

CPC COOPERATIVE PATENT CLASSIFICATION

G PHYSICS (NOTES omitted)

NUCLEONICS

G21 NUCLEAR PHYSICS; NUCLEAR ENGINEERING

G21C NUCLEAR REACTORS (analogue computers therefor [G06G 7/54](#); fusion reactors, hybrid fission-fusion reactors [G21B](#); nuclear explosives [G21J](#))

WARNING

The following IPC groups are not used in the CPC scheme:

[G21C 1/01](#)

covered by

all other groups of [G21C](#)

[G21C 19/33](#)

covered by

all other subgroups of [G21C 19/34](#)

1/00	Reactors	1/20	. . . . . moderator being liquid, e.g. pressure-tube reactor {also the construction of the pressure-tubes}
1/02	. Fast fission reactors, i.e. reactors not using a moderator{; Metal cooled reactors; Fast breeders}		
1/022	. . {Characterised by the concept and properties of the core}	1/22	. . . using liquid or gaseous fuel
1/024	. . . {where the core is divided in zones with fuel and zones with breeding material}	1/24	. . Homogeneous reactors, i.e. in which the fuel and moderator present an effectively homogeneous medium to the neutrons
1/026	. . . {Reactors not needing refueling, i.e. reactors of the type breed-and-burn, e.g. travelling or deflagration wave reactors or seed-blanket reactors}	1/26	. . . Single-region reactors
1/028	. . {cooled by a pressurised coolant (cooling arrangements G21C 15/00)}	1/28	. . . Two-region reactors
1/03	. . cooled by a coolant not essentially pressurised, e.g. pool-type reactors	1/30	. Subcritical reactors{; Experimental reactors with exception of swimming-pool reactors or zero-energy reactors}
1/04	. Thermal reactors{; Epithermal reactors}	1/303	. . {Experimental and irradiation arrangements inside the reactor (irradiation loops G21C 1/306 ; material testing by neutrons G01N 23/005)}
1/06	. . Heterogeneous reactors, i.e. in which fuel and moderator are separated	1/306	. . {Irradiation loops}
1/07	. . . Pebble-bed reactors; Reactors with granular fuel	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)
1/08	. . . moderator being highly pressurised, e.g. boiling water reactor, integral super-heat reactor, pressurised water reactor (G21C 1/22 takes precedence)	1/322	. . {wherein the heat exchanger is disposed above the core}
1/082	. . . . {Reactors where the coolant is overheated}	1/324	. . {wherein the heat exchanger is disposed beneath the core}
1/084	. . . . {Boiling water reactors}	1/326	. . {wherein the heat exchanger is disposed next to or beside the core}
1/086	. . . . {Pressurised water reactors}	1/328	. . {wherein the prime mover is also disposed in the vessel}
2001/088	. . . . {Inherently safe boiling water reactors}		
1/09	. . . . Pressure regulating arrangements, i.e. pressurisers	3/00	Reactor fuel elements and their assemblies; Selection of substances for use as reactor fuel elements
1/10	. . . . moderator and coolant being different or separated	3/02	. Fuel elements {(manufacture thereof G21C 21/02)}
1/12	. . . . . moderator being solid, e.g. Magnox reactor {gas-graphite reactor}	3/04	. . Constructional details
1/14	. . . moderator being substantially not pressurised, e.g. swimming-pool reactor (G21C 1/22 takes precedence)	3/041	. . . {Means for removal of gases from fuel elements}
1/16	. . . . moderator and coolant being different or separated, e.g. sodium-graphite reactor {sodium-heavy water reactor, organic coolant-heavy water reactor}	3/042	. . . {Fuel elements comprising casings with a mass of granular fuel with coolant passages through them}
1/18	. . . . . coolant being pressurised	3/044	. . . {Fuel elements with porous or capillary structure}
		2003/045	. . . {Pellets}
		2003/047	. . . . {Pellet-clad interaction}

