

## SECTION C — CHEMISTRY; 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)

#### Subclass index

##### HEAT TREATMENT

General methods or devices.....	1/00, 11/00
of cast-iron, of iron alloys.....	5/00, 6/00
adapted for particular articles.....	9/00
MECHANICAL TREATMENT.....	7/00
COMBINED MECHANICAL AND THERMAL TREATMENTS.....	8/00
OTHER TREATMENTS.....	10/00
DIFFUSION PROCESSES FOR EXTRACTION OF NON-METALS.....	3/00

<b>1/00 General methods or devices for heat treatment, e.g. annealing, hardening, quenching, tempering</b> (furnaces in general F27; electric heating H05B)	1/54 • Determining when the hardening temperature has been reached by measurement of magnetic or electrical properties
1/02 • Hardening articles or materials formed by forging or rolling, with no further heating beyond that required for the formation	1/55 • Hardenability tests, e.g. end-quench tests (investigating or analysing materials by determining their chemical or physical properties, in general G01N) [3]
1/04 • with simultaneous application of supersonic waves, magnetic or electric fields	1/56 • characterised by the quenching agents
1/06 • Surface hardening	1/58 • • Oils
1/08 • • with flames	1/60 • • Aqueous agents
1/09 • • by direct application of electrical or wave energy; by particle radiation [3]	1/607 • • Molten salts [3]
1/10 • • • by electric induction [3]	1/613 • • Gases; Liquefied or solidified normally gaseous material [3]
1/18 • Hardening (C21D 1/02 takes precedence); Quenching with or without subsequent tempering (quenching devices C21D 1/62) [3]	1/62 • Quenching devices
1/19 • • by interrupted quenching [3]	1/63 • • for bath quenching [3]
1/20 • • • Isothermal quenching, e.g. bainitic hardening [3]	1/64 • • • with circulating liquids (in general F28D) [3]
1/22 • • • Martempering [3]	1/667 • • for spray quenching [3]
1/25 • • Hardening, combined with annealing between 300 °C and 600 °C, i.e. heat refining ("Vergüten") [3]	1/673 • • for die quenching [3]
1/26 • Methods of annealing	1/68 • Temporary coatings or embedding materials applied before or during heat treatment
1/28 • • Normalising	1/70 • • while heating or quenching
1/30 • • Stress-relieving	1/72 • • during chemical change of surfaces
1/32 • • Soft annealing, e.g. spheroidising	1/74 • Methods of treatment in inert gas, controlled atmosphere, vacuum, or pulverulent material (production of gases C01, C10)
1/34 • Methods of heating (C21D 1/06 takes precedence)	1/76 • • Adjusting the composition of the atmosphere
1/38 • • Heating by cathodic discharges	1/767 • • with forced gas circulation; Reheating thereof [3]
1/40 • • Direct resistance heating	1/773 • • under reduced pressure or vacuum [3]
1/42 • • Induction heating	1/78 • Combined heat-treatments not provided for above
1/44 • • in heat-treatment baths	1/82 • Descaling by thermal stresses (mechanically B21, B23; chemically C23; electrolytically C25F)
1/46 • • • Salt baths	1/84 • Controlled slow cooling (cooling-beds for metal rolling B21B 43/00) [3]
1/48 • • • Metal baths	
1/50 • • • Oil baths	
1/52 • • with flames	<b>3/00 Diffusion processes for extraction of non-metals; Furnaces therefor</b> (local protective coatings C21D 1/72; furnaces in general F27)
1/53 • • Heating in fluidised beds [3]	

## C21D

- 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 treatment 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
- 5/10 • • • • in gaseous agents
- 5/12 • • • • in solid agents
- 5/14 • • • Graphitising
- 5/16 • • • • Packing agents
  
