

## METALLURGY

## C 21 METALLURGY OF IRON

C 21 B MANUFACTURE OF IRON OR STEEL (preliminary treatment of ferrous ores or scrap C 22 B 1/00; electric heating H 05 B)

Notes

- (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 F 27).
- (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 C 12 S. [5]

Subclass Index

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

**3/00 General features in the manufacture of pig-iron**

(mixers for pig-iron C 21 C 1/06)

- 3/02 . by applying additives, e.g. fluxing agents
- 3/04 . Recovery of by-products, e.g. slag
- 3/06 . . Treatment of liquid slag (slag wool C 03 B; slag stones C 04 B)
- 3/08 . . . Cooling slag
- 3/10 . . . Slag pots; Slag cars

**5/00 Making pig-iron in the blast furnace**

- 5/02 . Making special pig-iron, e.g. by applying additives, e.g. oxides of other metals
- 5/04 . Making slag of special composition
- 5/06 . using top gas in the blast furnace process (in coke ovens C 10 B)

**7/00 Blast furnaces** (lifts associated with blast furnaces B 66 B 9/06)

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

**9/00 Stoves for heating the blast in blast furnaces**

- 9/02 . Brick hot-blast stoves
- 9/04 . . with combustion shaft
- 9/06 . . Linings
- 9/08 . Iron hot-blast stoves
- 9/10 . Other details, e.g. blast mains
- 9/12 . . Hot-blast valves or slides for blast furnaces (valves in general F 16 K)
- 9/14 . Preheating the combustion air
- 9/16 . Cooling or drying the hot-blast

**11/00 Making pig-iron other than in blast furnaces**

- 11/02 . in low shaft furnaces
- 11/06 . in rotary kilns
- 11/08 . in hearth-type furnaces
- 11/10 . in electric furnaces

**13/00 Making spongy iron or liquid steel, by direct processes**

- 13/02 . in shaft furnaces
- 13/04 . in retorts
- 13/06 . in multi-storied furnaces
- 13/08 . in rotary furnaces
- 13/10 . in hearth-type furnaces
- 13/12 . in electric furnaces
- 13/14 . Multi-stage processes

**15/00 Other processes for the manufacture of iron from iron compounds** (general methods of reducing to metal C 22 B 5/00; by electrolysis C 25 C 1/06)

- 15/02 . Metallothermic processes, e.g. thermit reduction
- 15/04 . from iron carbonyl

**C 21 C PROCESSING OF PIG-IRON, e.g. REFINING, MANUFACTURE OF WROUGHT-IRON OR STEEL** (refining or remelting metals in general [C 22 B 9/00](#)); **TREATMENT IN MOLTEN STATE OF FERROUS ALLOYS**

