### CPC - COOPERATIVE PATENT CLASSIFICATION

**C**

**CHEMISTRY; METALLURGY**

(NOTES omitted)

**METALLURGY**

**C21**

**METALLURGY OF IRON**

**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)

<table>
<thead>
<tr>
<th>1/00</th>
<th>General methods or devices for heat treatment, e.g. annealing, hardening, quenching or tempering</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/02</td>
<td>. Hardening articles or materials formed by forging or rolling, with no further heating beyond that required for the formation</td>
</tr>
<tr>
<td>1/04</td>
<td>. with simultaneous application of supersonic waves, magnetic or electric fields</td>
</tr>
<tr>
<td>1/06</td>
<td>. Surface hardening</td>
</tr>
<tr>
<td>1/08</td>
<td>. with flames</td>
</tr>
<tr>
<td>1/09</td>
<td>. by direct application of electrical or wave energy; by particle radiation</td>
</tr>
<tr>
<td>1/10</td>
<td>. by electric induction</td>
</tr>
<tr>
<td>1/18</td>
<td>. Hardening (C21D 1/02 takes precedence); Quenching with or without subsequent tempering (quenching devices C21D 1/62)</td>
</tr>
<tr>
<td>1/185</td>
<td>. [from an intercritical temperature]</td>
</tr>
<tr>
<td>1/19</td>
<td>. by interrupted quenching</td>
</tr>
<tr>
<td>1/20</td>
<td>. . Isothermal quenching, e.g. bainitic hardening</td>
</tr>
<tr>
<td>1/22</td>
<td>. . Martempering</td>
</tr>
<tr>
<td>1/25</td>
<td>. . Hardening, combined with annealing between 300 degrees Celsius and 600 degrees Celsius, i.e. heat refining (&quot;Vergüten&quot;)</td>
</tr>
<tr>
<td>1/26</td>
<td>. Methods of annealing</td>
</tr>
<tr>
<td>1/28</td>
<td>. . Normalising</td>
</tr>
<tr>
<td>1/30</td>
<td>. . Stress-relieving</td>
</tr>
<tr>
<td>1/32</td>
<td>. . Soft annealing, e.g. spheroidising</td>
</tr>
<tr>
<td>1/34</td>
<td>. . Methods of heating (C21D 1/06 takes precedence)</td>
</tr>
<tr>
<td>1/38</td>
<td>. . Heating by cathodic discharges</td>
</tr>
<tr>
<td>1/40</td>
<td>. . Direct resistance heating</td>
</tr>
<tr>
<td>1/42</td>
<td>. . Induction heating</td>
</tr>
<tr>
<td>1/44</td>
<td>. . in heat-treatment baths</td>
</tr>
<tr>
<td>1/46</td>
<td>. . Salt baths</td>
</tr>
<tr>
<td>1/48</td>
<td>. . Metal baths</td>
</tr>
<tr>
<td>1/50</td>
<td>. . Oil baths</td>
</tr>
<tr>
<td>1/52</td>
<td>. . with flames</td>
</tr>
<tr>
<td>1/53</td>
<td>. . Heating in fluidised beds</td>
</tr>
<tr>
<td>1/54</td>
<td>. . Determining when the hardening temperature has been reached by measurement of magnetic or electrical properties</td>
</tr>
<tr>
<td>1/55</td>
<td>. . Hardenability tests, e.g. end-quench tests</td>
</tr>
<tr>
<td>1/56</td>
<td>. . characterised by the quenching agents</td>
</tr>
</tbody>
</table>

| 1/58 | . . Oils |
| 1/60 | . . Aqueous agents |
| 1/607 | . . Molten salts |
| 1/613 | . . Gases; Liquefied or solidified normally gaseous material |
| 1/62 | . . Quenching devices |
| 1/63 | . . for bath quenching |
| 1/64 | . . with circulating liquids |
| 1/667 | . . for spray quenching |
| 1/673 | . . for die quenching |
| 1/68 | . . Temporary coatings or embedding materials applied before or during heat treatment |
| 1/70 | . . while heating or quenching |
| 1/72 | . . during chemical change of surfaces |
| 1/74 | . . Methods of treatment in inert gas, controlled atmosphere, vacuum or pulverulent material |
| 1/76 | . . Adjusting the composition of the atmosphere |
| 1/763 | . . [using a catalyst] |
| 1/767 | . . with forced gas circulation; Reheating thereof |
| 1/773 | . . under reduced pressure or vacuum |
| 1/78 | . . Combined heat-treatments not provided for above |
| 1/785 | . . [Thermocycling] |
| 1/82 | . . Descaling by thermal stresses (mechanically B21, B23; chemically C23; electrolytically C25F 1/00) |
| 1/84 | . . Controlled slow cooling (cooling-beds for metal rolling B21B 43/00) |

