

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

1/00	General methods or devices for heat treatment, e.g. annealing, hardening, quenching, tempering (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	3/00	Diffusion processes for extraction of non-metals; Furnaces therefor (local protective coatings C21D 1/72; furnaces in general F27)
1/52	• • with flames		
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]