

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](#))

Guidance heading:

- C21D 1/00** **General methods or devices for heat treatments, e.g. annealing, hardening, quenching, tempering (furnaces in general [F27](#) ; electric heating per se [H05B](#))**
- [C21D 1/02](#) . Hardening articles or materials formed by forging or rolling, with no further heating beyond that required for the formation
- [C21D 1/04](#) . with simultaneous application of supersonic waves, magnetic or electric fields
- [C21D 1/06](#) . Surface hardening
- [C21D 1/08](#) . . with flames
- [C21D 1/09](#) . . by direct application of electrical or wave energy ; by particle radiation
- [C21D 1/10](#) . . . by electric induction
- [C21D 1/18](#) . Hardening ([C21D 1/02](#) takes precedence) ; Quenching with or without subsequent tempering ([quenching devices C21D 1/62](#))
- [C21D 1/185](#) . . { from an intercritical temperature }
- [C21D 1/19](#) . . by interrupted quenching
- [C21D 1/20](#) . . . Isothermal quenching, e.g. bainitic hardening
- [C21D 1/22](#) . . . Martempering
- [C21D 1/25](#) . . Hardening, combined with annealing between 300 degrees Celsius and 600 degrees Celsius, i.e. heat refining ("Vergüten")
- [C21D 1/26](#) . Methods of annealing
- [C21D 1/28](#) . . Normalising
- [C21D 1/30](#) . . Stress-relieving
- [C21D 1/32](#) . . Soft annealing, e.g. spheroidising
- [C21D 1/34](#) . Methods of heating ([C21D 1/06](#) takes precedence)
- [C21D 1/38](#) . . Heating by cathodic discharges
- [C21D 1/40](#) . . Direct resistance heating
- [C21D 1/42](#) . . Induction heating
- [C21D 1/44](#) . . in heat-treatment baths

- C21D 1/46 . . . Salt baths
- C21D 1/48 . . . Metal baths
- C21D 1/50 . . . Oil baths
- C21D 1/52 . . with flames
- C21D 1/53 . . Heating in fluidised beds

- C21D 1/54 . Determining when the hardening temperature has been reached by measurement of magnetic or electrical properties

- C21D 1/55 . Hardenability tests, e.g. end-quench tests ([investigating chemical or physical properties of materials in general G01N](#))

- C21D 1/56 . characterised by the quenching agents
- C21D 1/58 . . Oils
- C21D 1/60 . . Aqueous agents
- C21D 1/607 . . Molten salts
- C21D 1/613 . . Gases ; Liquefied or solidified normally gaseous material

- C21D 1/62 . Quenching devices
- C21D 1/63 . . for bath quenching
- C21D 1/64 . . . with circulating liquids ([in general F28D](#))
- C21D 1/667 . . for spray quenching
- C21D 1/673 . . for die quenching

- C21D 1/68 . Temporary coatings or embedding materials applied before or during heat treatment
- C21D 1/70 . . while heating or quenching
- C21D 1/72 . . during chemical change of surfaces

- C21D 1/74 . Methods of treatment in inert gas, controlled atmosphere, vacuum, or pulverulent material ([production of gases C01](#) , [C10](#))
- C21D 1/76 . . Adjusting the composition of the atmosphere
- C21D 1/763 . . . { [using a catalyst](#) }
- C21D 1/767 . . with forced gas circulation ; Reheating thereof
- C21D 1/773 . . under reduced pressure or vacuum

- C21D 1/78 . Combined heat-treatments not provided for above
- C21D 1/785 . . { [Thermocycling](#) }

- C21D 1/82 . Descaling by thermal stresses ([mechanically B21](#) , [B23](#) ; [chemically C23](#) ; [electrolytically C25F](#))

- C21D 1/84 . Controlled slow cooling ([cooling-beds for metal rolling B21B 43/00](#))

