SECTION C — CHEMISTRY; METALLURGY

C21 METALLURGY OF IRON

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

Note(s)

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 or air heaters.

Subclass index

3/00 General features in the manufacture of pig-iron (mixers for pig-iron C21C 1/06) **[1, 2006.01]**
3/02 • by applying additives, e.g. fluxing agents **[1, 2006.01]**
3/04 • Recovery of by-products, e.g. slag **[1, 2006.01]**
3/06 • • Treatment of liquid slag **[1, 2006.01]**
3/08 • • • Cooling slag **[1, 2006.01]**
3/10 • • • Slag pots; Slag cars **[1, 2006.01]**

5/00 Making pig-iron in the blast furnace [1, 2006.01]
5/02 • Making special pig-iron, e.g. by applying additives, e.g. oxides of other metals **[1, 2006.01]**
5/04 • Making slag of special composition **[1, 2006.01]**
5/06 • using top gas in the blast furnace process **[1, 2006.01]**

7/00 Blast furnaces [1, 2006.01]
7/02 • Internal forms **[1, 2006.01]**
7/04 • with special refractories **[1, 2006.01]**
7/06 • • Linings for furnaces **[1, 2006.01]**
7/08 • Top armourings **[1, 2006.01]**
7/10 • Cooling; Devices therefor **[1, 2006.01]**
7/12 • Opening or sealing the tap holes **[1, 2006.01]**
7/14 • Discharging devices, e.g. for slag **[1, 2006.01]**
7/16 • Tuyères **[1, 2006.01]**
7/18 • Bell-and-hopper arrangements **[1, 2006.01]**
7/20 • • with appliances for distributing the burden **[1, 2006.01]**
7/22 • Dust arresters **[1, 2006.01]**
7/24 • Test rods or other checking devices **[1, 2006.01]**

9/00 Stoves for heating the blast in blast furnaces [1, 2006.01]
9/02 • Brick hot-blast stoves **[1, 2006.01]**
9/04 • • with combustion shaft **[1, 2006.01]**
9/06 • • Linings **[1, 2006.01]**
9/08 • Iron hot-blast stoves **[1, 2006.01]**
9/10 • Other details, e.g. blast mains **[1, 2006.01]**
9/12 • • Hot-blast valves or slides for blast furnaces **[1, 2006.01]**
9/14 • Preheating the combustion air **[1, 2006.01]**
9/16 • Cooling or drying the hot-blast **[1, 2006.01]**

11/00 Making pig-iron other than in blast furnaces [1, 2006.01]
11/02 • in low shaft furnaces **[1, 2006.01]**
11/06 • in rotary kilns **[1, 2006.01]**
11/08 • in hearth-type furnaces **[1, 2006.01]**
11/10 • in electric furnaces **[1, 2006.01]**

13/00 Making spongy iron or liquid steel, by direct processes [1, 2006.01]
13/02 • in shaft furnaces **[1, 2006.01]**
13/04 • in retorts **[1, 2006.01]**
13/06 • in multi-storied furnaces **[1, 2006.01]**
13/08 • in rotary furnaces **[1, 2006.01]**
13/10 • in hearth-type furnaces **[1, 2006.01]**
13/12 • in electric furnaces **[1, 2006.01]**
13/14 • Multi-stage processes **[1, 2006.01]**

15/00 Other processes for the manufacture of iron from iron compounds (by electrolysis C25C 1/06) **[1, 2006.01]**
15/02 • Metallothermic processes, e.g. thermit reduction **[1, 2006.01]**
15/04 • from iron carbonyl **[1, 2006.01]**

C21C PROCESSING OF PIG-IRON, e.g. REFINING, MANUFACTURE OF WROUGHT-IRON OR STEEL; TREATMENT IN MOLTEN STATE OF FERROUS ALLOYS

1/00 Refining of pig-iron; Cast iron [1, 2006.01]

1/02 • Dephosphorising or desulfurising **[1, 2006.01]**

1/04 • Removing impurities other than carbon, phosphorus, or sulfur **[1, 2006.01]**

1/06 • Constructional features of mixers for pig-iron **[1, 2006.01]**

1/08 • Manufacture of cast-iron **[1, 2006.01]**

1/10 • Making spheroidal graphite cast-iron **[1, 2006.01]**

3/00 Manufacture of wrought-iron or wrought-steel [1, 2006.01]

