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.

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

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.

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

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

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

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

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

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

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

B22F 9/305

{of metal carbonyls}

References

Limiting references

This place does not cover:

Manufacturing of iron from iron carbonyl	C21B 15/04

General method of reducing metals from metal carbonyls	C22B 5/20

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.

Groups B28B 1/00 and C04B 35/00 cover additive manufacturing of ceramics. Reference is made to making ceramic green bodies or pre-forms by computer aided shaping in C04B 2235/6026, to aspects relating to heat treatments of ceramic bodies such as green ceramics or pre-sintered ceramics, including local sintering, e.g. laser sintering, in C04B 2235/665 and (ceramic) mixtures specially adapted for three-dimensional printing in C04B 2111/00181.

The relevant groups under B29C 64/00, B22F, or B28B or C04B are applied according to the nature of the end product—polymer, metallic or ceramic, respectively.

Metallic articles manufactured by additive manufacturing, but where the manufacturing method is only described in general (e.g. simply as "additive manufacturing" or "3D printing", or where several methods are listed with no particular emphasis), should only be classified in B33Y 80/00 and B22F 5/00 and/or the specific product class.

Workpieces or articles from metallic powder characterised by the special shape of the product are classified in group B22F 5/00.

Compositions are classified in the appropriate groups in subclass C22C.

Repairing turbine components by additive methods is covered in B23P 6/007.

Generation and modification of 3D models of the shape as such (voxel models, boundary representations or polygon meshes) is covered by G06T 17/00.

Aspects of computer-aided design, such as design optimisation and analysis/simulation, are covered by G06F 30/00.

References

Limiting references

This place does not cover:

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

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
Making customized prostheses implantable into the body	A61F 2/30942
Making customized prostheses not-implantable into the body	A61F 2/5046
Materials for prostheses or for coating prostheses	A61L 27/00
Moulds or cores for foundry moulding	B22C 9/00
Build-up welding by means of gas flame	B23K 5/18
Build-up welding by means of arc	B23K 9/04
Build-up welding by means of plasma	B23K 10/027
Build-up welding by means of resistance heating	B23K 11/0013
Build-up welding by means electron beam	B23K 15/0086
Build-up welding by applying impact or other pressure	B23K 20/1215
Build-up welding by means of slag	B23K 25/005
Build-up welding by laser	B23K 26/342
Repairing turbine components by build-up welding	B23P 6/007
Producing shaped articles from ceramic or cementitious material	B28B 1/00
Moulds, cores or 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
Blades and blade-carrying members for non-positive displacement machines	F01D 5/00
Making sintered bearings by built-up welding	F16C 2220/24

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
Computer-aided design [CAD]	G06F 30/00
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 10/10

Formation of a green body

Definition statement

This place covers:

Processes where a green body is first formed and where the metallic article is usually obtained by subsequent de-binding and sintering.

The green body comprises metallic powder bonded by a binder which may include organic or inorganic material.

B22F 10/12

by photopolymerisation, e.g. stereolithography [SLA] or digital light processing [DLP]

Definition statement

This place covers:

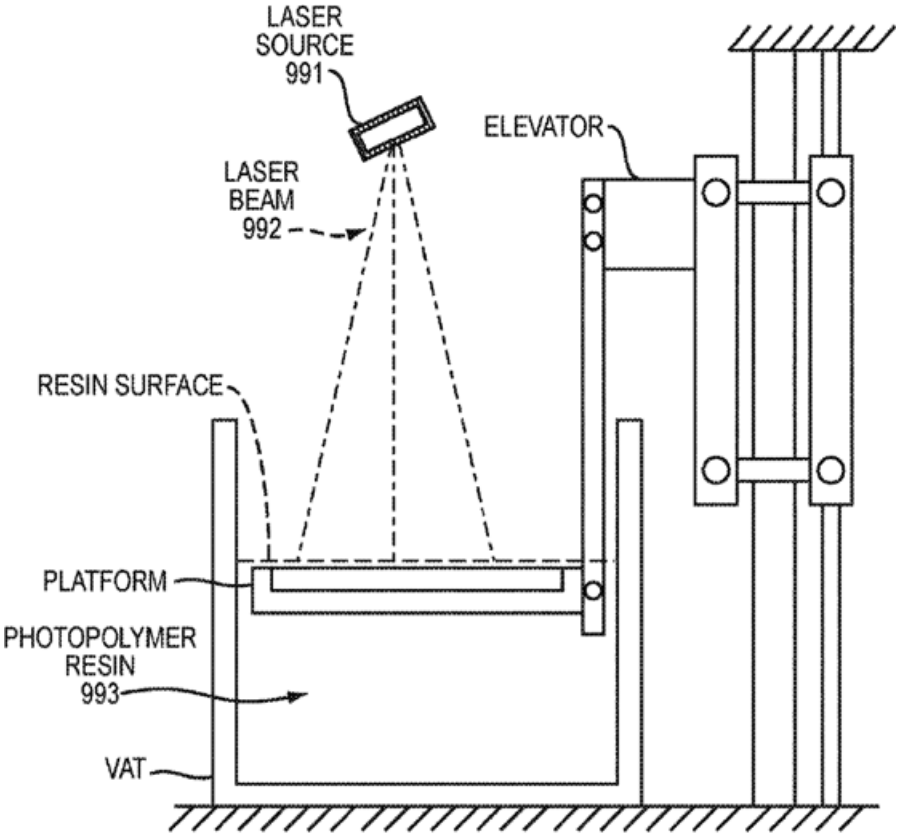
Processes where a light source is used to cure a mixture comprising a photopolymer (light-activated resin) and a metallic powder to form a green body.

In the stereolithography [SLA] process, the light source traces the contour of a part, solidifying the photopolymer of the mixture.

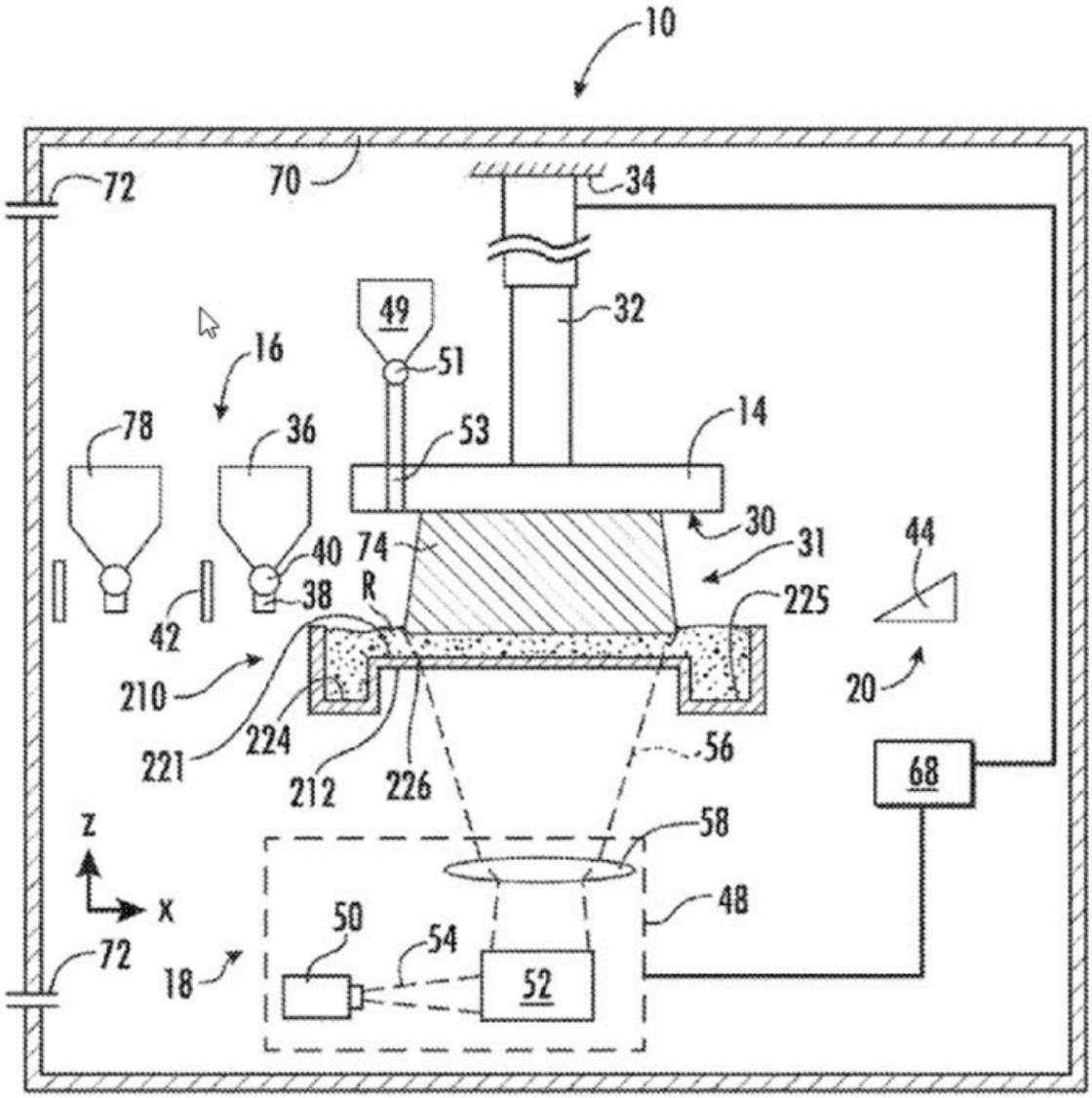
In the digital light processing [DLP] process, the solidification of the photopolymer of the mixture occurs using a digital light projector screen to flash an image of each layer at once.

Illustrative examples of subject matter classified in this place:

1. Stereolithography [SLA]



2. Digital light processing [DLP]



B22F 10/14

by jetting of binder onto a bed of metal powder

Definition statement

This place covers:

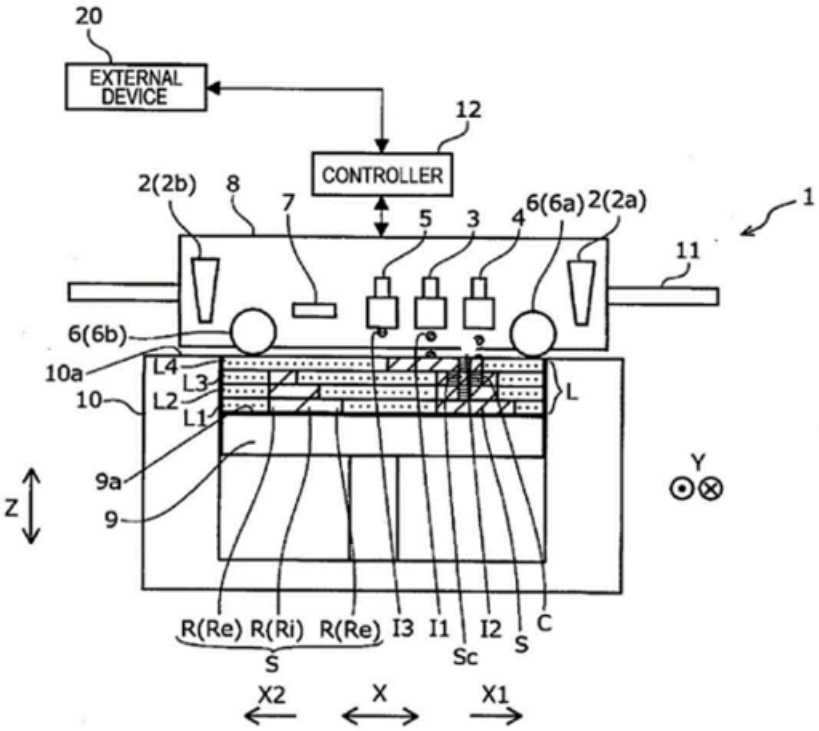
The deposition of a liquid bonding agent onto a thin layer of metallic particles forming a powder bed to join the metallic particles and build up a green body layer by layer.

