# SECTION G — PHYSICS

## G21 NUCLEAR PHYSICS; NUCLEAR ENGINEERING

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

**Subclass index**



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**1/00 Thermonuclear fusion reactors [1, 2006.01]**
1/01 • Hybrid fission-fusion nuclear reactors **[2006.01]**
1/03 • with inertial plasma confinement **[2006.01]**
1/05 • with magnetic or electric plasma confinement **[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]**
1/19 • • Targets for producing thermonuclear fusion reactions **[2006.01]**
1/21 • • Electric power supply systems, e.g. for magnet systems **[2006.01]**
1/23 • • Optical systems, e.g. for irradiating targets, for heating plasma or for plasma diagnostics **[2006.01]**
1/25 • Maintenance, e.g. repair or remote inspection **[2006.01]**

**3/00 Low-temperature nuclear fusion reactors, e.g. alleged cold fusion reactors [2006.01]**

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

**Subclass index**



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**1/00 Reactor types [1, 2006.01, 2018.01]**
1/02 • Fast fission reactors, i.e. reactors not using a moderator **[1, 2006.01]**
1/03 • • cooled by a coolant not essentially pressurised, e.g. pool-type reactors **[5, 2006.01]**
1/04 • Thermal reactors **[1, 2006.01]**
1/06 • • Heterogeneous reactors, i.e. in which fuel and moderator are separated **[1, 2006.01]**
1/07 • • • Pebble-bed reactors; Reactors with granular fuel **[5, 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]**
1/09 • • • • Pressure regulating arrangements, i.e. pressurisers **[5, 2006.01]**
1/10 • • • • moderator and coolant being different or separated **[1, 2006.01]**
1/12 • • • • • • moderator being solid, e.g. Magnox reactor **[1, 2006.01]**
1/14 • • • moderator being substantially not pressurised, e.g. swimming-pool reactor (G21C 1/22 takes precedence) **[1, 2006.01]**
1/16 • • • • moderator and coolant being different or separated, e.g. sodium-graphite reactor **[1, 2006.01]**
1/18 • • • • • coolant being pressurised **[1, 2006.01]**
1/20 • • • • • • moderator being liquid, e.g. pressure-tube reactor **[1, 2006.01]**
1/22 • • • using liquid or gaseous fuel **[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]**
1/26 • • • Single-region reactors **[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]**

**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)

**1/00 Arrangements for obtaining electrical energy from radioactive sources, e.g. from radioactive isotopes [1, 2006.01]**

1/02 • Cells charged directly by beta radiation **[1, 2006.01]**

1/04 • Cells using secondary emission induced by alpha radiation, beta radiation, or gamma radiation **[1, 2006.01]**

1/06 • Cells wherein radiation is applied to the junction of different semiconductor materials **[1, 2006.01]**

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]**

1/10 • Cells in which radiation heats a thermoelectric junction or a thermionic converter **[1, 2, 2006.01]**

1/12 • Cells using conversion of the radiation into light combined with subsequent photoelectric conversion into electric energy **[1, 2006.01]**

**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]**

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]**

**5/00 Applications of radiation from radioactive sources or arrangements therefor, not otherwise provided for [1, 2006.01]**

5/02 • as tracers **[1, 2006.01]**

**7/00 Use of effects of cosmic radiation [1, 2006.01]**

**G21J NUCLEAR EXPLOSIVES; APPLICATIONS THEREOF**

**Note(s)**

This subclass covers uncontrollable fission or fusion reactions.

**1/00 Nuclear explosive devices [1, 2006.01]**

**3/00 Peaceful applications of nuclear explosive devices [1, 2006.01]**

3/02 • for excavation **[1, 2006.01]**

**5/00 Detection arrangements for nuclear explosions [1, 2006.01]**

**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.

**1/00 Arrangements for handling particles or ionising radiation, e.g. focusing or moderating** (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]**

1/02 • using diaphragms, collimators **[2, 2006.01]**

1/04 • • using variable diaphragms, shutters, choppers **[2, 2006.01]**

1/06 • using diffraction, refraction, or reflection, e.g. monochromators (G21K 1/10, G21K 7/00 take precedence) **[2, 2006.01]**

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]**

1/087 • • by electrical means **[4, 2006.01]**

1/093 • • by magnetic means **[4, 2006.01]**

1/10 • Scattering devices; Absorbing devices **[2, 2006.01]**

1/12 • • Resonant absorbers or driving arrangements therefor, e.g. for Mössbauer-effect devices **[3, 2006.01]**

1/14 • using charge exchange devices, e.g. for neutralising or changing the sign of the electrical charges of beams **[3, 2006.01]**

1/16 • using polarising devices, e.g. for obtaining a polarised ion beam **[3, 2006.01]**

**3/00 Ionising radiation filters, e.g. X-ray filters [2, 2006.01]**

**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]**

**5/00 Irradiation devices** (adaptations of reactors to facilitate irradiation G21C 23/00; discharge tubes for irradiating H01J 33/00, H01J 37/00) **[2, 2006.01]**

5/02 • having no beam-forming means **[2, 2006.01]**

5/04 • with beam-forming means **[2, 2006.01]**

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]**