

CPC COOPERATIVE PATENT CLASSIFICATION

C CHEMISTRY; METALLURGY

(NOTES omitted)

METALLURGY

C21 METALLURGY OF IRON

C21D MODIFYING THE PHYSICAL STRUCTURE OF FERROUS METALS; GENERAL DEVICES FOR HEAT TREATMENT OF FERROUS OR NON-FERROUS METALS OR ALLOYS; MAKING METAL MALLEABLE BY DECARBURISATION, TEMPERING OR OTHER TREATMENTS (cementation by diffusion processes [C23C](#); surface treatment of metallic material involving at least one process provided for in class [C23](#) and at least one process covered by this subclass, [C23F 17/00](#); unidirectional solidification of eutectic materials or unidirectional demixing of eutectoid materials [C30B](#))

| | | | |
|-------------|---|-------------|---|
| 1/00 | General methods or devices for heat treatment, e.g. annealing, hardening, quenching or tempering | 1/58 | . . Oils |
| 1/02 | . Hardening articles or materials formed by forging or rolling, with no further heating beyond that required for the formation | 1/60 | . . Aqueous agents |
| 1/04 | . with simultaneous application of supersonic waves, magnetic or electric fields | 1/607 | . . Molten salts |
| 1/06 | . Surface hardening | 1/613 | . . Gases; Liquefied or solidified normally gaseous material |
| 1/08 | . . with flames | 1/62 | . Quenching devices |
| 1/09 | . . by direct application of electrical or wave energy; by particle radiation | 1/63 | . . for bath quenching |
| 1/10 | . . . by electric induction | 1/64 | . . . with circulating liquids |
| 1/18 | . Hardening (C21D 1/02 takes precedence); Quenching with or without subsequent tempering (quenching devices C21D 1/62) | 1/667 | . . for spray quenching |
| 1/185 | . . {from an intercritical temperature} | 1/673 | . . for die quenching |
| 1/19 | . . by interrupted quenching | 1/68 | . Temporary coatings or embedding materials applied before or during heat treatment |
| 1/20 | . . . Isothermal quenching, e.g. bainitic hardening | 1/70 | . . while heating or quenching |
| 1/22 | . . . Martempering | 1/72 | . . during chemical change of surfaces |
| 1/25 | . . Hardening, combined with annealing between 300 degrees Celsius and 600 degrees Celsius, i.e. heat refining ("Vergüten") | 1/74 | . Methods of treatment in inert gas, controlled atmosphere, vacuum or pulverulent material |
| 1/26 | . Methods of annealing | 1/76 | . . Adjusting the composition of the atmosphere |
| 1/28 | . . Normalising | 1/763 | . . . {using a catalyst} |
| 1/30 | . . Stress-relieving | 1/767 | . . with forced gas circulation; Reheating thereof |
| 1/32 | . . Soft annealing, e.g. spheroidising | 1/773 | . . under reduced pressure or vacuum |
| 1/34 | . Methods of heating (C21D 1/06 takes precedence) | 1/78 | . Combined heat-treatments not provided for above |
| 1/38 | . . Heating by cathodic discharges | 1/785 | . . {Thermocycling} |
| 1/40 | . . Direct resistance heating | 1/82 | . Descaling by thermal stresses (mechanically B21, B23 ; chemically C23 ; electrolytically C25F 1/00) |
| 1/42 | . . Induction heating | 1/84 | . Controlled slow cooling (cooling-beds for metal rolling B21B 43/00) |
| 1/44 | . . in heat-treatment baths | | |
| 1/46 | . . . Salt baths | 3/00 | Diffusion processes for extraction of non-metals; Furnaces therefor (local protective coatings C21D 1/72) |
| 1/48 | . . . Metal baths | 3/02 | . Extraction of non-metals |
| 1/50 | . . . Oil baths | 3/04 | . . Decarburising |
| 1/52 | . . with flames | 3/06 | . . Extraction of hydrogen |
| 1/53 | . . Heating in fluidised beds | 3/08 | . . Extraction of nitrogen |
| 1/54 | . Determining when the hardening temperature has been reached by measurement of magnetic or electrical properties | 3/10 | . Furnaces therefor |
| 1/55 | . Hardenability tests, e.g. end-quench tests | 5/00 | Heat treatments of cast-iron |
| 1/56 | . characterised by the quenching agents | 5/02 | . improving the malleability of grey cast-iron |
| | | 5/04 | . of white cast-iron |
| | | 5/06 | . . Malleabilising |
| | | 5/08 | . . . with oxidation of carbon |

