

SECTION C — CHEMISTRY; METALLURGY

C21 METALLURGY OF IRON

C21B MANUFACTURE OF IRON OR STEEL (preliminary treatment of ferrous ores or scrap C22B 1/00; electric heating H05B)

Note(s)

1. This subclass covers:
 - the production of iron or steel from source materials, e.g. the production of pig-iron;
 - apparatus specially adapted therefor, e.g. blast furnaces, air heaters (furnaces in general F27).
2. Processes using enzymes or micro-organisms in order to:
 - i. liberate, separate or purify a pre-existing compound or composition, or to
 - ii. treat textiles or clean solid surfaces of materials
 are further classified in subclass C12S.

Subclass index

MAKING PIG-IRON	
In blast furnaces.....	5/00, 7/00, 9/00
Other processes.....	11/00
General features.....	3/00
MAKING IRON.....	13/00, 15/00
MAKING LIQUID STEEL BY DIRECT PROCESSES.....	13/00

3/00	General features in the manufacture of pig-iron (mixers for pig-iron C21C 1/06)	9/02	• Brick hot-blast stoves
3/02	• by applying additives, e.g. fluxing agents	9/04	• • with combustion shaft
3/04	• Recovery of by-products, e.g. slag	9/06	• • Linings
3/06	• • Treatment of liquid slag (slag wool C03B; slag stones C04B)	9/08	• Iron hot-blast stoves
3/08	• • • Cooling slag	9/10	• Other details, e.g. blast mains
3/10	• • • Slag pots; Slag cars	9/12	• • Hot-blast valves or slides for blast furnaces (valves in general F16K)
5/00	Making pig-iron in the blast furnace	9/14	• Preheating the combustion air
5/02	• Making special pig-iron, e.g. by applying additives, e.g. oxides of other metals	9/16	• Cooling or drying the hot-blast
5/04	• Making slag of special composition	11/00	Making pig-iron other than in blast furnaces
5/06	• using top gas in the blast furnace process (in coke ovens C10B)	11/02	• in low shaft furnaces
7/00	Blast furnaces (lifts associated with blast furnaces B66B 9/06)	11/06	• in rotary kilns
7/02	• Internal forms	11/08	• in hearth-type furnaces
7/04	• with special refractories (refractory materials C04B)	11/10	• in electric furnaces
7/06	• • Linings for furnaces	13/00	Making spongy iron or liquid steel, by direct processes
7/08	• Top armourings	13/02	• in shaft furnaces
7/10	• Cooling; Devices therefor	13/04	• in retorts
7/12	• Opening or sealing the tap holes	13/06	• in multi-storied furnaces
7/14	• Discharging devices, e.g. for slag	13/08	• in rotary furnaces
7/16	• Tuyères	13/10	• in hearth-type furnaces
7/18	• Bell-and-hopper arrangements	13/12	• in electric furnaces
7/20	• • with appliances for distributing the burden	13/14	• Multi-stage processes
7/22	• Dust arresters	15/00	Other processes for the manufacture of iron from iron compounds (general methods of reducing to metal C22B 5/00; by electrolysis C25C 1/06)
7/24	• Test rods or other checking devices	15/02	• Metallothermic processes, e.g. thermit reduction
9/00	Stoves for heating the blast in blast furnaces	15/04	• from iron carbonyl

C21B

C21C PROCESSING OF PIG-IRON, e.g. REFINING, MANUFACTURE OF WROUGHT-IRON OR STEEL (refining or remelting metals in general C22B 9/00); **TREATMENT IN MOLTEN STATE OF FERROUS ALLOYS**

- 1/00 **Refining of pig-iron; Cast iron**
- 1/02 • Dephosphorising or desulfurising
- 1/04 • Removing impurities other than carbon, phosphorus, or sulfur
- 1/06 • Constructional features of mixers for pig-iron
- 1/08 • Manufacture of cast-iron
- 1/10 • Making spheroidal graphite cast-iron
- 3/00 **Manufacture of wrought-iron or wrought-steel**
- 5/00 **Manufacture of carbon steel, e.g. plain mild steel, medium carbon steel, or cast-steel**
- 5/02 • Crucible furnace processes
- 5/04 • Manufacture of hearth-furnace steel, e.g. Siemens-Martin steel
- 5/06 • • Processes yielding slags of special composition
- 5/28 • Manufacture of steel in the converter
- 5/30 • • Regulating or controlling the blowing
- 5/32 • • • Blowing from above (C21C 5/35 takes precedence) [5]
- 5/34 • • • Blowing through the bath (C21C 5/35 takes precedence) [5]
- 5/35 • • • Blowing from above and through the bath [5]
- 5/36 • • Processes yielding slags of special composition
- 5/38 • • Removal of waste gases or dust
- 5/40 • • • Offtakes or separating apparatus for converter waste gases or dust
- 5/42 • • Constructional features of converters
- 5/44 • • • Refractory linings
- 5/46 • • • Details or accessories
- 5/48 • • • • Bottoms or tuyères of converters
- 5/50 • • • • Tilting mechanisms for converters
- 5/52 • Manufacture of steel in electric furnaces (electric heating *per se* H05B)
- 5/54 • • Processes yielding slags of special composition
- 5/56 • Manufacture of steel by other methods (making liquid steel by direct processes C21B 13/00)
- 7/00 **Treating molten ferrous alloys, e.g. steel, not covered by groups C21C 1/00-C21C 5/00** (treating molten metals during moulding B22D 1/00, B22D 27/00; remelting ferrous metals C22B)
- 7/04 • Removing impurities by adding a treating agent
- 7/06 • • Deoxidising, e.g. killing [2]
- 7/064 • • Dephosphorising; Desulfurising [3]
- 7/068 • • Decarburising [3]
- 7/072 • • Treatment with gases (C21C 7/06, C21C 7/064, C21C 7/068 take precedence) [3]
- 7/076 • • Use of slags or fluxes as treating agents (C21C 7/06, C21C 7/064, C21C 7/068 take precedence) [3]
- 7/10 • Handling in vacuum

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

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- 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]**

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

C21D

- 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]**