CPC COOPERATIVE PATENT CLASSIFICATION

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 treatments, e.g. annealing, hardening, quenching, tempering** (furnaces in general F27; electric heating per se H05B)

1/02 . Hardening articles or materials formed by forging or rolling, with no further heating beyond that required for the formation

1/04 . with simultaneous application of supersonic waves, magnetic or electric fields

1/06 . Surface hardening

1/08 . . with flames

1/09 . . by direct application of electrical or wave energy; by particle radiation

1/10 . . . by electric induction

1/18 . Hardening (C21D 1/02 takes precedence); Quenching with or without subsequent tempering (quenching devices C21D 1/62)

1/185 . . {from an intercritical temperature}

1/19 . . by interrupted quenching

1/20 . . . Isothermal quenching, e.g. bainitic hardening

1/22 . . . Martempering

1/25 . . Hardening, combined with annealing between 300 degrees Celsius and 600 degrees Celsius, i.e. heat refining ("Vergüten")

1/26 . Methods of annealing

1/28 . . Normalising

1/30 . . Stress-relieving

1/32 . . Soft annealing, e.g. spheroidising

1/34 . Methods of heating (C21D 1/06 takes precedence)

1/38 . . Heating by cathodic discharges

1/40 . . Direct resistance heating

1/42 . . Induction heating

1/44 . . in heat-treatment baths

1/46 . . . Salt baths

1/48 . . . Metal baths

1/50 . . . Oil baths

1/52 . . with flames

1/53 . . Heating in fluidised beds

1/54 . Determining when the hardening temperature has been reached by measurement of magnetic or electrical properties

1/55 . Hardenability tests, e.g. end-quench tests (investigating chemical or physical properties of materials in general G01N)

1/56 . characterised by the quenching agents

1/58 . . Oils

1/60 . . Aqueous agents

1/607 . . Molten salts

1/613 . . Gases; Liquefied or solidified normally gaseous material

1/62 . Quenching devices

1/63 . . for bath quenching

1/64 . . . with circulating liquids (in general F28D)

1/667 . . for spray quenching

1/673 . . for die quenching

1/68 . Temporary coatings or embedding materials applied before or during heat treatment

1/70 . . while heating or quenching

1/72 . . during chemical change of surfaces

1/74 . Methods of treatment in inert gas, controlled atmosphere, vacuum, or pulverulent material (production of gases C01, C10)

1/76 . . Adjusting the composition of the atmosphere

1/763 . . . {using a catalyst}

1/767 . . with forced gas circulation; Reheating thereof

1/773 . . under reduced pressure or vacuum

1/78 . Combined heat-treatments not provided for above

1/785 . . {Thermocycling}

1/82 . Descaling by thermal stresses (mechanically B21, B23; chemically C23; electrolytically C25F)

1/84 . Controlled slow cooling (cooling-beds for metal rolling B21B 43/00)

3/00 **Diffusion processes for extraction of non-metals; Furnaces therefor** (local protective coatings C21D 1/72; furnaces in general F27)

3/02 . Extraction of non-metals

3/04 . . Decarburising

3/06 . . Extraction of hydrogen

3/08 . . Extraction of nitrogen

3/10 . Furnaces therefor

5/00 **Heat treatments of cast-iron**

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, tempering, adapted for particular articles; Furnaces therefor (furnaces in general F27)
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 (apparatus for heat treatment of railway rails on the spot E01B 31/18)
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- 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, 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)
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 (controlling or regulating in general G05)
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
2241/01 . under pressure
2241/02 . . Hot isostatic pressing
2241/03 . in zero gravity (e.g. in spce)

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