B CPC

PERFORMING OPERATIONS; TRANSPORTING

(NOTES omitted)

SHAPING

B22 CASTING; POWDER METALLURGY

B22F WORKING METALLIC POWDER; MANUFACTURE OF ARTICLES FROM METALLIC POWDER; MAKING METALLIC POWDER (processes or devices for granulating materials in general B01J 2/00; making ceramics by compacting or sintering C04B, e.g. C04B 35/64; for the production of metals as such, see class C22; reduction or decomposition of metal compounds in general C22B; making alloys by powder metallurgy C22C; electrolytic production of metal powder C25C 5/00)

NOTES
1. This subclass covers the making of metallic powder only insofar as powder with specific physical characteristics is made;
2. In this subclass, the following terms or expressions are used with the meanings indicated:
   • "metallic powder" covers powders containing a substantial proportion of non-metallic material;
   • "powder" includes somewhat larger particles which are worked, obtained or behave in a manner similar to powder, e.g. fibres.

WARNINGS
1. The following IPC groups are not in the CPC scheme. The subject matter for these IPC groups is classified in the following CPC groups:
   B22F 3/035 covered by B22F 3/03
2. In this subclass non-limiting references (in the sense of paragraph 39 of the Guide to the IPC) may still be displayed in the scheme.

1/00 Special treatment of metallic powder, e.g. to facilitate working, to improve properties
   (treatment of powder by mechanical means, e.g. by grinding, milling, rolling B22F 3/04d); Metallic powders per se, e.g. mixtures of particles of different composition (C04, C08 take precedence; amorphous powder B22F 9/002)
   1/003 . . . (Metallic powders per se; Mixtures of metallic powders; Metallic powders mixed with a lubricating or binding agent (making ferrous alloys using a mixture of prealloyed powders C22C 33/0207))
   1/007 . . . (Metallic powder characterised by its shape or structure, e.g. fibre structure)
   1/0011 . . . (Metallic powder characterised by size or surface area only)
   1/0014 . . . . . . (by size mixtures or distribution)
   1/0018 . . . . . . (Nanometer sized particles)
   1/0022 . . . . . . (Dispersions or suspensions thereof)
   1/0025 . . . . . . (Nanofibres or nanotubes)
   2001/0029 . . . . . . (Hollow particles, including tubes and shells)
   2001/0033 . . . . . . (Flake form nanoparticles)
   2001/0037 . . . . . . (Complex form nanoparticles, e.g.. prism, pyramid, octahedron)
   1/004 . . . . . . (Fibre structure (B22F 1/0025 takes precedence))
   1/0044 . . . . . . (Nanometer size structures)
   1/0048 . . . . . . (Spherical powder)
   1/0051 . . . . . . (Hollow particles)
   1/0055 . . . . . . (Flake form powders)
   1/0059 . . . . . . (Metallic powders mixed with a lubricating or binding agent or organic material)
   1/0062 . . . . . . (Powders coated with organic material)
   2001/0066 . . . . . . (Organic binder comprising a mixture or obtained by reaction of more than one component other than solvent, lubricant)
   1/007 . . . . . . (Non-organic or metal salt binders or lubricants)
   1/0074 . . . . . . (Organic materials comprising a solvent, e.g. for slip casting)
   1/0077 . . . . . . (Mixtures obtained by warm mixing)
   1/0081 . . . . . . (Special treatment of metallic powder, e.g. to facilitate working, to improve properties (coating with organic material B22F 1/0062))
   1/0085 . . . . . . (Thermal or thermo-mechanical treatment)
   1/0088 . . . . . . (Chemical treatment, e.g. passivation)
   2001/0092 . . . . . . (Making a dispersion)
   1/0096 . . . . . . (Treatment resulting in the production of agglomerates)
   1/02 . . . . . comprising coating of the powder {(coating with organic material B22F 1/0062; chemical surface treatment B22F 1/0088)}
   1/025 . . . . . (Metallic coating)

3/00 Manufacture of workpieces or articles from metallic powder characterised by the manner of compacting or sintering; Apparatus specially adapted therefor {; Presses and furnaces}
B22F

3/001 . . . [Starting from powder comprising reducible metal compounds (making ferrous alloys starting from compounds C22C 33/0235)]

3/002 . . . [Manufacture of articles essentially made from metallic fibres]

3/003 . . . [Apparatus, e.g. furnaces (in general F27B)]

3/004 . . . [Filling molds with powder (feeding material to presses in general B30B 15/302)]