2003/048	. . . . {Shape of pellets}	3/3305	. . . . {Lower nozzle}
3/06	. . . Casings; Jackets	3/331	. . . . {Comprising hold-down means, e.g. springs}
3/07	. . . . characterised by their material, e.g. alloys	3/3315	. . . . {Upper nozzle}
3/08	. . . . provided with external means to promote heat-transfer, e.g. fins, baffles	3/332	. . . . Supports for spacer grids
3/10	. . . . End closures{; Means for tight mounting therefor}	3/334	. . . Assembling {, maintenance or repair of} the bundles {(assembling, maintenance or repair of other reactor components G21C 19/207)}
3/105	. . . . . {Flattened end-closures}	3/335	. . . Exchanging elements in irradiated bundles
3/12	. . . . Means forming part of the element for locating it within the reactor core {(means not forming part of the element G21C 5/06)}	3/336	. . . Spacer elements for fuel rods in the bundle (spacer grids G21C 3/34)
3/14	. . . . Means forming part of the element for inserting it into, or removing it from, the core; Means for coupling adjacent elements{, e.g. to form a stringer}	3/338	. . . . Helicoidal spacer elements
3/16	. . . Details of the construction within the casing	3/34	. . . Spacer grids
3/17	. . . . Means for storage or immobilisation of gases in fuel elements	3/3408	. . . . {Compact spacer grids, e.g. made of a plate or a blade}
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)	3/3416	. . . . {Spacer grids formed by metallic wires, e.g. springs}
3/20	. . . . with coating on fuel or on inside of casing; with non-active interlayer between casing and active material {with multiple casings or multiple active layers}	3/3424	. . . . {Fabrication of spacer grids}
3/22	. . with fissile or breeder material in contact with coolant	2003/3432	. . . . {Grids designed to influence the coolant, i.e. coolant mixing function}
3/24	. . with fissile or breeder material in fluid form within a non-active casing	3/344	. . . . formed of assembled tubular elements
3/26	. . with fissile or breeder material in powder form within a non-active casing	3/348	. . . . formed of assembled non-intersecting strips
3/28	. . with fissile or breeder material in solid form within a non-active casing	3/352	. . . . formed of assembled intersecting strips
3/30	. Assemblies of a number of fuel elements in the form of a rigid unit	3/356	. . . . being provided with fuel element supporting members
3/32	. . Bundles of parallel pin-, rod-, or tube-shaped fuel elements	3/3563	. . . . . {Supporting members formed only by deformations in the strips}
3/3206	. . . {Means associated with the fuel bundle for filtering the coolant, e.g. nozzles, grids}	3/3566	. . . . . {Supporting members formed only of elements fixed on the strips}
3/3213	. . . {Means for the storage or removal of fission gases (means for the storage of fission gases in the elements G21C 3/16; means for the removal of fission gases from elements G21C 3/04)}	3/36	. . Assemblies of plate-shaped fuel elements or coaxial tubes
3/322	. . . Means to influence the coolant flow through or around the bundles	3/38	. Fuel units consisting of a single fuel element in a supporting sleeve {or in another supporting element}
2003/3225	. . . . {by waterrods}	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) {or with another arrangement for direct production of electric energy, e.g. a thermionic device (combination with thermoelements for temperature measurements G21C 17/102)}
3/324	. . . Coats or envelopes for the bundles	3/42	. Selection of substances for use as reactor fuel
3/3245	. . . . {made of moderator material}	3/44	. . Fluid or fluent reactor fuel
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	3/46	. . . Aqueous compositions
2003/3262	. . . . . {Enrichment distribution in zones}	3/48	. . . . True or colloidal solutions of the active constituent
2003/3265	. . . . . {Radial distribution}	3/50	. . . . Suspensions of the active constituent; Slurries
2003/3267	. . . . . {Axial distribution}	3/52	. . . Liquid metal compositions
3/328	. . . . Relative disposition of the elements in the bundle lattice	3/54	. . . Fused salt, oxide or hydroxide compositions
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	3/56	. . . Gaseous compositions; Suspensions in a gaseous carrier
		3/58	. . Solid reactor fuel {Pellets made of fissile material}
		3/60	. . . Metallic fuel; Intermetallic dispersions
		3/62	. . . Ceramic fuel
		3/623	. . . . {Oxide fuels}
		3/626	. . . . {Coated fuel particles}
		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 {(means forming part of the element G21C 3/12)}	7/26	. by displacement of the moderator or parts thereof {by changing the moderator concentration}
5/08	. . Means for preventing undesired asymmetric expansion of the complete structure {; Stretching devices, pins }	7/27	. . Spectral shift control
