

**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( <a href="#">cold coilers B21C</a> )
C21D 9/70	.	Furnaces for ingots, i.e. soaking pits
<b>C21D 10/00</b>		<b>Modifying the physical properties by methods other than heat treatment or deformation</b>
C21D 10/005	.	{by laser shock processing}
<b>C21D 11/00</b>		<b>Process control or regulation for heat treatments( <a href="#">controlling or regulating in general G05</a>)</b>
C21D 11/005	.	{for cooling}
<b>C21D 2201/00</b>		<b>Treatment for obtaining particular effects</b>
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