

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