5/10	. . Means for supporting the complete structure {(arrangements for supporting vessels and core-structures G21C 13/024)}	7/28	. by displacement of the reflector or parts thereof
5/12	. characterised by composition, e.g. the moderator containing additional substances which ensure improved heat resistance of the moderator {(purification of fluid moderators during the operation of the reactor G21C 19/30)}	7/30	. by displacement of the reactor fuel or fuel elements
5/123	. . {Moderators made of organic materials}	7/32	. by varying flow of coolant through the core {by adjusting the coolant or moderator temperature}
5/126	. . {Carbonic moderators (carbon and graphite in general C01B 32/00 ; refractory carbon-bulbs C04B 35/00 ; carbon electrodes C25B)}	7/34	. by utilisation of a primary neutron source
5/14	. characterised by shape	7/36	. Control circuits
5/16	. . Shape of its constituent parts	9/00	Emergency protection arrangements structurally associated with the reactor {, e.g. safety valves provided with pressure equalisation devices} (emergency cooling arrangements G21C 15/18)
5/18	. characterised by the provision of more than one active zone	9/001	. {against explosions, e.g. blast shields}
5/20	. . wherein one zone contains fissile material and another zone contains breeder material	9/002	. {against Na- or K- reactions}
5/22	. . wherein one zone is a superheating zone	9/004	. Pressure suppression
7/00	Control of nuclear reaction	9/008	. . by rupture-discs or -diaphragms
7/005	. {Flux flattening}	9/012	. . by thermal accumulation or by steam condensation, e.g. ice condensers
7/02	. by using self-regulating properties of reactor materials, {e.g. Doppler effect} (arrangements that involve temperature stability G21C 7/32)	9/016	. Core catchers
7/04	. . of burnable poisons (burnable poisons in fuel rods G21C 3/326)	9/02	. Means for effecting very rapid reduction of the reactivity factor under fault conditions, e.g. reactor fuse; {Control elements having arrangements activated in an emergency} (control elements per se G21C 7/00)
7/06	. by application of neutron-absorbing material, i.e. material with absorption cross-section very much in excess of reflection cross-section	9/022	. . {Reactor fuses}
7/08	. . by displacement of solid control elements, e.g. control rods	9/024	. . {Rupture diaphragms}
7/10	. . . Construction of control elements	9/027	. . by fast movement of a solid, e.g. pebbles
7/103	. . . . Control assemblies containing one or more absorbants as well as other elements, e.g. fuel or moderator elements	9/033	. . by an absorbent fluid
7/107	. . . . Control elements adapted for pebble-bed reactors	9/04	. Means for suppressing fires { Earthquake protection }
7/11	. . . . Deformable control elements, e.g. flexible, telescopic, articulated	9/06	. . Means for preventing accumulation of explosives gases, e.g. recombiners
7/113	. . . . Control elements made of flat elements; Control elements having cruciform cross-section	11/00	Shielding structurally associated with the reactor
7/117	. . . . Clusters of control rods; Spider construction	11/02	. Biological shielding (in general G21F) {Neutron or gamma shielding}
7/12	. . . Means for moving control elements to desired position (dropping rods in an emergency G21C 9/02)	11/022	. . {inside the reactor vessel}
7/14	. . . . Mechanical drive arrangements	11/024	. . . {structurally combined with the casing}
7/16	. . . . Hydraulic or pneumatic drive	11/026	. . {in apertures or channels through a wall}
7/18	. . . Means for obtaining differential movement of control elements	11/028	. . {characterised by the form or by the material}
7/20	. . . Disposition of shock-absorbing devices (shock-absorbers in general F16F) {Braking arrangements}	11/04	. . on waterborne craft
7/22	. . by displacement of a fluid or fluent neutron-absorbing material {, e.g. by adding neutron-absorbing material to the coolant}	11/06	. Reflecting shields, i.e. for minimising loss of neutrons
7/24	. . Selection of substances for use as neutron-absorbing material	11/08	. Thermal shields; Thermal linings, i.e. for dissipating heat from gamma radiation which would otherwise heat an outer biological shield {Thermal insulation}
		11/081	. . {consisting of a non-metallic layer of insulating material}
		11/083	. . {consisting of one or more metallic layers}
		11/085	. . . {consisting exclusively of several metallic layers}
		11/086	. . {consisting of a combination of non-metallic and metallic layers, e.g. metal-sand-metal-concrete}
		11/088	. . {consisting of a stagnant or a circulating fluid}
		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
		13/022	. . {Ventilating arrangements}
		13/024	. . Supporting constructions for pressure vessels or containment vessels