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.

Illustrative example of subject matter classified in this place:

Binder jetting



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.

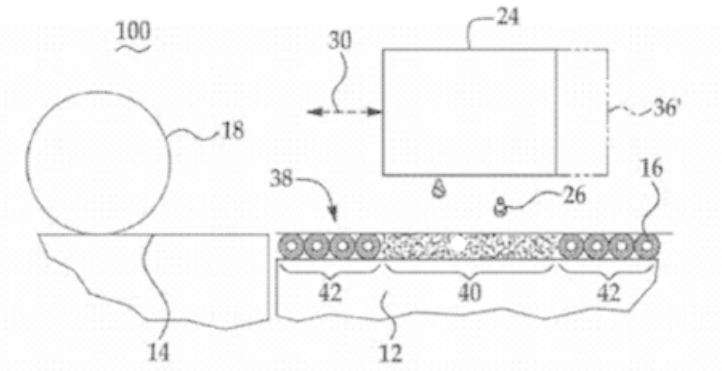
The binder might be activated by a heat source (such as a laser beam, IR-light, etc.) to bond the metallic particles.

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.

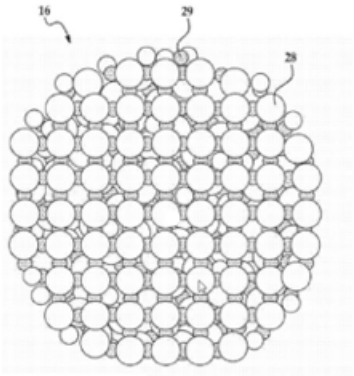
Illustrative example of subject matter classified in this place:

1.a



Binder jetting comprising selectively depositing a patterning fluid (26) onto granules (16) of build material.

1.b



Granules (16) of the build material comprising metal particles (28) bound by a polymeric binder (29).

B22F 10/18

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

Definition statement

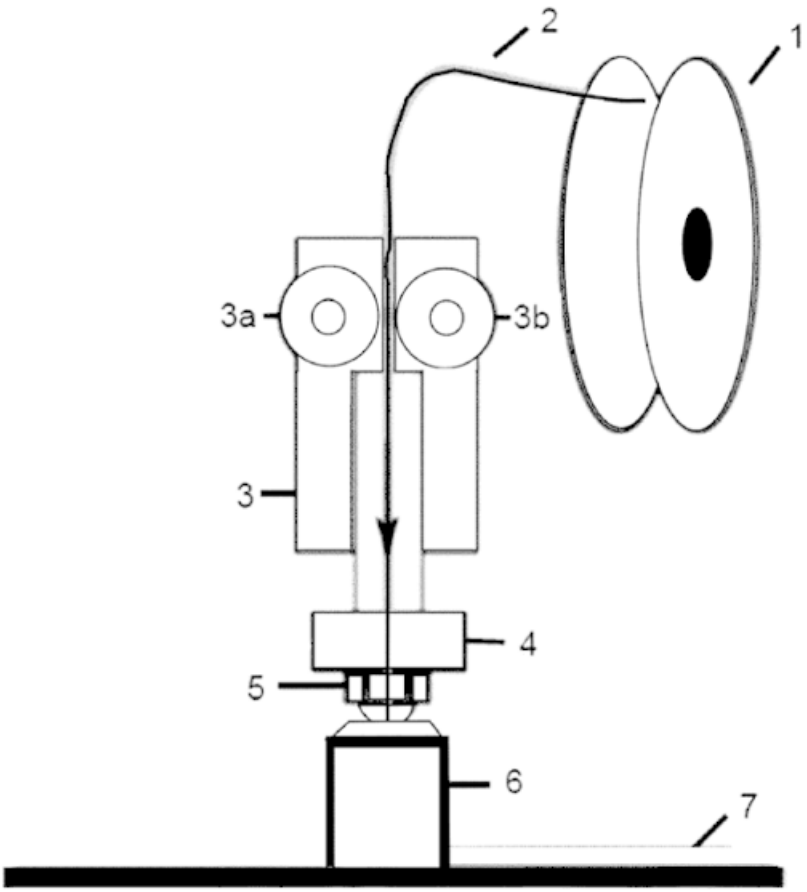
This place covers:

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.

Illustrative example of subject matter classified in this place:

Fused filament fabrication



B22F 10/20

Direct sintering or melting

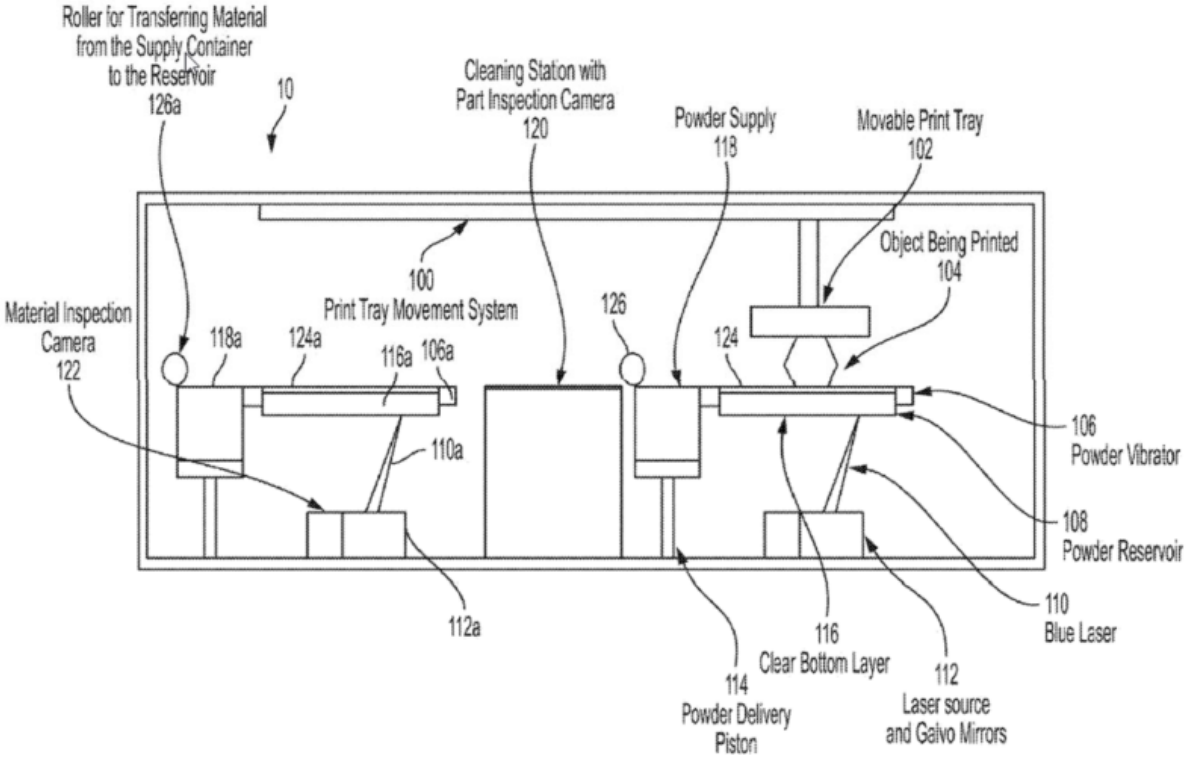
Definition statement

This place covers:

Manufacture of articles where the final metallic part is formed directly without need for subsequent sintering. The latter in this case is considered an after treatment.

Illustrative example of subject matter classified in this place:

Inverted laser sintering [ILS]



B22F 10/22

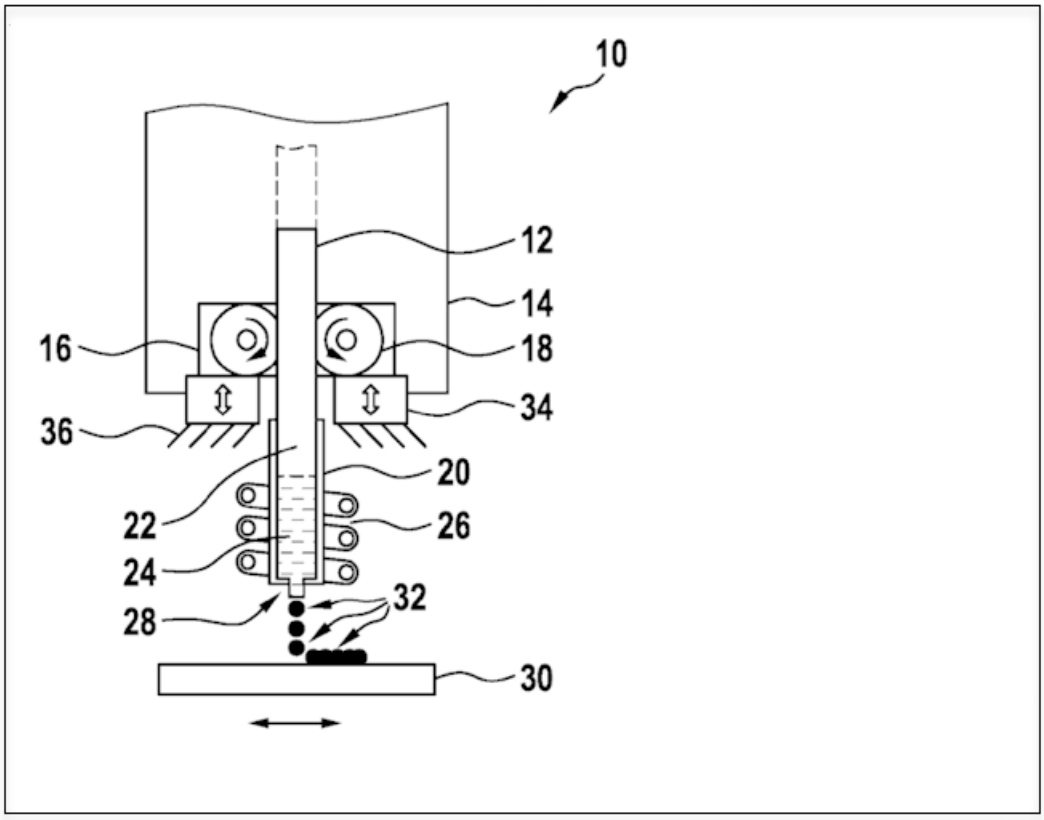
Direct deposition of molten metal

Definition statement

This place covers:

Processes where molten metal is deposited directly onto a substrate or previously fabricated preform, for example, as droplets, i.e. drop-on-demand [DOD].

