NUCLEONICS

G21 NUCLEAR PHYSICS; NUCLEAR ENGINEERING

G21B FUSION REACTORS (uncontrolled reactors G21J)

Subclass Index

THERMONUCLEAR FUSION REACTORS 1/00
LOW-TEMPERATURE NUCLEAR FUSION REACTORS 3/00

1/00 Thermonuclear fusion reactors [1,8]
1/01 . Hybrid fission-fusion nuclear reactors **[8]**
1/03 . with inertial plasma confinement **[8]**
1/05 . with magnetic or electric plasma confinement **[8]**
1/11 . Details **[8]**
1/13 . . First wall; Blanket; Divertor **[8]**
1/15 . . Particle injectors for producing thermonuclear fusion reactions, e.g. pellet injectors **[8]**
1/17 . . Vacuum chambers; Vacuum systems **[8]**
1/19 . . Targets for producing thermonuclear fusion reactions **[8]**
1/21 . . Electric power supply systems, e.g. for magnet systems **[8]**
1/23 . . Optical systems, e.g. for irradiating targets, for heating plasma or for plasma diagnostics **[8]**
1/25 . Maintenance, e.g. repair or remote inspection **[8]**

3/00 Low-temperature nuclear fusion reactors, e.g. alleged cold fusion reactors [8]

G21C NUCLEAR REACTORS (analogue computers therefor G06G 7/54; 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
Handling fuel and other materials 19/00
CONTROL; MONITORING, TESTING 7/00; 17/00
EMERGENCY PROTECTION 9/00
MANUFACTURE 21/00
ADAPTATIONS OF REACTORS FOR EXPERIMENTATION OR IRRADIATION 23/00

1/00 Reactors
1/01 . General details not provided for in groups G21C 3/00 to G21C 19/00 **[3]**
1/02 . Fast fission reactors, i.e. reactors not using a moderator
1/03 . . cooled by a coolant not essentially pressurised, e.g. pool-type reactors **[5]**
1/04 . Thermal reactors
1/06 . . Heterogeneous reactors, i.e. in which fuel and moderator are separated
1/07 . . . Pebble-bed reactors; Reactors with granular fuel **[5]**
1/08 . . . moderator being highly pressurised, e.g. boiling-water reactor, integral-superheat reactor, pressurised-water reactor (G21C 1/22 takes precedence)
1/09 . . . . Pressure regulating arrangements, i.e. pressurisers **[5]**
1/10 . . . . moderator and coolant being different or separated
1/12 . . . . . moderator being solid, e.g. Magnox reactor
1/14 . . . moderator being substantially not pressurised, e.g. swimming-pool reactor (G21C 1/22 takes precedence)
1/16 . . . . moderator and coolant being different or separated, e.g. sodium-graphite reactor
1/18 . . . . . coolant being pressurised
1/20 . . . . . moderator being liquid, e.g. pressure-tube reactor
1/22 . . . using liquid or gaseous fuel
1/24 . . Homogeneous reactors, i.e. in which fuel and moderator present an effectively homogeneous medium to the neutrons
1/26 . . . Single-region reactors
1/28 . . . Two-region reactors
1/30 . Subcritical reactors
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 to G21C 1/30 take precedence) **[3]**

3/00 Reactor fuel elements or their assemblies; Selection of substances for use as reactor fuel elements
3/02 . Fuel elements
3/04 . . Constructional details
3/06 . . . Casings; Jackets
3/07 . . . . characterised by their material, e.g. alloys **[5]**

