

B22F

WORKING METALLIC POWDER; MANUFACTURE OF ARTICLES FROM METALLIC POWDER; MAKING METALLIC POWDER (making alloys by powder metallurgy [C22C](#)); APPARATUS OR DEVICES SPECIALLY ADAPTED FOR METALLIC POWDER

Definition statement

This place covers:

Metallic powders per se.

Treatment of metallic powder, e.g. thermal, thermo-mechanical or chemical treatments, making agglomerates.

Manufacture of workpieces or articles from metallic powder characterised by the manner of compacting or sintering or by the special shape of the product.

Manufacture of composite layers, workpieces, or articles, comprising metallic powder, by sintering the powder, with or without compacting.

Manufacture of articles from scrap or waste metal particles.

Making metallic powder or suspensions thereof using physical or chemical processes.

Powder metallurgical apparatus or equipment specifically adapted therefor, e.g. furnaces, retorts or sintering apparatus.

Additive manufacturing of workpieces or articles from metallic powder and apparatus or devices therefor.

Relationships with other classification places

Subclass [B22F](#) covers the making of metallic powder including a metallic powder with specific physical characteristics. Non-metal particles or inorganic compounds coated with metal as well as metal particles coated with non-metals or inorganic compounds are classified in subclass [B22F](#). Subclass [B22F](#) covers powders containing a substantial proportion of non-metallic material. It means that, when the metal is in a significant proportion that cannot be seen as an impurity in the metallurgical process, it must be classified in subclass [B22F](#). When the metal is present only as an impurity, it is classified in other places in the IPC. When the subject matter does not refer to a manufacturing process or to articles characterized by having a special shape but only refers to the use of the metallic powder, it is classified in the other places in the IPC, e.g. dental implants using metallic powder are classified in [A61C 8/00](#).

Group [C22B 1/14](#) covers agglomerating; briquetting, granulating, binding or sintering of ores or scrap for obtaining metals

Groups [C22C 1/04](#), [C22C 1/05](#), [C22C 26/00](#), [C22C 29/00](#), [C22C 33/02](#) and [C22C 47/14](#) cover the making of alloys by powder metallurgy including using mixtures of metallic powder with non-metallic powder, fibres or filaments.

Subclass [C22F](#) covers changing the physical structure of non-ferrous metals or alloys by heat treatment or by hot or cold working, including special physical methods, e.g. treatment with neutrons.

Subclass [C04B](#) covers preparing or treating powders of inorganic compounds in preparation to the manufacturing of ceramic products, e.g. group [C04B 35/622](#). When the proportion of metallic powder is present not as an impurity in the compounds, it is classified in subclass [B22F](#).

Relationships with other classification places

Subclass [C08K](#) covers use of inorganic substances including metals as compounding ingredients in compositions based on macromolecular compounds.

Group [B01J 2/00](#) covers chemical or physical processes or devices for granulating materials in general.

Subclass [B02C](#) covers crushing, grinding or milling, in general.

Subclass [B22F](#) covers the manufacture of workpieces from metallic powder, e.g. by rolling, extrusion or forging. Other aspects of mechanical metal-working without essentially removing material are covered by class [B21](#). In particular, subclasses [B21B](#) and [B21H](#) cover rolling of metal, subclass [B21C](#) covers extrusion of metal and subclasses [B21J](#) and [B21K](#) cover forging of metal.

Magnets made by pressing, sintering or bonding metals or alloys in the form of particles, e.g. powder, are classified in groups [H01F 1/08](#), [H01F 1/22](#), and in subclass [B22F](#) for the process of manufacturing the metallic powder, the powder itself and the process for making the magnet by powder metallurgical techniques.

Subclass [B33Y](#) covers additive manufacturing, irrespective of the process or material used. Furthermore, the subclass [B33Y](#) is for obligatory supplementary classification of subject matter containing an aspect of additive manufacturing already classified in other classification places.