- 5/10 in gaseous agents
- 5/12 in solid agents
- 5/14 . . . Graphitising
- 5/16 Packing agents

6/00 Heat treatment of ferrous alloys

- 6/001 . {containing Ni ([C21D 6/004 takes precedence](#))}
- 6/002 . {containing Cr ([C21D 6/004 takes precedence](#))}
- 6/004 . {containing Cr and Ni}
- 6/005 . {containing Mn}
- 6/007 . {containing Co}
- 6/008 . {containing Si}
- 6/02 . Hardening by precipitation
- 6/04 . Hardening by cooling below 0 degrees Celsius

7/00 Modifying the physical properties of iron or steel by deformation ([apparatus for mechanical working of metal B21, B23, B24](#))

- 7/02 . by cold working
- 7/04 . . of the surface
- 7/06 . . . by shot-peening or the like
- 7/08 . . . by burnishing or the like
- 7/10 . . of the whole cross-section, e.g. of concrete reinforcing bars
- 7/105 . . . {of concrete reinforcing bars}
- 7/12 . . . by expanding tubular bodies
- 7/13 . by hot working

8/00 Modifying the physical properties by deformation combined with, or followed by, heat treatment ([hardening articles or materials formed by forging or rolling with no further heating beyond that required for the formation C21D 1/02](#))

- 8/005 . {of ferrous alloys ([C21D 8/02 - C21D 8/12 take precedence](#))}
- 8/02 . during manufacturing of plates or strips ([C21D 8/12 takes precedence](#))

NOTE

In this group classification is made according to the most important feature in one subgroup only; for other features indexing codes of [C21D](#) are added

- 8/0205 . . {of ferrous alloys}
- 8/021 . . {involving a particular fabrication or treatment of ingot or slab}
- 8/0215 . . . {Rapid solidification; Thin strip casting}
- 8/0221 . . {characterised by the working steps}
- 8/0226 . . . {Hot rolling}
- 8/0231 . . . {Warm rolling}
- 8/0236 . . . {Cold rolling}
- 8/0242 . . . {Flattening; Dressing; Flexing}
- 8/0247 . . {characterised by the heat treatment}
- 8/0252 . . . {with application of tension}
- 8/0257 . . . {with diffusion of elements, e.g. decarburising, nitriding}
- 8/0263 . . . {following hot rolling}
- 8/0268 . . . {between cold rolling steps}
- 8/0273 . . . {Final recrystallisation annealing}
- 8/0278 . . {involving a particular surface treatment ([C21D 8/0294 takes precedence](#))}
- 8/0284 . . . {Application of a separating or insulating coating}
- 8/0289 . . . {Application of a tension-inducing coating}

- 8/0294 . . {involving a localised treatment}
- 8/04 . . to produce plates or strips for deep-drawing

NOTE

In this group classification is made according to the most important feature in one subgroup only; for other features indexing codes of [C21D](#) are added

