, 2006.01]
- 15/12 • • from pressure vessel; from containment vessel [1, 2006.01]
- 15/14 • • from ducts conducting a hot fluid; from ducts comprising auxiliary apparatus, e.g. pumps, cameras [1, 2006.01]
- 15/16 • comprising means for separating liquid and steam [1, 2006.01]
- 15/18 • Emergency cooling arrangements; Removing shut-down heat [1, 2006.01]
- 15/20 • Partitions or thermal insulation between fuel channel and moderator, e.g. in pressure tube reactors [1, 2006.01]
- 15/22 • Structural association of coolant tubes with headers or other pipes, e.g. in pressure tube reactors [1, 4, 2006.01]
- 15/24 • Promoting flow of the coolant [1, 2006.01]
- 15/243 • • for liquids [5, 2006.01]

- 15/247 • • • for liquid metals [5, 2006.01]
- 15/25 • • • using jet pumps [5, 2006.01]
- 15/253 • • for gases, e.g. blowers [5, 2006.01]
- 15/257 • • using heat-pipes [5, 2006.01]
- 15/26 • • by convection, e.g. using chimneys, using divergent channels [1, 2006.01]
- 15/28 • Selection of specific coolants (if serving as the moderator G21C 5/12) [1, 2006.01]
  
- 17/00 Monitoring; Testing [1, 2006.01]**
- 17/003 • Remote inspection of vessels, e.g. pressure vessels [5, 2006.01]
- 17/007 • • Inspection of the outer surfaces of vessels [5, 2006.01]
- 17/01 • • Inspection of the inner surfaces of vessels [5, 2006.01]
- 17/013 • • Inspection vehicles [5, 2006.01]
- 17/017 • Inspection or maintenance of pipe-lines or tubes in nuclear installations [5, 2006.01]
- 17/02 • Devices or arrangements for monitoring coolant or moderator [1, 2006.01]
- 17/022 • • for monitoring liquid coolants or moderators [5, 2006.01]
- 17/025 • • • for monitoring liquid metal coolants [5, 2006.01]
- 17/028 • • for monitoring gaseous coolants [5, 2006.01]
- 17/032 • • Reactor-coolant flow measuring or monitoring [5, 2006.01]
- 17/035 • • Moderator- or coolant-level detecting devices [5, 2006.01]
- 17/038 • • Boiling detection in moderator or coolant [5, 2006.01]
- 17/04 • • Detecting burst slugs [1, 2006.01]
- 17/06 • Devices or arrangements for monitoring or testing fuel or fuel elements outside the reactor core, e.g. for burn-up, for contamination (G21C 17/08, G21C 17/10 take precedence; detecting leaking fuel elements during reactor operation G21C 17/04) [1, 2006.01]
- 17/07 • • Leak testing [5, 2006.01]
- 17/08 • Structural combination of reactor core or moderator structure with viewing means, e.g. with television camera, periscope, window [1, 2006.01]
- 17/10 • Structural combination of fuel element, control rod, reactor core, or moderator structure with sensitive instruments, e.g. for measuring radioactivity, strain [1, 2006.01]
- 17/104 • • Measuring reactivity [5, 2006.01]
- 17/108 • • Measuring reactor flux [5, 2006.01]
- 17/112 • • Measuring temperature [5, 2006.01]
- 17/116 • • Passages or insulators, e.g. for electric cables [5, 2006.01]
- 17/12 • • Sensitive element forming part of control element [1, 2006.01]
- 17/14 • Period meters [1, 2006.01]
  
- 19/00 Arrangements for treating, for handling, or for facilitating the handling of, fuel or other materials which are used within the reactor, e.g. within its pressure vessel [1, 2, 2006.01]**
- 19/02 • Details of handling arrangements [1, 2006.01]
- 19/04 • • Means for controlling flow of coolant over objects being handled; Means for controlling flow of coolant through channel being serviced [1, 2006.01]
- 19/06 • • Means for supporting or storing fuel elements or control elements [1, 4, 2006.01]
  