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

- C21D 3/02 . Extraction of non-metals

- C21D 3/04 . . Decarburising
- C21D 3/06 . . Extraction of hydrogen
- C21D 3/08 . . Extraction of nitrogen
- C21D 3/10 . Furnaces therefor

C21D 5/00 Heat treatments of cast-iron

- C21D 5/02 . improving the malleability of grey cast-iron
- C21D 5/04 . of white cast-iron
- C21D 5/06 . . Malleabilising
- C21D 5/08 . . . with oxidation of carbon
- C21D 5/10 in gaseous agents
- C21D 5/12 in solid agents
- C21D 5/14 . . . Graphitising
- C21D 5/16 Packing agents

C21D 6/00 Heat treatment of ferrous alloys

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

C21D 7/00 Modifying the physical properties of iron or steel by deformation ([apparatus for mechanical working of metal B21](#) , [B23](#) , [B24](#))

- C21D 7/02 . by cold working
- C21D 7/04 . . of the surface
- C21D 7/06 . . . by shot-peening or the like
- C21D 7/08 . . . by burnishing or the like
- C21D 7/10 . . of the whole cross-section, e.g. of concrete reinforcing bars
- C21D 7/105 . . . { of concrete reinforcing bars }
- C21D 7/12 . . . by expanding tubular bodies

C21D 7/13 . by hot working

C21D 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](#))

C21D 8/005 . { of ferrous alloys ([C21D 8/02](#) to [C21D 8/12](#) take precedence) }

C21D 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 [M21D](#) are added

- C21D 8/0205 . . { of ferrous alloys }
- C21D 8/021 . . { involving a particular fabrication or treatment of ingot or slab }
- C21D 8/0215 . . . { Rapid solidification; Thin strip casting }
- C21D 8/0221 . . { characterised by the working steps }
- C21D 8/0226 . . . { Hot rolling }
- C21D 8/0231 . . . { Warm rolling }
- C21D 8/0236 . . . { Cold rolling }
- C21D 8/0242 . . . { Flattening; Dressing; Flexing }
- C21D 8/0247 . . { characterised by the heat treatment }
- C21D 8/0252 . . . { with application of tension }
- C21D 8/0257 . . . { with diffusion of elements, e.g. decarburising, nitriding }
- C21D 8/0263 . . . { following hot rolling }
- C21D 8/0268 . . . { between cold rolling steps }
- C21D 8/0273 . . . { Final recrystallisation annealing }
- C21D 8/0278 . . { involving a particular surface treatment ([C21D 8/0294](#) takes precedence) }
- C21D 8/0284 . . . { Application of a separating or insulating coating }
- C21D 8/0289 . . . { Application of a tension-inducing coating }
- C21D 8/0294 . . { involving a localised treatment }
- C21D 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 [M21D](#) are added

- C21D 8/0405 . . . { of ferrous alloys }
- C21D 8/041 . . . { involving a particular fabrication or treatment of ingot or slab }
- C21D 8/0415 { Rapid solidification; Thin strip casting }
- C21D 8/0421 . . . { characterised by the working steps }
- C21D 8/0426 { Hot rolling }
- C21D 8/0431 { Warm rolling }

C21D 8/0436 { Cold rolling }
C21D 8/0442 { Flattening; Dressing; Flexing }
C21D 8/0447	... { characterised by the heat treatment }
C21D 8/0452 { with application of tension }
C21D 8/0457 { with diffusion of elements, e.g. decarburising, nitriding }
C21D 8/0463 { following hot rolling }
C21D 8/0468 { between cold rolling steps }
C21D 8/0473 { Final recrystallisation annealing }
C21D 8/0478	... { involving a particular surface treatment (C21D 8/0494 takes precedence) }
C21D 8/0484 { Application of a separating or insulating coating }
C21D 8/0489 { Application of a tension-inducing coating }
C21D 8/0494	... { involving a localised treatment }
C21D 8/06	. during manufacturing of rods or wires
C21D 8/065	.. { of ferrous alloys }
C21D 8/08	.. for concrete reinforcement
C21D 8/10	. during manufacturing of tubular bodies
C21D 8/105	.. { of ferrous alloys }
C21D 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 [M21D](#) are added