References

Limiting references

This place does not cover:

Making non-ferrous alloy compositions by powder metallurgy	C22C 1/04
Making non-ferrous alloys from mixtures of metallic powder with non-metallic powder	C22C 1/05
Alloys containing diamond	C22C 26/00
Alloys based on metal compounds, e.g. cermets	C22C 29/00
Non-ferrous alloys containing metal compounds	C22C 32/00
Making ferrous alloys by powder metallurgy	C22C 33/02
Making alloys containing metallic or non-metallic fibres or filaments by powder metallurgy	C22C 47/14

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

Making ceramics by compacting or sintering	C04B
Shaped ceramic products characterised by their composition	C04B 35/00
Burning or sintering process for ceramic compositions	C04B 35/64
Production or refining of metals; Pretreatment of raw materials	C22B
Sintering; Agglomerating of raw materials for obtaining metals	C22B 1/16
Electrolytic production, recovery or refining of metallic powder	C25C 5/00
Magnets or magnetic bodies characterised by the magnetic materials in the form of particles, e.g. powder	H01F 1/06 , H01F 1/20
Magnets made by pressing, sintering or bonding metals or alloys in the form of particles, e.g. powder, together	H01F 1/08 , H01F 1/22

Application-oriented references

Magnetic cores made from powder	H01F 3/08
Devices using superconductivity or hyperconductivity characterised by the material	H10N 60/85

Informative references

Attention is drawn to the following places, which may be of interest for search:

Dental implants	A61C 8/00
Prostheses implantable into the body	A61F 2/02
Use of metals or alloys for artificial teeth, for filling or for capping teeth	A61K 6/84
Use of metals or alloys for prostheses or for coating prostheses	A61L 27/04
Chemical or physical processes or devices for granulating materials in general	B01J 2/00
Catalysts comprising metals	B01J 23/00
Methods for preparing or activation of catalysts	B01J 37/00
Crushing, grinding or milling in general	B02C
Disposal of solid waste	B09B
Melting down metal particles in a mould	B22D 23/06
Soldering or unsoldering; Welding; Cladding or plating by soldering or welding	B23K
Abrasive tools	B24D
Cutting tools	B26D , B26F
Presses specially adapted for forming articles from material in particulate or plastic state	B30B 11/00
Layered products characterised by features of a layer formed of particles, e.g. chips, chopped fibres, powder	B32B 5/16
Printing	B41J , B41M
Chemical aspects of powdering or granulating of macromolecular substances	C08J 3/12
Metallic pigments or fillers	C09C 1/62
Compressing powdered coating material, e.g. by milling	C23C 24/06
Earth or rock drilling tools	E21B 10/00 , E21B 11/00 , E21B 12/00
Structural composition and use of special materials in brasses, bushes and linings of sliding contact bearings	F16C 33/12
Conductive material dispersed in non-conductive organic material	H01B 1/22
Elements or alloys used as active materials in battery in electrodes	H01M 4/38
Printed circuits	H05K
Selection of a metal for the legs of a junction of a thermoelectric device	H10N 10/854

Special rules of classification

Combination Sets (C-Sets):

In this subclass, C-Sets classification is applied to the following groups, listed in the table below, if the document discloses a pertinent combination of technical features that cannot be covered by the allocation of a single symbol. The fourth column of the table indicates the place where the detailed information about the C-Sets construction and the associated syntax rules can be found, in the definition section "Special rules of classification".