- 8/0405 . . . {of ferrous alloys}
- 8/041 . . . {involving a particular fabrication or treatment of ingot or slab}
- 8/0415 {Rapid solidification; Thin strip casting}
- 8/0421 . . . {characterised by the working steps}
- 8/0426 {Hot rolling}
- 8/0431 {Warm rolling}
- 8/0436 {Cold rolling}
- 8/0442 {Flattening; Dressing; Flexing}
- 8/0447 . . . {characterised by the heat treatment}
- 8/0452 {with application of tension}
- 8/0457 {with diffusion of elements, e.g. decarburising, nitriding}
- 8/0463 {following hot rolling}
- 8/0468 {between cold rolling steps}
- 8/0473 {Final recrystallisation annealing}
- 8/0478 . . . {involving a particular surface treatment ([C21D 8/0494 takes precedence](#))}
- 8/0484 {Application of a separating or insulating coating}
- 8/0489 {Application of a tension-inducing coating}
- 8/0494 . . . {involving a localised treatment}
- 8/06 . during manufacturing of rods or wires
- 8/065 . . {of ferrous alloys}
- 8/08 . . for concrete reinforcement
- 8/10 . during manufacturing of tubular bodies
- 8/105 . . {of ferrous alloys}
- 8/12 . during manufacturing of articles with special electromagnetic properties

NOTE

In this group classification is made according to the most important feature in one subgroup only; for other features indexing codes of [C21D](#) are added

- 8/1205 . . {involving a particular fabrication or treatment of ingot or slab}
- 8/1211 . . . {Rapid solidification; Thin strip casting}
- 8/1216 . . {the working step(s) being of interest}
- 8/1222 . . . {Hot rolling}
- 8/1227 . . . {Warm rolling}
- 8/1233 . . . {Cold rolling}
- 8/1238 . . . {Flattening; Dressing; Flexing}
- 8/1244 . . {the heat treatment(s) being of interest}
- 8/125 . . . {with application of tension}
- 8/1255 . . . {with diffusion of elements, e.g. decarburising, nitriding}
- 8/1261 . . . {following hot rolling}
- 8/1266 . . . {between cold rolling steps}
- 8/1272 . . . {Final recrystallisation annealing}
- 8/1277 . . {involving a particular surface treatment ([C21D 8/1294 takes precedence](#))}
- 8/1283 . . . {Application of a separating or insulating coating}

- 8/1288 . . . {Application of a tension-inducing coating}
- 8/1294 . . {involving a localized treatment}

9/00 Heat treatment, e.g. annealing, hardening, quenching or tempering, adapted for particular articles; Furnaces therefor

- 9/0006 . {Details, accessories not peculiar to any of the following furnaces ([control devices C21D 11/00](#))}
- 9/0012 . . {Rolls; Roll arrangements}
- 9/0018 . . {for charging, discharging or manipulation of charge}
- 9/0025 . . {Supports; Baskets; Containers; Covers}
- 9/0031 . {Rotary furnaces with horizontal or slightly inclined axis}
- 9/0037 . {Rotary furnaces with vertical axis; Furnaces with rotating floor}
- 9/0043 . {Muffle furnaces; Retort furnaces}
- 9/005 . {Furnaces in which the charge is moving up or down ([for wire, strip C21D 9/54](#))}
- 9/0056 . {Furnaces through which the charge is moved in a horizontal straight path ([C21D 9/0043 takes precedence](#))}
- 9/0062 . {Heat-treating apparatus with a cooling or quenching zone}
- 9/0068 . {for particular articles not mentioned below}
- 9/0075 . {for rods of limited length ([of unlimited length C21D 9/52](#))}
- 9/0081 . {for slabs; for billets}
- 9/0087 . {for chains, for chain links}
- 9/0093 . {for screws; for bolts}
- 9/02 . for springs
- 9/04 . for rails
- 9/06 . . with diminished tendency to become wavy
- 9/08 . for tubular bodies or pipes
- 9/085 . . {Cooling or quenching}
- 9/10 . . shotgun barrels
- 9/12 . . barrels for ordnance
- 9/14 . . wear-resistant or pressure-resistant pipes
- 9/16 . for explosive shells
- 9/18 . for knives, scythes, scissors, or like hand cutting tools
- 9/20 . for blades for skates
- 9/22 . for drills; for milling cutters; for machine cutting tools
- 9/24 . for saw blades
- 9/26 . for needles; for teeth for card-clothing
- 9/28 . for plain shafts
- 9/30 . for crankshafts; for camshafts
- 9/32 . for gear wheels, worm wheels, or the like
- 9/34 . for tyres; for rims
- 9/36 . for balls; for rollers
- 9/38 . for roll bodies
- 9/40 . for rings; for bearing races
- 9/42 . for armour plate
- 9/44 . for equipment for lining mine shafts, e.g. segments, rings or props
- 9/46 . for sheet metals
- 9/48 . . deep-drawing sheets
- 9/50 . for welded joints
- 9/505 . . {Cooling thereof}
- 9/52 . for wires; for strips; for rods of unlimited length}
- 9/525 . . {for wire, for rods ([C21D 9/54 takes precedence](#))}

