CPC COOPERATIVE PATENT CLASSIFICATION

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)

NOTE

This subclass covers the making of metallic powder only insofar as powder with specific physical characteristics is made;

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.

WARNING

1. The following IPC groups are not used in the CPC scheme. Subject matter covered by these groups is classified in the following CPC groups:
B22F 3/035 covered by B22F 3/03

B22F 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 9/04)}; Metallic powders per se, e.g. mixtures of particles of different composition (C04, C08 take precedence; { amorphous powder B22F 9/002})

B22F 1/0003 . {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)}

B22F 1/0007 . . {Metallic powder characterised by its shape or structure, e.g. fibre structure }

B22F 1/0011 . . . {Metallic powder characterised by size or surface area only}

WARNING

Groups B22F 1/0011 and B22F 1/0014 are not complete, see also B22F 1/0007

B22F 1/0014 . . . . {by size mixtures or distribution}

B22F 1/0018 . . . . {Nanometer sized particles}

B22F 1/0022 . . . . . { Dispersions or suspensions thereof}{ WARNING: Not complete, see also B22F 1/0018}

B22F 1/0025 . . . . . { Nanofibres or nanotubes}{ WARNING: Not complete, see also B22F 1/0018}

B22F 2001/0029 . . . . . {Hollow particles, including tubes and shells }

B22F 2001/0033 . . . . . {Flake form nanoparticles }

B22F 2001/0037 . . . . . {Complex form nanoparticles , e.g.. prism, pyramid, octahedron }

B22F 1/004 . . . { Fibre structure (B22F 1/0025 takes precedence)}

B22F 1/0044 . . . {Nanometer size structures}

B22F 1/0048 . . . {Spherical powder}

B22F 1/0051 . . . . {Hollow particles}

B22F 1/0055 . . . { Flake form powders}{ WARNING: Not complete, see also B22F 1/0007}

B22F 1/0059 . . {Metallic powders mixed with a lubricating or binding agent or organic material}

B22F 1/0062 . . . { Powders coated with organic material}

B22F 2001/0066 . . . {Organic binder comprising a mixture or obtained by reaction of more than one component other than solvent, lubricant }

B22F 1/007 . . . { Non-organic or metal salt binders or lubricants}

B22F 1/0074 . . . { Organic materials comprising a solvent e.g. for slip casting}

B22F 1/0077 . . . { Mixtures obtained by warm mixing}

B22F 1/0081 . { Special treatment of metallic powder, e.g. to facilitate working, to improve properties (coating with organic material B22F 1/0062)}

B22F 1/0085 . . {Thermal or thermo-mechanical treatment}

B22F 1/0088 . . {Chemical treatment, e.g. passivation}

B22F 2001/0092 . . . {Making a dispersion }

B22F 1/0096 . . {Treatment resulting in the production of agglomerates}

B22F 1/02 . comprising coating of the powder {(coating with organic material B22F 1/0062; chemical surface treatment B22F 1/0088)}

B22F 1/025 . . {Metallic coating}

B22F 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)}

B22F 3/002 . {Manufacture of articles essentially made from metallic fibres}

B22F 3/003 . {Apparatus, e.g. furnaces (in general F27B)}

B22F 3/004 . {Filling molds with powder (feeding material to presses in general B30B 15/302)}

B22F 3/005 . {Loading or unloading powder metal objects (transport in general B65G)}

B22F 3/006 . {Amorphous articles}

B22F 3/007 .. {by diffusion starting from non-amorphous articles prepared by powder metallurgy}

B22F 3/008 . {Selective deposition modelling (B22F 3/1055 takes precedence)}

B22F 3/02 . Compacting only

B22F 2003/023 .. {Lubricant mixed with the metal powder }

B22F 2003/026 .. {Mold wall lubrication or article surface lubrication }

B22F 3/03 .. Press-moulding apparatus therefor

B22F 2003/031 ... {with punches moving in different directions in different planes }