Illustrative example of subject matter classified in this place:



Additive manufacturing using a print head (10) for ejecting droplets (32) of liquid metal (24). The wire (12) in a solid phase (22), is pushed into a melting chamber (20) and melted into its liquid phase (24). At the far end of the melting chamber is an exit orifice (28) for the ejection of gobs (32) of molten wire.

References

Informative references

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

Manufacture of workpieces or articles from metallic powder by spraying molten metal, i.e. spray sintering or spray casting	B22F 3/115
Moulding by spraying metal on a surface	B22D 23/003
Coating by spraying molten metal	C23C 4/123
Separation of the coating material from the substrate	C23C 4/185

B22F 10/25

Direct deposition of metal particles, e.g. direct metal deposition [DMD] or laser engineered net shaping [LENS]

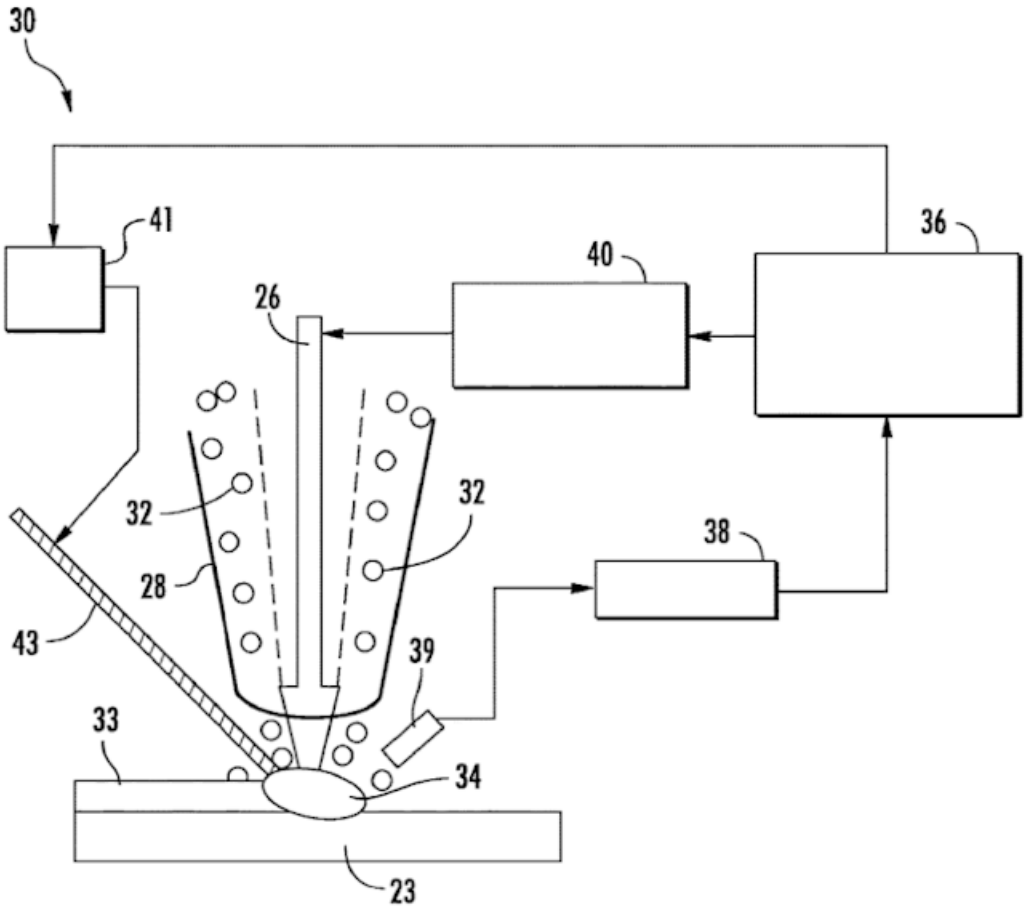
Definition statement

This place covers:

Processes where metal particles are deposited into a melt pool that has been generated on the surface of a substrate or previously fabricated preform by using an energy source, forming an article layer by layer. Typical energy sources are laser and electron beams and plasma.

Illustrative example of subject matter classified in this place:

Direct metal deposition [DMD]



Laser (26), DMD head (28), powder (32) and melt pool (34) are disclosed.

References

Informative references

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

Metal wire melting to create build up weld	B23K

B22F 10/28

Powder bed fusion, e.g. selective laser melting [SLM] or electron beam melting [EBM]

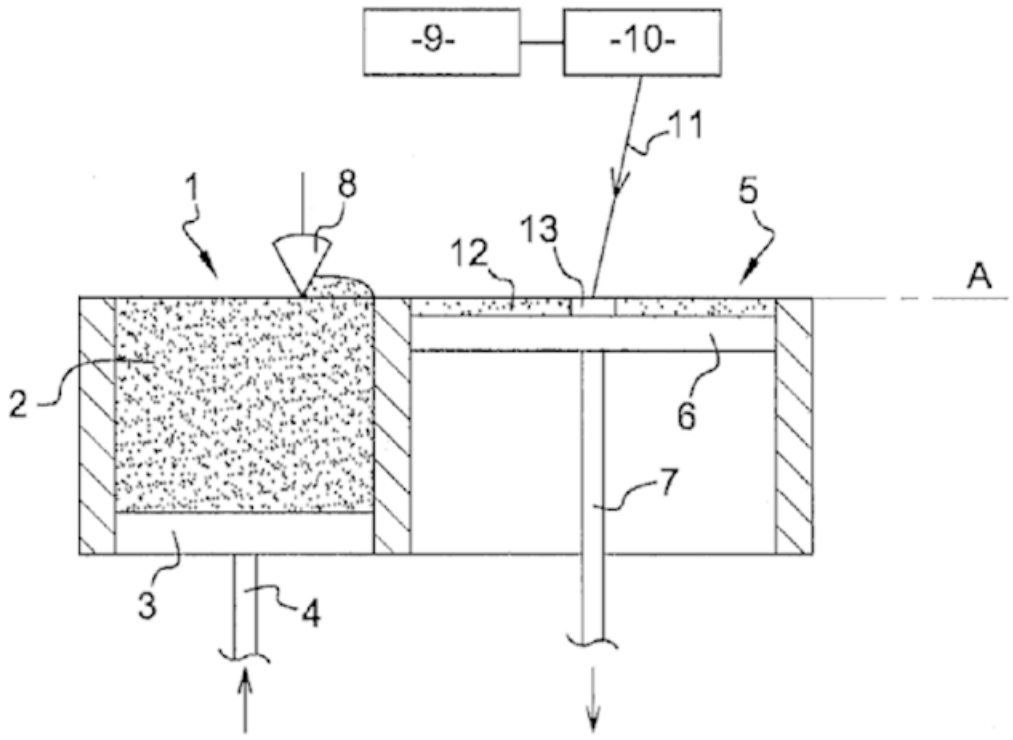
Definition statement

This place covers:

Processes where metal particles are selectively consolidated by melting or sintering them together using a heat source such as laser or electron beam. The powder surrounding the consolidated part acts as support material.

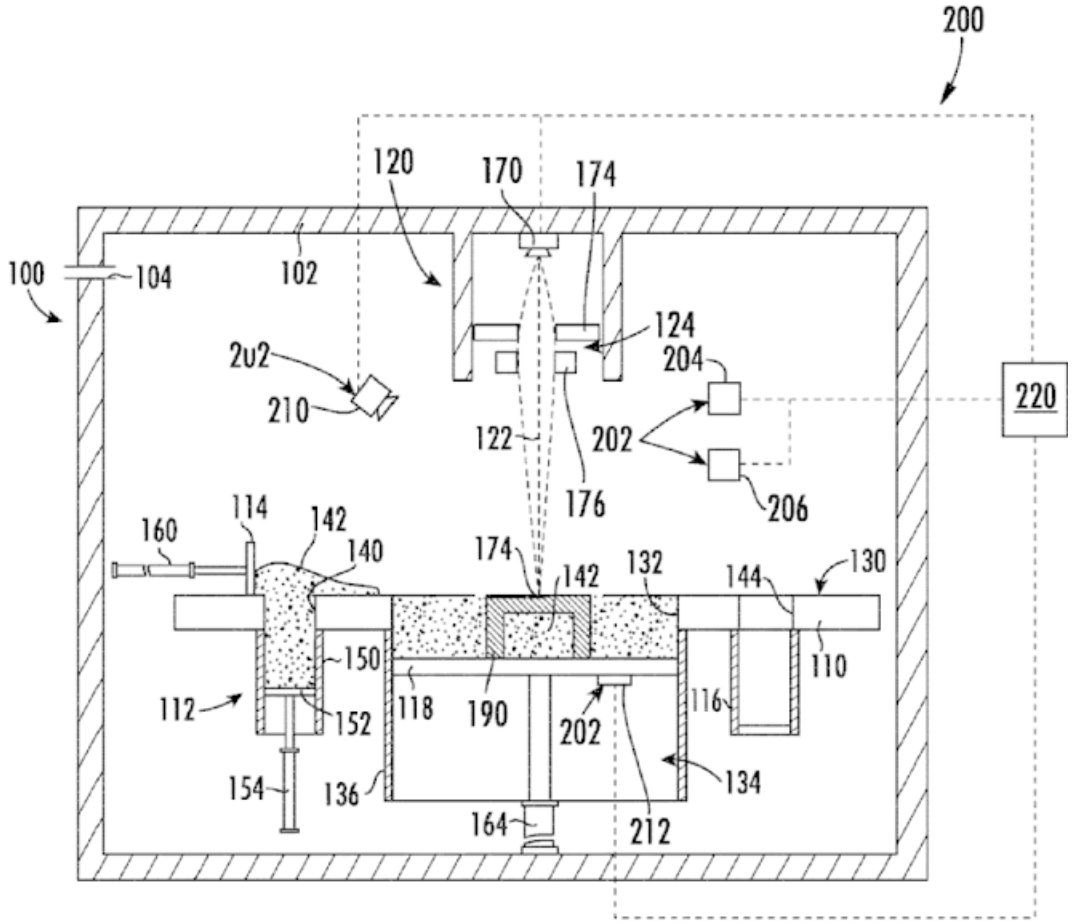
Illustrative examples of subject matter classified in this place:

1.



Selective melting in powder bed using laser or electron beam (11).

2.



Electron beam (122) melting in powder (142) bed.

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.