C21D 8/1205	.. { involving a particular fabrication or treatment of ingot or slab }
C21D 8/1211	... { Rapid solidification; Thin strip casting }
C21D 8/1216	.. { the working step(s) being of interest }
C21D 8/1222	... { Hot rolling }
C21D 8/1227	... { Warm rolling }
C21D 8/1233	... { Cold rolling }
C21D 8/1238	... { Flattening; Dressing; Flexing }
C21D 8/1244	.. { the heat treatment(s) being of interest }
C21D 8/125	... { with application of tension }
C21D 8/1255	... { with diffusion of elements, e.g. decarburising, nitriding }
C21D 8/1261	... { following hot rolling }
C21D 8/1266	... { between cold rolling steps }
C21D 8/1272	... { Final recrystallisation annealing }
C21D 8/1277	.. { involving a particular surface treatment (C21D 8/1294 takes precedence) }
C21D 8/1283	... { Application of a separating or insulating coating }
C21D 8/1288	... { Application of a tension-inducing coating }
C21D 8/1294	.. { involving a localized treatment }

C21D 9/00 Heat treatment, e.g. annealing, hardening, quenching, tempering, adapted for

particular articles ; Furnaces therefor (furnaces in general [F27](#))

- C21D 9/0006 . { Details, accessories not peculiar to any of the following furnaces (control devices [C21D 11/00](#)) }
- C21D 9/0012 . . { Rolls; Roll arrangements }
- C21D 9/0018 . . { for charging, discharging or manipulation of charge }
- C21D 9/0025 . . { Supports; Baskets; Containers; Covers }
- C21D 9/0031 . { Rotary furnaces with horizontal or slightly inclined axis }
- C21D 9/0037 . { Rotary furnaces with vertical axis; Furnaces with rotating floor }
- C21D 9/0043 . { Muffle furnaces; Retort furnaces }
- C21D 9/005 . { Furnaces in which the charge is moving up or down (for wire, strip [C21D 9/54](#)) }
- C21D 9/0056 . { Furnaces through which the charge is moved in a horizontal straight path ([C21D 9/0043](#) takes precedence) }
- C21D 9/0062 . { Heat-treating apparatus with a cooling or quenching zone }
- C21D 9/0068 . { for particular articles not mentioned below }
- C21D 9/0075 . { for rods of limited length (of unlimited length [C21D 9/52](#)) }
- C21D 9/0081 . { for slabs; for billets }
- C21D 9/0087 . { for chains, for chain links }
- C21D 9/0093 . { for screws; for bolts }
- C21D 9/02 . for springs
- C21D 9/04 . for rails (apparatus for heat treatment of railway rails on the spot [E01B 31/18](#))
- C21D 9/06 . . with diminished tendency to become wavy
- C21D 9/08 . for tubular bodies or pipes
- C21D 9/085 . . { Cooling or quenching }
- C21D 9/10 . . shotgun barrels
- C21D 9/12 . . barrels for ordnance
- C21D 9/14 . . wear- or pressure-resistant pipes
- C21D 9/16 . for explosive shells
- C21D 9/18 . for knives, scythes, scissors, or like hand cutting tools
- C21D 9/20 . for blades for skates
- C21D 9/22 . for drills ; for milling cutters ; for machine cutting tools