C-Sets ID	Base Symbols	Subsequent Symbols	C-Sets Formula; Location of C-Sets Rules
#B22Fa	B22F 2998/00	B22F 1/00 - B22F 2207/20 , C22C 1/00 - C22C 2204/00 (including breakdown indexing codes), other subclasses	(B22F , B22F); a process relating to powder metallurgy; see B22F 2998/00
#B22Fb	B22F 2998/10	B22F 1/00 - B22F 2207/20 , C22C 1/00 - C22C 2204/00 (including breakdown indexing codes), other subclasses	(B22F , B22F); a process relating to powder metallurgy characterized by the sequence of the steps; see B22F 2998/10
#B22Fc	B22F 2999/00	B22F 1/00 - B22F 2207/20 , C22C 1/00 - C22C 2204/00 (including breakdown indexing codes), other subclasses	(B22F , B22F); a process relating to aspects linked to processes or compositions used in powder metallurgy; see B22F 2999/00

The specific C-Sets rule is located at only one place of the base symbol in the section "Special rules of classification" in the definition. If the C-Sets rule is applicable to all groups of a subclass, it is located at the subclass level only. If the same C-Sets rule is applicable to multiple groups or subgroups within the same subclass, the C-Sets rule is placed at the highest group or subgroup of the multiple groups.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Compacting	join or press firmly together.
Sintering	forming powder into a coherent mass by heating the powder whereby adjacent particles are joined by diffusion or superficial melting.
Alloy	a composition of plural elements at least one of which is a metal in the oxidation state zero. Also includes material containing any combination of fibres, filaments, whiskers and particles, e.g. carbides, diamond, oxides, borides, nitrides or sulfides, embedded in a metallic matrix.
Furnace	covers kilns, ovens or retorts

Synonyms and Keywords

In patent documents, the following words/expressions are often used as synonyms:

- "apparatus", "equipment" or "device"
- "residue", "waste", "remain", "scrap", "rejects" or "shred"
- "compacting" or "compressing"

B22F 1/00

Metallic powder; Treatment of metallic powder, e.g. to facilitate working or to improve properties

Definition statement

This place covers:

Metal particles per se as well as mixtures of metal particles with a lubricant, binding agent or organic material. Particles per se can have a specific size, size distribution, shape or structure. Treatment of metallic powder and coating thereof is also covered.

A special case, which is also covered by this subclass, concerns non-metallic or inorganic particles which have a metallic coating. Equally metal particles coated with non-metals or inorganic compounds are classified in subclass [B22F 1/00](#). [B22F 1/00](#) also covers powders containing a substantial proportion of non-metallic material. When the metal is present in a proportion significantly relevant so that it could not be seen as an impurity in the metallurgic process it must be classified in [B22F 1/00](#).

Relationships with other classification places

Main group [B82Y 5/00](#) covers nanobiotechnology or nanomedicine. Furthermore, main group [B82Y 5/00](#) is for obligatory supplementary classification of subject matter containing an aspect of nanobiotechnology or nanomedicine already classified in other classification places.

Main group [B82Y 30/00](#) covers nanotechnology for materials or surface science. Furthermore, main group [B82Y 30/00](#) is for obligatory supplementary classification of subject matter containing an aspect of nanotechnology for materials or surface science already classified in other classification places.

Compositions of metal and ceramic powder, e.g. cermets, are classified in [C22C](#).

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Shot peening	C21D 7/06 , B24C 11/00
Ammunition shot	F42B 7/046

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

"Nanosize" or "nanoscale"	relate to a controlled geometrical size below 100 nanometres (nm) in one or more dimensions.
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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}

Definition statement

This place covers:

Apart from the manufacturing of workpieces or articles from metallic powder, also the manufacturing of parts which are based on metallic fibres only (no matrix material) as well as processes starting from decomposable or reducible metal compounds.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Mechanical metal-working without essentially removing material; Punching metal	B21D
Forging; Hammering; Pressing; Forge Furnaces	B21J
Making forged or pressed products	B21K
Presses in general	B30B
Furnaces, Kilns, Ovens, or retorts in general; Open sintering or like apparatus	F27B

Special rules of classification

Although [B22F 3/12](#) specifies processes including both compacting and sintering, this group is mainly used for information concerning the container or model used during the compacting and sintering. For the compacting and sintering step, the more detailed subgroups under [B22F 3/02](#) (compacting) and/or [B22F 3/10](#) (sintering) are applied.