5/00 Manufacture of carbon steel, e.g. plain mild steel, medium carbon steel, or cast-steel [1, 2006.01]

5/02 • Crucible furnace processes **[1, 2006.01]**

5/04 • Manufacture of hearth-furnace steel, e.g. Siemens-Martin steel **[1, 2006.01]**

5/06 • • Processes yielding slags of special composition **[1, 2006.01]**

5/28 • Manufacture of steel in the converter **[1, 2006.01]**

5/30 • • Regulating or controlling the blowing **[1, 2006.01]**

5/32 • • • Blowing from above (C21C 5/35 takes precedence) **[1, 5, 2006.01]**

5/34 • • • Blowing through the bath (C21C 5/35 takes precedence) **[1, 5, 2006.01]**

5/35 • • • Blowing from above and through the bath **[5, 2006.01]**

5/36 • • Processes yielding slags of special composition **[1, 2006.01]**

5/38 • • Removal of waste gases or dust **[1, 2006.01]**

5/40 • • • Offtakes or separating apparatus for converter waste gases or dust **[1, 2006.01]**

5/42 • • Constructional features of converters **[1, 2006.01]**

5/44 • • • Refractory linings **[1, 2006.01]**

5/46 • • • Details or accessories **[1, 2006.01]**

5/48 • • • • Bottoms or tuyères of converters **[1, 2006.01]**

5/50 • • • • Tilting mechanisms for converters **[1, 2006.01]**

5/52 • Manufacture of steel in electric furnaces **[1, 2006.01]**

5/54 • • Processes yielding slags of special composition **[1, 2006.01]**

5/56 • Manufacture of steel by other methods (making liquid steel by direct processes C21B 13/00) **[1, 2006.01]**

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) **[1, 2006.01]**

7/04 • Removing impurities by adding a treating agent **[1, 2006.01]**

7/06 • • Deoxidising, e.g. killing **[1, 2, 2006.01]**

7/064 • • Dephosphorising; Desulfurising **[3, 2006.01]**

7/068 • • Decarburising **[3, 2006.01]**

7/072 • • Treatment with gases (C21C 7/06, C21C 7/064, C21C 7/068 take precedence) **[3, 2006.01]**

7/076 • • Use of slags or fluxes as treating agents (C21C 7/06, C21C 7/064, C21C 7/068 take precedence) **[3, 2006.01]**

7/10 • Handling in vacuum **[1, 2006.01]**

C21D MODIFYING THE PHYSICAL STRUCTURE OF FERROUS METALS; GENERAL DEVICES FOR HEAT TREATMENT OF FERROUS OR NON-FERROUS METALS OR ALLOYS; MAKING METAL MALLEABLE, e.g. BY DECARBURISATION OR TEMPERING (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)

Note(s) [2012.01]

1. Cementation by diffusion processes is classified in C23C.
2. Surface treatments of metallic material involving at least one process provided for in class C23 and at least one process covered by this subclass are classified in group C23F 17/00.

Subclass index

1/00 General methods or devices for heat treatment, e.g. annealing, hardening, quenching or tempering [1, 2006.01]

1/02 • Hardening articles or materials formed by forging or rolling, with no further heating beyond that required for the formation **[1, 2006.01]**

1/04 • with simultaneous application of supersonic waves, magnetic or electric fields **[1, 2006.01]**