- 6/00 Heat treatment of ferrous alloys [2]**
- Note(s)**
- 1. When classifying in group C21D 6/00, any aspect of the method for the heat treatment of ferrous alloys which is considered to represent information of interest for search may also be classified in groups C21D 1/02-C21D 1/84. This can, for example, be the case when it is considered of interest to enable searching of heat treatment methods of ferrous alloys using a combination of classification symbols. Such non-obligatory classification should be given as "additional information".
- 2. When classifying in group C21D 6/00, any alloying constituent which is considered to represent information of interest for search may also be classified in groups C22C 38/02-C22C 38/60. This can, for example, be the case when it is considered of interest to enable searching of heat treatment of specific ferrous alloys using a combination of classification symbols. Such non-obligatory classification should be given as "additional information".
- 6/02 • Hardening by precipitation [2]
- 6/04 • Hardening by cooling below 0° C [2]
  
- 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
- 7/12 • • • 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) [3]
- 8/02 • during manufacturing of plates or strips (C21D 8/12 takes precedence) [3]
- 8/04 • • to produce plates or strips for deep-drawing [3]
- 8/06 • during manufacturing of rods or wires [3]
- 8/08 • • for concrete reinforcement [3]
- 8/10 • during manufacturing of tubular bodies [3]
  
- 8/12 • during manufacturing of articles with special electromagnetic properties [3]
  
- 9/00 Heat treatment, e.g. annealing, hardening, quenching, tempering, adapted for particular articles; Furnaces therefor** (furnaces in general F27)
- 9/02 • for springs
- 9/04 • for rails (apparatus for heat treatment of railway rails on the spot E01B 31/18)
- 9/06 • • with diminished tendency to become wavy
- 9/08 • for tubular bodies or pipes
- 9/10 • • shotgun barrels
- 9/12 • • barrels for ordnance
- 9/14 • • wear- or pressure-resistant pipes
- 9/16 • for explosive shells
- 9/18 • for knives, scythes, scissors, or like hand cutting tools
- 9/20 • for blades for skates
- 9/22 • for drills; for milling cutters; for machine cutting tools
- 9/24 • for saw blades
- 9/26 • for needles; for teeth for card-clothing
- 9/28 • for plain shafts
- 9/30 • for crankshafts; for camshafts
- 9/32 • for gear wheels, worm wheels, or the like
- 9/34 • for tyres; for rims
- 9/36 • for balls; for rollers
- 9/38 • for roll bodies
- 9/40 • for rings; for bearing races
- 9/42 • for armour plate
- 9/44 • for equipment for lining mine shafts, e.g. segments, rings, props
- 9/46 • for sheet metals
- 9/48 • • deep-drawing sheets
- 9/50 • for welded joints
- 9/52 • for wires; for strips
- 9/54 • • Furnaces for treating strips or wire
- 9/56 • • • Continuous furnaces for strip or wire
- 9/567 • • • • with heating in fluidised beds [3]
- 9/573 • • • • with cooling [3]
- 9/58 • • • • with heating by baths
- 9/60 • • • • with induction heating
- 9/62 • • • • with direct resistance heating
- 9/63 • • • • the strip being supported by a cushion of gas [3]
- 9/64 • • • Patenting furnaces
- 9/66 • • • Tower-type furnaces
- 9/663 • • • Bell-type furnaces [3]
- 9/665 • • • • inverted or side-facing [3]
- 9/667 • • • • Multi-station furnaces [3]
- 9/67 • • • • adapted for treating the charge in vacuum or special atmosphere [3]
- 9/673 • • • • Details, accessories, or equipment peculiar to bell-type furnaces [3]
- 9/675 • • • • Arrangements of charging or discharging devices [3]
- 9/677 • • • • Arrangements of heating devices [3]
- 9/68 • • • Furnace coilers; Hot coilers (cold coilers B21C)
- 9/70 • Furnaces for ingots, i.e. soaking pits
  
- 10/00 Modifying the physical properties by methods other than heat treatment or deformation [3]**
  
- 11/00 Process control or regulation for heat treatments** (controlling or regulating in general G05) [2]