3/005 . . . [Loading or unloading powder metal objects (transport in general B65G)]

3/006 . . . [Amorphous articles]

3/007 . . . [by diffusion starting from non-amorphous articles prepared by powder metallurgy]

3/008 . . . [Selective deposition modelling (B22F 3/1055 takes precedence)]

3/02 . . . Compacting only

2003/023 . . . [Lubricant mixed with the metal powder]

2003/026 . . . [Mold wall lubrication or article surface lubrication]

3/03 . . . Press-moulding apparatus therefor

2003/031 . . . [with punches moving in different directions in different planes]

2003/033 . . . [with multiple punches working in the same direction]

3/04 . . . by applying fluid pressure, e.g. by cold isostatic pressing [CIP]

3/045 . . . [Semi-isostatic pressure]

3/06 . . . by centrifugal forces

3/08 . . . by explosive forces (generating shock waves in general G10K 15/043)

3/087 . . . using high energy impulses, e.g. magnetic field impulses

3/093 . . . using vibrations (or friction)

3/10 . . . Sintering only

2003/1003 . . . [Use of special medium during sintering, e.g. sintering aid]

2003/1007 . . . [Atmosphere (B22F 3/1021 takes precedence)]

2003/101 . . . [Changing atmosphere]

2003/1014 . . . [Getter]

2003/1017 . . . [Multiple heating or additional steps (B22F 3/101 takes precedence)]

2003/1021 . . . [Removal of binder or filler (removal of binder from ceramics C04B 35/638)]

2003/1025 . . . [not by heating only]

2003/1028 . . . [Controlled cooling]

2003/1032 . . . [comprising a grain growth inhibitor]

2003/1035 . . . [Liquid phase sintering]

2003/1039 . . . [by reaction (B22F 3/001, B22F 3/23 take precedence)]

2003/1042 . . . [with support for articles to be sintered]

2003/1046 . . . [with separating means for articles to be sintered]

3/105 . . . [by using electric current (other than for infrared radiant energy), laser radiation or plasma (B22F 3/11 takes precedence) (by ultrasonic bonding (B22F 3/115 takes precedence)]

2003/1051 . . . [by electric discharge]

2003/1052 . . . [assisted by energy absorption enhanced by the coating or powder]

2003/1053 . . . [by induction]

2003/1054 . . . [by microwave]

3/1055 . . . [Selective sintering, i.e. stereolithography (selective sintering of powdered plastics B29C 64/153)]

2003/1056 . . . [Apparatus components, details or accessories]

2003/1057 . . . [for control or data processing, e.g. algorithms]

2003/1058 . . . [Support structures for the 3D object during manufacturing, e.g. using sacrificial material]

2003/1059 . . . [for cleaning or recycling]

3/11 . . . Making porous workpieces or articles

3/1103 . . . [with particular physical characteristics]

2003/1006 . . . [Product comprising closed porosity]

3/1009 . . . [Inhomogenous pore distribution (composite layers of porous nature B22F 7/002)]

3/1112 . . . [comprising hollow spheres or hollow fibres]

3/1115 . . . [comprising complex forms, e.g. honeycombs]

3/1118 . . . [comprising internal reinforcements]

3/1121 . . . [by using decomposable, meltable or sublimatable fillers]

3/1125 . . . [involving a foaming process]

2003/1128 . . . [Foaming by expansion of dissolved gas, other than with foaming agent]

2003/1011 . . . [Foaming in a liquid suspension and decomposition]

3/1134 . . . [Inorganic fillers (carbonaceous or paper filler B22F 3/121)]

3/1137 . . . [by coating porous removable preforms]

3/114 . . . [the porous products being formed by impregnation (B22F 3/1137, B22F 3/26 take precedence)]

3/1143 . . . [involving an oxidation, reduction or reaction step]

3/1146 . . . [After-treatment maintaining the porosity (B22F 3/114 takes precedence)]

3/115 . . . by spraying molten metal, i.e. spray sintering, spray casting

3/12 . . . Both compacting and sintering (by forging B22F 3/17)

3/1208 . . . [Containers or coating used therefor]

3/1216 . . . [Container composition]

3/1225 . . . [Glass]

3/1233 . . . [Organic material]

3/1241 . . . [layered]

3/125 . . . [Initially porous container]

3/1258 . . . [Container manufacturing]

3/1266 . . . [by coating or sealing the surface of the preformed article, e.g. by melting]