B22F 2003/033 ... {with multiple punches working in the same direction }

B22F 3/04 .. by applying fluid pressure { e.g. by cold isostatic pressing [CIP}]

B22F 3/045 ... {Semi-isostatic pressure}

B22F 3/06 .. by centrifugal forces

B22F 3/08 .. by explosive forces {(generating shock waves in general G10K 15/043)}

B22F 3/087 .. using high energy impulses, e.g. magnetic field impulses

B22F 3/093 .. using vibrations {or friction}

B22F 3/10 . Sintering only

B22F 3/1003 .. {Use of special medium during sintering, e.g. sintering aid}

B22F 3/1007 ... {Atmosphere (B22F 3/1021 takes precedence)}

B22F 3/101 .... {Changing atmosphere}

B22F 2003/1014 ... {Getter }

B22F 3/1017 .. {Multiple heating or additional steps (B22F 3/101 takes precedence)}

B22F 3/1021 ... {Removal of binder or filler (removal of binder from ceramics C04B 35/638)}

B22F 3/1025 .... {not by heating only}

B22F 3/1028 ... {Controlled cooling}

B22F 2003/1032 .. {comprising a grain growth inhibitor }

B22F 3/1035 .. {Liquid phase sintering}

B22F 3/1039 .. {by reaction (B22F 3/001, B22F 3/23 take precedence)}

B22F 2003/1042 .. {with support for articles to be sintered }

B22F 2003/1046 ... {with separating means for articles to be sintered }

B22F 3/105 .. by using electric current {other than for infra-red radiant energy}, laser radiation or plasma (B22F 3/11 takes precedence); {by ultrasonic bonding (B22F 3/115 takes precedence)}

B22F 2003/1051 ... {by electric discharge }

B22F 2003/1052 ... {assisted by energy absorption enhanced by the coating or powder }

B22F 2003/1053 ... {by induction }

B22F 2003/1054 ... {by microwave }

B22F 3/1055 ... { Selective sintering, i.e. stereolithography (selective sintering of powdered plastics B29C 67/0077)}

B22F 2003/1056 .... {Apparatus components, details or accessories }
B22F 2003/1057 ..... {for control or data processing, e.g. algorithms }
B22F 2003/1058 ..... {Support structures for the 3D object during manufacturing, e.g. using sacrificial material }
B22F 2003/1059 ..... {for cleaning or recycling }
B22F 3/11 .. Making porous workpieces or articles
B22F 3/1103 ... {with particular physical characteristics}
B22F 2003/1106 .... {Product comprising closed porosity }
B22F 3/1109 .... {Inhomogenous pore distribution (composite layers of porous nature B22F 7/002)}
B22F 3/1112 .... {comprising hollow spheres or hollow fibres}
B22F 3/1115 .... {comprising complex forms, e.g. honeycombs}
B22F 3/1118 .... {comprising internal reinforcements}
B22F 3/1121 ... {by using decomposable, meltable or sublimatable fillers}
B22F 3/1125 .... {involving a foaming process}
B22F 2003/1128 ..... {Foaming by expansion of dissolved gas, other than with foaming agent }
B22F 2003/1131 ..... {Foaming in a liquid suspension and decomposition }
B22F 3/1134 .... {Inorganic fillers (carbonaceous or paper filler B22F 3/1121)}
B22F 3/1137 .... {by coating porous removable preforms}
B22F 3/114 ... {the porous products being formed by impregnation (B22F 3/1137, B22F 3/26 take precedence)}
B22F 3/1143 ... {involving an oxidation, reduction or reaction step}
B22F 3/1146 ... {After-treatment maintaining the porosity (B22F 3/114 takes precedence)}

B22F 3/115 . by spraying molten metal, i.e. spray sintering, spray casting {(also classified in C23C 4/121, C23C 4/185)}

