

**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 ( <a href="#">C21D 8/0494</a> 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 ( <a href="#">C21D 8/1294</a> 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