Group B22F 10/85 concerns data acquisition or data processing for controlling or regulating additive manufacturing processes.

B22F 10/31

Calibration of process steps or apparatus settings, e.g. before or during manufacturing

Definition statement

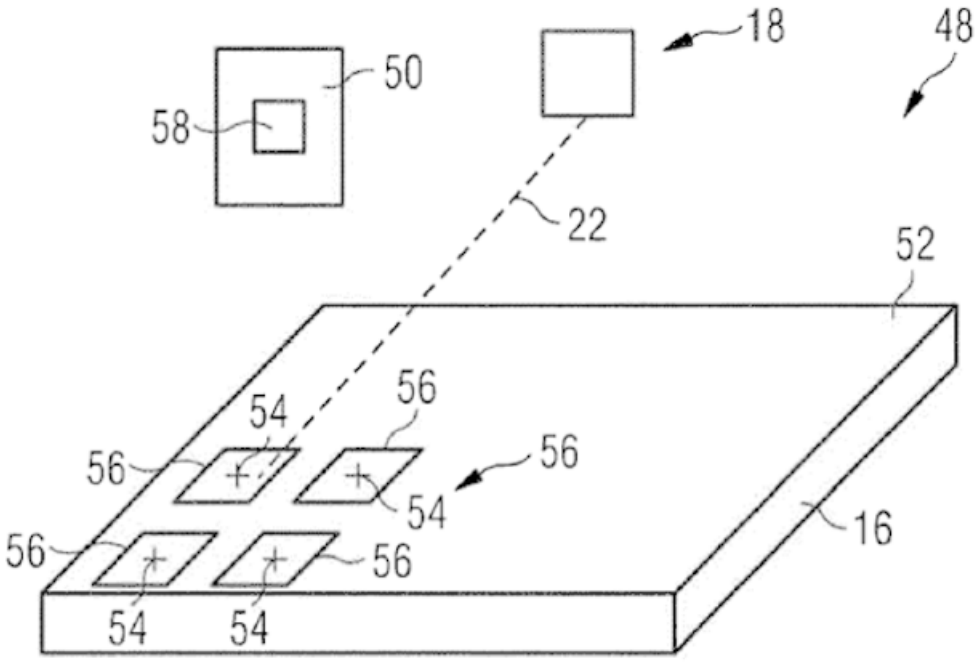
This place covers:

Process control with the purpose of calibrating either process steps or apparatus settings, e.g. before or during manufacturing.

For example, the position of the laser beam spot is calibrated within the building plane in selective laser melting [SLM].

Illustrative example of subject matter classified in this place:

Calibration of irradiation system in SLM



B22F 10/32

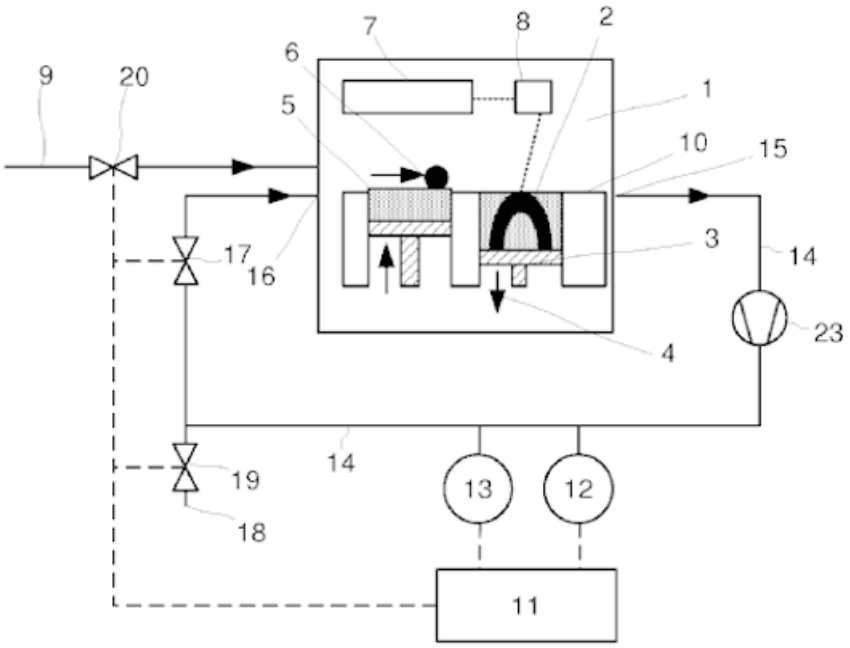
of the atmosphere, e.g. composition or pressure in a building chamber

Definition statement

This place covers:

Process control with the purpose of controlling the atmosphere within the additive manufacturing apparatus, e.g. composition or pressure within a build chamber.

Illustrative example of subject matter classified in this place:



Atmosphere control for SLM using a hydrogen sensor (12) and an oxygen sensor (13) for controlling the atmosphere in the processing chamber (1) based on the sensor values.

References

Informative references

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

Recycling of gas	B22F 10/77

B22F 10/322

of the gas flow, e.g. rate or direction

Definition statement

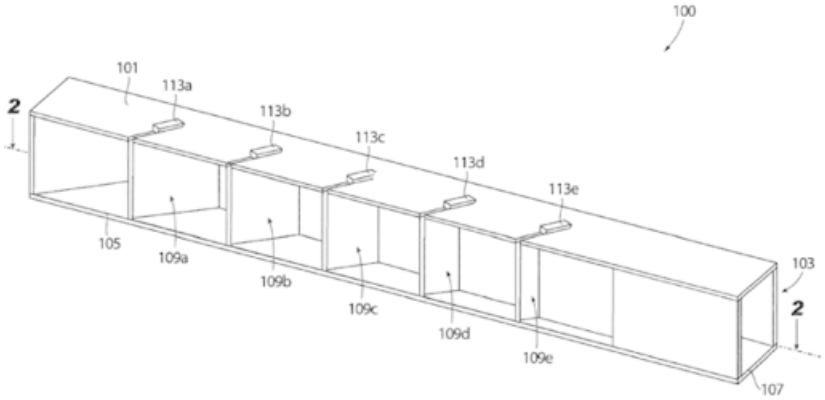
This place covers:

Process control with the purpose of controlling the gas flow, e.g. rate or direction, within the additive manufacturing apparatus before or during the additive manufacture.

Process control such as removal of fumes generated during the additive manufacture.

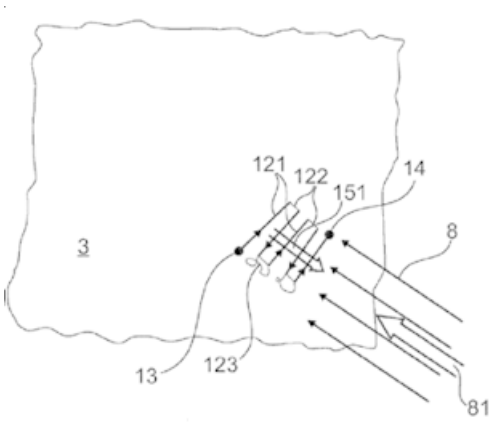
Illustrative examples of subject matter classified in this place:

1.



Controlling gas flow above the build plate, where flow filed sensor data is used to modify the flow with the help of actuators (113 a-e) connected to baffles (109 a-e) of an exhaust manifold (100).

2.



Controlling shielding gas flow direction (81) dependent on, e.g. the direction of scanning (151).

References

Informative references

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

Recycling of gas	B22F 10/77
Gas flow means	B22F 12/70

B22F 10/34

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

Definition statement

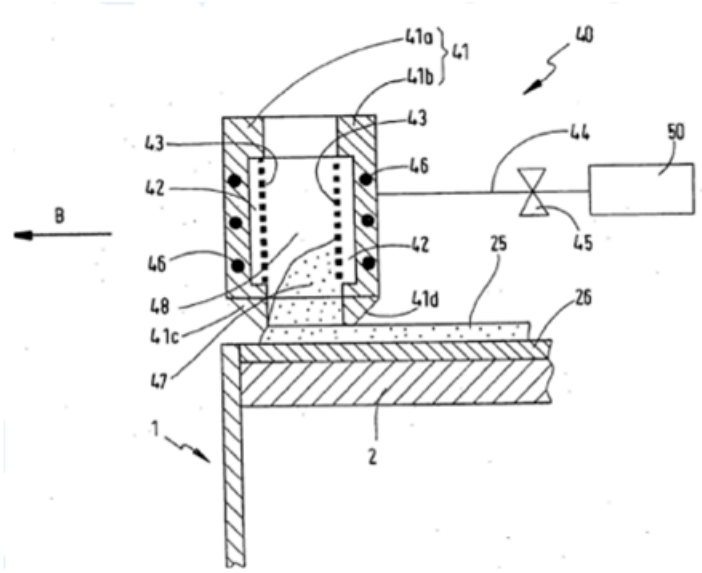
This place covers:

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 properties of powders before they are fed to the powder bed, such as control during mixing of powders, or while drying or protecting powders from oxidation.

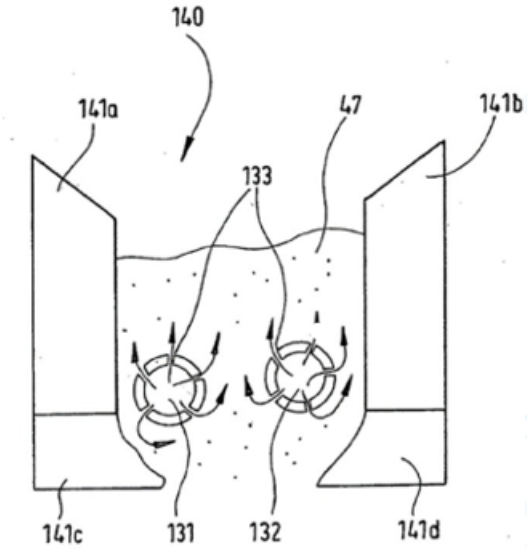
Illustrative examples of subject matter classified in this place:

1.



Control of fluidization of powder material (47) comprised in an application device (40) through a fluidization device integrated into the longitudinal walls (41a and 41b) of the application device (40).

2.



Control of fluidization of powder material (47) comprised in an application device (140) through a fluidization device (131 and 132) integrated within said application device (140).

Relationships with other classification places

The powders and their characteristics per se are classified in group B22F 1/00.

Special rules of classification

In this group, C-Sets (#B22Fc) are used. The detailed information about the C-Sets construction and the associated syntax rules are found in the "Special rules of classification" in B22F.

For example, where a particular aspect mentioned in B22F 1/00 is controlled, a C-Set should be included of the form (B22F 2999/00, B22F 10/34, B22F 1/00 and subgroups).

B22F 10/36

of energy beam parameters

Definition statement

This place covers:

Process control related to the energy beam. Note that process control of other types of energy sources, such as LED arrays or lamps, is also classified here.

Special rules of classification

Controlling energy beam parameters, such as scan speed and intensity, is classified in B22F 10/36, while controlling energy beam parameters for the purpose of calibration is classified in B22F 10/31.