B22F 3/12 . Both compacting and sintering (by forging B22F 3/17)
B22F 3/1208 .. {Containers or coating used therefor}
B22F 3/1216 ... {Container composition}
B22F 3/1225 .... {Glass}
B22F 3/1233 .... {Organic material}
B22F 3/1241 .... {layered}
B22F 3/125 ... {Initially porous container}
B22F 3/1258 ... {Container manufacturing}
B22F 3/1266 .... {by coating or sealing the surface of the preformed article, e.g. by melting}
B22F 3/1275 .... {by coating a model and eliminating the model before consolidation}
B22F 3/1283 .... {Container formed as an undeformable model eliminated after consolidation}
B22F 3/1291 .... {Solid insert eliminated after consolidation}
B22F 3/14 .. simultaneously
B22F 2003/145 ... {by warm compacting, below debindering temperature }
B22F 3/15 ... Hot isostatic pressing

B22F 2003/153 .... {apparatus specific to HIP }

B22F 3/156 .... { by a pressure medium in liquid or powder form}

B22F 3/16 .. in successive or repeated steps { WARNING: Subgroups of B22F 3/16 are not complete, see also B22F 3/16}

B22F 3/162 ... { Machining, working after consolidation}

B22F 3/164 ... { Partial deformation or calibration}

B22F 2003/166 .... {Surface calibration, blasting, burnishing, sizing, coining }

B22F 3/168 .... { Local deformation}

B22F 3/17 . by forging

B22F 3/172 .. {Continuous compaction, e.g. rotary hammering (with axial pressure and without reduction of section B22F 3/204)}

B22F 2003/175 .. {by hot forging, below sintering temperature }

B22F 3/177 .. {Rocking die forging}

B22F 3/18 . by using pressure rollers

B22F 2003/185 .. {by hot rolling, below sintering temperature }

B22F 3/20 . by extruding

B22F 2003/202 .. {with back pressure }

B22F 3/204 .. {Continuous compaction with axial pressure and without reduction of section}

B22F 2003/206 .. {Hydrostatic or hydraulic extrusion }

B22F 2003/208 .. {Warm or hot extruding }

B22F 3/22 . for producing castings from a slip

B22F 3/222 .. {by freeze-casting or in a supercritical fluid}

B22F 3/225 .. { by injection molding} [WARNING: Not complete, see also B22F 3/22]

B22F 3/227 .. { by organic binder assisted extrusion}{ WARNING: Not complete, see also B22F 3/22}

B22F 3/23 . involving a self-propagating high-temperature synthesis or reaction sintering step {(making cermets by reaction sintering C22C 1/058)}

B22F 3/24 . After-treatment of workpieces or articles {(B22F 3/1146 takes precedence)}

B22F 2003/241 .. {Chemical after-treatment on the surface }

B22F 2003/242 ... {Coating }

B22F 2003/244 ... {Leaching }

B22F 2003/245 .. {Making recesses, grooves etc on the surface by removing material }

B22F 2003/247 .. {Removing material: carving, cleaning, grinding, hobbing, honing, lapping, polishing, milling, shaving, skiving, turning the surface }

B22F 2003/248 .. {Thermal after-treatment }

B22F 3/26 .. Impregnating {(making ferrous alloys by impregnation C22C 33/0242)}

B22F 5/00 **Manufacture of workpieces or articles from metallic powder characterised by the special shape of the product**

B22F 2005/001 . {Cutting tools, earth boring or grinding tool other than table ware }

B22F 2005/002 . {Tools other than cutting tools }

B22F 5/003 . {Articles made for being fractured or separated into parts}

B22F 2005/004 . {Article comprising helical form elements (B22F 5/085 takes precedence)}

B22F 2005/005 . {Article surface comprising protrusions }

B22F 5/006 . {of flat products, e.g. sheets (B22F 3/1103 takes precedence; by using pressure rollers only see B22F 3/18)}

B22F 5/007 . {of moulds}

B22F 5/008 . { of engine cylinder parts or of piston parts other than piston rings (of piston rings B22F 5/02)}

B22F 5/009 . { of turbine components other than turbine blades (of turbine blades B22F 5/04)}

