

ECLA**EUROPEAN 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, [C23F17/00](#); unidirectional solidification of eutectic materials or unidirectional demixing of eutectoid materials C30B)

C21D1/00

General methods or devices for heat treatments, e.g. annealing, hardening, quenching, tempering (furnaces in general [F27](#); electric heating per se [H05B](#))

[C21D1/02](#)

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

[C21D1/04](#)

- . with simultaneous application of supersonic waves, magnetic or electric fields

[C21D1/06](#)

- . Surface hardening

[C21D1/08](#)

- . . with flames

[C21D1/09](#)

- . . by direct application of electrical or wave energy; by particle radiation

[C21D1/10](#)

- . . . by electric induction

[C21D1/18](#)

- . Hardening ([C21D1/02](#) takes precedence); Quenching with or without subsequent tempering ([quenching devices C21D1/62](#))

[C21D1/18B](#)

- . . [N: from an intercritical temperature]

[C21D1/19](#)

- . . by interrupted quenching

[C21D1/20](#)

- . . . Isothermal quenching, e.g. bainitic hardening

[C21D1/22](#)

- . . . Martempering

[C21D1/25](#)

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

[C21D1/26](#)

- . Methods of annealing

[C21D1/28](#)

- . . Normalising

[C21D1/30](#)

- . . Stress-relieving

[C21D1/32](#)

- . . Soft annealing, e.g. spheroidising

[C21D1/34](#)

- . Methods of heating ([C21D1/06](#) takes precedence)

[C21D1/38](#)

- . . Heating by cathodic discharges

[C21D1/40](#)

- . . Direct resistance heating

[C21D1/42](#)

- . . Induction heating

[C21D1/44](#)

- . . in heat-treatment baths

[C21D1/46](#)

- . . . Salt baths

[C21D1/48](#)

- . . . Metal baths

- C21D1/50 . . . Oil baths
- C21D1/52 . . with flames
- C21D1/53 . . Heating in fluidised beds
- C21D1/54 . Determining when the hardening temperature has been reached by measurement of magnetic or electrical properties
- C21D1/55 . Hardenability tests, e.g. end-quench tests ([investigating chemical or physical properties of materials in general G01N](#))
- C21D1/56 . characterised by the quenching agents
- C21D1/58 . . Oils
- C21D1/60 . . Aqueous agents
- C21D1/607 . . Molten salts
- C21D1/613 . . Gases; Liquefied or solidified normally gaseous material
- C21D1/62 . Quenching devices
- C21D1/63 . . for bath quenching
- C21D1/64 . . . with circulating liquids ([in general F28D](#))
- C21D1/667 . . for spray quenching
- C21D1/673 . . for die quenching
- C21D1/68 . Temporary coatings or embedding materials applied before or during heat treatment
- C21D1/70 . . while heating or quenching
- C21D1/72 . . during chemical change of surfaces
- C21D1/74 . Methods of treatment in inert gas, controlled atmosphere, vacuum, or pulverulent material ([production of gases C01, C10](#))
- C21D1/76 . . Adjusting the composition of the atmosphere
- C21D1/76C . . . [\[N: using a catalyst\] \[N9702\]](#)
- C21D1/767 . . with forced gas circulation; Reheating thereof
- C21D1/773 . . under reduced pressure or vacuum
- C21D1/78 . Combined heat-treatments not provided for above
- C21D1/78C . . [\[N: Thermocycling\] \[N9502\]](#)
- C21D1/82 . Descaling by thermal stresses ([mechanically B21, B23; chemically C23; electrolytically C25F](#))
- C21D1/84 . Controlled slow cooling ([cooling-beds for metal rolling B21B43/00](#))
- C21D3/00** **Diffusion processes for extraction of non-metals; Furnaces therefor** ([local protective coatings C21D1/72; furnaces in general F27](#))
- C21D3/02 . Extraction of non-metals
- C21D3/04 . . Decarburising
- C21D3/06 . . Extraction of hydrogen

C21D3/08 . . . Extraction of nitrogen

C21D3/10 . . . Furnaces therefor

C21D5/00 Heat treatments of cast-iron

C21D5/02 . . . improving the malleability of grey cast-iron

C21D5/04 . . . of white cast-iron

C21D5/06 . . . Malleabilising

C21D5/08 with oxidation of carbon

C21D5/10 in gaseous agents

C21D5/12 in solid agents

C21D5/14 Graphitising

C21D5/16 Packing agents

C21D6/00 Heat treatment of ferrous alloys

C21D6/00B . . . [N: containing Ni ([C21D6/00F](#) takes precedence)]

C21D6/00D . . . [N: containing Cr ([C21D6/00F](#) takes precedence)]

C21D6/00F . . . [N: containing Cr and Ni]

C21D6/00H . . . [N: containing Mn]

C21D6/00J . . . [N: containing Co]

C21D6/00K . . . [N: containing Si]

C21D6/02 . . . Hardening by precipitation

C21D6/04 . . . Hardening by cooling below 0 degrees Celsius

C21D7/00 Modifying the physical properties of iron or steel by deformation ([apparatus for mechanical working of metal](#) [B21](#), [B23](#), [B24](#)) [[C9506](#)]

