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.

WARNING
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

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 9/004); Metallic powders per se, e.g. mixtures of particles of different composition (C04, C08 take precedence; amorphous powder B22F 9/002)
   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)]
   1/0007 . . . . [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 . . . . . . . . . [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)
   3/001 . . . . . . [Starting from powder comprising reducible metal compounds (making ferrous alloys starting from compounds C22C 33/0235)]
Sintering only

Compacting only

Lubricant mixed with the metal powder

Press-moulding apparatus therefor

Multiple punches working in the same direction

by applying fluid pressure, e.g. by cold isostatic pressing (CIP)

Semi-isostatic pressure

by centrifugal forces

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

using high energy impulses, e.g. magnetic field impulses

using vibrations or friction

Sintering only

Use of special medium during sintering, e.g. sintering aid

Atmosphere (B22F 3/1021 takes precedence)

Changing atmosphere

Press-moulding apparatus therefor

Getting

Multiple heating or additional steps (B22F 3/101 takes precedence)

Removal of binder or filler (removal of binder from ceramics C04B 35/638)

not by heating only

Controlled cooling

comprising a grain growth inhibitor

Liquid phase sintering

(by reaction B22F 3/001, B22F 3/23 take precedence)

with support for articles to be sintered

with separating means for articles to be sintered

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)

by electric discharge

assisted by energy absorption enhanced by the coating or powder

by induction

by microwave

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

Apparatus components, details or accessories

for control or data processing, e.g. algorithms

Support structures for the 3D object during manufacturing, e.g. using sacrificial material

for cleaning or recycling

Making porous workpieces or articles

with particular physical characteristics

Product comprising closed porosity

Inhomogeneous pore distribution (composite layers of porous nature B22F 7/002)

comprising hollow spheres or hollow fibres

comprising complex forms, e.g. honeycombs

by using decomposable, meltable or sublimatable fillers

by multiple heating process

by expansion of dissolved gas, other than with foaming agent

Foaming in a liquid suspension and decomposition

Inorganic fillers (carbonaceous or paper filler B22F 3/1121)

by coating porous removable preforms

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

by involving an oxidation, reduction or reaction step

After-treatment maintaining the porosity (B22F 3/114 takes precedence)

by spraying molten metal, i.e. spray sintering, spray casting

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

Containers or coating used therefor

Container composition

Glass

Organic material

layered

Initially porous container

Container manufacturing

by coating or sealing the surface of the preformed article, e.g. by melting

by coating a model and eliminating the model before consolidation

Container formed as an undeformable model eliminated after consolidation

Solid insert eliminated after consolidation

simultaneously

by warm compacting, below debinding temperature

Hot isostatic pressing

apparatus specific to HIP

by a pressure medium in liquid or powder form

in successive or repeated steps

Machining, working after consolidation

Partial deformation or calibration

Surface calibration, blasting, burnishing, sizing, coining
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))

7/00 . . . {porous nature}
7/004 . . . {comprising at least one non-porous part}
7/006 . . . {the porous part being obtained by foaming}
7/008 . . . {characterised by the composition}
7/02 . . . of composite layers {((B22F 7/002 takes precedence))}
7/04 . . . with one or more layers not made from powder, e.g. made from solid metal

2007/042 . . . {characterised by the layer forming method}
2007/045 . . . {accompanied by fusion or impregnation}
2007/047 . . . {non-pressurised baking of the paste or slurry containing metal powder}
7/06 . . . of composite workpieces or articles from parts, e.g. to form tipped tools {((B22F 7/002 takes precedence))}
7/062 . . . {involving the connection or repairing of preformed parts}
7/064 . . . {using an intermediate powder layer}
2007/066 . . . {using impregnation}
2007/068 . . . {repairing articles}
7/08 . . . 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

9/00 Making metallic powder or suspensions thereof
2009/001 . . . {from scrap particles}
9/002 . . . {amorphous or microcrystalline}
9/004 . . . {by diffusion, e.g. solid state reaction}
9/005 . . . {Transformation into amorphous state by milling}
9/007 . . . {Transformation of amorphous into microcrystalline state}
9/008 . . . {Rapid solidification processing}
9/02 . . . {using physical processes}
9/023 . . . {Hydrogen absorption}
9/026 . . . {Spray drying of solutions or suspensions}
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}

2009/041 . . . {by mechanical alloying, e.g. blending, milling}
2009/042 . . . {using a particular milling fluid}
2009/043 . . . {by ball milling}
2009/044 . . . {by jet milling}
2009/045 . . . {by other means than ball or jet milling}
2009/046 . . . {by cutting}
2009/047 . . . {by rolling}
2009/048 . . . {by pulverising a quenched ribbon}
2009/049 . . . {by pulverising at particular temperature}
9/06 . . . starting from liquid material
2009/065 . . . {Melting inside a liquid, e.g. making spherical balls}
Treatment under specific atmosphere

9/08 by casting, e.g. through sieves or in water, by atomising or spraying (using electric discharge B22F 9/14)

2009/0804 [Dispersion in or on liquid, other than with sieves]

2009/0808 [Mechanical dispersion of melt, e.g. by sieves]

2009/0812 [Pulverisation with a moving liquid coolant stream, by centrifugally rotating stream]

2009/0816 [by casting with pressure or pulsating pressure on the metal bath]

9/082 [atomising using a fluid (using centrifugal force B22F 9/10)]

2009/0824 [with a specific atomising fluid]

2009/0828 [with water]