B22F 3/03

Press-moulding apparatus therefor

Definition statement

This place covers:

Press apparatuses specially adapted for metal powder pressing.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Presses in general	B30B
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Special rules of classification

Methods or special apparatuses for the filling of the moulds with powder are classified in [B22F 3/003](#).

B22F 3/08

by explosive forces {(generating shock waves in general [G10K 15/043](#))}

Definition statement

This place covers:

Processes in which compacting is accomplished through the use of shock waves or explosive forces, including processes that utilize a time-related detonating effect

References**Informative references**

Attention is drawn to the following places, which may be of interest for search:

Application of shock-waves for chemical reactions or for modifying structures in general	B01J 3/08
Generating shock-waves in general	G10K 15/043

Special rules of classification

- Flyer impact effect: [B22F 3/087](#)
- Compression in the presence of a magnetic field: [B22F 3/087](#) and/or with Indexing Code [B22F 2202/05](#)

B22F 3/093

using vibrations {or friction}

Definition statement

This place covers:

Compaction aided by vibrations or friction.

B22F 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)}

Definition statement

This place covers:

All sintering processes involving EM-wave energy: electric current, plasma, laser, microwave, etc and ultra-sonic bonding.

References**Limiting references**

This place does not cover:

Making porous workpieces or articles	B22F 3/11
Manufacture of workpieces or articles by spraying molten metal	B22F 3/115

Informative references

Attention is drawn to the following places, which may be of interest for search:

Stereolithographic techniques for making dental prostheses	A61C 13/0013
Laser welding and relative movement between laser beam and workpiece	B23K 26/08
Selective sintering of ceramic or cementitious material	B28B 1/00
Rapid manufacturing and prototyping of 3D objects by additive depositing, agglomerating or laminating of plastics material	B29C 64/00
Selective printing	B41J 2/00

B22F 3/115

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

Definition statement

This place covers:

(hot) spraying of molten metal wherein the sprayed material forms the product (i.e. not as a coating process).

References**Limiting references**

This place does not cover:

Cold spraying of metal	C23C 24/04
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Informative references

Attention is drawn to the following places, which may be of interest for search:

Adding compound dispersions to the spray	C22C 1/1042
Thermal spraying fibre reinforced material	C22C 47/16

Special rules of classification

These documents are also classified in [C23C 4/123](#) (spraying molten metal) and [C23C 4/185](#) (separation of coating from substrate) as well as [B22D 23/003](#) (moulding by spraying metal on a surface).

B22F 3/24

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

Definition statement

This place covers:

Chemical or thermal after-treatments and mechanical treatments only in as far as material is removed from the surface, such as making recesses or grooves, honing, polishing, milling, grinding, carving etc.

Special rules of classification

The after-treatment is further specified by means of an Indexing Code.

B22F 3/26**Impregnating {(making ferrous alloys by impregnation [C22C 33/0242](#))}****References****Limiting references***This place does not cover:*

Porous articles or workpieces formed by impregnation remaining porous	B22F 3/114
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Informative references*Attention is drawn to the following places, which may be of interest for search:*

Apparatus for impregnation	B05C 3/109
Impregnating a ceramic preform with molten metal	C04B 41/51
Non-ferrous alloys obtained by impregnation of a powder metallurgy product	C22C 1/0475
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****Definition statement***This place covers:*

Processes in which a defined geometrical configuration of a final product is specified, and also moulds, turbine components other than blades, engine parts different from piston rings, flat products and articles to be fractured or separated into parts.