13/028	. . Seals, e.g. for pressure vessels or containment vessels	15/28	. Selection of specific coolants (if serving as the moderator G21C 5/12 ; compositions per se C09K 5/00 ; {organic coolants G21C 5/123 }); {Additions to the reactor coolants, e.g. against moderator corrosion (purification and regeneration of the reactor coolants G21C 19/30)}
13/0285	. . . {for container apertures}		
13/032	. . Joints between tubes and vessel walls, e.g. taking into account thermal stresses		
13/036	. . . the tube passing through the vessel wall, i.e. continuing on both sides of the wall		
13/04	. . Arrangements for expansion and contraction	17/00	Monitoring; Testing (measuring in general G01); {Maintaining}
13/06	. . Sealing-plugs (for pressure vessels in general F16J 13/00)	17/001	. {Mechanical simulators (electrical or magnetic simulators G06G 7/54)}
2013/063	. . . {Seals for closures or for rotatable closures}	17/002	. {Detection of leaks (by testing the coolant or the moderator G21C 17/04)}
13/067	. . . for tubes, e.g. standpipes; Locking devices for plugs	17/003	. Remote inspection of vessels, e.g. pressure vessels
13/0675	. . . . {Seals for the plugs}	17/007	. . Inspection of the outer surfaces of vessels
13/073	. . . Closures for reactor-vessels, e.g. rotatable	17/01	. . Inspection of the inner surfaces of vessels
13/0735	. . . . {Seals for closures or for rotatable closures}	17/013	. . Inspection vehicles
13/08	. Vessels characterised by the material; Selection of materials for pressure vessels	17/017	. Inspection or maintenance of pipe-lines or tubes in nuclear installations
13/087	. . Metallic vessels	17/02	. Devices or arrangements for monitoring coolant or moderator
13/0875	. . . {Tube-type vessels, e.g. for not essentially pressurised coolants}	17/021	. . {Solid moderators testing, e.g. graphite}
13/093	. . Concrete vessels	17/022	. . for monitoring liquid coolants or moderators
13/0933	. . . {made of prestressed concrete}	17/0225	. . . {Chemical surface treatment, e.g. corrosion (corrosion prevention in presence of water from scale removal or by modification of the properties of the liquid C02F 5/00 ; inhibiting corrosion by adding corrosion inhibitors C23F 11/00)}
13/0936	. . . . {Particulars concerning prestressing devices and cables}		
13/10	. Means for preventing contamination in the event of leakage, {e.g. double wall}	17/025	. . . for monitoring liquid metal coolants {(molten metal sampling in general G01N 1/125)}
15/00	Cooling arrangements within the pressure vessel containing the core; Selection of specific coolants	17/0255	. . . . {Liquid metal leaks detection (detecting leaks in pipe-line systems in general F17D 5/00)}
15/02	. Arrangements or disposition of passages in which heat is transferred to the coolant; {Coolant flow control devices (G21C 19/04 takes precedence; coolant flow control through fuel assemblies, e.g. flow restrictors G21C 3/322)}	17/028	. . for monitoring gaseous coolants
15/04	. . from fissile or breeder material {(G21C 3/32 takes precedence)}	17/032	. . Reactor-coolant flow measuring or monitoring {(measuring volume or mass flow in general G01F)}
15/06	. . . in fuel elements	17/035	. . Moderator- or coolant-level detecting devices {(indicating or measuring liquid level in general G01F 23/00)}
15/08	. . from moderating material	17/038	. . Boiling detection in moderator or coolant
15/10	. . from reflector or thermal shield	17/04	. . Detecting burst slugs
15/12	. . from pressure vessel; from containment vessel	17/041	. . . {characterised by systems for checking the coolant channels, e.g. matrix systems}
15/14	. . from headers; from joints in ducts	17/042	. . . {Devices for selective sampling, e.g. valves, shutters, rotatable selector valves}
15/16	. comprising means for separating liquid and steam (separating in general B01D ; steam traps F16D)	17/044	. . . {Detectors and metering devices for the detection of fission products}
15/18	. Emergency cooling arrangements; Removing shut-down heat	17/045	. . . . {Precipitation chambers}
15/182	. . {comprising powered means, e.g. pumps}	17/047	. . . . {Detection and metering circuits}
2015/185	. . . {using energy stored in reactor system}	17/048	. . . {characterised by a special construction of fuel elements, e.g. by a confined "tracer"}
2015/187	. . . {using energy from the electric grid}	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)
15/20	. Partitions or thermal insulation between fuel channel and moderator	17/063	. . {Burn-up control (G21C 17/066 takes precedence)}
15/22	. Structural association of coolant tubes with headers (joints of tubes in general F16L)	17/066	. . {Control of spherical elements}
15/24	. Promoting flow of the coolant (electrodynamic pumps H02K 44/02)	17/07	. . Leak testing
15/243	. . for liquids	17/08	. Structural combination of reactor core or moderator structure with viewing means, e.g. with television camera, periscope, window
15/247	. . . for liquid metals		
15/25	. . . using jet pumps		
15/253	. . for gases, e.g. blowers		
15/257	. . using heat-pipes {(in general F28D , F28F)}		
15/26	. . by convection, e.g. using chimneys, using divergent channels		