3/08 . . . . provided with external means to promote heat-transfer, e.g. fins, baffles, corrugations
3/10 . . . . End closures
3/12 . . . . Means forming part of the element for locating it within the reactor core; External spacers for this purpose
3/14 . . . . Means forming part of the element for inserting it into, or removing it from, the core; Means for coupling adjacent elements
3/16 . . . Details of the construction within the casing
3/17 . . . . Means for storage or immobilisation of gases in fuel elements **[5]**
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)
3/20 . . . . with coating on fuel or on inside of casing; with non-active interlayer between casing and active material
3/22 . . with fissile or breeder material in contact with coolant
3/24 . . with fissile or breeder material in fluid form within a non-active casing
3/26 . . with fissile or breeder material in powder form within a non-active casing
3/28 . . with fissile or breeder material in solid form within a non-active casing
3/30 . Assemblies of a number of fuel elements in the form of a rigid unit
3/32 . . Bundles of parallel pin-, rod-, or tube-shaped fuel elements
3/322 . . . Means to influence the coolant flow through or around the bundles **[5]**
3/324 . . . Coats or envelopes for the bundles **[5]**
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]**
3/328 . . . . Relative disposition of the elements in the bundle lattice **[5]**
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]**
3/332 . . . . Supports for spacer grids **[5]**
3/334 . . . Assembling the bundles **[5]**
3/335 . . . Exchanging elements in irradiated bundles **[5]**
3/336 . . . Spacer elements for fuel rods in the bundle (spacer grids G21C 3/34) **[5]**
3/338 . . . . Helicoidal spacer elements **[5]**
3/34 . . . Spacer grids
3/344 . . . . formed of assembled tubular elements **[5]**
3/348 . . . . formed of assembled non-intersecting strips **[5]**
3/352 . . . . formed of assembled intersecting strips **[5]**
3/356 . . . . being provided with fuel element supporting members **[5]**
3/36 . . Assemblies of plate-shaped fuel elements or coaxial tubes
3/38 . Fuel units consisting of a single fuel element in a supporting sleeve
3/40 . Structural combination of fuel element with thermoelectric element for direct production of electric energy from fission heat (for temperature measurement G21C 17/10)
3/42 . Selection of substances for use as reactor fuel
3/44 . . Fluid or fluent reactor fuel
3/46 . . . Aqueous compositions
3/48 . . . . True or colloidal solutions of the active constituent
3/50 . . . . Suspensions of the active constituent; Slurries
3/52 . . . Liquid metal compositions
3/54 . . . Fused salt, oxide, or hydroxide compositions
3/56 . . . Gaseous compositions; Suspensions in a gaseous carrier
3/58 . . Solid reactor fuel
3/60 . . . Metallic fuel; Intermetallic dispersions
3/62 . . . Ceramic fuel
3/64 . . . . Ceramic dispersion fuel, e.g. cermet

5/00 Moderator or core structure; **Selection of materials for use as moderator**

5/02 . Details
5/04 . . Spatial arrangements allowing for Wigner growth
5/06 . . Means for locating or supporting fuel elements
5/08 . . Means for preventing undesired asymmetric expansion of the complete structure
5/10 . . Means for supporting the complete structure
5/12 . characterised by composition, e.g. the moderator containing additional substances which ensure improved heat resistance of the moderator
5/14 . characterised by shape
5/16 . . Shape of its constituent parts
5/18 . characterised by the provision of more than one active zone
5/20 . . wherein one zone contains fissile material and another zone contains breeder material
5/22 . . wherein one zone is a superheating zone

7/00 Control of nuclear reaction

7/02 . by using self-regulating properties of reactor materials (arrangements that involve temperature stability G21C 7/32)
7/04 . . of burnable poisons (burnable poisons in fuel rods G21C 3/326) **[5]**
7/06 . by application of neutron-absorbing material, i.e. material with absorption cross-section very much in excess of reflection cross-section
7/08 . . by displacement of solid control elements, e.g. control rods
7/10 . . . Construction of control elements
7/103 . . . . Control assemblies containing one or more absorbants as well as other elements, e.g. fuel or moderator elements **[5]**
7/107 . . . . Control elements adapted for pebble-bed reactors **[5]**
7/11 . . . . Deformable control elements, e.g. flexible, telescopic, articulated **[5]**
7/113 . . . . Control elements made of flat elements; Control elements having cruciform cross-section **[5]**
7/117 . . . . Clusters of control rods; Spider construction **[5]**
7/12 . . . Means for moving control elements to desired position (dropping rods in an emergency G21C 9/02)
7/14 . . . . Mechanical drive arrangements
7/16 . . . . Hydraulic or pneumatic drive arrangements
7/18 . . . Means for obtaining differential movement of control elements