B22F 5/04**of turbine blades****References****Informative references***Attention is drawn to the following places, which may be of interest for search:*

Making turbine blades (by machining)from one piece from several pieces	B23P 15/02 , B23P 15/04
Turbine blades	F01D 5/00

B22F 5/06**of threaded articles, e.g. nuts****References****Informative references***Attention is drawn to the following places, which may be of interest for search:*

Making screw-threaded elements (e.g. nuts, bolts)	B21K 1/56
Screw bolts	F16B 35/00

B22F 5/08**of toothed articles, e.g. gear wheels; of cam discs****References****Informative references***Attention is drawn to the following places, which may be of interest for search:*

Gear wheels by stamping	B21D 53/28
Gear wheels by rolling	B21H 5/00
Gear wheels forged or pressed	B21K 1/30
Coupling members, e.g. clutch systems	B21K 1/762
Making gears or toothed racks	B23F
Making gear wheels by "other" processes	B23P 15/14
Mechanically actuated clutches	F16D 23/025
Toothed gearings	F16H 1/00 , F16H 3/00

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](#))}****Definition statement***This place covers:*

Manufacture of composite parts (limited geometry) and layers ("infinite"), including porous layers or parts, comprising metallic powder, by sintering the powder, with or without compacting

References**Limiting references***This place does not cover:*

Coatings applied by use of metal powder (not involving compression and/or sintering)	C23C
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Informative references

Attention is drawn to the following places, which may be of interest for search:

Layered products characterised by the non-homogeneity or physical structure of a layer, comprising fibres or filaments formed of particles foamed or porous material combinations thereof in at least 2 layers	B32B 5/00 – B32B 5/2795 , B32B 5/30 , B32B 5/32
Layered products characterised by the relation between layers	B32B 7/00
Layered products, essential comprising metal	B32B 15/00 - B32B 15/20
Methods or apparatus for laminating	B32B 37/00 - B32B 37/30

B22F 7/06

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

References**Informative references**

Attention is drawn to the following places, which may be of interest for search:

Tools for cutting or boring with bits of special material or diamond bits	B23B 27/14 , B23B 27/20
Connecting cutting edges by brazing	B23K 31/025
Making cutting tools	B23P 15/28
Tools for grinding, with metallic binder	B24D 3/06 - B24D 3/10
Hand cutting tools	B26
Earth or rock drilling bits, with diamond insertswith button type inserts	E21B , E21B 10/46 , E21B 10/56

B22F 7/062

{involving the connection or repairing of preformed parts}

Definition statement

This place covers:

Only connecting (i.e not co-forming or in-situ forming) or repairing.

References**Informative references**

Attention is drawn to the following places, which may be of interest for search:

Repairing methods or devices for turbine blades	F01D 5/005
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B22F 8/00**Manufacture of articles from scrap or waste metal particles****Glossary of terms**

In this place, the following terms or expressions are used with the meaning indicated:

Scrap, waste	swarf, residue, remains, rejects, shred
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B22F 9/00**Making metallic powder or suspensions thereof****References****Informative references**

Attention is drawn to the following places, which may be of interest for search:

Granulation of slag	C21B 3/06
Granulation of ores or scrap	C22B 1/14

B22F 9/008**{Rapid solidification processing}****Definition statement**

This place covers:

Solidification by means of quenching rates above 104 C/s.

References**Informative references**

Attention is drawn to the following places, which may be of interest for search:

Processes or devices for granulating materials, in general	B01J 2/00
Metallic powder obtained by crushing, pulverising, disintegrating in general; milling grain	B02C

B22F 9/06**starting from liquid material****Definition statement**

This place covers:

Only starting from melts.

B22F 9/12**starting from gaseous material****Definition statement***This place covers:*

Processes employing a gaseous precursor of the powder, plasma, or the evaporation of metal.

B22F 9/16**using chemical processes****Definition statement***This place covers:*

Including the recovery of one metal from a mixture/solution containing multiple metals.