- 17/10 . Structural combination of fuel element, control rod, reactor core, or moderator structure with sensitive instruments, e.g. for measuring radioactivity, strain
- 17/102 . . {the sensitive element being part of a fuel element or a fuel assembly (structural combination with a thermoelectric element for direct production of electrical energy G21C 3/40)}
- 17/104 . . Measuring reactivity
- 17/108 . . Measuring reactor flux
- 17/112 . . Measuring temperature
- 17/116 . . Passages or insulators, e.g. for electric cables
- 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**
- 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{, e.g. for preventing "blow-out"}
- 19/06 . . Magazines for holding fuel elements or control elements
- 19/065 . . . {Rotatable magazines}
- 19/07 . . . Storage racks; Storage pools
- 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
- 19/11 . . . with revolving coupling elements, e.g. socket coupling
- 19/115 . . . with latching devices and ball couplings
- 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
- 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
- 19/202 . . {Arrangements for handling ball-form, i.e. pebble fuel}
- 19/205 . . {Interchanging of fuel elements in the core, i.e. fuel shuffling}
- 19/207 . . {Assembling, maintenance or repair of reactor components (G21C 3/334 takes precedence)}
- 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 {deterioration or corrosion products, impurities, e.g. by cold traps (purification of circulating fluid fuels G21C 19/50; separation in general B01D)}
- 19/303 . . . specially adapted for gases (decontamination of gases G21F 9/02)
- 19/307 . . . specially adapted for liquids (decontamination of liquids G21F 9/04)
- 19/31 for molten metals
- 19/313 using cold traps
- 19/317 . . . Recombination devices for radiolytic dissociation products
- 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)
- 19/34 . Apparatus or processes for dismantling nuclear fuel, e.g. before reprocessing{; Apparatus or processes for dismantling strings of spent fuel elements} (shielded cells G21F 7/00)
- 19/36 . . Mechanical means only
- 19/365 . . . Removing cannings or casings from fuel
- 19/37 by separating into pieces both the casing or the casing and the fuel element, e.g. by cutting or shearing
- 19/375 . . . Compacting devices, e.g. for fuel assemblies
- 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{, e.g. by using organic extraction means, including the regeneration of these means}
- 19/48 . . . Non-aqueous processes
- 19/50 . . of irradiated fluid fuel{, e.g. regeneration of fuels while the reactor is in operation}
- 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 {of fuel in the jacket}
- 21/06 . . by {rotatable} swaging {of the jacket around the fuel}
- 21/08 . . by a slip-fit cladding process {by crimping the jacket around the fuel}
- 21/10 . . by extrusion, drawing, or stretching {by rolling, e.g. "picture frame" technique}
- 21/12 . . by hydrostatic or thermo-pneumatic canning {in general by pressing without lengthening, e.g. explosive coating}
- 21/14 . . by plating {the fuel} in a fluid

G21C

- 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**