- C21D 9/24 . for saw blades
- C21D 9/26 . for needles ; for teeth for card-clothing
- C21D 9/28 . for plain shafts
- C21D 9/30 . for crankshafts ; for camshafts
- C21D 9/32 . for gear wheels, worm wheels, or the like
- C21D 9/34 . for tyres ; for rims
- C21D 9/36 . for balls ; for rollers
- C21D 9/38 . for roll bodies
- C21D 9/40 . for rings ; for bearing races
- C21D 9/42 . for armour plate
- C21D 9/44 . for equipment for lining mine shafts, e.g. segments, rings, props
- C21D 9/46 . for sheet metals
- C21D 9/48 .. deep-drawing sheets
- C21D 9/50 . for welded joints
- C21D 9/505 .. { Cooling thereof }
- C21D 9/52 . for wires ; for strips; { for rods of unlimited length }
- C21D 9/525 .. { for wire, for rods ([C21D 9/54](#) takes precedence) }
- C21D 9/54 .. Furnaces for treating strips or wire
- C21D 9/56 ... Continuous furnaces for strip or wire
- C21D 9/561 { with a controlled atmosphere or vacuum }
- C21D 9/562 { Details }
- C21D 9/563 { Rolls; Drums; Roll arrangements }
- C21D 9/564 { Tension control }
- C21D 9/565 { Sealing arrangements }
- C21D 9/567 with heating in fluidised beds
- C21D 9/573 with cooling
- C21D 9/5732 { of wires; of rods }
- C21D 9/5735 { Details }
- C21D 9/5737 { Rolls; Drums; Roll arrangements }
- C21D 9/58 with heating by baths
- C21D 9/60 with induction heating
- C21D 9/62 with direct resistance heating
- C21D 9/63 the strip being supported by a cushion of gas

- C21D 9/64 . . . Patenting furnaces
- C21D 9/66 . . . Tower-type furnaces
- C21D 9/663 . . . Bell-type furnaces
- C21D 9/665 inverted or side-facing
- C21D 9/667 Multi-station furnaces
- C21D 9/67 adapted for treating the charge in vacuum or special atmosphere
- C21D 9/673 Details, accessories, or equipment peculiar to bell-type furnaces
- C21D 9/675 Arrangements of charging or discharging devices
- C21D 9/677 Arrangements of heating devices
- C21D 9/68 . . . Furnace coilers ; hot coilers ([cold coilers B21C](#))

- C21D 9/70 . Furnaces for ingots, i.e. soaking pits

C21D 10/00 Modifying the physical properties by methods other than heat treatment or deformation

- C21D 10/005 . { [by laser shock processing](#) }

C21D 11/00 Process control or regulation for heat treatments ([controlling or regulating in general G05](#))

- C21D 11/005 . { [for cooling](#) }

Guidance heading:

C21D 2201/00 Treatment for obtaining particular effects

- C21D 2201/01 . Shape memory effect
- C21D 2201/02 . Superplasticity
- C21D 2201/03 . Amorphous or microcrystalline structure
- C21D 2201/04 . Single or very large crystals
- C21D 2201/05 . Grain orientation

Guidance heading:

C21D 2211/00 Microstructure comprising significant phases

- C21D 2211/001 . Austenite
- C21D 2211/002 . Bainite
- C21D 2211/003 . Cementite

C21D 2211/004	. Dispersions ; Precipitations
C21D 2211/005	. Ferrite
C21D 2211/006	. Graphite
C21D 2211/007	. Ledeburite
C21D 2211/008	. Martensite
C21D 2211/009	. Pearlite
C21D 2221/00	Treating localised areas of an article
C21D 2221/01	. End parts (e.g. leading, trailing end)
C21D 2221/02	. Edge parts
C21D 2221/10	. Differential treatment of inner with respect to outer regions, e.g. core and periphery, respectively
C21D 2241/00	Treatments in a special environment
C21D 2241/01	. under pressure
C21D 2241/02	. . Hot isostatic pressing
C21D 2241/03	. in zero gravity (e.g. in spce)
C21D 2251/00	Treating composite or clad material
C21D 2251/02	. Clad material
C21D 2251/04	. Welded or brazed overlays
C21D 2261/00	Machining or cutting being involved
C21D 2281/00	Making use of special physico-chemical means
C21D 2281/01	. Seed crystals being used
C21D 2281/02	. temperature gradient