

CPC COOPERATIVE PATENT CLASSIFICATION

G PHYSICS (NOTES omitted)

NUCLEONICS

G21 NUCLEAR PHYSICS; NUCLEAR ENGINEERING

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

WARNINGS

- The following IPC groups are not in the CPC scheme. The subject matter for these IPC groups is classified in the following CPC groups:
[G21C 19/33](#) covered by [G21C 19/34](#)
- In this subclass non-limiting references (in the sense of paragraph 39 of the Guide to the IPC) may still be displayed in the scheme.

1/00	Reactor types	1/18	. . . . . coolant being pressurised
1/02	. Fast fission reactors, i.e. reactors not using a moderator {; Metal cooled reactors; Fast breeders}	1/20	. . . . . moderator being liquid, e.g. pressure-tube reactor
1/022	. . {characterised by the design or 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 refuelling, 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 other than swimming-pool reactors or zero-energy reactors}
1/04	. Thermal reactors {; Epithermal reactors}	1/303	. . {Experimental or irradiation arrangements inside the reactor (irradiation loops G21C 1/306)}
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}
1/088	. . . . {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 {or 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 or organic coolant-heavy water reactor}	3/042	. . . {Fuel elements comprising casings with a mass of granular fuel with coolant passages through them}
		3/044	. . . {Fuel elements with porous or capillary structure}
		3/045	. . . {Pellets}