B22F 5/02 . of piston rings

B22F 5/04 . of turbine blades

B22F 5/06 . of threaded articles, e.g. nuts

B22F 5/08 . of toothed articles, e.g. gear wheels; of cam discs

B22F 5/085 . . { with helical contours}

B22F 5/10 . of articles with cavities or holes, not otherwise provided for in the preceding subgroups

B22F 2005/103 . . {Cavity made by removal of insert }

B22F 5/106 . . { Tube or ring forms}{ WARNING: Not complete, see also B22F 5/10}

B22F 5/12 . of wires {(of tubes B22F 5/10)}

B22F 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)}

B22F 7/002 . {of porous nature}

B22F 7/004 . . {comprising at least one non-porous part}

B22F 7/006 . . . {the porous part being obtained by foaming}

B22F 7/008 . {characterised by the composition}

B22F 7/02 . of composite layers {(B22F 7/002 takes precedence)}
B22F 7/04 . . with one or more layers not made from powder, e.g. made from solid metal
B22F 2007/042 . . . {characterised by the layer forming method }
B22F 2007/045 . . . . {accompanied by fusion or impregnation }
B22F 2007/047 . . . . {non-pressurised baking of the paste or slurry containing metal powder }

B22F 7/06 . of composite workpieces or articles from parts, e.g. to form tipped tools {(B22F 7/002 takes precedence)}
B22F 7/062 . . {involving the connection or repairing of preformed parts}
B22F 7/064 . . . {using an intermediate powder layer}
B22F 2007/066 . . . {using impregnation }
B22F 2007/068 . . . {repairing articles }
B22F 7/08 . . with one or more parts not made from powder {(B22F 7/062 takes precedence)}

B22F 8/00 **Manufacture of articles from scrap or waste metal particles**

B22F 9/00 **Making metallic powder or suspensions thereof**

B22F 2009/001 . {from scrap particles }

B22F 9/002 . {amorphous or microcrystalline}
B22F 9/004 . . {by diffusion, e.g. solid state reaction}
B22F 9/005 . . . {Transformation into amorphous state by milling}
B22F 9/007 . . {Transformation of amorphous into microcrystalline state}
B22F 9/008 . . {Rapid solidification processing}

B22F 9/02 . using physical processes
B22F 9/023 . . {Hydrogen absorption}
B22F 9/026 . . {Spray drying of solutions or suspensions}
B22F 9/04 . . 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)
B22F 2009/041 . . . {by mechanical alloying , e.g. blending, milling }
B22F 2009/042 . . . {using a particular milling fluid }
B22F 2009/043 . . . {by ball milling }
B22F 2009/044 . . . {by jet milling }
B22F 2009/045 . . . {by other means than ball or jet milling }
B22F 2009/046 . . . . {by cutting }
B22F 2009/047 . . . . {by rolling }
B22F 2009/048 . . . {by pulverising a quenched ribbon }