| 3/00 | Diffusion processes for extraction of non-metals; Furnaces therefor (local protective coatings C21D 1/72) |
| 3/02 | . . Extraction of non-metals |
| 3/04 | . . Decarburising |
| 3/06 | . . Extraction of hydrogen |
| 3/08 | . . Extraction of nitrogen |
| 3/10 | . . Furnaces therefor |

| 5/00 | Heat treatments of cast-iron |
| 5/02 | . . improving the malleability of grey cast-iron |
| 5/04 | . . of white cast-iron |
| 5/06 | . . Malleabilising |
| 5/08 | . . with oxidation of carbon |
6/00 Heat treatment of ferrous alloys
6/001 . [containing Ni (C21D 6/004 takes precedence)]
6/002 . [containing Cr (C21D 6/004 takes precedence)]
6/004 . [containing Cr and Ni]
6/005 . [containing Mn]
6/007 . [containing Co]
6/008 . [containing Si]
6/02 . Hardening by precipitation
6/04 . Hardening by cooling below 0 degrees Celsius

7/00 Modifying the physical properties of iron or steel by deformation (apparatus for mechanical working of metal B21, B23, B24)
7/02 . by cold working
7/04 . of the surface
7/06 . by shot-peening or the like
7/08 . by burnishing or the like
7/10 . of the whole cross-section, e.g. of concrete reinforcing bars
7/105 . [of concrete reinforcing bars]
7/12 . by expanding tubular bodies
7/13 . by hot working

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)
8/005 . [of ferrous alloys (C21D 8/02 - C21D 8/12 take precedence)]
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 C21D are added

8/0205 . [of ferrous alloys]
8/021 . [involving a particular fabrication or treatment of ingot or slab]
8/0215 . [Rapid solidification; Thin strip casting]
8/0221 . [characterised by the working steps]
8/0226 . [Hot rolling]
8/0231 . [Warm rolling]
8/0236 . [Cold rolling]
8/0242 . [Flattening; Dressing; Flexing]
8/0247 . [characterised by the heat treatment]
8/0252 . [with application of tension]
8/0257 . [with diffusion of elements, e.g. decarburising, nitriding]
8/0263 . [following hot rolling]
8/0268 . [between cold rolling steps]
8/0273 . [Final recrystallisation annealing]
8/0278 . [involving a particular surface treatment (C21D 8/0294 takes precedence)]
8/0284 . [Application of a separating or insulating coating]
8/0289 . [Application of a tension-inducing coating]
8/0294 . [involving a localised treatment]
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 C21D are added

8/0405 . [of ferrous alloys]
8/041 . [involving a particular fabrication or treatment of ingot or slab]
8/0415 . [Rapid solidification; Thin strip casting]
8/0421 . [characterised by the working steps]
8/0426 . [Hot rolling]
8/0431 . [Warm rolling]
8/0436 . [Cold rolling]
8/0442 . [Flattening; Dressing; Flexing]
8/0447 . [characterised by the heat treatment]
8/0452 . [with application of tension]
8/0457 . [with diffusion of elements, e.g. decarburising, nitriding]
8/0463 . [following hot rolling]
8/0468 . [between cold rolling steps]
8/0473 . [Final recrystallisation annealing]
8/0478 . [involving a particular surface treatment (C21D 8/0494 takes precedence)]
8/0484 . [Application of a separating or insulating coating]
8/0489 . [Application of a tension-inducing coating]
8/0494 . [involving a localised treatment]
8/06 . during manufacturing of rods or wires
8/065 . [of ferrous alloys]
8/08 . for concrete reinforcement
8/10 . during manufacturing of tubular bodies
8/105 . [of ferrous alloys]
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 C21D are added

8/1205 . [involving a particular fabrication or treatment of ingot or slab]
8/1211 . [Rapid solidification; Thin strip casting]
8/1216 . [the working step(s) being of interest]
8/1222 . [Hot rolling]
8/1227 . [Warm rolling]
8/1233 . [Cold rolling]
8/1238 . [Flattening; Dressing; Flexing]
8/1244 . [the heat treatment(s) being of interest]
8/125 . [with application of tension]
8/1255 . [with diffusion of elements, e.g. decarburising, nitriding]
8/1261 . [following hot rolling]
8/1266 . [between cold rolling steps]
8/1272 . [Final recrystallisation annealing]
8/1277 . [involving a particular surface treatment (C21D 8/1294 takes precedence)]
8/1283 . [Application of a separating or insulating coating]
Heat treatment, e.g. annealing, hardening, quenching or tempering, adapted for particular articles; Furnaces therefor