3/047	. . . . {Pellet-clad interaction}	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
3/048	. . . . {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	3/3432	. . . . {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}
3/3225	. . . . {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
3/3262	. . . . {Enrichment distribution in zones}	3/48	. . . . True or colloidal solutions of the active constituent
3/3265	. . . . . {Radial distribution}	3/50	. . . . Suspensions of the active constituent; Slurries
3/3267	. . . . . {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
		3/56	. . . 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](#))}
- 5/08 . . Means for preventing undesired asymmetric expansion of the complete structure {; [Stretching devices, pins](#)}
- 5/10 . . Means for supporting the complete structure
{(arrangements for supporting vessels and core-structures [G21C 13/024](#))}
- 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](#))}
- 5/123 . . {[Moderators made of organic materials](#)}
- 5/126 . . {[Carbonic moderators \(carbon and graphite in general \[C01B 32/00\]\(#\); refractory carbon-bulbs \[C04B 35/00\]\(#\); carbon electrodes \[C25B\]\(#\)\)](#)}
- 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**
- 7/005 . {[Flux flattening](#)}
- 7/02 . by using self-regulating properties of reactor materials, {e.g. [Doppler effect](#)} (arrangements that involve temperature stability [G21C 7/32](#))
- 7/04 . . of burnable poisons ([burnable poisons in fuel rods \[G21C 3/326\]\(#\)](#))
- 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
- 7/107 Control elements adapted for pebble-bed reactors
- 7/11 Deformable control elements, e.g. flexible, telescopic, articulated
- 7/113 Control elements made of flat elements; Control elements having cruciform cross-section
- 7/117 Clusters of control rods; Spider construction
- 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
- 7/18 . . . Means for obtaining differential movement of control elements
- 7/20 . . . Disposition of shock-absorbing devices ([shock-absorbers in general \[F16F\]\(#\)](#)) {; [Braking arrangements](#)}
- 7/22 . . by displacement of a fluid or fluent neutron-absorbing material {, e.g. [by adding neutron-absorbing material to the coolant](#)}
- 7/24 . . Selection of substances for use as neutron-absorbing material
- 7/26 . by displacement of the moderator or parts thereof
{[by changing the moderator concentration](#)}
- 7/27 . . Spectral shift control
- 7/28 . by displacement of the reflector or parts thereof
- 7/30 . by displacement of the reactor fuel or fuel elements
- 7/32 . by varying flow of coolant through the core {[by adjusting the coolant or moderator temperature](#)}
- 7/34 . by utilisation of a primary neutron source
- 7/36 . Control circuits
- 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](#))**
- 9/001 . {[against explosions, e.g. blast shields](#)}
- 9/002 . {[against Na- or Ka- reactions](#)}
- 9/004 . Pressure suppression
- 9/008 . . by rupture-discs or -diaphragms
- 9/012 . . by thermal accumulation or by steam condensation, e.g. ice condensers
- 9/016 . Core catchers
- 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 \[G21C 7/00\]\(#\)](#))
- 9/022 . . {[Reactor fuses](#)}
- 9/024 . . {[Rupture diaphragms](#)}
- 9/027 . . by fast movement of a solid, e.g. pebbles
- 9/033 . . by an absorbent fluid
- 9/04 . Means for suppressing fires {; [Earthquake protection](#)}
- 9/06 . . Means for preventing accumulation of explosives gases, e.g. recombiners
- 11/00 Shielding structurally associated with the reactor**
- 11/02 . Biological shielding ([in general \[G21F\]\(#\)](#)) {; [Neutron or gamma shielding](#)}
- 11/022 . . {[inside the reactor vessel](#)}
- 11/024 . . . {[structurally combined with the casing](#)}
- 11/026 . . {[in apertures or channels through a wall](#)}
- 11/028 . . {[characterised by the form or by the material](#)}
- 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 {; [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)	15/247	. . . for liquid metals
13/02	. Details	15/25	. . . using jet pumps
13/022	. . {Ventilating arrangements}	15/253	. . for gases, e.g. blowers
13/024	. . Supporting constructions for pressure vessels or containment vessels	15/257	. . using heat-pipes {(in general F28D , F28F)}
13/028	. . Seals, e.g. for pressure vessels or containment vessels	15/26	. . by convection, e.g. using chimneys, using divergent channels
13/0285	. . . {for container apertures}	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)}
13/032	. . Joints between tubes and vessel walls, e.g. taking into account thermal stresses	17/00	Monitoring; Testing (measuring in general G01); {Maintaining}
13/036	. . . the tube passing through the vessel wall, i.e. continuing on both sides of the wall	17/001	. {Mechanical simulators (electrical or magnetic simulators G06G 7/54)}
13/04	. . Arrangements for expansion and contraction	17/002	. {Detection of leaks (by testing the coolant or the moderator G21C 17/04)}
13/06	. . Sealing-plugs (for pressure vessels in general F16J 13/00)	17/003	. Remote inspection of vessels, e.g. pressure vessels
13/063	. . . {Seals for closures or for rotatable closures}	17/007	. . Inspection of the outer surfaces of vessels
13/067	. . . for tubes, e.g. standpipes; Locking devices for plugs	17/01	. . Inspection of the inner surfaces of vessels
13/0675	. . . . {Seals for the plugs}	17/013	. . Inspection vehicles
13/073	. . . Closures for reactor-vessels, e.g. rotatable	17/017	. Inspection or maintenance of pipe-lines or tubes in nuclear installations
13/0735	. . . . {Seals for closures or for rotatable closures}	17/02	. Devices or arrangements for monitoring coolant or moderator
13/08	. Vessels characterised by the material; Selection of materials for pressure vessels	17/021	. . {Solid moderators testing, e.g. graphite}
13/087	. . Metallic vessels	17/022	. . for monitoring liquid coolants or moderators
13/0875	. . . {Tube-type vessels, e.g. for not essentially pressurised coolants}	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)}
13/093	. . Concrete vessels	17/025	. . . for monitoring liquid metal coolants {(molten metal sampling in general G01N 1/125)}
13/0933	. . . {made of prestressed concrete}	17/0255	. . . . {Liquid metal leaks detection (detecting leaks in pipe-line systems in general F17D 5/00)}
13/0936	. . . . {Particulars concerning prestressing devices and cables}	17/028	. . for monitoring gaseous coolants
13/10	. Means for preventing contamination in the event of leakage, {e.g. double wall}	17/032	. . Reactor-coolant flow measuring or monitoring {(measuring volume or mass flow in general G01F)}
15/00	Cooling arrangements within the pressure vessel containing the core; Selection of specific coolants	17/035	. . Moderator- or coolant-level detecting devices {(indicating or measuring liquid level in general G01F 23/00)}
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)}	17/038	. . Boiling detection in moderator or coolant
15/04	. . from fissile or breeder material {(G21C 3/32 takes precedence)}	17/04	. . Detecting burst slugs
15/06	. . . in fuel elements	17/041	. . . {characterised by systems for checking the coolant channels, e.g. matrix systems}
15/08	. . from moderating material	17/042	. . . {Devices for selective sampling, e.g. valves, shutters, rotatable selector valves}
15/10	. . from reflector or thermal shield	17/044	. . . {Detectors and metering devices for the detection of fission products}
15/12	. . from pressure vessel; from containment vessel	17/045	. . . . {Precipitation chambers}
15/14	. . from headers; from joints in ducts	17/047	. . . . {Detection and metering circuits}
15/16	. comprising means for separating liquid and steam (separating in general B01D ; steam traps F16D)	17/048	. . . {characterised by a special construction of fuel elements, e.g. by a confined "tracer"}
15/18	. Emergency cooling arrangements; Removing shut-down heat	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)
15/182	. . {comprising powered means, e.g. pumps}		
15/185	. . . {using energy stored in reactor system}		
15/187	. . . {using energy from the electric grid}		
15/20	. Partitions or thermal insulation between fuel channel and moderator		
15/22	. Structural association of coolant tubes with headers (joints of tubes in general F16L)		
15/24	. Promoting flow of the coolant (electrodynamic pumps H02K 44/02)		
15/243	. . for liquids		