- 19/07 • • • Storage racks; Storage pools [5, 2006.01]
- 19/08 • • Means for heating fuel elements before introduction into the core; Means for heating or cooling fuel elements after removal from the core [1, 2006.01]
- 19/10 • • Lifting devices or pulling devices adapted for co-operation with fuel elements or with control elements [1, 2006.01]
- 19/105 • • • with grasping or spreading coupling elements [5, 2006.01]
- 19/11 • • • with revolving coupling elements, e.g. socket coupling [5, 2006.01]
- 19/115 • • • with latching devices and ball couplings [5, 2006.01]
- 19/12 • • Arrangements for exerting direct hydraulic or pneumatic force on fuel element or on control element [1, 2006.01]
- 19/14 • characterised by their adaptation for use with horizontal channels in the reactor core [1, 2006.01]
- 19/16 • Articulated or telescopic chutes or tubes for connection to channels in the reactor core [1, 2006.01]
- 19/18 • Apparatus for bringing fuel elements to the reactor charge area, e.g. from a storage place [1, 2006.01]
- 19/19 • Reactor parts specifically adapted to facilitate handling, e.g. to facilitate charging or discharging of fuel elements [3, 2006.01]
- 19/20 • Arrangements for introducing objects into the pressure vessel; Arrangements for handling objects within the pressure vessel; Arrangements for removing objects from the pressure vessel [1, 2006.01]
- 19/22 • • Arrangements for obtaining access to the interior of a pressure vessel whilst the reactor is operating [1, 2006.01]
- 19/24 • • • by using an auxiliary vessel which is temporarily sealed to the pressure vessel [1, 2006.01]
- 19/26 • Arrangements for removing jammed or damaged fuel elements or control elements; Arrangements for moving broken parts thereof [1, 2006.01]
- 19/28 • Arrangements for introducing fluent material into the reactor core; Arrangements for removing fluent material from the reactor core [1, 2006.01]
- 19/30 • • with continuous purification of circulating fluent material, e.g. by extraction of fission products [1, 2006.01]
- 19/303 • • • specially adapted for gases (decontamination of gases G21F 9/02) [5, 2006.01]
- 19/307 • • • specially adapted for liquids (decontamination of liquids G21F 9/04) [5, 2006.01]
- 19/31 • • • • for molten metals [5, 2006.01]
- 19/313 • • • • using cold traps [5, 2006.01]
- 19/317 • • • Recombination devices for radiolytic dissociation products [5, 2006.01]
- 19/32 • Apparatus for removing radioactive objects or materials from the reactor discharge area, e.g. to a storage place; Apparatus for handling radioactive objects or materials within a storage place or removing them therefrom (disposal of waste material G21F 9/00) [1, 2006.01]
- 19/33 • Apparatus or processes for dismantling strings of spent fuel elements (G21C 19/34 takes precedence) [2, 2006.01]
- 19/34 • Apparatus or processes for dismantling nuclear fuel, e.g. before reprocessing [1, 5, 2006.01]
- 19/36 • • Mechanical means only [1, 2006.01]

- 19/365 • • • Removing cannings or casings from fuel [5, 2006.01]
- 19/37 • • • • by separating into pieces both the canning or the casing and the fuel element, e.g. by cutting or shearing [5, 2006.01]
- 19/375 • • • Compacting devices, e.g. for fuel assemblies [5, 2006.01]
- 19/38 • • Chemical means only [1, 2006.01]
- 19/40 • Arrangements for preventing occurrence of critical conditions, e.g. during storage [1, 2006.01]
- 19/42 • Reprocessing of irradiated fuel [1, 2006.01]
- 19/44 • • of irradiated solid fuel [1, 2006.01]
- 19/46 • • • Aqueous processes [1, 2006.01]
- 19/48 • • • Non-aqueous processes [1, 2006.01]
- 19/50 • • of irradiated fluid fuel [1, 2006.01]