3/1275 . . . [by coating a model and eliminating the model before consolidation]

3/1283 . . . [Container formed as an undeformable model eliminated after consolidation]

3/1291 . . . [Solid insert eliminated after consolidation]

3/14 . . . simultaneously

2003/145 . . . [by warm compacting, below debindering temperature]

3/15 . . . Hot isostatic pressing

2003/153 . . . [apparatus specific to HIP]

3/156 . . . [by a pressure medium in liquid or powder form]
Manufacture of metallic powder or suspensions thereof

- in successive or repeated steps
- [Machining, working after consolidation]
- [Partial deformation or calibration]

- Surface calibration, blasting, burnishing, sizing, coining

- by forging
- [Continuous compaction, e.g. rotary hammering (with axial pressure and without reduction of section B22F 3/204)]

- by hot forging, below sintering temperature
- [Rocking die forging]
- by using pressure rollers

- by hot rolling, below sintering temperature
- by extruding
- [with back pressure]

- [Continuous compaction with axial pressure and without reduction of section]
- [Hydrostatic or hydraulic extrusion]
- [Warm or hot extruding]

- for producing castings from a slip
- by freeze-casting or in a supercritical fluid
- by injection molding
- by organic binder assisted extrusion

- involving a self-propagating high-temperature synthesis or reaction sintering step ([making cermets by reaction sintering C22C 1/058])

- After-treatment of workpieces or articles ([B22F 3/1146 takes precedence])

- Chemical after-treatment on the surface
- [Coating]
- [Leaching]

- [Making recesses, grooves etc on the surface by removing material]

- [Removing material: carving, cleaning, grinding, hobbing, honing, lapping, polishing, milling, shaving, skiving, turning the surface]

- [Thermal after-treatment]

- Impregnating ([making ferrous alloys by impregnation C22C 330242])

Manufacture of workpieces of articles from metallic powder characterised by the special shape of the product

- Cutting tools, earth boring or grinding tool other than table ware

- Tools other than cutting tools

- Articles made for being fractured or separated into parts

- [Article comprising helical form elements (B22F 5/085 takes precedence)]

- [Article surface comprising protrusions (B22F 3/1103 takes precedence; by using pressure rollers only see B22F 3/18)]

- [of flat products, e.g. sheets (B22F 3/1103 takes precedence; by using pressure rollers only see B22F 3/18)]

- [of moulds]

- [of engine cylinder parts or of piston parts other than piston rings (of piston rings B22F 5/02)]

- [of turbine components other than turbine blades (of turbine blades B22F 5/04)]

- of piston rings

- of threaded articles, e.g. nuts

- of toothed articles, e.g. gear wheels; of cam discs

- with helical contours

- of articles with cavities or holes, not otherwise provided for in the preceding subgroups

- Cavity made by removal of insert

- Tube or ring forms

- of wires (of tubes B22F 5/10)

7/00 Manufacture of composite layers, workpieces, or articles, comprising metallic powder, by sintering the powder, with or without compacting (wherein at least one part is obtained by sintering or compression (application of coating layers by use of metal powders, see C23C))

- of porous nature

- [comprising at least one non-porous part]

- the porous part being obtained by foaming

- [characterised by the composition]

- of composite layers ([B22F 7/002 takes precedence])

- with one or more layers not made from powder, e.g. made from solid metal

- [characterised by the layer forming method]

- [accompanied by fusion or impregnation]

- [non-pressurised baking of the paste or slurry containing metal powder]

- of composite workpieces or articles from parts, e.g. to form tipped tools ([B22F 7/002 takes precedence])

- involving the connection or repairing of preformed parts

- [using an intermediate powder layer]

- [using impregnation]

- [repairing articles]

- with one or more parts not made from powder ([B22F 7/002 takes precedence])

8/00 Manufacture of articles from scrap or waste metal particles

- Making metallic powder or suspensions thereof

- [from scrap particles]

- [amorphous or microcrystalline]

- [by diffusion, e.g. solid state reaction]

- [Transformation into amorphous state by milling]

- [Transformation of amorphous into microcrystalline state]

- [Rapid solidification processing]

- using physical processes

- [Hydrogen absorption]

- [Spray drying of solutions or suspensions]

- starting from solid material, e.g. by crushing, grinding or milling ([C22C 1/1084 takes precedence]; crushing, grinding or milling, in general, see the relevant subclasses, e.g. B02C)

- [by mechanical alloying, e.g. blending, milling]

