

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)

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)

- 1/02 . Hardening articles or materials formed by forging or rolling, with no further heating beyond that required for the formation
- 1/04 . with simultaneous application of supersonic waves, magnetic or electric fields
- 1/06 . Surface hardening
- 1/08 . . with flames
- 1/09 . . by direct application of electrical or wave energy; by particle radiation [3]
- 1/10 . . . by electric induction [3]
- 1/18 . Hardening (C21D 1/02 takes precedence); Quenching with or without subsequent tempering (quenching devices C21D 1/62) [3]
- 1/19 . . by interrupted quenching [3]
- 1/20 . . . Isothermal quenching, e.g. bainitic hardening [3]
- 1/22 . . . Martempering [3]
- 1/25 . . Hardening, combined with annealing between 300 °C and 600 °C, i.e. heat refining ("Vergüten") [3]
- 1/26 . Methods of annealing
- 1/28 . . Normalising
- 1/30 . . Stress-relieving
- 1/32 . . Soft annealing, e.g. spheroidising
- 1/34 . Methods of heating (C21D 1/06 takes precedence)
- 1/38 . . Heating by cathodic discharges
- 1/40 . . Direct resistance heating
- 1/42 . . Induction heating
- 1/44 . . in heat-treatment baths
- 1/46 . . . Salt baths
- 1/48 . . . Metal baths
- 1/50 . . . Oil baths
- 1/52 . . with flames
- 1/53 . . Heating in fluidised beds [3]
- 1/54 . Determining when the hardening temperature has been reached by measurement of magnetic or electrical properties
- 1/55 . Hardenability tests, e.g. end-quench tests (investigating or analysing materials by determining their chemical or physical properties, in general G01N) [3]
- 1/56 . characterised by the quenching agents
- 1/58 . . Oils
- 1/60 . . Aqueous agents

- 1/607 . . Molten salts [3]
- 1/613 . . Gases; Liquefied or solidified normally gaseous material [3]
- 1/62 . Quenching devices
- 1/63 . . for bath quenching [3]
- 1/64 . . . with circulating liquids (in general F28D) [3]
- 1/667 . . for spray quenching [3]
- 1/673 . . for die quenching [3]
- 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 (production of gases C01, C10)
- 1/76 . . Adjusting the composition of the atmosphere
- 1/767 . . with forced gas circulation; Reheating thereof [3]
- 1/773 . . under reduced pressure or vacuum [3]
- 1/78 . Combined heat-treatments not provided for above
- 1/82 . Descaling by thermal stresses (mechanically B21, B23; chemically C23; electrolytically C25F)
- 1/84 . Controlled slow cooling (cooling-beds for metal rolling B21B 43/00) [3]

3/00 Diffusion processes for extraction of non-metals; Furnaces therefor (local protective coatings C21D 1/72; furnaces in general F27)

- 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]

- (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”. [8]
- (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”. [8]
- 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]