- 21/00 Apparatus or processes specially adapted to the manufacture of reactors or parts thereof [1, 2006.01]**
- 21/02 • Manufacture of fuel elements or breeder elements contained in non-active casings [1, 2006.01]
- 21/04 • • by vibrational compaction or tamping [1, 2006.01]
- 21/06 • • by swaging [1, 2006.01]
- 21/08 • • by a slip-fit cladding process [1, 2006.01]
- 21/10 • • by extrusion, drawing, or stretching [1, 2006.01]
- 21/12 • • by hydrostatic or thermo-pneumatic canning [1, 2006.01]
- 21/14 • • by plating in a fluid [1, 2006.01]
- 21/16 • • by casting or dipping techniques [1, 2006.01]
- 21/18 • Manufacture of control elements covered by group G21C 7/00 [1, 2006.01]

**23/00 Adaptations of reactors to facilitate experimentation or irradiation [3, 2006.01]**

**G21D NUCLEAR POWER PLANT**

- 1/00 Details of nuclear power plant (control G21D 3/00) [1, 2006.01]**
- 1/02 • Arrangements of auxiliary equipment [1, 2006.01]
- 1/04 • Pumping arrangements (by means within the reactor pressure vessel G21C 15/24) [1, 2006.01]
- 3/00 Control of nuclear power plant (control of nuclear reaction G21C 7/00) [1, 2006.01]**
- 3/02 • Manual control [1, 2006.01]
- 3/04 • Safety arrangements (emergency protection of reactor G21C 9/00) [1, 2006.01]
- 3/06 • • responsive to faults within the plant (in the reactor G21C 9/02) [1, 2006.01]
- 3/08 • Regulation of any parameters in the plant [1, 2006.01]
- 3/10 • • by a combination of a variable derived from neutron flux with other controlling variables, e.g. derived from temperature, cooling flow, pressure [1, 2006.01]
- 3/12 • • by adjustment of the reactor in response only to changes in engine demand [1, 2006.01]
- 3/14 • • • Varying flow of coolant [1, 2006.01]
- 3/16 • • • Varying reactivity [1, 2006.01]
- 3/18 • • by adjustment of plant external to the reactor only in response to change in reactivity [1, 2006.01]
- 5/00 Arrangements of reactor and engine in which reactor-produced heat is converted into mechanical energy [1, 2006.01]**

- 5/02 • Reactor and engine structurally combined, e.g. portable [1, 2006.01]
- 5/04 • Reactor and engine not structurally combined [1, 2006.01]
- 5/06 • • with engine working medium circulating through reactor core [1, 2006.01]
- 5/08 • • with engine working medium heated in a heat exchanger by the reactor coolant [1, 2006.01]
- 5/10 • • • Liquid working medium partially heated by reactor and vaporised by heat source external to the core, e.g. with oil heating [1, 2006.01]
- 5/12 • • • Liquid working medium vaporised by reactor coolant [1, 2006.01]
- 5/14 • • • • and also superheated by reactor coolant [1, 2006.01]
- 5/16 • • • • superheated by separate heat source [1, 2006.01]
- 7/00 Arrangements for direct production of electric energy from fusion or fission reactions (obtaining electric energy from radioactive sources G21H 1/00) [1, 2006.01]**
- 7/02 • using magneto-hydrodynamic generators [1, 2006.01]
- 7/04 • using thermoelectric elements (structural combination of fuel element with thermoelectric element G21C 3/40) [1, 2006.01]
- 9/00 Arrangements to provide heat for purposes other than conversion into power, e.g. for heating buildings [1, 2006.01]**

**G21F PROTECTION AGAINST X-RADIATION, GAMMA RADIATION, CORPUSCULAR RADIATION OR PARTICLE BOMBARDMENT; TREATING RADIOACTIVELY CONTAMINATED MATERIAL; DECONTAMINATION ARRANGEMENTS THEREFOR (radiation protection by pharmaceutical means A61K 8/00, A61Q 17/04; in cosmonautic vehicles B64G 1/54; combined with a reactor G21C 11/00; combined with X-ray tubes H01J 35/16; combined with X-ray apparatus H05G 1/02)**