B22F 10/362

for preheating

Definition statement

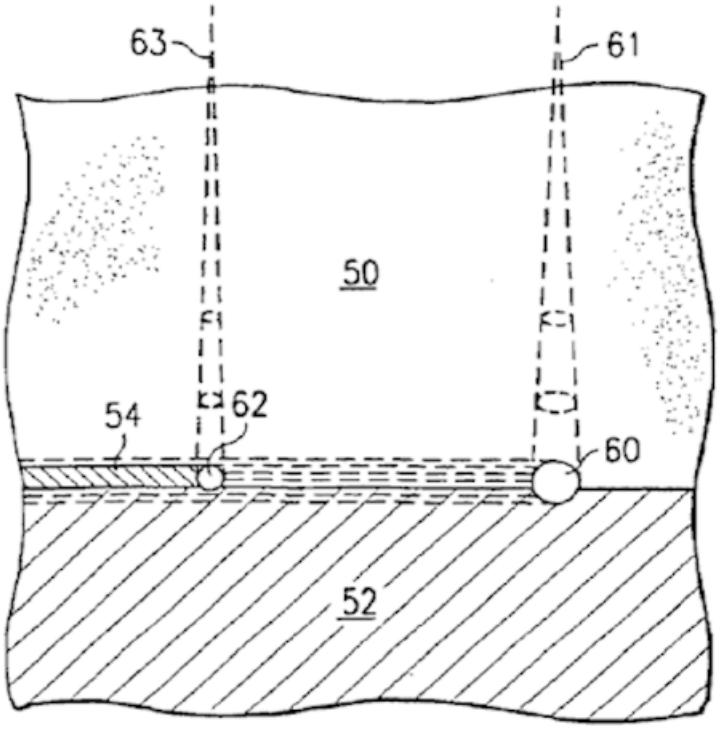
This place covers:

Process control with the purpose of providing preheating within the additive manufacturing apparatus by controlling the energy beam parameters, such as power or spot size, wherein preheating refers to any heating operation that takes place prior to the selective treatment of the powder, such as sintering, melting or binding, to form a section of the workpiece.

Preheating may relate to the heating of the metallic powder or may relate to the heating of the additive manufacturing apparatus, such as a build platform.

Illustrative example of subject matter classified in this place:

Preheating in selective laser melting/sintering [SLM/SLS]



B22F 10/364

for post-heating, e.g. remelting

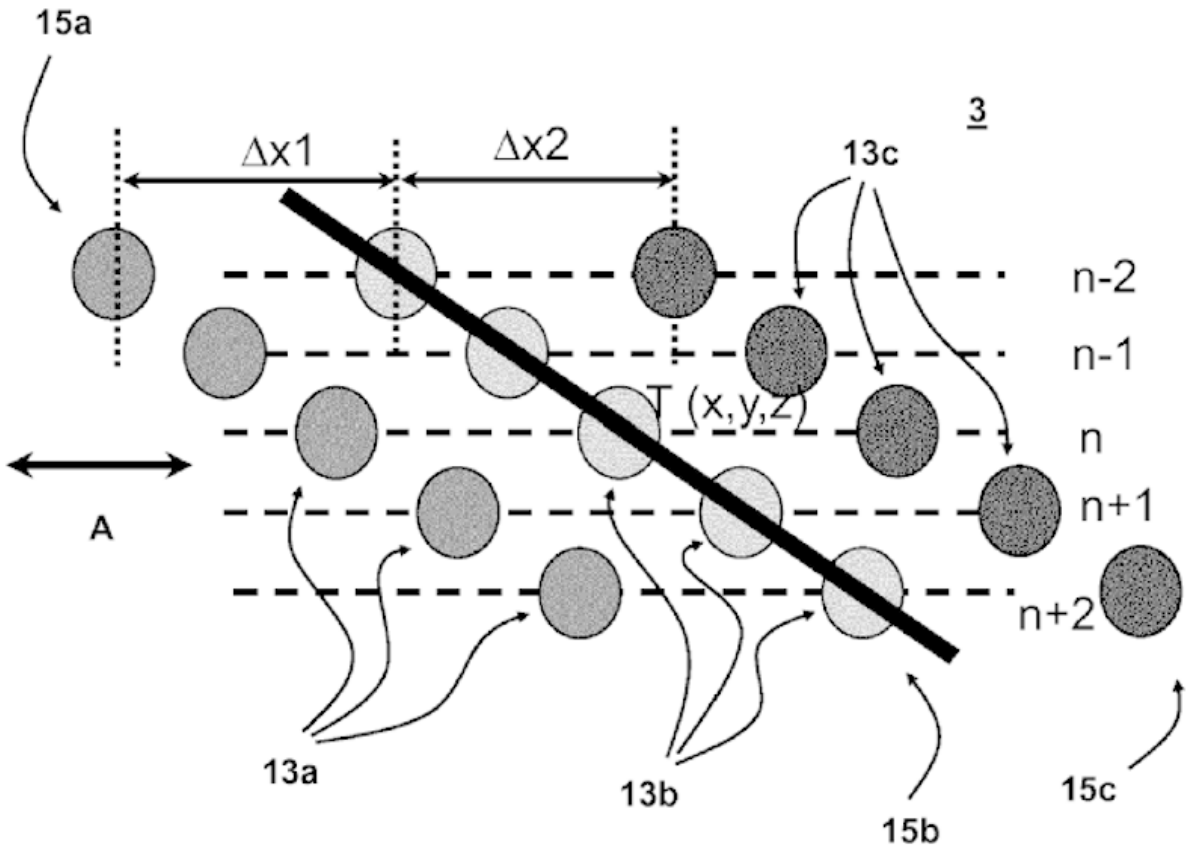
Definition statement

This place covers:

Process control with the purpose of providing post-heating within the additive manufacturing apparatus by controlling the energy beam parameters, such as power or spot size, wherein post-heating refers to any heating operation that takes place after the selective treatment of the powder, such as sintering, melting or binding, to form a section of the workpiece.

Post-heating may relate to the remelting of the section of the workpiece, typically for smoothening the surface.

Illustrative example of subject matter classified in this place:



Arrays (15a-c) of beam spots (13a-13c) for both preheating (a) and post-heating (c) in addition to fusing (b).

B22F 10/366

Scanning parameters, e.g. hatch distance or scanning strategy

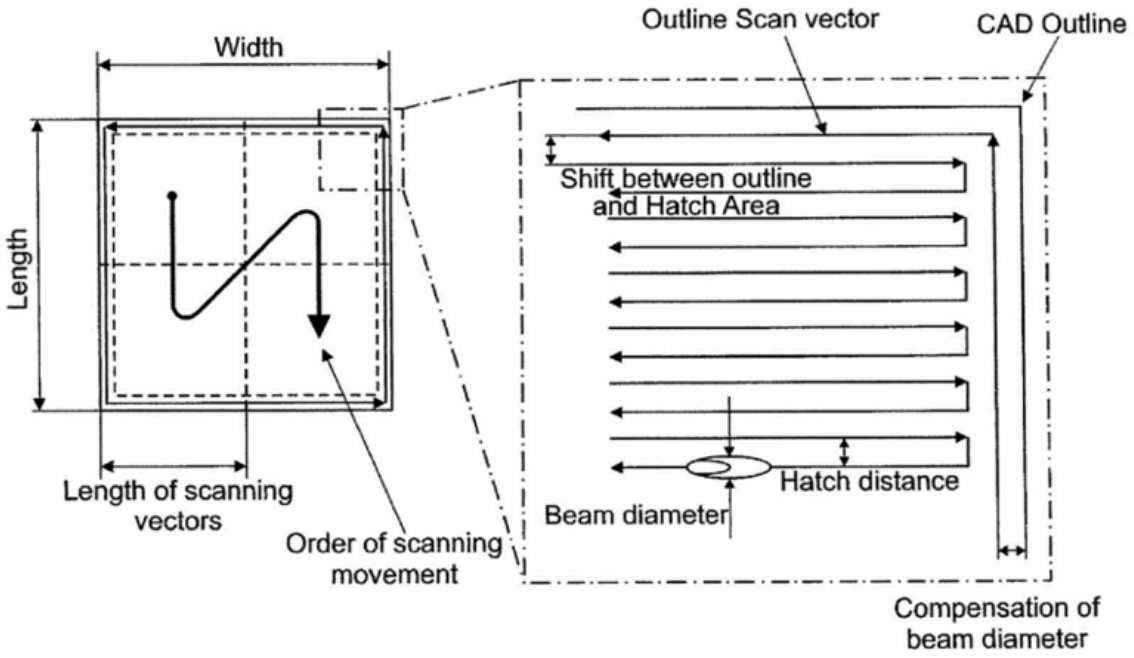
Definition statement

This place covers:

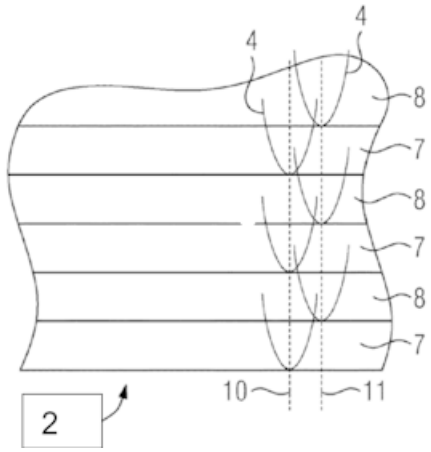
Process control with the purpose of controlling the beam parameters to implement a desired scanning. The aspect control may relate to scanning parameters, such as hatch distance, scan path, rastering, or overlap, or scan strategies to selectively sinter or fuse the powder in SLM or SLS, for example to improve productivity, optimize thermal conductivity or modify the microstructure of the workpiece.

Illustrative examples of subject matter classified in this place:

1. Track alignment in selective laser melting [SLM]



2.



SLS, where a contour position (10,11) of the object (2) is different for different layers (7,8).