C21D7/02 . . . by cold working

C21D7/04 . . . of the surface

C21D7/06 by shot-peening or the like

C21D7/08 by burnishing or the like

C21D7/10 . . . of the whole cross-section, e.g. of concrete reinforcing bars

C21D7/10B [N: of concrete reinforcing bars]

C21D7/12 by expanding tubular bodies

C21D7/13 . . . by hot working

C21D8/00 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 [C21D1/02](#))

- C21D8/00A . [N: of ferrous alloys ([C21D8/02](#) to [C21D8/12](#) take precedence)]
- C21D8/02 . during manufacturing of plates or strips ([C21D8/12](#) takes precedence)
- [N: **Note**
[N9605]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
]
- C21D8/02A . . [N: of ferrous alloys]
- C21D8/02B . . [N: involving a particular fabrication or treatment of ingot or slab] [N9605]
- C21D8/02B2 . . . [N: Rapid solidification; Thin strip casting] [N9605]
- C21D8/02D . . [N: characterised by the working steps] [N9605]
- C21D8/02D2 . . . [N: Hot rolling] [N9605]
- C21D8/02D4 . . . [N: Warm rolling] [N9605]
- C21D8/02D6 . . . [N: Cold rolling] [N9605]
- C21D8/02D8 . . . [N: Flattening; Dressing; Flexing] [N9605]
- C21D8/02F . . [N: characterised by the heat treatment] [N9605]
- C21D8/02F2 . . . [N: with application of tension] [N9605]
- C21D8/02F4 . . . [N: with diffusion of elements, e.g. decarburising, nitriding] [N9605]
- C21D8/02F6 . . . [N: following hot rolling] [N9605]
- C21D8/02F7 . . . [N: between cold rolling steps] [N9605]
- C21D8/02F8 . . . [N: Final recrystallisation annealing] [N9605]
- C21D8/02H . . [N: involving a particular surface treatment ([C21D8/02L](#) takes precedence)] [N9605]
- C21D8/02H2 . . . [N: Application of a separating or insulating coating] [N9605]
- C21D8/02H4 . . . [N: Application of a tension-inducing coating] [N9605]
- C21D8/02L . . [N: involving a localised treatment] [N9605]
- C21D8/04 . . to produce plates or strips for deep-drawing
- [N: **Note**
[N9605]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
]
- C21D8/04A . . . [N: of ferrous alloys]
- C21D8/04B . . . [N: involving a particular fabrication or treatment of ingot or slab] [N9605]
- C21D8/04B2 [N: Rapid solidification; Thin strip casting] [N9605]
- C21D8/04D . . . [N: characterised by the working steps] [N9605]
- C21D8/04D2 [N: Hot rolling] [N9605]
- C21D8/04D4 [N: Warm rolling] [N9605]
- C21D8/04D6 [N: Cold rolling] [N9605]
- C21D8/04D8 [N: Flattening; Dressing; Flexing] [N9605]
- C21D8/04F . . . [N: characterised by the heat treatment] [N9605]

C21D8/04F2 [N: with application of tension] [N9605]
C21D8/04F4 [N: with diffusion of elements, e.g. decarburising, nitriding] [N9605]
C21D8/04F6 [N: following hot rolling] [N9605]
C21D8/04F7 [N: between cold rolling steps] [N9605]
C21D8/04F8 [N: Final recrystallisation annealing] [N9605]
C21D8/04H	. . . [N: involving a particular surface treatment (C21D8/04L takes precedence)] [N9605]
C21D8/04H2 [N: Application of a separating or insulating coating] [N9605]
C21D8/04H4 [N: Application of a tension-inducing coating] [N9605]
C21D8/04L	. . . [N: involving a localised treatment] [N9605]
C21D8/06	. during manufacturing of rods or wires
C21D8/06A	. . [N: of ferrous alloys]
C21D8/08	. . for concrete reinforcement
C21D8/10	. during manufacturing of tubular bodies
C21D8/10A	. . [N: of ferrous alloys] [N9611]
C21D8/12	. during manufacturing of articles with special electromagnetic properties
	[N: 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]
C21D8/12B	. . [N: involving a particular fabrication or treatment of ingot or slab]
C21D8/12B2	. . . [N: Rapid solidification; Thin strip casting]
C21D8/12D	. . [N: the working step(s) being of interest]
C21D8/12D2	. . . [N: Hot rolling]
C21D8/12D4	. . . [N: Warm rolling]
C21D8/12D6	. . . [N: Cold rolling]
C21D8/12D8	. . . [N: Flattening; Dressing; Flexing]
C21D8/12F	. . [N: the heat treatment(s) being of interest]
C21D8/12F2	. . . [N: with application of tension]
C21D8/12F4	. . . [N: with diffusion of elements, e.g. decarburising, nitriding]
C21D8/12F6	. . . [N: following hot rolling]
C21D8/12F7	. . . [N: between cold rolling steps]
C21D8/12F8	. . . [N: Final recrystallisation annealing]
C21D8/12H	. . [N: involving a particular surface treatment (C21D8/12L takes precedence)]
C21D8/12H2	. . . [N: Application of a separating or insulating coating]
C21D8/12H4	. . . [N: Application of a tension-inducing coating]
C21D8/12L	. . [N: involving a localized treatment]