B22F 2009/049	. . .	{by pulverising at particular temperature }
B22F 9/06	. .	starting from liquid material
B22F 2009/065	. . .	{Melting inside a liquid, e.g. making spherical balls }
B22F 9/08	. . .	by casting, e.g. through sieves or in water, by atomising or spraying (using electric discharge B22F 9/14)
B22F 2009/0804	. . . .	{Dispersion in or on liquid, other than with sieves }
B22F 2009/0808	. . . . .	{Mechanical dispersion of melt, e.g. by sieves }
B22F 2009/0812	. . . . .	{Pulverisation with a moving liquid coolant stream, by centrifugally rotating stream }
B22F 2009/0816	. . . .	{by casting with pressure or pulsating pressure on the metal bath }
B22F 9/082	. . . .	{ atomising using a fluid (using centrifugal force B22F 9/10)}
B22F 2009/0824	. . . . .	{with a specific atomising fluid }
B22F 2009/0828	. . . . .	{with water }
B22F 2009/0832	. . . . .	{Handling of atomising fluid, e.g. heating, cooling, cleaning, recirculating }
B22F 2009/0836	. . . . .	{with electric or magnetic field or induction }
B22F 2009/084	. . . . .	{combination of methods }
B22F 2009/0844	. . . . .	{in controlled atmosphere }
B22F 2009/0848	. . . . .	{Melting process before atomisation }
B22F 2009/0852	. . . . .	{Electroslag melting }
B22F 2009/0856	. . . . .	{Skull melting }
B22F 2009/086	. . . . .	{Cooling after atomisation }
B22F 2009/0864	. . . . .	{by oil, other non-aqueous fluid or fluid-bed cooling }
B22F 2009/0868	. . . . .	{by injection of solid particles in the melt stream }
B22F 2009/0872	. . . . .	{by water }
B22F 2009/0876	. . . . .	{by gas }
B22F 2009/088	. . . . .	{Fluid nozzles , e.g. angle, distance }
B22F 2009/0884	. . . . .	{Spiral fluid }
B22F 2009/0888	. . . . .	{casting construction of the melt process, apparatus, intermediate reservoir e.g. tundish, devices for temperature control }
B22F 2009/0892	. . . . .	{casting nozzle; controlling metal stream in or after the casting nozzle }
B22F 2009/0896	. . . . .	{particle transport, separation: process and apparatus }
B22F 9/10	. . . .	using centrifugal force
B22F 9/12	. .	starting from gaseous material
B22F 9/14	. .	using electric discharge
B22F 9/16	.	using chemical processes
B22F 2009/165	. .	{Chemical reaction in an Ionic Liquid [IL] (B22F 2009/245 takes precedence)}
B22F 9/18	. .	with reduction of metal compounds
B22F 9/20	. . .	starting from solid metal compounds
B22F 9/22	. . . .	using gaseous reductors
B22F 9/24	. . .	starting from liquid metal compounds, e.g. solutions

B22F 2009/245 . . . . {Reduction reaction in an Ionic Liquid [IL] }
B22F 9/26 . . . . using gaseous reductors
B22F 9/28 . . . starting from gaseous metal compounds
B22F 9/30 . . with decomposition of metal compounds, e.g. by pyrolysis
B22F 9/305 . . . {of metal carbonyls}

B22F 2201/00 Treatment under specific atmosphere

B22F 2201/01 . Reducing atmosphere
B22F 2201/013 . . Hydrogen
B22F 2201/016 . . NH3

B22F 2201/02 . Nitrogen

B22F 2201/03 . Oxygen

B22F 2201/04 . CO or CO_2

B22F 2201/05 . Water or water vapour

B22F 2201/10 . Inert gases
B22F 2201/11 . . Argon
B22F 2201/12 . . Helium

B22F 2201/20 . Use of vacuum

B22F 2201/30 . Carburising atmosphere

B22F 2201/32 . Decarburising atmosphere

B22F 2201/40 . Metal compounds

B22F 2201/50 . air

B22F 2202/00 Treatment under specific physical conditions

B22F 2202/01 . Use of vibrations

B22F 2202/03 . Treatment under cryogenic or supercritical conditions

B22F 2202/05 . Use of magnetic field

B22F 2202/06 . Use of electric fields

B22F 2202/07 . by induction

B22F 2202/09 . Use of non-gravitational conditions

B22F 2202/11 . Use of irradiation

B22F 2202/13 . Use of plasma

B22F 2202/15 . Use of fluidised beds

B22F 2202/17 . use of centrifugal or vortex forces

B22F 2203/00 Controlling

B22F 2203/01 . To-be-deleted with administrative transfer to B22F 2203/00

B22F 2203/03 . for feed-back

B22F 2203/05 . thermal expansion

B22F 2203/11 . temperature, temperature profile

B22F 2203/13 . pressure

B22F 2203/15 . weight

B22F 2207/00 Aspects of the compositions, gradients

B22F 2207/01 . Composition gradients
B22F 2207/03 . . of the metallic binder phase in cermets
B22F 2207/05 . . . eta-phase
B22F 2207/07 . . Particles with core-rim gradient