B22F 10/368

Temperature or temperature gradient, e.g. temperature of the melt pool

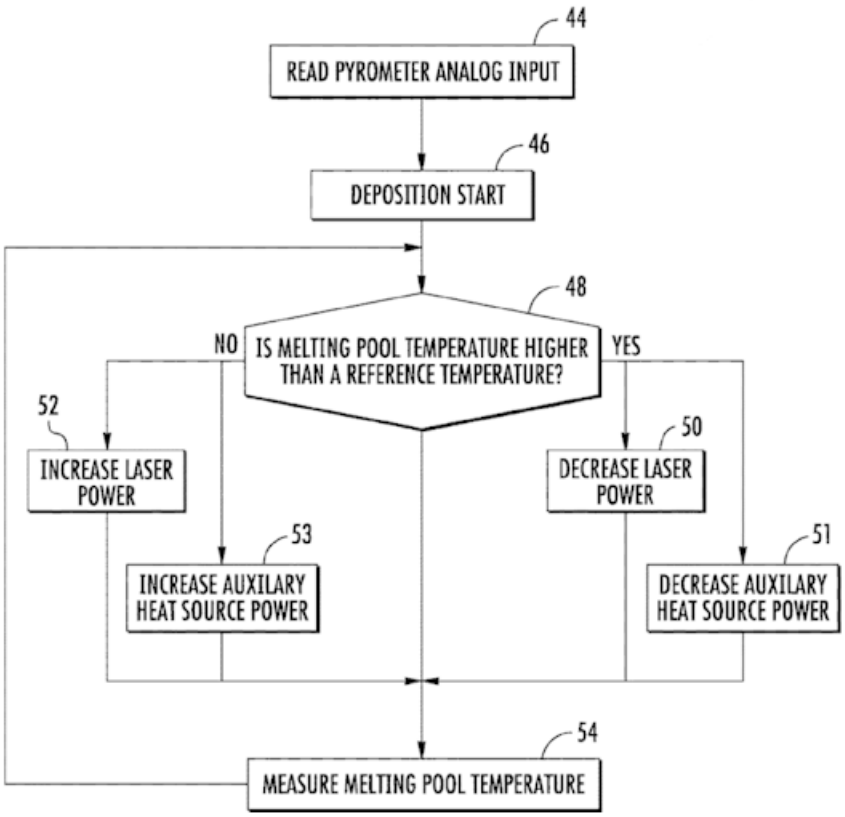
Definition statement

This place covers:

Process control with the purpose of controlling temperature or temperature gradients. The process aspect control may relate to operations such as controlling the temperature in the melt pool in SLM or temperature gradients within the workpiece (or within the powder bed in SLS or SLM).

Illustrative example of subject matter classified in this place:

Temperature control of melt pool



B22F 10/37

of powder bed aspects, e.g. density

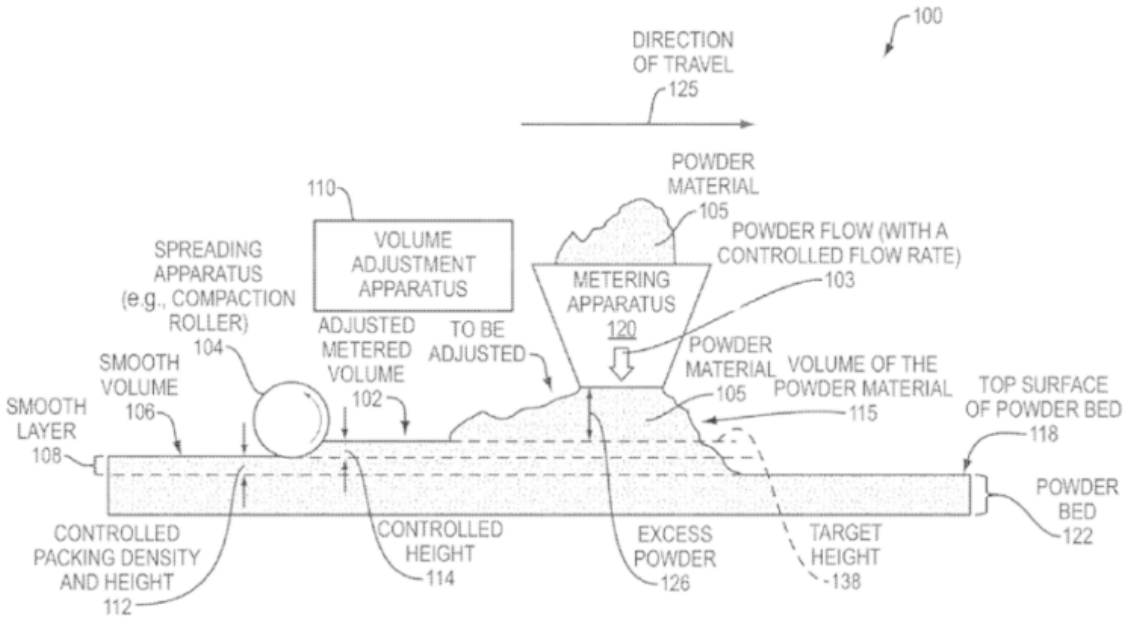
Definition statement

This place covers:

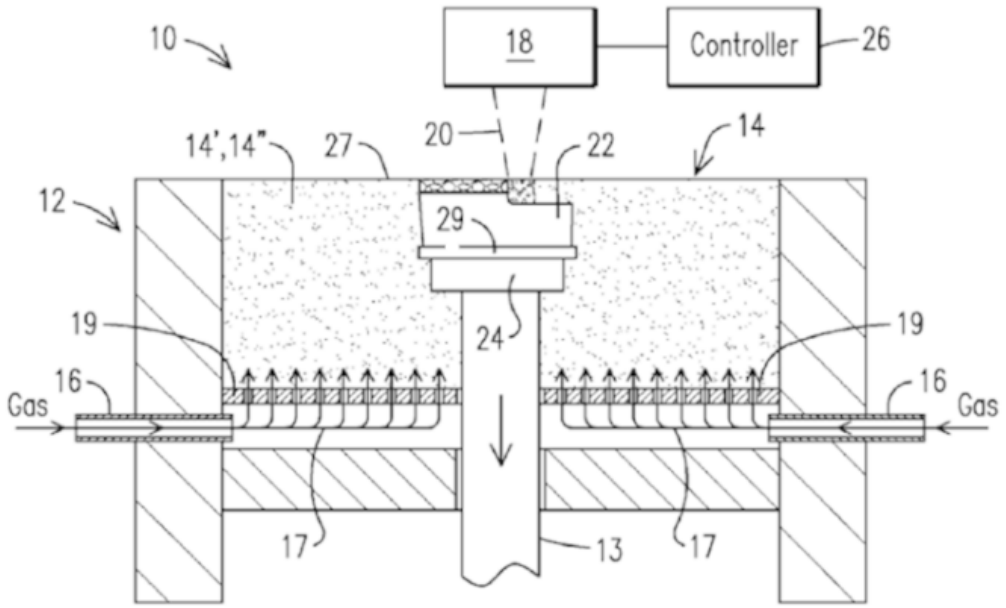
Powder bed aspects, e.g. smoothness of the bed, its density or the presence of defects, e.g. spatters.

Illustrative examples of subject matter classified in this place:

1. Control of powder bed aspect, packing density and height



2. Control of the fluidisation of the powder contained in the powder bed



Special rules of classification

Classification in group B22F 10/37 is made if the powder bed is seen as a distinct aspect or entity.

B22F 10/38

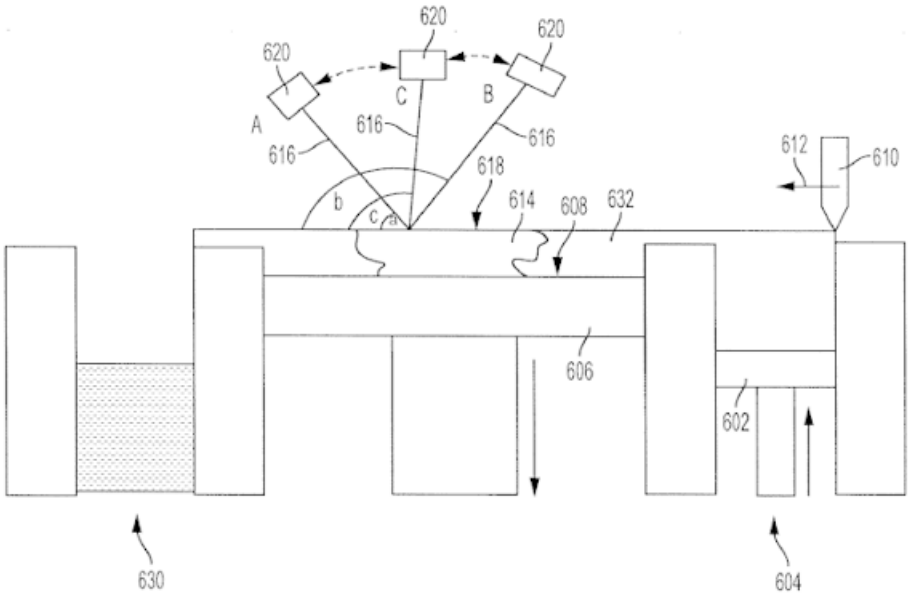
to achieve specific product aspects, e.g. surface smoothness, density, porosity or hollow structures

Definition statement

This place covers:

Process control with the purpose of achieving specific properties of the manufactured product, such as surface smoothness, density, porosity or specific microstructure or grain orientation.

Illustrative example of subject matter classified in this place:



Additively manufacturing a turbine engine component, where grain orientation is controlled by varying the laser (616) irradiation angle (a, b, c) of the galvanometric scanner (620).

B22F 10/385

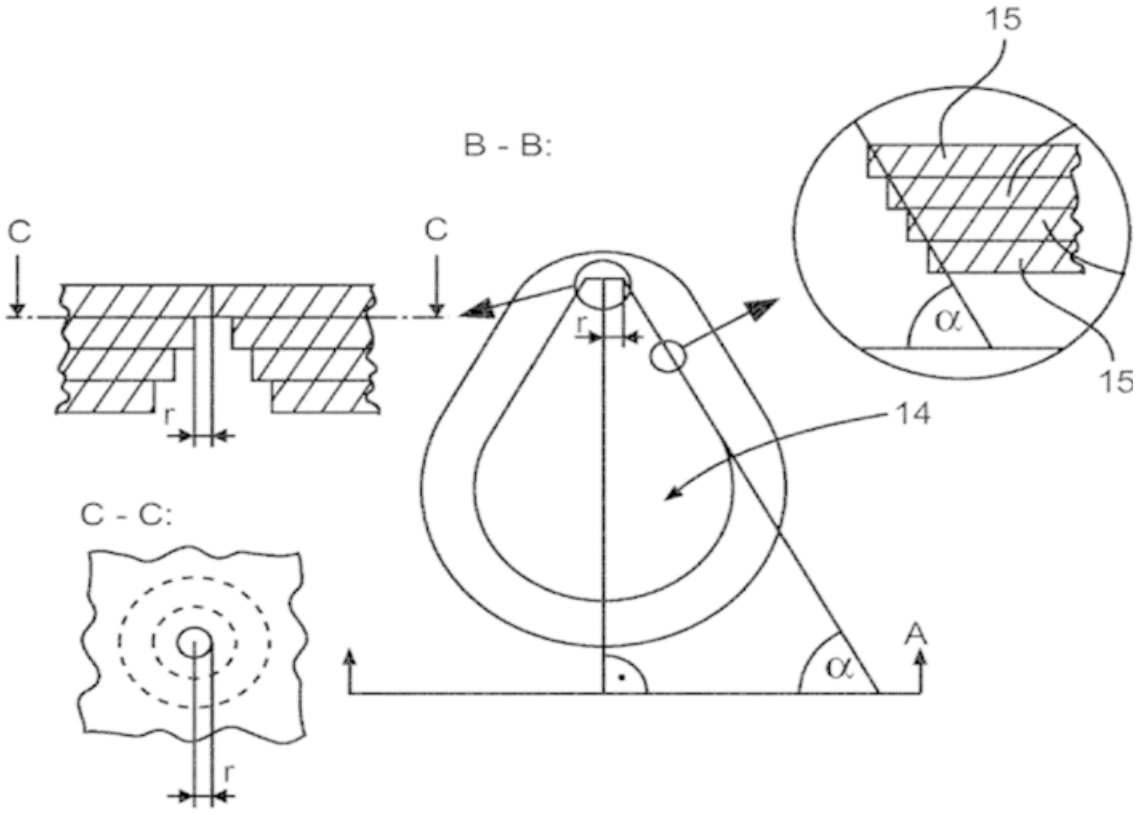
{Overhang structures}

Definition statement

This place covers:

Processes to control the formation of overhanging structures including down-skin surfaces and hollow portions inside the product by means other than support structures.