- 9/54 . . Furnaces for treating strips or wire
- 9/56 . . . Continuous furnaces for strip or wire
- 9/561 {with a controlled atmosphere or vacuum}
- 9/562 {Details}
- 9/563 {Rolls; Drums; Roll arrangements}
- 9/564 {Tension control}
- 9/565 {Sealing arrangements}
- 9/567 with heating in fluidised beds
- 9/573 with cooling
- 9/5732 {of wires; of rods}
- 9/5735 {Details}
- 9/5737 {Rolls; Drums; Roll arrangements}
- 9/58 with heating by baths
- 9/60 with induction heating
- 9/62 with direct resistance heating
- 9/63 the strip being supported by a cushion of gas
- 9/64 . . . Patenting furnaces
- 9/66 . . . Tower-type furnaces
- 9/663 . . . Bell-type furnaces
- 9/665 inverted or side-facing
- 9/667 Multi-station furnaces
- 9/67 adapted for treating the charge in vacuum or special atmosphere
- 9/673 Details, accessories, or equipment peculiar to bell-type furnaces
- 9/675 Arrangements of charging or discharging devices
- 9/677 Arrangements of heating devices
- 9/68 . . . Furnace coilers; Hot coilers ([cold coilers B21C 47/00](#))
- 9/70 . Furnaces for ingots, i.e. soaking pits

10/00 Modifying the physical properties by methods other than heat treatment or deformation

- 10/005 . {by laser shock processing}

11/00 Process control or regulation for heat treatments

- 11/005 . {for cooling}

2201/00 Treatment for obtaining particular effects

- 2201/01 . Shape memory effect
- 2201/02 . Superplasticity
- 2201/03 . Amorphous or microcrystalline structure
- 2201/04 . Single or very large crystals
- 2201/05 . Grain orientation

2211/00 Microstructure comprising significant phases

- 2211/001 . Austenite
- 2211/002 . Bainite
- 2211/003 . Cementite
- 2211/004 . Dispersions; Precipitations
- 2211/005 . Ferrite
- 2211/006 . Graphite
- 2211/007 . Ledeburite
- 2211/008 . Martensite
- 2211/009 . Pearlite

2221/00 Treating localised areas of an article

- 2221/01 . End parts (e.g. leading, trailing end)
- 2221/02 . Edge parts
- 2221/10 . Differential treatment of inner with respect to outer regions, e.g. core and periphery, respectively

2241/00 Treatments in a special environment

C21D

- 2241/01 . under pressure
- 2241/02 . . Hot isostatic pressing
- 2241/03 . in zero gravity (e.g. in space)

2251/00 Treating composite or clad material

- 2251/02 . Clad material
- 2251/04 . Welded or brazed overlays

2261/00 Machining or cutting being involved

2281/00 Making use of special physico-chemical means

- 2281/01 . Seed crystals being used
- 2281/02 . temperature gradient