- [using a particular milling fluid]

- [by ball milling]

- [by jet milling]

- [by other means than ball or jet milling]

- [by cutting]

- by rolling
using chemical processes pyrolysis with decomposition of metal compounds, e.g. by reduction of metal compounds (B22F 2009/245 takes precedence) }
{ Chemical reaction in an Ionic Liquid [IL] starting from gaseous material starting from gaseous metal compounds

atomising or spraying (using electric discharge by casting, e.g. through sieves or in water, by atomising or spraying (using electric discharge B22F 9/14))

Dispersion in or on liquid, other than with sieves}
{ Mechanical dispersion of melt, e.g. by sieves}
{ Pulverisation with a moving liquid coolant stream, by centrifugally rotating stream}
{ by casting with pressure or pulsating pressure on the metal bath}
{ atomising using a fluid (using centrifugal force B22F 9/10) }
{ with a specific atomising fluid}
{ with water}
{ Handling of atomising fluid, e.g. heating, cooling, cleaning, recirculating}
{ with electric or magnetic field or induction}
{ combination of methods}
{ in controlled atmosphere}
{ Melting process before atomisation}
{ Electroslag melting}
{ Skull melting}
{ Cooling after atomisation}
{ by oil, other non-aqueous fluid or fluid-bed cooling}
{ by injection of solid particles in the melt stream}
{ by water}
{ by gas}
{ Fluid nozzles, e.g. angle, distance}
{ Spiral fluid}
{ casting construction of the melt process, apparatus, intermediate reservoir, e.g. tundish, devices for temperature control}
{ casting nozzle; controlling metal stream in or after the casting nozzle}
{ particle transport; separation: process and apparatus}
{ using centrifugal force}
{ starting from gaseous material}
{ using electric discharge}
{ using chemical processes}
{ Chemical reaction in an Ionic Liquid [IL] (B22F 2009/245 takes precedence) }
{ with reduction of metal compounds}
{ starting from solid metal compounds}
{ using gaseous reductors}
{ starting from liquid metal compounds, e.g. solutions}
{ Reduction reaction in an Ionic Liquid [IL]}
{ using gaseous reductors}
{ starting from gaseous metal compounds}
{ with decomposition of metal compounds, e.g. by pyrolysis}

Metallic composition of the powder or its coating

Aspects of the compositions, gradients

Controlling

Treatment under specific physical conditions

Treatment under specific atmosphere

Use of vibrations

Treatment under cryogenic or supercritical conditions

Use of magnetic field

Use of electric fields

by induction

Use of non-gravitational conditions

Use of irradiation

Use of plasma

Use of fluidised beds

use of centrifugal or vortex forces

To-be-deleted with administrative transfer to B22F 2009/00

Composition gradients

of the metallic binder phase in cermets

et-phases

Particles with core-rim gradient

Gradients other than composition gradients, e.g. size gradients

Size gradients

Temperature gradients

density or porosity gradients

Cooperating components

Metallic composition of the powder or its coating

Light metals

Aluminium

Alkali metals, i.e. Li, Na, K, Rb, Cs, Fr

Alkaline metals, i.e. Ca, Sr, Ba, Ra

Magnesium

Copper

Nickel or cobalt

Rare Earth - Co or -Ni intermetallic alloys

Refractory metals

Titanium, zirconium or hafnium
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<th>Noble metals, i.e. Ag, Au, Os, Pd, Pt, Rh, Ru</th>
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<td>2301/255</td>
<td>Silver or gold</td>
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<tr>
<td>2301/30</td>
<td>Low melting point metals, i.e. Zn, Pb, Sn, Cd, In, Ga</td>
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<tr>
<td>2301/35</td>
<td>Iron</td>
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<td>2301/355</td>
<td>Rare Earth - Fe intermetallic alloys</td>
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<tr>
<td>2301/40</td>
<td>Intermetallics other than rare earth-Co or -Ni or -Fe intermetallic alloys</td>
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<tr>
<td>2301/45</td>
<td>Rare earth metals, i.e. Sc, Y, Lanthanides (57-71)</td>
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<td>2302/20</td>
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<td>2302/35</td>
<td>Complex boride, carbide, carbonitride, nitride, oxide or oxynitride</td>
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<td>Carbon, graphite</td>
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<td>2302/403</td>
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<td>2302/406</td>
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<td>2302/45</td>
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| 2999/00 | Aspects linked to processes or compositions used in powder metallurgy |