Illustrative example of subject matter classified in this place:



A method for manufacturing a component having an overhang, wherein a local build-up angle (α), which occurs between two consecutive layer sections (15) of an overhang, does not fall below a predetermined minimum build-up angle to the base layer.

References

Informative references

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

Structures for supporting workpieces or articles during manufacture and removed afterwards	B22F 10/40

B22F 10/39

Traceability, e.g. incorporating identifier into a workpiece or article

Definition statement

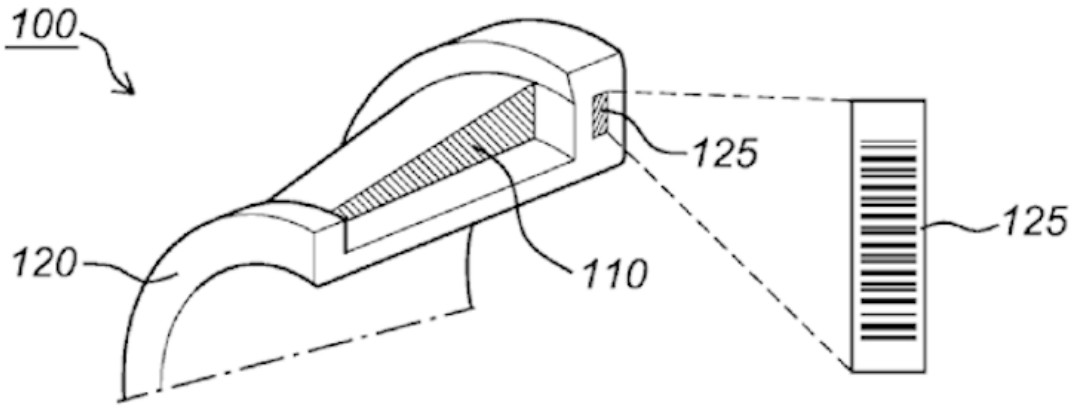
This place covers:

Process control concerning the history of a workpiece by means of documented recorded identification.

The history of the workpiece may include information relating to any step occurring before, during or after the additive manufacture of the workpiece, such as the material used to manufacture the workpiece, parameter values during the additive manufacture, plant location or customer name.

Traceability may be achieved by incorporating an identifier into the workpiece.

Illustrative example of subject matter classified in this place:



Identification barcode (125).

B22F 10/40

Structures for supporting workpieces or articles during manufacture and removed afterwards

Definition statement

This place covers:

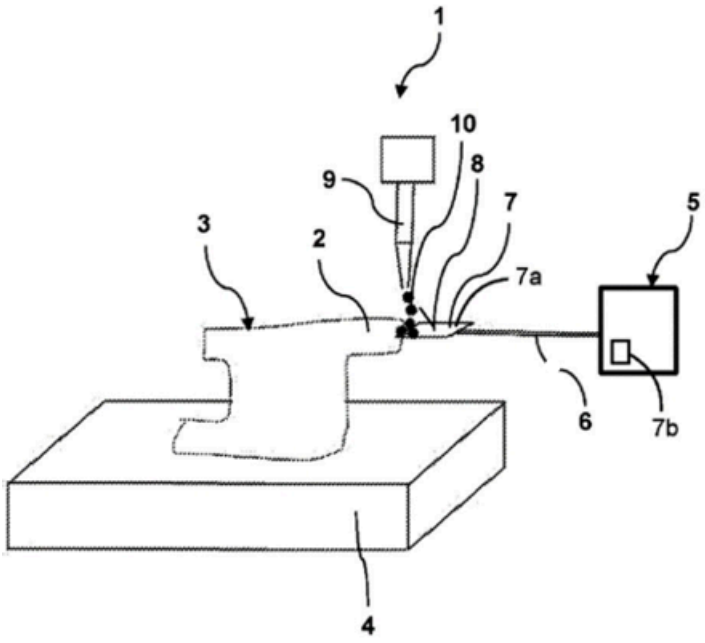
Process aspects relating to the provision of a support structure for the workpiece during its manufacture.

The term support structure may relate to a structure additively generated simultaneously with the workpiece, as it is typically the case in powder bed techniques, or may relate to an external support provided to enable the generation of a specific portion of the workpiece subjected to (mechanical) stress, such as may be the case in direct deposition techniques. The support structure is removed afterwards to recover the workpiece. The support structure does not need to be attached to the object to fulfil the requirement of conducting heat away from the object as in powder bed fusion.

Support devices as an alternative to additively manufactured support structures are also included in this group.

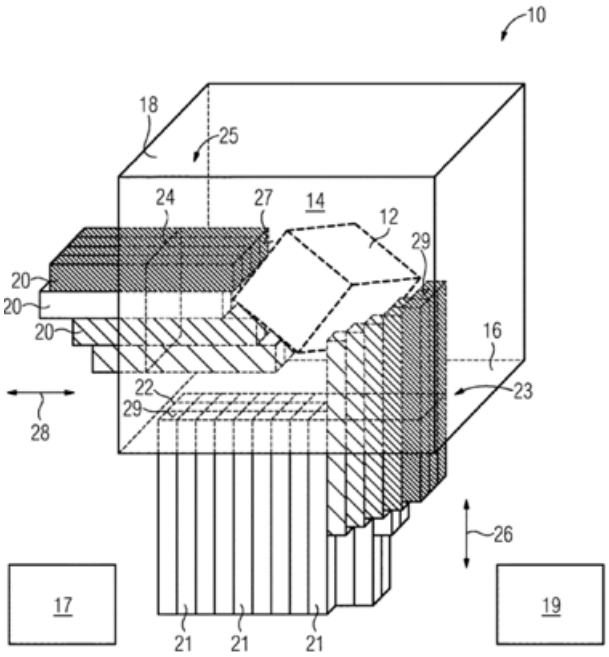
Illustrative examples of subject matter classified in this place:

1.



Support device (5) with at least one movable support arm (6) for temporary holding of at least one support element (7) arranged on the support arm during the additive manufacturing of a particular component (3) above the building platform (4).

2.



Bar elements (20, 21) for supporting manufactured article (12).

References

Informative references

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

Structures for supporting 3D objects during manufacture and intended to be sacrificed after completion thereof	B29C 64/40

B22F 10/43

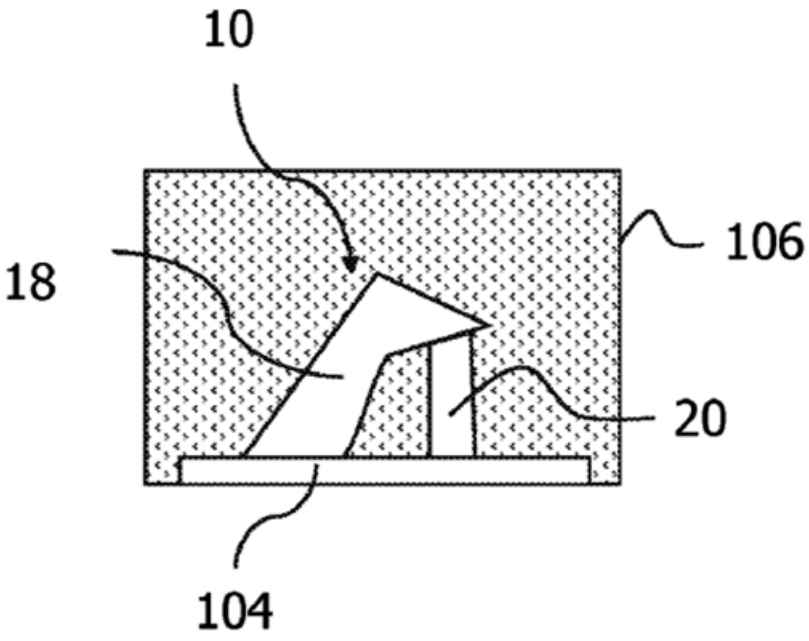
characterised by material

Definition statement

This place covers:

Process aspects relating to the material selected to form the structure supporting the workpiece during its manufacture. The material is selected for a specific purpose, such as to facilitate the removal of the support structure or to improve its thermal conductivity.

Illustrative example of subject matter classified in this place:



Support structure (20) material with high thermal conductivity.

B22F 10/47

characterised by structural features

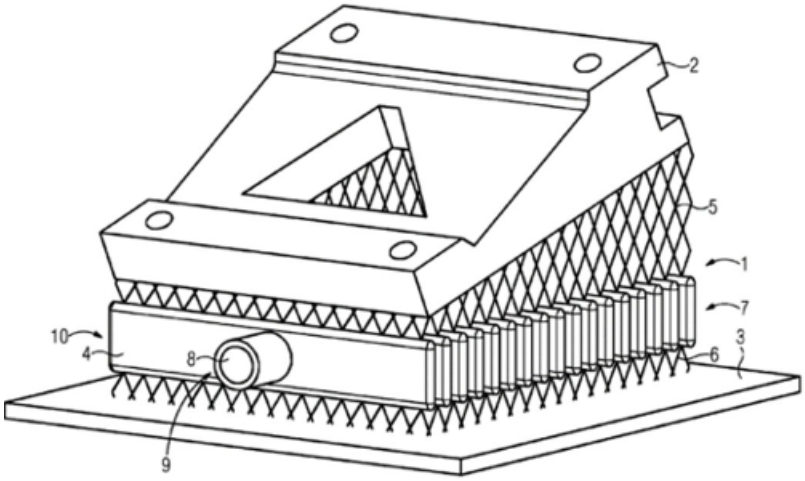
Definition statement

This place covers:

Process aspects relating to structural features of the structure supporting the workpiece during its manufacture. The structural features serve a specific purpose, such as to facilitate the removal of the support structure or to improve the mechanical support.