C21D9/00 Heat treatment, e.g. annealing, hardening, quenching, tempering, adapted for particular articles; Furnaces therefor ([furnaces in general F27](#))

C21D9/00D	. [N: Details, accessories not peculiar to any of the following furnaces (control devices C21D11/00)]
C21D9/00D2	. . [N: Rolls; Roll arrangements]
C21D9/00D3	. . [N: for charging, discharging or manipulation of charge]
C21D9/00D5	. . [N: Supports; Baskets; Containers; Covers]
C21D9/00E	. [N: Rotary furnaces with horizontal or slightly inclined axis]
C21D9/00F	. [N: Rotary furnaces with vertical axis; Furnaces with rotating floor]
C21D9/00G	. [N: Muffle furnaces; Retort furnaces]
C21D9/00H	. [N: Furnaces in which the charge is moving up or down (for wire, strip C21D9/54)]
C21D9/00J	. [N: Furnaces through which the charge is moved in a horizontal straight path (C21D9/00G takes precedence)]
C21D9/00K	. [N: Heat-treating apparatus with a cooling or quenching zone]
C21D9/00P	. [N: for particular articles not mentioned below]
C21D9/00R	. [N: for rods of limited length (of unlimited length C21D9/52)]
C21D9/00S	. [N: for slabs; for billets]
C21D9/00T	. [N: for chains, for chain links]
C21D9/00U	. [N: for screws; for bolts]
C21D9/02	. for springs
C21D9/04	. for rails (apparatus for heat treatment of railway rails on the spot E01B31/18)
C21D9/06	. . with diminished tendency to become wavy
C21D9/08	. for tubular bodies or pipes
C21D9/08K	. . [N: Cooling or quenching] [N9601]
C21D9/10	. . shotgun barrels
C21D9/12	. . barrels for ordnance
C21D9/14	. . wear- or pressure-resistant pipes
C21D9/16	. for explosive shells
C21D9/18	. for knives, scythes, scissors, or like hand cutting tools
C21D9/20	. for blades for skates
C21D9/22	. for drills; for milling cutters; for machine cutting tools
C21D9/24	. for saw blades

- C21D9/26 . for needles; for teeth for card-clothing
- C21D9/28 . for plain shafts
- C21D9/30 . for crankshafts; for camshafts
- C21D9/32 . for gear wheels, worm wheels, or the like
- C21D9/34 . for tyres; for rims
- C21D9/36 . for balls; for rollers
- C21D9/38 . for roll bodies
- C21D9/40 . for rings; for bearing races
- C21D9/42 . for armour plate
- C21D9/44 . for equipment for lining mine shafts, e.g. segments, rings, props
- C21D9/46 . for sheet metals
- C21D9/48 . . deep-drawing sheets
- C21D9/50 . for welded joints
- C21D9/50K . . [N: Cooling thereof] [N9412]
- C21D9/52 . for wires; for strips; [N: for rods of unlimited length]
- C21D9/52B . . [N: for wire, for rods (C21D9/54 takes precedence)]
- C21D9/54 . . Furnaces for treating strips or wire
- C21D9/56 . . . Continuous furnaces for strip or wire
- C21D9/56C [N: with a controlled atmosphere or vacuum]
- C21D9/56D [N: Details]
- C21D9/56D2 [N: Rolls; Drums; Roll arrangements]
- C21D9/56D4 [N: Tension control] [N9601]
- C21D9/56D6 [N: Sealing arrangements] [N9903]
- C21D9/567 with heating in fluidised beds
- C21D9/573 with cooling
- C21D9/573B [N: of wires; of rods]
- C21D9/573D [N: Details]
- C21D9/573D2 [N: Rolls; Drums; Roll arrangements]
- C21D9/58 with heating by baths
- C21D9/60 with induction heating
- C21D9/62 with direct resistance heating
- C21D9/63 the strip being supported by a cushion of gas
- C21D9/64 . . . Patenting furnaces
- C21D9/66 . . . Tower-type furnaces

- C21D9/663 . . . Bell-type furnaces
- C21D9/665 inverted or side-facing
- C21D9/667 Multi-station furnaces
- C21D9/67 adapted for treating the charge in vacuum or special atmosphere
- C21D9/673 Details, accessories, or equipment peculiar to bell-type furnaces
- C21D9/675 Arrangements of charging or discharging devices
- C21D9/677 Arrangements of heating devices
- C21D9/68 . . . Furnace coilers; hot coilers ([cold coilers B21C](#))
- C21D9/70 . Furnaces for ingots, i.e. soaking pits
- C21D10/00** **Modifying the physical properties by methods other than heat treatment or deformation**
- C21D10/00L . [\[N: by laser shock processing\] \[N9812\]](#)
- C21D11/00** **Process control or regulation for heat treatments ([controlling or regulating in general G05](#))**
- C21D11/00K . [\[N: for cooling\] \[N0108\]](#)