B22F 2207/11 . Gradients other than composition gradients, e.g. size gradients
B22F 2207/13 . . Size gradients
B22F 2207/15 . . Temperature gradients
B22F 2207/17 . . density or porosity gradients

B22F 2207/20 . Cooperating components

B22F 2301/00 Metallic composition of the powder or its coating

B22F 2301/05 . Light metals
B22F 2301/052 . . Aluminium
B22F 2301/054 . . Alkali metals, i.e. Li, Na, K, Rb, Cs, Fr
B22F 2301/056 . . Alkaline metals, i.e. Ca, Sr, Ba, Ra

B22F 2301/058 . . Magnesium

B22F 2301/10 . Copper

B22F 2301/15 . Nickel or cobalt

B22F 2301/155 . . Rare Earth - Co or -Ni intermetallic alloys

B22F 2301/20 . Refractory metals

B22F 2301/205 . . Titanium, zirconium or hafnium

B22F 2301/25 . Noble metals, i.e. Ag Au, Ir, Os, Pd, Pt, Rh, Ru

B22F 2301/255 . . Silver or gold

B22F 2301/30 . Low melting point metals, i.e. Zn, Pb, Sn, Cd, In, Ga

B22F 2301/35 . Iron

B22F 2301/355 . . Rare Earth - Fe intermetallic alloys

B22F 2301/40 . Intermetallics other than rare earth-Co or -Ni or -Fe intermetallic alloys

B22F 2301/45 . Rare earth metals, i.e. Sc, Y, Lanthanides (57-71)

B22F 2302/00 **Metal Compound , non-Metallic compound or non-metal composition of the powder or its coating**

B22F 2302/05 . Boride

B22F 2302/10 . Carbide

B22F 2302/105 . . Silicium carbide (SiC)

B22F 2302/15 . Carbonitride

B22F 2302/20 . Nitride

B22F 2302/205 . Cubic boron nitride

B22F 2302/25 . Oxide

B22F 2302/253 . . Aluminum oxide (Al_2O_3)

B22F 2302/256 . . Silicium oxide (SiO_2)

B22F 2302/30 . Oxynitride

B22F 2302/35 . Complex boride, carbide, carbonitride, nitride, oxide or oxynitride

B22F 2302/40 . Carbon, graphite

B22F 2302/403 . . Carbon nanotube

B22F 2302/406 . . Diamond

B22F 2302/45 . Others, including non-metals

B22F 2303/00 Functional details of metal or compound in the powder or product,

B22F 2303/01 . Main component

B22F 2303/05 . Compulsory alloy component

B22F 2303/10 . Optional alloy component

B22F 2303/15 . Intermetallic

B22F 2303/20 . Coating by means of particles

B22F 2303/25 . Coating by means of fibres

B22F 2303/30 . Coating alloy

B22F 2303/35 . Molten metal infiltrating a metal preform

B22F 2303/40 . Layer in a composite stack of layers, workpiece or article

B22F 2303/405 . . Support layer

B22F 2303/45 . Part of a final mixture to be processed further

B22F 2304/00 Physical aspects of the powder

B22F 2304/05 . Submicron size particles

B22F 2304/052 . . Particle size below 1nm

B22F 2304/054 . . Particle size between 1 and 100 nm

B22F 2304/056 . . Particle size above 100 nm up to 300 nm

B22F 2304/058 . . Particle size above 300 nm up to 1 micrometer

B22F 2304/10 . Micron size particles, i.e. above 1 micrometer up to 500 micrometer

B22F 2304/15 . Millimeter size particles, i.e. above 500 micrometer

B22F 2998/00 Supplementary information concerning processes or compositions relating to powder metallurgy

B22F 2998/10 . Processes characterised by the sequence of their steps

B22F 2999/00 Aspects linked to processes or compositions used in powder metallurgy