7/20 . . . Disposition of shock-absorbing devices (shock-absorbers in general F16F)
7/22 . . by displacement of a fluid or fluent neutron-absorbing material
7/24 . . Selection of substances for use as neutron-absorbing material
7/26 . by displacement of the moderator or parts thereof
7/27 . . Spectral shift control **[5]**
7/28 . by displacement of the reflector or parts thereof
7/30 . by displacement of reactor fuel or fuel elements
7/32 . by varying flow of coolant through the core
7/34 . by utilisation of a primary neutron source
7/36 . Control circuits

9/00 **Emergency protection arrangements structurally associated with the reactor** (emergency cooling arrangements G21C 15/18)
9/004 . Pressure suppression **[5]**
9/008 . . by rupture-discs or -diaphragms **[5]**
9/012 . . by thermal accumulation or by steam condensation, e.g. ice condensers **[5]**
9/016 . Core catchers **[5]**
9/02 . Means for effecting very rapid reduction of the reactivity factor under fault conditions, e.g. reactor fuse
9/027 . . by fast movement of a solid, e.g. pebbles **[5]**
9/033 . . by an absorbent fluid **[5]**
9/04 . Means for suppressing fires
9/06 . . Means for preventing accumulation of explosives gases, e.g. recombiners **[5]**

11/00 **Shielding structurally associated with the reactor**
11/02 . Biological shielding (in general G21F)
11/04 . . on waterborne craft
11/06 . Reflecting shields, i.e. for minimising loss of neutrons
11/08 . Thermal shields; Thermal linings, i.e. for dissipating heat from gamma radiation which would otherwise heat an outer biological shield

13/00 **Pressure vessels**; **Containment vessels**; **Containment in general** (for chemical or physical processes B01J 3/00; pressure vessels in general F16J 12/00)
13/02 . Details
13/024 . . Supporting constructions for pressure vessels or containment vessels **[5]**
13/028 . . Seals, e.g. for pressure vessels or containment vessels **[5]**
13/032 . . Joints between tubes and vessel walls, e.g. taking into account thermal stresses **[5]**
13/036 . . . the tube passing through the vessel wall, i.e. continuing on both sides of the wall **[5]**
13/04 . . Arrangements for expansion and contraction
13/06 . . Sealing-plugs (for pressure vessels in general F16J 13/00)
13/067 . . . for tubes, e.g. standpipes; Locking devices for plugs **[5]**
13/073 . . . Closures for reactor-vessels, e.g. rotatable **[5]**
13/08 . Vessels characterised by the material; Selection of materials for pressure vessels
13/087 . . Metallic vessels **[5]**
13/093 . . Concrete vessels **[5]**
13/10 . Means for preventing contamination in event of leakage

15/00 **Cooling arrangements within the pressure vessel containing the core**; **Selection of specific coolants**
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
15/04 . . from fissile or breeder material
15/06 . . . in fuel elements
15/08 . . from moderating material
15/10 . . from reflector or thermal shield
15/12 . . from pressure vessel; from containment vessel
15/14 . . from ducts conducting a hot fluid; from ducts comprising auxiliary apparatus, e.g. pumps, cameras
15/16 . comprising means for separating liquid and steam (separating in general B01D; steam traps F16T)
15/18 . Emergency cooling arrangements; Removing shut-down heat
15/20 . Partitions or thermal insulation between fuel channel and moderator, e.g. in pressure tube reactors
15/22 . Structural association of coolant tubes with headers or other pipes, e.g. in pressure tube reactors (joints of tubes in general F16L) **[4]**
15/24 . Promoting flow of the coolant (electrodynamic pumps H02K 44/02)
15/243 . . for liquids **[5]**
15/247 . . . for liquid metals **[5]**
15/25 . . . using jet pumps **[5]**
15/253 . . for gases, e.g. blowers **[5]**
15/257 . . using heat-pipes **[5]**
15/26 . . by convection, e.g. using chimneys, using divergent channels
15/28 . Selection of specific coolants (if serving as the moderator G21C 5/12; heat-transfer or heat-exchange materials C09K 5/00)