References**Informative references***Attention is drawn to the following places, which may be of interest for search:*

By hydrogen absorption / desorption	B22F 9/023
Electrolytic production, recovery or refining of metal powders	C25C 5/00

B22F 9/20**starting from solid metal compounds****Relationships with other classification places**Direct reduction of iron ores: [C21B 13/00](#)General processes of reducing to metals: [C22B 5/00](#)Dry reduction processes for obtaining specific non-ferrous metals: [C22B](#)**References****Informative references***Attention is drawn to the following places, which may be of interest for search:*

Controlled atmosphere, or pulverulent material; Adjusting the composition of the atmosphere	C21D 1/74 - C21D 1/773
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B22F 9/305**{of metal carbonyls}****References****Limiting references***This place does not cover:*

Manufacturing of iron from iron carbonyl	C21B 15/04
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General method of reducing metals from metal carbonyls	C22B 5/20
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B22F 10/00

Additive manufacturing of workpieces or articles from metallic powder (apparatus or devices therefor [B22F 12/00](#))

Definition statement

This place covers:

Technologies involving the use or application of processes or apparatus that produce three dimensionally shaped structures by selectively depositing successive layers of metallic powder one upon another.

Processes of additive manufacturing, i.e. making, repairing or modifying articles of manufacture by the selective application of multiple layers of metallic powder.

Either the complete product may be built up layer-by-layer or powder can be applied on a prefabricated part, wherein the pre-fabrication step is not limited to additive manufacturing. The powder can be applied as a layer, of which only a part is consolidated and used for the product, or locally at the consolidation area.

In addition to metallic powder, mixtures of metallic particles with organic or inorganic material are also covered by this group. For example, metallic particles having an organic or a (non-metallic) inorganic coating and (non-metallic) inorganic particles having a metallic coating.

Relationships with other classification places

Group [B29C 64/00](#) covers additive manufacturing of plastics or materials in a plastic state, not otherwise provided for.

Subclass [B33Y](#) covers additive manufacturing, irrespective of the process or material used. Furthermore, subclass [B33Y](#) is for obligatory supplementary classification of subject matter containing an aspect of additive manufacturing already classified as such in other classification places.

References

Limiting references

This place does not cover:

Apparatus or devices specially adapted for additive manufacturing	B22F 12/00
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Informative references

Attention is drawn to the following places, which may be of interest for search:

Preparation of cocoa products	A23G 1/00
Shaping or working of foodstuff	A23P 10/00
Making of dental prostheses	A61C 13/00
Materials for prostheses or for coating prostheses	A61L 27/00
Moulds or cores for foundry moulding	B22C 9/00
Build-up welding by laser	B23K 26/342
Producing shaped articles from ceramic or cementitious material	B28B 1/00
Moulds, cores, mandrels for shaping clay or other ceramic compositions	B28B 7/00

Additive manufacturing of plastics	B29C 64/00
Ancillary operations in connection with laminating processes	B32B 38/00
Forme preparation for the manufacture or reproduction of printing surfaces	B41C 1/00
Typewriters or selective printers for marking on special material	B41J 3/407
Braille printing	B41M 3/16
Processes for producing ornamental structures by superimposing layers	B44C 3/02
Forming processes for shaped ceramic products	C04B 35/622
Culture of cells	C12N 5/00
Photosensitive materials for photographic purposes	G03C 1/00
Photographic processes	G03C 5/00
Photomechanical production of textured or patterned surface	G03F 7/00
Electrographic processes using a charge pattern	G03G 13/00
Electric numerical control systems for the surface or curve machining, making 3D objects	G05B 19/4099
3D modelling for computer graphics	G06T 17/00
Models for surveying; Models for geography, e.g. relief models	G09B 25/06
Discharge tubes for applying thin layers on objects	H01J 37/00
Apparatus or processes for manufacturing printed circuits using printing techniques to apply the conductive material	H05K 3/12

B22F 10/14

by jetting of binder onto a bed of metal powder

Definition statement

This place covers:

The deposition of a liquid bonding agent onto a thin layer of metallic particles forming a powder bed to join the metallic particles and build up a green body layer by layer.

The bonding agent may include organic and inorganic materials.