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| <p><b>1/00 Refining of pig-iron; Cast iron</b></p> <p>1/02 . Dephosphorising or desulfurising</p> <p>1/04 . Removing impurities other than carbon, phosphorus, or sulfur</p> <p>1/06 . Constructional features of mixers for pig-iron</p> <p>1/08 . Manufacture of cast-iron</p> <p>1/10 . Making spheroidal graphite cast-iron</p> <p><b>3/00 Manufacture of wrought-iron or wrought-steel</b></p> <p><b>5/00 Manufacture of carbon steel, e.g. plain mild steel, medium carbon steel, or cast-steel</b></p> <p>5/02 . Crucible furnace processes</p> <p>5/04 . Manufacture of hearth-furnace steel, e.g. Siemens-Martin steel</p> <p>5/06 . . Processes yielding slags of special composition</p> <p>5/28 . Manufacture of steel in the converter</p> <p>5/30 . . Regulating or controlling the blowing</p> <p>5/32 . . . Blowing from above (<a href="#">5/35</a> takes precedence) [5]</p> <p>5/34 . . . Blowing through the bath (<a href="#">5/35</a> takes precedence) [5]</p> <p>5/35 . . . Blowing from above and through the bath [5]</p> <p>5/36 . . Processes yielding slags of special composition</p> <p>5/38 . . Removal of waste gases or dust</p> <p>5/40 . . . Offtakes or separating apparatus for converter waste gases or dust</p> | <p>5/42 . . Constructional features of converters</p> <p>5/44 . . . Refractory linings</p> <p>5/46 . . . Details or accessories</p> <p>5/48 . . . . Bottoms or tuyères of converters</p> <p>5/50 . . . . Tilting mechanisms for converters</p> <p>5/52 . Manufacture of steel in electric furnaces (electric heating <i>per se</i> <a href="#">H 05 B</a>)</p> <p>5/54 . . Processes yielding slags of special composition</p> <p>5/56 . Manufacture of steel by other methods (making liquid steel by direct processes <a href="#">C 21 B 13/00</a>)</p> <p><b>7/00 Treating molten ferrous alloys, e.g. steel, not covered by groups 1/00 to 5/00</b> (treating molten metals during moulding <a href="#">B 22 D 1/00, 27/00</a>; remelting ferrous metals <a href="#">C 22 B</a>)</p> <p>7/04 . Removing impurities by adding a treating agent</p> <p>7/06 . . Deoxidising, e.g. killing [2]</p> <p>7/064 . . Dephosphorising; Desulfurising [3]</p> <p>7/068 . . Decarburising [3]</p> <p>7/072 . . Treatment with gases (<a href="#">7/06, 7/064, 7/068</a> take precedence) [3]</p> <p>7/076 . . Use of slags or fluxes as treating agents (<a href="#">7/06, 7/064, 7/068</a> take precedence) [3]</p> <p>7/10 . Handling in vacuum</p> |
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**C 21 D 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 [C 23 C](#); surface treatment of metallic material involving at least one process provided for in class [C 23](#) and at least one process covered by this subclass [C 23 F 17/00](#); unidirectional solidification of eutectic materials or unidirectional demixing of eutectoid materials [C 30 B](#))

**Note**

In this subclass, it is desirable to add the indexing codes of subclass [C 22 K](#), relating to changing the physical characteristics of alloys. The indexing codes should be [unlinked](#). [6]

**Subclass Index**

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

- 1/00 General methods or devices for heat treatment, e.g. annealing, hardening, quenching, tempering** (furnaces in general F 27; electric heating H 05 B)
- 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 (1/02 takes precedence); Quenching with or without subsequent tempering (quenching devices 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 (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 G 01 N) [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 F 28 D) [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 C 01, C 10)
- 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 B 21, B 23, chemically C 23, electrolytically C 25 F)
- 1/84 . Controlled slow cooling (cooling-beds for metal rolling B 21 B 43/00) [3]

**3/00 Diffusion processes for extraction of non-metals; Furnaces therefor** (local protective coatings 1/72; furnaces in general F 27)

- 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]**

**Notes**

- (1) *In this group, it is desirable to add the indexing codes relating to aspects of the heat treatment methods. The indexing codes are chosen from groups 1/02 to 1/84, have the same numbers as the classification symbols, but a colon is used instead of the oblique stroke, and should be unlinked. [7]*
- (2) *In this group, it is desirable to add the indexing codes relating to the alloying constituents. The indexing codes are chosen from groups C 22 C 38/02 to 38/60, have the same numbers as the classification symbols, but a colon is used instead of the oblique stroke, and should be unlinked. [7]*
- (3) *Attention is drawn to Chapter IV of the Guide which sets forth the rules concerning the application and presentation of the different types of indexing code. [7]*

- 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 B 21, B 23, B 24)

- 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 1/02) [3]
- 8/02 . during manufacturing of plates or strips (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 F 27)
- 9/02 . for springs
- 9/04 . for rails (apparatus for heat treatment of railway rails on the spot E 01 B 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 B 21 C)
- 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 G 05) [2]