17/00 **Monitoring**; **Testing** (measuring in general G01)
17/003 . Remote inspection of vessels, e.g. pressure vessels **[5]**
17/007 . . Inspection of the outer surfaces of vessels **[5]**
17/01 . . Inspection of the inner surfaces of vessels **[5]**
17/013 . . Inspection vehicles **[5]**
17/017 . Inspection or maintenance of pipe-lines or tubes in nuclear installations **[5]**
17/02 . Devices or arrangements for monitoring coolant or moderator
17/022 . . for monitoring liquid coolants or moderators **[5]**
17/025 . . . for monitoring liquid metal coolants **[5]**
17/028 . . for monitoring gaseous coolants **[5]**
17/032 . . Reactor-coolant flow measuring or monitoring **[5]**
17/035 . . Moderator- or coolant-level detecting devices **[5]**
17/038 . . Boiling detection in moderator or coolant **[5]**
17/04 . . Detecting burst slugs
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)
17/07 . . Leak testing **[5]**
17/08 . Structural combination of reactor core or moderator structure with viewing means, e.g. with television camera, periscope, window
17/10 . Structural combination of fuel element, control rod, reactor core, or moderator structure with sensitive instruments, e.g. for measuring radioactivity, strain
17/104 . . Measuring reactivity **[5]**
17/108 . . Measuring reactor flux **[5]**

17/112 . . Measuring temperature **[5]**
17/116 . . Passages or insulators, e.g. for electric cables **[5]**
17/12 . . Sensitive element forming part of control element
17/14 . Period meters

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 [2]
19/02 . Details of handling arrangements
19/04 . . Means for controlling flow of coolant over objects being handled; Means for controlling flow of coolant through channel being serviced
19/06 . . Means for supporting or storing fuel elements or control elements **[4]**
19/07 . . . Storage racks; Storage pools **[5]**
19/08 . . Means for heating fuel elements before introduction into the core; Means for heating or cooling fuel elements after removal from the core
19/10 . . Lifting devices or pulling devices adapted for co-operation with fuel elements or with control elements (manipulators B25J)
19/105 . . . with grasping or spreading coupling elements **[5]**
19/11 . . . with revolving coupling elements, e.g. socket coupling **[5]**
19/115 . . . with latching devices and ball couplings **[5]**
19/12 . . Arrangements for exerting direct hydraulic or pneumatic force on fuel element or on control element
19/14 . characterised by their adaptation for use with horizontal channels in the reactor core
19/16 . Articulated or telescopic chutes or tubes for connection to channels in the reactor core
19/18 . Apparatus for bringing fuel elements to the reactor charge area, e.g. from a storage place
19/19 . Reactor parts specifically adapted to facilitate handling, e.g. to facilitate charging or discharging of fuel elements **[3]**
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
19/22 . . Arrangements for obtaining access to the interior of a pressure vessel whilst the reactor is operating
19/24 . . . by using an auxiliary vessel which is temporarily sealed to the pressure vessel
19/26 . Arrangements for removing jammed or damaged fuel elements or control elements; Arrangements for moving broken parts thereof
19/28 . Arrangements for introducing fluent material into the reactor core; Arrangements for removing fluent material from the reactor core (pumping coolant G21D)
19/30 . . with continuous purification of circulating fluent material, e.g. by extraction of fission products
19/303 . . . specially adapted for gases (decontamination of gases G21F 9/02) **[5]**
19/307 . . . specially adapted for liquids (decontamination of liquids G21F 9/04) **[5]**
19/31 . . . . for molten metals **[5]**
19/313 . . . . . using cold traps **[5]**
19/317 . . . Recombination devices for radiolytic dissociation products **[5]**
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)
19/33 . Apparatus or processes for dismantling strings of spent fuel elements (G21C 19/34 takes precedence) **[2]**
19/34 . Apparatus or processes for dismantling nuclear fuel, e.g. before reprocessing (shielded cells G21F 7/00) **[5]**
19/36 . . Mechanical means only
19/365 . . . Removing cannings or casings from fuel **[5]**
19/37 . . . . by separating into pieces both the canning or the casing and the fuel element, e.g. by cutting or shearing **[5]**
19/375 . . . Compacting devices, e.g. for fuel assemblies **[5]**
19/38 . . Chemical means only
19/40 . Arrangements for preventing occurrence of critical conditions, e.g. during storage
19/42 . Reprocessing of irradiated fuel
19/44 . . of irradiated solid fuel
19/46 . . . Aqueous processes
19/48 . . . Non-aqueous processes
19/50 . . of irradiated fluid fuel