The powder bed may be formed from mixtures of metallic particles with (non-metallic) inorganic particles, for example (non-metallic) inorganic particles having a metallic coating or metallic particles having a (non-metallic) inorganic coating.

B22F 10/16

by embedding the binder within the powder bed

Definition statement

This place covers:

The formation layer by layer of a green body by selectively depositing a viscous material comprising activating a binder embedded in a powder bed of metallic particles.

The binder might be activated by a heat source (such as a laser beam, IR-light, etc.) to bond the metallic particles.

The binder may include organic and inorganic materials and may be present in the powder bed as a mixture with the metallic particles or may be present as a coating on the metallic particles.

The powder bed may be formed from mixtures of metallic particles with (non-metallic) inorganic particles, for example (non-metallic) inorganic particles having a metallic coating or metallic particles having a (non-metallic) inorganic coating, with an additional binder embedded in the said powder bed.

B22F 10/18

by mixing binder with metal in filament form, e.g. fused filament fabrication [FFF]

Definition statement

This place covers:

The formation layer by layer of a green body by selectively depositing beads of a viscous material composed of a mixture of metal particles embedded in a binder, the mixture having the form of a filament. The binder may include organic and inorganic materials.

For example, the filament material might be extruded by a nozzle in beads.

B22F 10/30

Process control

Definition statement

This place covers:

Operations performed before or during the additive manufacturing specially adapted for managing the additive manufacturing process by one or more additive manufacturing apparatuses.

This group typically comprises acquiring, sending or receiving data that will be used in additive manufacturing, either internal or external to the additive manufacturing apparatus.

Relationships with other classification places

Group [B29C 64/393](#) concerns processes for additive manufacturing of plastics.

B22F 10/34

of powder characteristics, e.g. density, oxidation or flowability

Definition statement

This place covers:

Control of the powder characteristics before or during the additive manufacture. The powder characteristics are controlled or selected in a particular way.

Process control with respect to powder properties such as mixing processes of powders, drying or protecting from oxidation, before being fed to the powder bed.

Relationships with other classification places

The powders and their characteristics per se are classified in group [B22F 1/00](#).

B22F 10/37

of powder bed aspects, e.g. density

Definition statement

This place covers:

Powder bed aspects, e.g. smoothness of the bed, its density or the presence of defects, e.g. spatters.

The classification in group [B22F 10/37](#) is made if the powder bed is seen as a distinct aspect or entity.

B22F 12/86

Serial processing with multiple devices grouped

Definition statement

This place covers:

Modular set-up of workstations connected to each other by robots or continuous transport means but clustered.

B22F 2998/00

Supplementary information concerning processes or compositions relating to powder metallurgy

Special rules of classification

Combination sets (C-Sets):

C-Sets statement: #B22Fa

- In group [B22F 2998/00](#), supplementary information concerning processes related to powder metallurgy is classified in the form of C-Sets.
- In these C-Sets, the base symbol is [B22F 2998/00](#), whereas the subsequent symbol(s) representing the processes related to powder metallurgy are taken from the groups [B22F 1/00](#) - [B22F 2207/20](#), [C22C 1/00](#) - [C22C 2204/00](#) (including breakdown indexing codes), and other subclasses from other fields.
- C-Sets #B22Fa is always allocated as additional information (ADD).
- #B22Fa is actually rarely used in practice.

C-Sets syntax rules:

- Each C-Sets can contain two or more symbols.
- Duplicate symbols are not allowed in these C-Sets.
- Breakdown codes are allowed as subsequent symbols.
- The order of C-Sets is as follows: [B22F 2998/00](#) is always used as a base symbol, while the order of the subsequent symbols in these C-Sets is not relevant.
- The subsequent symbols are not arranged in alphanumerical order.

C-Sets examples:

- #B22Fa: A method of forming ([B22F 2998/00](#)) a product can be by injection moulding, additive manufacturing or extrusion, not being particularly claimed or having a preference, is classified as ([B22F 2998/00](#), [B22F 3/225](#), [B22F 3/20](#), [B22F 10/00](#)) (ADD).