2009/0832 [Handling of atomising fluid, e.g. heating, cooling, cleaning, recirculating]

2009/0836 [with electric or magnetic field or induction]

2009/084 [combination of methods]

2009/0844 [in controlled atmosphere]

2009/0848 [Melting process before atomisation]

2009/0852 [Electroslag melting]

2009/0856 [Skull melting]

2009/086 [Cooling after atomisation]

2009/0864 [by oil, other non-aqueous fluid or fluid-bed cooling]

2009/0868 [by injection of solid particles in the melt stream]

2009/0872 [by water]

2009/0876 [by gas]

2009/088 [Fluid nozzles, e.g. angle, distance]

2009/0884 [Spiral fluid]

2009/0888 [casting construction of the melt process, apparatus, intermediate reservoir, e.g. tundish, devices for temperature control]

2009/0892 [casting nozzle; controlling metal stream in or after the casting nozzle]

2009/0896 [particle transport, separation: process and apparatus]

9/10 using centrifugal force

9/12 starting from gaseous material

9/14 using electric discharge

9/16 using chemical processes

2009/165 (Chemical reaction in an Ionic Liquid [IL] (B22F 2009/245 takes precedence))

9/18 with reduction of metal compounds

9/20 starting from solid metal compounds

9/22 using gaseous reductors

9/24 starting from liquid metal compounds, e.g. solutions

2009/245 (Reduction reaction in an Ionic Liquid [IL])

9/26 using gaseous reductors

9/28 starting from gaseous metal compounds

9/30 with decomposition of metal compounds, e.g. by pyrolysis

9/305 [of metal carboxyls]

2201/00 Treatment under specific atmosphere

2201/01 Reducing atmosphere

2201/013 Hydrogen

2201/016 NH₃

2201/02 Nitrogen

2201/03 Oxygen

2201/04 CO or CO₂

2201/05 Water or water vapour

2201/10 Inert gases

2201/11 Argon

2201/12 Helium

2201/20 Use of vacuum

2201/30 Carburising atmosphere

2201/32 Decarburising atmosphere

2201/40 Metal compounds

2201/50 air

2202/00 Treatment under specific physical conditions

2202/01 Use of vibrations

2202/03 Treatment under cryogenic or supercritical conditions

2202/05 Use of magnetic field

2202/06 Use of electric fields

2202/07 by induction

2202/09 Use of non-gravitational conditions

2202/11 Use of irradiation

2202/13 Use of plasma

2202/15 Use of fluidised beds

2202/17 use of centrifugal or vortex forces

2203/00 Controlling

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

2203/03 for feed-back

2203/05 thermal expansion

2203/11 temperature, temperature profile

2203/13 pressure

2203/15 weight

2207/00 Aspects of the compositions, gradients

2207/01 Composition gradients

2207/03 of the metallic binder phase in cermets

2207/05 eta-phase

2207/07 Particles with core-rim gradient

2207/11 Gradients other than composition gradients, e.g. size gradients

2207/13 Size gradients

2207/15 Temperature gradients

2207/17 density or porosity gradients

2207/20 Cooperating components

2301/00 Metallic composition of the powder or its coating

2301/05 Light metals

2301/052 Aluminium

2301/054 Alkali metals, i.e. Li, Na, K, Rb, Cs, Fr

2301/056 Alkaline metals, i.e. Ca, Sr, Ba, Ra

2301/058 Magnesium

2301/10 Copper

2301/15 Nickel or cobalt

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

2301/20 Refractory metals

2301/205 Titanium, zirconium or hafnium

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

2301/255 Silver or gold

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

2301/35 Iron
2301/355 Rare Earth - Fe intermetallic alloys
2301/40 Intermetallics other than rare earth-Co or -Ni or -Fe intermetallic alloys
2301/45 Rare earth metals, i.e. Sc, Y, Lanthanides (57-71)

2302/00 Metal Compound, non-Metallic compound or non-metal composition of the powder or its coating
2302/05 Boride
2302/10 Carbide
2302/105 Silicium carbide (SiC)
2302/15 Carbonitride
2302/20 Nitride
2302/25 Oxide
2302/253 Aluminum oxide (Al₂O₃)
2302/256 Silicium oxide (SiO₂)
2302/30 Oxynitride
2302/35 Complex boride, carbide, carbonitride, nitride, oxide or oxynitride
2302/40 Carbon, graphite
2302/403 Carbon nanotube
2302/406 Diamond
2302/45 Others, including non-metals

2303/00 Functional details of metal or compound in the powder or product,
2303/01 Main component
2303/05 Compulsory alloy component
2303/10 Optional alloy component
2303/15 Intermetallic
2303/20 Coating by means of particles
2303/25 Coating by means of fibres
2303/30 Coating alloy
2303/35 Molten metal infiltrating a metal preform
2303/40 Layer in a composite stack of layers, workpiece or article
2303/405 Support layer
2303/45 Part of a final mixture to be processed further

2304/00 Physical aspects of the powder
2304/05 Submicron size particles
2304/052 Particle size below 1 nm
2304/054 Particle size between 1 and 100 nm
2304/056 Particle size above 100 nm up to 300 nm
2304/058 Particle size above 300 nm up to 1 micrometer
2304/10 Micron size particles, i.e. above 1 micrometer up to 500 micrometer
2304/15 Millimeter size particles, i.e. above 500 micrometer

2998/00 Supplementary information concerning processes or compositions relating to powder metallurgy
2998/10 Processes characterised by the sequence of their steps

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