- 1/00 Shielding characterised by the composition of the material [1, 2006.01]**
- 1/02 • Selection of uniform shielding materials [1, 2006.01]
- 1/04 • • Concretes; Other hydraulic hardening materials [1, 2006.01]
- 1/06 • • Ceramics; Glasses; Refractories (cermets G21F 1/08) [1, 2006.01]

- 1/08 • • Metals; Alloys; Cermets, i.e. sintered mixtures of ceramics and metals [1, 2006.01]
- 1/10 • • Organic substances; Dispersions in organic carriers [1, 2006.01]
- 1/12 • Laminated shielding materials [1, 2006.01]

## G21F

### 3/00 Shielding characterised by its physical form, e.g. granules, or shape of the material [1, 2006.01]

- 3/02 • Clothing [1, 2006.01]
- 3/025 • • Clothing completely surrounding the wearer [5, 2006.01]
- 3/03 • • Aprons [5, 2006.01]
- 3/035 • • Gloves (mounting means on glove boxes G21F 7/053) [5, 2006.01]
- 3/04 • Bricks; Shields made up therefrom [1, 2006.01]

### 5/00 Transportable or portable shielded containers [1, 2006.01]

- 5/002 • Containers for fluid radioactive wastes [5, 2006.01]
- 5/005 • Containers for solid radioactive wastes, e.g. for ultimate disposal [5, 2006.01]
- 5/008 • • Containers for fuel elements [5, 2006.01]
- 5/012 • • • Fuel element racks in the containers [5, 2006.01]
- 5/015 • for storing radioactive sources, e.g. source carriers for irradiation units; Radioisotope containers [5, 2006.01]
- 5/018 • • Syringe shields or holders (syringe shielding for applying radioactive material to the body A61M 36/08) [5, 2006.01]
- 5/02 • with provision for restricted exposure of a radiation source within the container [1, 2006.01]
- 5/04 • • Means for controlling exposure, e.g. time, size of aperture (controlling exposure to X-radiation H05G 1/30) [1, 2006.01]
- 5/06 • Details of, or accessories to, the containers [5, 2006.01]
- 5/08 • • Shock-absorbers, e.g. impact buffers for containers [5, 2006.01]
- 5/10 • • Heat-removal systems, e.g. using circulating fluid or cooling fins [5, 2006.01]
- 5/12 • • Closures for containers; Sealing arrangements [5, 2006.01]
- 5/14 • • Devices for handling containers or shipping-casks, e.g. transporting devices [5, 2006.01]

### 7/00 Shielded cells or rooms [1, 2006.01]

- 7/005 • Shielded passages through walls; Locks; Transferring devices between rooms (between glove-boxes G21F 7/047) [5, 2006.01]
- 7/01 • • Transferring by fluidic means [5, 2006.01]
- 7/015 • Room atmosphere, temperature or pressure control devices [5, 2006.01]
- 7/02 • Observation devices permitting vision but shielding the observer [1, 2006.01]
- 7/03 • • Windows, e.g. shielded [5, 2006.01]
- 7/04 • Shielded glove-boxes [1, 2006.01]
- 7/047 • • Shielded passages; Closing or transferring means between glove-boxes [5, 2006.01]
- 7/053 • • Glove mounting means [5, 2006.01]
- 7/06 • Structural combination with remotely-controlled apparatus, e.g. with manipulators [1, 2006.01]