21/00 Apparatus or processes specially adapted to the manufacture of reactors or parts thereof (in general, section B, e.g. B23)
21/02 . Manufacture of fuel elements or breeder elements contained in non-active casings
21/04 . . by vibrational compaction or tamping
21/06 . . by swaging
21/08 . . by a slip-fit cladding process
21/10 . . by extrusion, drawing, or stretching
21/12 . . by hydrostatic or thermo-pneumatic canning
21/14 . . by plating in a fluid
21/16 . . by casting or dipping techniques
21/18 . Manufacture of control elements covered by group G21C 7/00

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

G21D NUCLEAR POWER PLANT (electric or magnetic analogue computers, e.g. simulators, for nuclear physics G06G 7/54)

1/00 Details of nuclear power plant (control G21D 3/00)
1/02 . Arrangements of auxiliary equipment
1/04 . Pumping arrangements (by means within the reactor pressure vessel G21C 15/24; electrodynamic pumps H02K 44/02)

3/00 Control of nuclear power plant (control of nuclear reaction in general G21C 7/00)
3/02 . Manual control
3/04 . Safety arrangements (emergency protection of reactor G21C 9/00)

3/06 . . responsive to faults within the plant (in the reactor G21C 9/00)
3/08 . Regulation of any parameters in the plant
3/10 . . by a combination of a variable derived from neutron flux with other controlling variables, e.g. derived from temperature, cooling flow, pressure
3/12 . . by adjustment of the reactor in response only to changes in engine demand
3/14 . . . Varying flow of coolant
3/16 . . . Varying reactivity
3/18 . . by adjustment of plant external to the reactor only in response to change in reactivity

5/00 Arrangements of reactor and engine in which reactor-produced heat is converted into mechanical energy

5/02 . Reactor and engine structurally combined, e.g. portable
5/04 . Reactor and engine not structurally combined
5/06 . . with engine working medium circulating through reactor core
5/08 . . with engine working medium heated in a heat exchanger by the reactor coolant
5/10 . . . Liquid working medium partially heated by reactor and vaporised by heat source external to the core, e.g. with oil heating
5/12 . . . Liquid working medium vaporised by reactor coolant
5/14 . . . . and also superheated by reactor coolant
5/16 . . . . superheated by separate heat source

7/00 Arrangements for direct production of electric energy from fusion or fission reactions (obtaining electric energy from radioactive sources G21H 1/00)

7/02 . using magneto-hydrodynamic generators
7/04 . using thermoelectric elements (structural combination of fuel element with thermoelectric element G21C 3/40; thermoelectric elements per se H01L 35/00, H01L 37/00)

9/00 Arrangements to provide heat for purposes other than conversion into power, e.g. for heating buildings

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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 17/00; in cosmonautic vehicles B64G; 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

1/02 . Selection of uniform shielding materials
1/04 . . Concretes; Other hydraulic hardening materials
1/06 . . Ceramics; Glasses; Refractories (cermets G21F 1/08)
1/08 . . Metals; Alloys; Cermets, i.e. sintered mixtures of ceramics and metals
1/10 . . Organic substances; Dispersions in organic carriers
1/12 . Laminated shielding materials

3/00 Shielding characterised by its physical form, e.g. granules, or shape of the material

3/02 . Clothing (protective clothing or garments in general A41D 13/00)
3/025 . . Clothing completely surrounding the wearer **[5]**
3/03 . . Aprons **[5]**
3/035 . . Gloves (mounting means on glove boxes G21F 7/053) **[5]**
3/04 . Bricks; Shields made up therefrom

5/00 Transportable or portable shielded containers

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

7/00 Shielded cells or rooms (chambers provided with manipulating devices in general B25J)