B22F 2998/10

Processes characterised by the sequence of their steps

Special rules of classification

Combination sets (C-Sets):

C-Sets statement: #B22Fb

- In group [B22F 2998/10](#), supplementary information concerning processes characterised by process steps is classified in the form of C-Sets.
- In these C-Sets, the base symbol is [B22F 2998/10](#), whereas the subsequent symbol(s) representing the processes or composition related to powder metallurgy are taken from the groups [B22F 1/00 - B22F 2207/20](#), [C22C 1/00 - C22C 2204/00](#) (including breakdown indexing codes), and other subclasses from other fields.
- C-Sets #B22Fb is always allocated as ADD.

C-Sets syntax rules:

- Each C-Sets can contain two or more symbols.
- Duplicate symbols are allowed in these C-Sets but not consecutively.
- Breakdown codes are allowed as subsequent symbols.
- The order of symbols in these C-Sets is relevant. [B22F 2999/00](#) is always used as a base symbol, while subsequent symbols reflect the sequence of steps performed in the process.
- In these C-Sets the symbols are not arranged in alphanumerical order.

C-Sets examples:

- #B22Fb: A process ([B22F 2998/10](#)) comprising specifically a mixture of metal powder and resin ([B22F 1/10](#)), a mould filled with this powder ([B22F 3/004](#)), pressed ([B22F 3/02](#)) and sintered with removal of binder ([B22F 3/1021](#)) is classified as ([B22F 2998/10](#), [B22F 1/10](#), [B22F 3/004](#), [B22F 3/02](#), [B22F 3/1021](#)) (ADD).
- #B22Fb: A process ([B22F 2998/10](#)) comprising specifically a workpiece manufactured by selective laser melting ([B22F 10/28](#)) followed by hot isostatic pressing ([B22F 3/15](#)) is classified as ([B22F 2998/10](#), [B22F 10/28](#), [B22F 3/15](#)) (ADD).

B22F 2999/00

Aspects linked to processes or compositions used in powder metallurgy

Special rules of classification

Combination sets (C-Sets):

C-Sets statement: #B22Fc

- In group [B22F 2999/00](#), aspects linked to processes or compositions used in powder metallurgy is classified in the form of C-Sets.
- In these C-Sets, the base symbol is [B22F 2999/00](#), whereas the subsequent symbol(s) representing the processes or composition related to powder metallurgy are taken from the groups [B22F 1/00 - B22F 2207/20](#), [C22C 1/00-C22C 2204/00](#) (including breakdown indexing codes), and other subclasses from other fields.
- C-Sets #B22Fc is always allocated as ADD.

C-Sets syntax rules:

- Each C-Sets can contain two or more symbols.
- Duplicate symbols are not allowed in these C-Sets.
- Breakdown codes are allowed as subsequent symbols.

- The order of symbols in these C-Sets is relevant. [B22F 2999/00](#) is always used as base symbol, while subsequent symbols are arranged to represent subject matter(s) with increasing specificity.
- In these C-Sets, the subsequent symbols are not arranged in alphanumerical order.

C-Sets examples:

- #B22Fc: Aspect ([B22F 2999/00](#)) concerning vacuum ([B22F 2201/20](#)) applied during the step of filling mould with powder ([B22F 3/004](#)) and the use of vibration ([B22F 2201/01](#)) to equalise the powder distribution in the mould is classified as ([B22F 2999/00](#), [B22F 3/004](#), [B22F 2202/01](#), [B22F 2201/20](#)) (ADD).
- #B22Fc: Aspects ([B22F 2999/00](#)) concerning sweep gas system ([B22F 12/70](#)) and driving means for a motion of said system along a direction within the plane of a layer ([B22F 12/224](#)) during additive manufacturing is classified as ([B22F 2999/00](#), [B22F 12/70](#), [B22F 12/224](#)) (ADD).