### 9/00 Treating radioactively contaminated material; Decontamination arrangements therefor [1, 2, 5, 2006.01]

- 9/02 • Treating gases [1, 2, 2006.01]
- 9/04 • Treating liquids [1, 2, 2006.01]
- 9/06 • • Processing [1, 2006.01]
- 9/08 • • • by evaporation; by distillation [1, 2006.01]
- 9/10 • • • by flocculation [1, 2006.01]
- 9/12 • • • by absorption; by adsorption; by ion-exchange [1, 2006.01]
- 9/14 • • • by incineration; by calcination, e.g. desiccation [1, 2006.01]
- 9/16 • • • by fixation in stable solid media [1, 2006.01]
- 9/18 • • • by biological processes [1, 2006.01]
- 9/20 • • Disposal of liquid waste [1, 2006.01]
- 9/22 • • • by storage in a tank or other container [1, 2006.01]
- 9/24 • • • by storage in the ground; by storage under water, e.g. in ocean [1, 2006.01]
- 9/26 • • • by dilution in water, e.g. in ocean, in stream [1, 2006.01]
- 9/28 • Treating solids [1, 2, 2006.01]
- 9/30 • • Processing [1, 2006.01]
- 9/32 • • • by incineration [1, 2006.01]
- 9/34 • • Disposal of solid waste [1, 2006.01]
- 9/36 • • • by packaging; by baling [1, 2006.01]

## G21G CONVERSION OF CHEMICAL ELEMENTS; RADIOACTIVE SOURCES [2]

### 1/00 Arrangements for converting chemical elements by electromagnetic radiation, corpuscular radiation, or particle bombardment, e.g. producing radioactive isotopes (by thermonuclear reactions in nuclear reactors G21B; conversion of nuclear fuel in nuclear reactors G21C) [1, 2, 2006.01]

- 1/02 • in nuclear reactors [1, 2006.01]
- 1/04 • outside of nuclear reactors or particle accelerators [2, 2006.01]
- 1/06 • • by neutron irradiation [2, 2006.01]
- 1/08 • • • accompanied by nuclear fission [2, 2006.01]
- 1/10 • • by bombardment with electrically-charged particles (irradiation devices G21K 5/00) [2, 2006.01]
- 1/12 • • by electromagnetic irradiation, e.g. with gamma or X-rays (irradiation devices G21K 5/00) [2, 2006.01]

### 4/00 Radioactive sources [2, 2006.01]

- 4/02 • Neutron sources [2, 2006.01]
- 4/04 • Radioactive sources other than neutron sources (radioactive dressings A61M 36/14) [2, 2006.01]
- 4/06 • • characterised by constructional features [2, 2006.01]
- 4/08 • • • specially adapted for medical applications (radiation therapy using radioactive sources A61N 5/10) [2, 2006.01]
- 4/10 • • with radium emanation [2, 2006.01]

### 5/00 Alleged conversion of chemical elements by chemical reaction [1, 2006.01]

### 7/00 Conversion of chemical elements not provided for in other groups of this subclass [2009.01]

**G21H OBTAINING ENERGY FROM RADIOACTIVE SOURCES; APPLICATIONS OF RADIATION FROM RADIOACTIVE SOURCES, NOT OTHERWISE PROVIDED FOR; UTILISING COSMIC RADIATION** (measurement of nuclear or X-radiation G01T; fusion reactors G21B; nuclear reactors G21C; lamps in which a gas filling is excited to luminescence by external corpuscular radiation or by radioactive material structurally associated with the lamp H01J 65/04, H01J 65/06)

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| <p><b>1/00 Arrangements for obtaining electrical energy from radioactive sources, e.g. from radioactive isotopes [1, 2006.01]</b></p> <p>1/02 • Cells charged directly by beta radiation [1, 2006.01]</p> <p>1/04 • Cells using secondary emission induced by alpha radiation, beta radiation, or gamma radiation [1, 2006.01]</p> <p>1/06 • Cells wherein radiation is applied to the junction of different semiconductor materials [1, 2006.01]</p> <p>1/08 • Cells in which radiation ionises a gas in the presence of a junction of two dissimilar metals, i.e. contact potential-difference cells [1, 2006.01]</p> <p>1/10 • Cells in which radiation heats a thermoelectric junction or a thermionic converter [1, 2, 2006.01]</p> <p>1/12 • Cells using conversion of the radiation into light combined with subsequent photoelectric conversion into electric energy [1, 2006.01]</p> | <p><b>3/00 Arrangements for direct conversion of radiation energy from radioactive sources into forms of energy other than electric energy, e.g. light [1, 2006.01]</b></p> <p>3/02 • in which material is excited to luminesce by the radiation (lamps in which a gas filling or screen or coating is excited to luminesce by radioactive material structurally associated with the lamp H01J 65/00) [1, 2006.01]</p> <p><b>5/00 Applications of radiation from radioactive sources or arrangements therefor, not otherwise provided for [1, 2006.01]</b></p> <p>5/02 • as tracers [1, 2006.01]</p> <p><b>7/00 Use of effects of cosmic radiation [1, 2006.01]</b></p> |
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**G21J NUCLEAR EXPLOSIVES; APPLICATIONS THEREOF**