7/005 . Shielded passages through walls; Locks; Transferring devices between rooms (between glove-boxes G21F 7/047) **[5]**
7/01 . . Transferring by fluidic means **[5]**
7/015 . Room atmosphere, temperature or pressure control devices **[5]**
7/02 . Observation devices permitting vision but shielding the observer
7/03 . . Windows, e.g. shielded **[5]**
7/04 . Shielded glove-boxes (glove-boxes in general B25J 21/02)
7/047 . . Shielded passages; Closing or transferring means between glove-boxes **[5]**
7/053 . . Glove mounting means **[5]**
7/06 . Structural combination with remotely-controlled apparatus, e.g. with manipulators (manipulators B25J; remote control in general G05)

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

9/02 . Treating gases **[2]**
9/04 . Treating liquids **[2]**

9/06 . . Processing (separating different isotopes of the same chemical element B01D 59/00)
9/08 . . . by evaporation; by distillation
9/10 . . . by flocculation
9/12 . . . by absorption; by adsorption; by ion-exchange
9/14 . . . by incineration; by calcination, e.g. desiccation
9/16 . . . by fixation in stable solid media
9/18 . . . by biological processes
9/20 . . Disposal of liquid waste
9/22 . . . by storage in a tank or other container
9/24 . . . by storage in the ground; by storage under water, e.g. in ocean
9/26 . . . by dilution in water, e.g. in ocean, in stream
9/28 . Treating solids **[2]**
9/30 . . Processing (separating different isotopes of the same chemical element B01D 59/00)
9/32 . . . by incineration
9/34 . . Disposal of solid waste
9/36 . . . by packaging; by baling

G21G CONVERSION OF CHEMICAL ELEMENTS; **RADIOACTIVE SOURCES** (applications of radiation in general G21H 5/00; handling particles, e.g. neutrons, or electromagnetic radiation not otherwise provided for G21K) **[2]**

1/00 Arrangements for converting chemical elements by electromagnetic radiation, corpuscular radiation, or particle bombardment, e.g. producing radioactive isotopes (separation of different isotopes of the same element B01D 59/00; by thermonuclear reactions in nuclear reactors G21B; conversion of nuclear fuel in nuclear reactors G21C) **[2]**
1/02 . in nuclear reactors
1/04 . outside of nuclear reactors or particle accelerators **[2]**
1/06 . . by neutron irradiation **[2]**
1/08 . . . accompanied by nuclear fission **[2]**
1/10 . . by bombardment with electrically-charged particles (irradiation devices G21K 5/00) **[2]**
1/12 . . by electromagnetic irradiation, e.g. with gamma or X-rays (applications of radiation G21H 5/00; irradiation devices G21K 5/00) **[2]**

4/00 Radioactive sources (producing neutrons or other subatomic particles, X- or gamma rays, in fusion reactors G21B, in nuclear reactors G21C, by cosmic radiation G21H 7/00, in accelerators H05H; X-ray tubes H01J 35/00; gamma masers H01S 4/00) **[2]**
4/02 . Neutron sources **[2]**
4/04 . Radioactive sources other than neutron sources (radioactive dressings A61M 36/14) **[2]**
4/06 . . characterised by constructional features **[2]**
4/08 . . . specially adapted for medical applications (radiation therapy using radioactive sources A61N 5/10) **[2]**
4/10 . . with radium emanation **[2]**

5/00 Alleged conversion of chemical elements by chemical reaction

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G21H OBTAINING ENERGY FROM RADIOACTIVE SOURCES; **APPLICATIONS OF RADIATION FROM RADIOACTIVE SOURCES**; **UTILISING COSMIC RADIATION** (measurement of nuclear or X-radiation G01T; fusion reactors G21B; nuclear reactors G21C; semiconductor devices sensitive to electromagnetic or corpuscular radiation H01L 31/00)