17/063	. . {Burn-up control (G21C 17/066 takes precedence)}	19/207	. . {Assembling, maintenance or repair of reactor components (G21C 3/334 takes precedence)}
17/066	. . {Control of spherical elements}	19/22	. . Arrangements for obtaining access to the interior of a pressure vessel whilst the reactor is operating
17/07	. . Leak testing	19/24	. . . by using an auxiliary vessel which is temporarily sealed to the pressure vessel
17/08	. Structural combination of reactor core or moderator structure with viewing means, e.g. with television camera, periscope, window	19/26	. Arrangements for removing jammed or damaged fuel elements or control elements; Arrangements for moving broken parts thereof
17/10	. Structural combination of fuel element, control rod, reactor core, or moderator structure with sensitive instruments, e.g. for measuring radioactivity, strain	19/28	. Arrangements for introducing fluent material into the reactor core; Arrangements for removing fluent material from the reactor core (pumping coolant G21D)
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)}	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)}
17/104	. . Measuring reactivity	19/303	. . . specially adapted for gases (decontamination of gases G21F 9/02)
17/108	. . Measuring reactor flux	19/307	. . . specially adapted for liquids (decontamination of liquids G21F 9/04)
17/112	. . Measuring temperature	19/31	. . . . for molten metals
17/116	. . Passages or insulators, e.g. for electric cables	19/313	. . . . . using cold traps
17/12	. . Sensitive element forming part of control element	19/317	. . . Recombination devices for radiolytic dissociation products
17/14	. Period meters	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)
19/00	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	19/34	. 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)
19/02	. Details of handling arrangements	19/36	. . Mechanical means only
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"}	19/365	. . . Removing cannings or casings from fuel
19/06	. . Magazines for holding fuel elements or control elements	19/37	. . . . by separating into pieces both the canning or the casing and the fuel element, e.g. by cutting or shearing
19/065	. . . {Rotatable magazines}	19/375	. . . Compacting devices, e.g. for fuel assemblies
19/07	. . . Storage racks; Storage pools	19/38	. . Chemical means only
19/08	. . Means for heating fuel elements before introduction into the core; Means for heating or cooling fuel elements after removal from the core	19/40	. Arrangements for preventing occurrence of critical conditions, e.g. during storage
19/10	. . Lifting devices or pulling devices adapted for co-operation with fuel elements or with control elements (manipulators B25J)	19/42	. Reprocessing of irradiated fuel
19/105	. . . with grasping or spreading coupling elements	19/44	. . of irradiated solid fuel
19/11	. . . with revolving coupling elements, e.g. socket coupling	19/46	. . . Aqueous processes {, e.g. by using organic extraction means, including the regeneration of these means}
19/115	. . . with latching devices and ball couplings	19/48	. . . Non-aqueous processes
19/12	. . Arrangements for exerting direct hydraulic or pneumatic force on fuel element or on control element	19/50	. . of irradiated fluid fuel {, e.g. regeneration of fuels while the reactor is in operation}
19/14	. characterised by their adaptation for use with horizontal channels in the reactor core	21/00	Apparatus or processes specially adapted to the manufacture of reactors or parts thereof (in general section B, e.g. B23)
19/16	. Articulated or telescopic chutes or tubes for connection to channels in the reactor core	21/02	. Manufacture of fuel elements or breeder elements contained in non-active casings
19/18	. Apparatus for bringing fuel elements to the reactor charge area, e.g. from a storage place	21/04	. . by vibrational compaction or tamping {of fuel in the jacket}
19/19	. Reactor parts specifically adapted to facilitate handling, e.g. to facilitate charging or discharging of fuel elements	21/06	. . by {rotatable} swaging {of the jacket around the fuel}
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	21/08	. . by a slip-fit cladding process {by crimping the jacket around the fuel}
19/202	. . {Arrangements for handling ball-form, i.e. pebble fuel}		
19/205	. . {Interchanging of fuel elements in the core, i.e. fuel shuffling}		

G21C

- 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
- 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