**Note(s)**

This subclass covers uncontrollable fission or fusion reactions.

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|--|---|
| <p><b>1/00 Nuclear explosive devices [1, 2006.01]</b></p> <p><b>3/00 Peaceful applications of nuclear explosive devices [1, 2006.01]</b></p> | <p>3/02 • for excavation [1, 2006.01]</p> <p><b>5/00 Detection arrangements for nuclear explosions [1, 2006.01]</b></p> |
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**G21K TECHNIQUES FOR HANDLING PARTICLES OR IONISING RADIATION NOT OTHERWISE PROVIDED FOR; IRRADIATION DEVICES; GAMMA RAY OR X-RAY MICROSCOPES [2]**

**Note(s) [2012.01]**

In this subclass, the following term is used with the meaning indicated:

- "particle" means a molecular, atomic or subatomic particle.

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| <p><b>1/00 Arrangements for handling particles or ionising radiation, e.g. focusing or moderating</b> (ionising radiation filters G21K 3/00; production or acceleration of neutrons, electrically-charged particles, neutral molecular beams or neutral atomic beams H05H 3/00-H05H 15/00) [1, 2, 2006.01]</p> <p>1/02 • using diaphragms, collimators [2, 2006.01]</p> <p>1/04 • • using variable diaphragms, shutters, choppers [2, 2006.01]</p> <p>1/06 • using diffraction, refraction, or reflection, e.g. monochromators (G21K 1/10, G21K 7/00 take precedence) [2, 2006.01]</p> <p>1/08 • Deviation, concentration, or focusing of the beam by electric or magnetic means (electron-optical arrangements in electric discharge tubes H01J 29/46) [2, 2006.01]</p> <p>1/087 • • by electrical means [4, 2006.01]</p> <p>1/093 • • by magnetic means [4, 2006.01]</p> <p>1/10 • Scattering devices; Absorbing devices [2, 2006.01]</p> | <p>1/12 • • Resonant absorbers or driving arrangements therefor, e.g. for Mössbauer-effect devices [3, 2006.01]</p> <p>1/14 • using charge exchange devices, e.g. for neutralising or changing the sign of the electrical charges of beams [3, 2006.01]</p> <p>1/16 • using polarising devices, e.g. for obtaining a polarised ion beam [3, 2006.01]</p> <p><b>3/00 Ionising radiation filters, e.g. X-ray filters [2, 2006.01]</b></p> <p><b>4/00 Conversion screens for the conversion of the spatial distribution of particles or ionising radiation into visible images, e.g. fluoroscopic screens [3, 2006.01]</b></p> <p><b>5/00 Irradiation devices</b> (adaptations of reactors to facilitate irradiation G21C 23/00; discharge tubes for irradiating H01J 33/00, H01J 37/00) [2, 2006.01]</p> <p>5/02 • having no beam-forming means [2, 2006.01]</p> <p>5/04 • with beam-forming means [2, 2006.01]</p> |
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G21K

- 5/08

- Holders for targets or for objects to be irradiated [2, 2006.01]
- 5/10

- with provision for relative movement of beam source and object to be irradiated [3, 2006.01]
- 7/00

**Gamma ray or X-ray microscopes [2, 2006.01]**