- Details, accessories not peculiar to any of the following furnaces (C21D 9/006)
- Rolls; Roll arrangements (C21D 9/0081)
- Charges, discharging or manipulation of charge (C21D 9/0087)
- Supports; Baskets; Containery; Covers (C21D 9/0093)
- Furnaces with vertical axis; Furnaces with rotating floor (C21D 9/0097)
- Muffle furnaces; Retort furnaces (C21D 9/0104)
- Furnaces in which the charge is moving up or down (C21D 9/0108)
- Furnaces through which the charge is moved in a horizontal straight path (C21D 9/0085)
- The charge to be handled by a furnace is moving up or down (C21D 9/0085)
- Cooling or quenching (C21D 9/0091)
- Shotguns (C21D 9/0102)
- Barrels for ordnance (C21D 9/0104)
- Wear-resistant or pressure-resistant pipes (C21D 9/0106)
- Explosive shells (C21D 9/0108)
- Knives, scythes, scissors, or like hand cutting tools (C21D 9/0110)
- Blades for skates (C21D 9/0112)
- Drills; for milling cutters; for machine cutting tools (C21D 9/0114)
- Saw blades (C21D 9/0116)
- Needles; for teeth for card-clothing (C21D 9/0118)
- Plain shafts (C21D 9/0120)
- Crankshafts; for camshafts (C21D 9/0124)
- Gear wheels, worm wheels, or the like (C21D 9/0126)
- Tyres; for rims (C21D 9/0128)
- Balls; for rollers (C21D 9/0130)
- Roll bodies (C21D 9/0132)
- Rings; for bearing races (C21D 9/0134)
- Armour plate (C21D 9/0136)
- Equipment for lining mine shafts, e.g. segments, rings or props (C21D 9/0138)
- Sheet metals (C21D 9/0140)
- Deep-drawing sheets (C21D 9/0142)
- Welded joints (C21D 9/0144)
- Cooling thereof (C21D 9/0146)
- Wires; for strips (C21D 9/0148)
- For wire, for rods (C21D 9/0150)

Treatment for obtaining particular effects

- Shape memory effect (C21D 2/01)
- Superplasticity (C21D 2/02)
- Amorphous or microcrystalline structure (C21D 2/03)
- Single or very large crystals (C21D 2/04)
- Grain orientation (C21D 2/05)

Microstructure comprising significant phases

- Austenite (C21D 2/06)
- Bainite (C21D 2/07)
- Cementite (C21D 2/08)
- Dispersions; Precipitations (C21D 2/09)
- Ferrite (C21D 2/10)
- Ledenite (C21D 2/11)
- Lakedite (C21D 2/12)
- Martensite (C21D 2/13)
- Pearlite (C21D 2/14)

Treating localised areas of an article

- End parts (e.g. leading, trailing end) (C21D 2/21)
- Edge parts (C21D 2/22)
- Differential treatment of inner with respect to outer regions, e.g. core and periphery, respectively (C21D 2/23)

Treatments in a special environment

- Furnaces for treating strips or wire (C21D 9/54)
- Continuous furnaces for strip or wire (C21D 9/56)
- Furnaces for strip or wire (C21D 9/56)
- (with a controlled atmosphere or vacuum) (C21D 9/561)
- Details (C21D 9/562)
- Rolls; Drums; Roll arrangements (C21D 9/563)
- Tension control (C21D 9/564)
- Sealing arrangements (C21D 9/565)
- Heating in fluidised beds (C21D 9/566)
- Cooling (C21D 9/567)
- Heating by baths (C21D 9/568)
- Induction heating (C21D 9/569)
- Direct resistance heating (C21D 9/570)
- Strip being supported by a cushion of gas (C21D 9/571)
- Patenting furnaces (C21D 9/572)
- Tower-type furnaces (C21D 9/573)
- Bell-type furnaces (C21D 9/574)
- Inverted or side-facing (C21D 9/575)
- Multi-station furnaces (C21D 9/576)
- Furnaces for ingots, i.e. soaking pits (C21D 9/577)
- Furnaces for treating the charge in vacuum or special atmosphere (C21D 9/578)
- Details, accessories, or equipment peculiar to bell-type furnaces (C21D 9/579)
- Arrangements of charging or discharging devices (C21D 9/580)
- Arrangements of heating devices (C21D 9/581)
- Furnace coilers; Hot coilers (C21D 9/582)
- Cooling (C21D 9/583)
- Lased coilers (C21D 9/584)
- Processes for controlling or regulating heat treatments (C21D 9/585)
- Laser shock processing (C21D 9/586)
<table>
<thead>
<tr>
<th>Class Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2241/01</td>
<td>under pressure</td>
</tr>
<tr>
<td>2241/02</td>
<td>Hot isostatic pressing</td>
</tr>
<tr>
<td>2241/03</td>
<td>in zero gravity (e.g. in space)</td>
</tr>
<tr>
<td>2251/00</td>
<td>Treating composite or clad material</td>
</tr>
<tr>
<td>2251/02</td>
<td>Clad material</td>
</tr>
<tr>
<td>2251/04</td>
<td>Welded or brazed overlays</td>
</tr>
<tr>
<td>2261/00</td>
<td>Machining or cutting being involved</td>
</tr>
<tr>
<td>2281/00</td>
<td>Making use of special physico-chemical means</td>
</tr>
<tr>
<td>2281/01</td>
<td>Seed crystals being used</td>
</tr>
<tr>
<td>2281/02</td>
<td>temperature gradient</td>
</tr>
</tbody>
</table>