1/00 Arrangements for obtaining electrical energy from radioactive sources, e.g. from radioactive isotopes
1/02 . Cells charged directly by beta radiation
1/04 . Cells using secondary emission induced by alpha radiation, beta radiation, or gamma radiation (discharge tubes H01J 40/00, H01J 47/00)
1/06 . Cells wherein radiation is applied to the junction of different semiconductor materials
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 (discharge tubes H01J)
1/10 . Cells in which radiation heats a thermoelectric junction or a thermionic converter (discharge tubes functioning as thermionic generators H01J 45/00; thermoelectric devices comprising a junction of dissimilar materials H01L 35/00) **[2]**
1/12 . Cells using conversion of the radiation into light combined with subsequent photoelectric conversion into electric energy

3/00 Arrangements for direct conversion of radiation energy from radioactive sources into forms of energy other than electric energy, e.g. light (lasers H01S 3/00)
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)

5/00 **Applications of radiation from radioactive sources or arrangements therefor** (producing mutation in plants A01H 1/06; preservation of dairy products A23C; preservation of foodstuffs A23L 3/26; for therapeutic purposes A61N 5/10; in chemical, physical or physicochemical processes in general B01J 19/08; in electrostatic separation B03C 3/38; for after-treatment of coatings applied as liquids or other fluent materials B05D 3/06; for action between electric vehicles and tracked apparatus B61L 1/10, B61L 3/06; introducing isotopes into organic compounds C07B 59/00; for preparation of organic chemical compounds C07, C08, e.g. C08F 2/46; for treating macromolecular substances or articles made therefrom B29C 71/04, C08J 3/28, C08J 7/18; for cracking of hydrocarbon oils C10G 15/00, C10G 32/04; for reforming naphtha C10G 35/16; preservation or ageing of products obtained from fermentation processes C12H 1/06, C12H 1/16; for bleaching fibres D06L 3/04; measuring G01; irradiation devices, gamma- or X-ray microscopes G21K; in discharge tubes H01J; apparatus for generating ions to be introduced into non-enclosed gases, e.g. into the atmosphere, H01T 23/00; for carrying-off electrostatic charges H05F 3/06)

5/02 **.** as tracers

7/00 **Use of effects of cosmic radiation**

G21J **NUCLEAR EXPLOSIVES**; **APPLICATIONS THEREOF** (electric or magnetic analogue computers, e.g. simulators, for nuclear physics G06G 7/54)

Note

This subclass covers uncontrollable fission or fusion reactions.

1/00 **Nuclear explosive devices**

3/00 **Peaceful applications of nuclear explosive devices**

3/02 **.** for excavation

5/00 **Detection arrangements for nuclear explosions** (individual measuring devices G01)

G21K **TECHNIQUES FOR HANDLING PARTICLES OR ELECTROMAGNETIC RADIATION NOT OTHERWISE PROVIDED FOR**; **IRRADIATION DEVICES**; **GAMMA- OR X-RAY MICROSCOPES** (X-ray technique H05G; plasma technique H05H) **[2]**

1/00 **Arrangements for handling radiation or particles, e.g. focusing, moderating** (radiation filters G21K 3/00) **[2]**

1/02 **.** using diaphragms, collimators **[2]**

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

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

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]**

1/087 **. .** by electrical means **[4]**

1/093 **. .** by magnetic means **[4]**

1/10 **.** Scattering devices; Absorbing devices **[2]**

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

1/14 **.** using charge exchange devices, e.g. for neutralising or changing the sign of the electrical charges of beams (producing or accelerating neutral particle beams H05H 3/00) **[3]**

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

3/00 **Radiation filters, e.g. X-ray filters [2]**

4/00 **Conversion screens for the conversion of the spatial distribution of X-rays or particle radiation into visible images, e.g. fluoroscopic screens** (photographic processes using X-ray intensifiers G03C 5/17; discharge tubes comprising luminescent screens H01J 1/62; cathode ray tubes for X-ray conversion with optical output H01J 31/50) **[3]**

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

5/02 **.** having no beam-forming means **[2]**

5/04 **.** with beam-forming means **[2]**

5/08 **.** Holders for targets or for objects to be irradiated **[2]**

5/10 **.** with provision for relative movement of beam source and object to be irradiated **[3]**

7/00 **Gamma- or X-ray microscopes [2]**