1/06 • Surface hardening **[1, 2006.01]**
1/08 • • with flames **[1, 2006.01]**
1/09 • • by direct application of electrical or wave energy; by particle radiation **[3, 2006.01]**
1/10 • • • by electric induction **[1, 3, 2006.01]**
1/18 • Hardening (C21D 1/02 takes precedence); Quenching with or without subsequent tempering (quenching devices C21D 1/62) **[1, 3, 2006.01]**
1/19 • • by interrupted quenching **[3, 2006.01]**
1/20 • • • Isothermal quenching, e.g. bainitic hardening **[1, 3, 2006.01]**
1/22 • • • Martempering **[1, 3, 2006.01]**
1/25 • • Hardening, combined with annealing between 300 °C and 600 °C, i.e. heat refining ("Vergüten") **[3, 2006.01]**
1/26 • Methods of annealing **[1, 2006.01]**
1/28 • • Normalising **[1, 2006.01]**
1/30 • • Stress-relieving **[1, 2006.01]**
1/32 • • Soft annealing, e.g. spheroidising **[1, 2006.01]**
1/34 • Methods of heating (C21D 1/06 takes precedence) **[1, 2006.01]**
1/38 • • Heating by cathodic discharges **[1, 2006.01]**
1/40 • • Direct resistance heating **[1, 2006.01]**
1/42 • • Induction heating **[1, 2006.01]**
1/44 • • in heat-treatment baths **[1, 2006.01]**
1/46 • • • Salt baths **[1, 2006.01]**
1/48 • • • Metal baths **[1, 2006.01]**
1/50 • • • Oil baths **[1, 2006.01]**
1/52 • • with flames **[1, 2006.01]**
1/53 • • Heating in fluidised beds **[3, 2006.01]**
1/54 • Determining when the hardening temperature has been reached by measurement of magnetic or electrical properties **[1, 2006.01]**
1/55 • Hardenability tests, e.g. end-quench tests **[3, 2006.01]**
1/56 • characterised by the quenching agents **[1, 2006.01]**
1/58 • • Oils **[1, 2006.01]**
1/60 • • Aqueous agents **[1, 2006.01]**
1/607 • • Molten salts **[3, 2006.01]**
1/613 • • Gases; Liquefied or solidified normally gaseous material **[3, 2006.01]**
1/62 • Quenching devices **[1, 2006.01]**
1/63 • • for bath quenching **[3, 2006.01]**
1/64 • • • with circulating liquids **[1, 3, 2006.01]**
1/667 • • for spray quenching **[3, 2006.01]**
1/673 • • for die quenching **[3, 2006.01]**
1/68 • Temporary coatings or embedding materials applied before or during heat treatment **[1, 2006.01]**
1/70 • • while heating or quenching **[1, 2006.01]**
1/72 • • during chemical change of surfaces **[1, 2006.01]**
1/74 • Methods of treatment in inert gas, controlled atmosphere, vacuum or pulverulent material **[1, 2006.01]**
1/76 • • Adjusting the composition of the atmosphere **[1, 2006.01]**
1/767 • • with forced gas circulation; Reheating thereof **[3, 2006.01]**
1/773 • • under reduced pressure or vacuum **[3, 2006.01]**
1/78 • Combined heat-treatments not provided for above **[1, 2006.01]**
1/82 • Descaling by thermal stresses (mechanically B21, B23; chemically C23; electrolytically C25F 1/00) **[1, 2006.01]**
1/84 • Controlled slow cooling (cooling-beds for metal rolling B21B 43/00) **[3, 2006.01]**

3/00 Diffusion processes for extraction of non-metals; Furnaces therefor (local protective coatings C21D 1/72) **[1, 2006.01]**
3/02 • Extraction of non-metals **[1, 2006.01]**
3/04 • • Decarburising **[1, 2006.01]**
3/06 • • Extraction of hydrogen **[1, 2006.01]**
3/08 • • Extraction of nitrogen **[1, 2006.01]**
3/10 • Furnaces therefor **[1, 2006.01]**

5/00 Heat treatment of cast-iron [1, 2006.01]
5/02 • improving the malleability of grey cast-iron **[1, 2006.01]**
5/04 • of white cast-iron **[1, 2006.01]**
5/06 • • Malleabilising **[1, 2006.01]**
5/08 • • • with oxidation of carbon **[1, 2006.01]**
5/10 • • • • in gaseous agents **[1, 2006.01]**
5/12 • • • • in solid agents **[1, 2006.01]**
5/14 • • • Graphitising **[1, 2006.01]**
5/16 • • • • Packing agents **[1, 2006.01]**

6/00 Heat treatment of ferrous alloys [2, 2006.01]

Note(s) [2006.01]

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, 2006.01]**
6/04 • Hardening by cooling below 0° C **[2, 2006.01]**

7/00 Modifying the physical properties of iron or steel by deformation (apparatus for mechanical working of metal B21, B23, B24) **[1, 2006.01]**
7/02 • by cold working **[1, 2006.01]**
7/04 • • of the surface **[1, 2006.01]**
7/06 • • • by shot-peening or the like **[1, 2006.01]**
7/08 • • • by burnishing or the like **[1, 2006.01]**
7/10 • • of the whole cross-section, e.g. of concrete reinforcing bars **[1, 2006.01]**
7/12 • • • by expanding tubular bodies **[1, 2006.01]**
7/13 • by hot working **[1, 2006.01]**

