

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](#))

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 }
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
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