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, 2006.01]**
8/02 • during manufacturing of plates or strips (C21D 8/12 takes precedence) **[3, 2006.01]**
8/04 • • to produce plates or strips for deep-drawing **[3, 2006.01]**

8/06 • during manufacturing of rods or wires **[3, 2006.01]**
8/08 • • for concrete reinforcement **[3, 2006.01]**
8/10 • during manufacturing of tubular bodies **[3, 2006.01]**
8/12 • during manufacturing of articles with special electromagnetic properties **[3, 2006.01]**

9/00 Heat treatment, e.g. annealing, hardening, quenching or tempering, adapted for particular articles; Furnaces therefor [1, 2006.01]
9/02 • for springs **[1, 2006.01]**
9/04 • for rails **[1, 2006.01]**
9/06 • • with diminished tendency to become wavy **[1, 2006.01]**
9/08 • for tubular bodies or pipes **[1, 2006.01]**
9/10 • • shotgun barrels **[1, 2006.01]**
9/12 • • barrels for ordnance **[1, 2006.01]**
9/14 • • wear-resistant or pressure-resistant pipes **[1, 2006.01]**
9/16 • for explosive shells **[1, 2006.01]**
9/18 • for knives, scythes, scissors, or like hand cutting tools **[1, 2006.01]**
9/20 • for blades for skates **[1, 2006.01]**
9/22 • for drills; for milling cutters; for machine cutting tools **[1, 2006.01]**
9/24 • for saw blades **[1, 2006.01]**
9/26 • for needles; for teeth for card-clothing **[1, 2006.01]**
9/28 • for plain shafts **[1, 2006.01]**
9/30 • for crankshafts; for camshafts **[1, 2006.01]**
9/32 • for gear wheels, worm wheels, or the like **[1, 2006.01]**
9/34 • for tyres; for rims **[1, 2006.01]**
9/36 • for balls; for rollers **[1, 2006.01]**
9/38 • for roll bodies **[1, 2006.01]**
9/40 • for rings; for bearing races **[1, 2006.01]**
9/42 • for armour plate **[1, 2006.01]**
9/44 • for equipment for lining mine shafts, e.g. segments, rings or props **[1, 2006.01]**
9/46 • for sheet metals **[1, 2006.01]**
9/48 • • deep-drawing sheets **[1, 2006.01]**
9/50 • for welded joints **[1, 2006.01]**
9/52 • for wires; for strips **[1, 2006.01]**
9/54 • • Furnaces for treating strips or wire **[1, 2006.01]**
9/56 • • • Continuous furnaces for strip or wire **[1, 2006.01]**
9/567 • • • • with heating in fluidised beds **[3, 2006.01]**
9/573 • • • • with cooling **[3, 2006.01]**
9/58 • • • • with heating by baths **[1, 2006.01]**
9/60 • • • • with induction heating **[1, 2006.01]**
9/62 • • • • with direct resistance heating **[1, 2006.01]**
9/63 • • • • the strip being supported by a cushion of gas **[3, 2006.01]**
9/64 • • • Patenting furnaces **[1, 2006.01]**
9/66 • • • Tower-type furnaces **[1, 2006.01]**
9/663 • • • Bell-type furnaces **[3, 2006.01]**
9/665 • • • • inverted or side-facing **[3, 2006.01]**
9/667 • • • • Multi-station furnaces **[3, 2006.01]**
9/67 • • • • • adapted for treating the charge in vacuum or special atmosphere **[3, 2006.01]**
9/673 • • • • Details, accessories, or equipment peculiar to bell-type furnaces **[3, 2006.01]**
9/675 • • • • Arrangements of charging or discharging devices **[3, 2006.01]**
9/677 • • • • Arrangements of heating devices **[3, 2006.01]**
9/68 • • • Furnace coilers; Hot coilers (cold coilers B21C 47/00) **[1, 2006.01]**
9/70 • Furnaces for ingots, i.e. soaking pits **[1, 2006.01]**

10/00 Modifying the physical properties by methods other than heat treatment or deformation [3, 2006.01]

11/00 Process control or regulation for heat treatments [2, 2006.01]