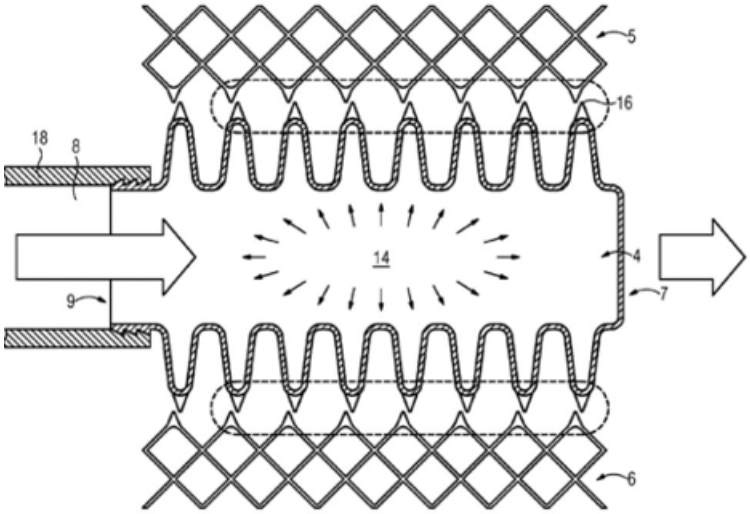
Illustrative example of subject matter classified in this place:

1a.



The support structure (1) connects the printed part (2) to the building plate (3). It comprises a first part (6), being arranged on the building plate (3), and a second part (5), being arranged below the printed part (2). The support structure (1) comprises a third part (4) which is arranged at a centre part (10) of the structure part (1), above the first part (6) and below the second part (5).

1b.



The bellows (4) comprises a pipe connector (8), forming one open end portion (9). The geometry of the bellows (4) makes it flexible and gives it the capability of elongating when a pressure (14) is applied on its internal surface.

B22F 10/50

Treatment of workpieces or articles during build-up, e.g. treatments applied to fused layers during build-up

Definition statement

This place covers:

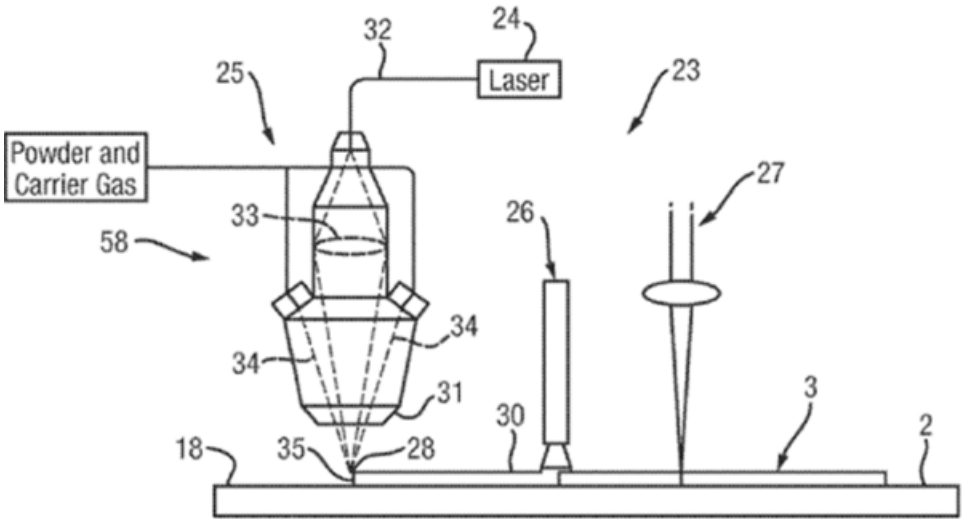
Process aspects relating to treatment applied to the workpiece during the additive manufacturing process itself, such as treatment provided to a specific section of the workpiece to achieve a specific purpose, e.g. to change the microstructure or improve the mechanical properties.

The treatments might be:

- chemical, such as leaching, coating or passivation;
- mechanical, such as removing material for forming recesses, removing material for grinding/ polishing the surface or calibration or partial local deformation of the surface, e.g. sand blasting, shot peening, laser shock peening or ultrasonic peening;
- by means of electric, magnetic or electromagnetic fields;
- thermal treatment.

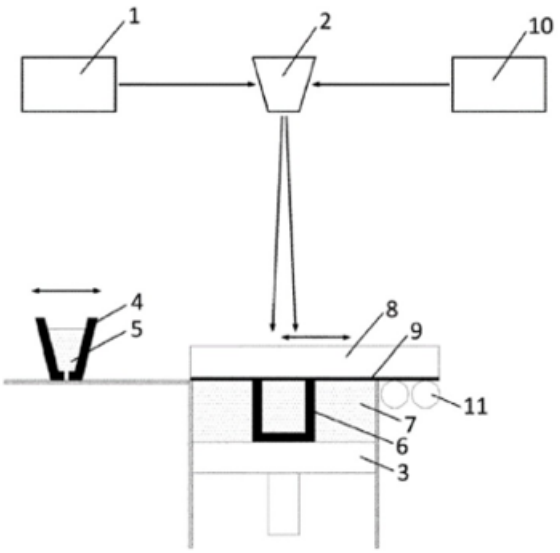
Illustrative examples of subject matter classified in this place:

1.



Direct energy deposition (25) of metallic powder + cryogenic quenching treatment (26) + laser shock peening (27).

2.



Applying laser shock peening between forming subsequent layers in SLM.

B22F 10/60

Treatment of workpieces or articles after build-up

Definition statement

This place covers:

Process aspects relating to treatments applied to the workpiece after its manufacture.

Removing support structures.

Relationships with other classification places

B22F 3/24 concerns after treatment of powder metallurgy articles in general, whereas B22F 10/60 concerns after treatment of articles made by additive manufacturing.

References

Informative references

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

Structures for supporting workpieces or articles during manufacture and removed afterwards	B22F 10/40

B22F 10/62

by chemical means

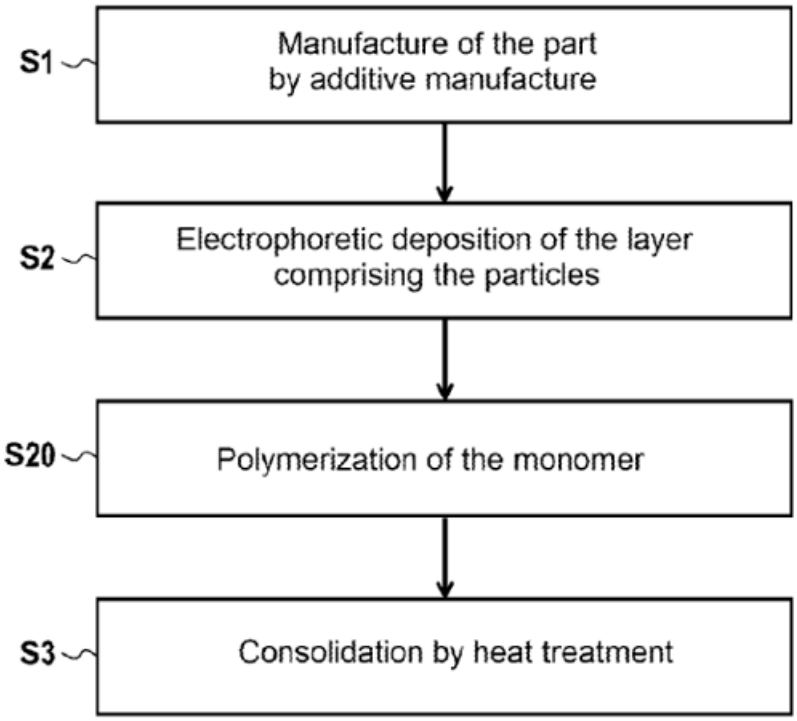
Definition statement

This place covers:

Process aspects relating to chemical treatments applied to the workpiece after its manufacture to serve a specific purpose such as to improve wear-, corrosion- or heat- resistance or to reduce surface rugosity. Typical chemical treatments may include leaching, coating or passivation.

Removing support structures by chemical means such as dissolution or electrochemistry.

Illustrative example of subject matter classified in this place:



References

Informative references

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

Coating metallic material; Coating material with metallic material; Surface treatment of metallic material by diffusion into the surface, by chemical conversion or substitution; Coating by vacuum evaporation, by sputtering, by ion implantation or by chemical vapour deposition, in general	C23C
Processes for the electrolytic or electrophoretic production of coatings	C25D
Processes for the electrolytic removal of material from objects	C25F

B22F 10/64

by thermal means (control of energy beam parameters for post heating B22F 10/364)

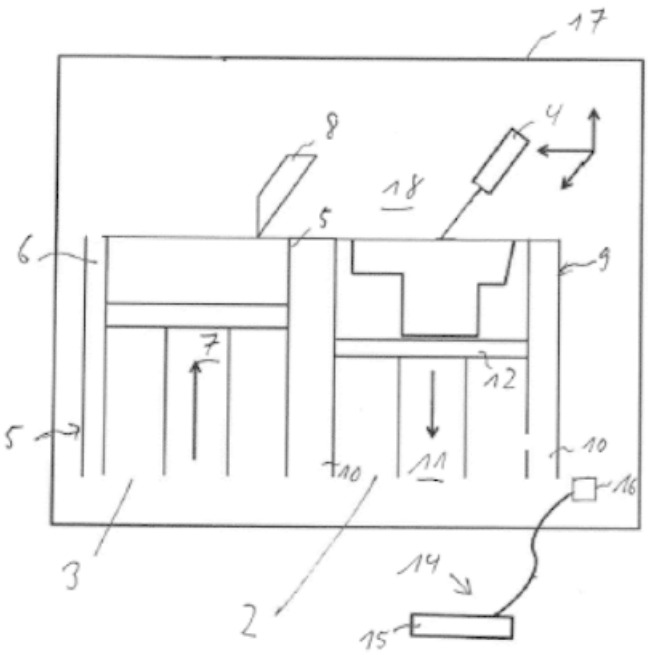
Definition statement

This place covers:

Process aspects relating to thermal treatments applied to the workpiece after its manufacture to serve a specific purpose such as to remove organic binders or to reduce porosity or modify the microstructure or mechanical properties. Typical thermal treatments may include thermal de-binding, sintering, hot isostatic pressing or annealing.

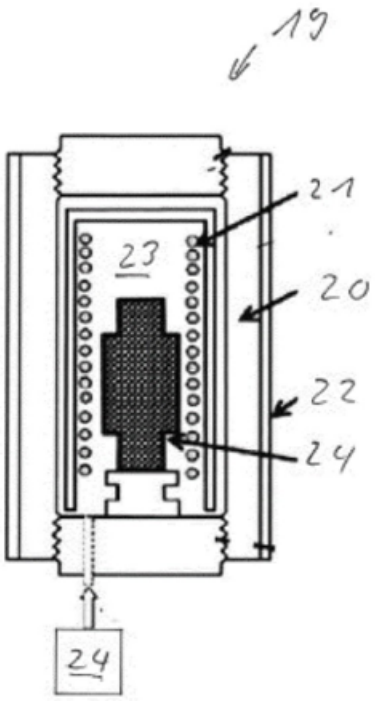
Illustrative example of subject matter classified in this place:

1.a



Step 1: Manufacture of a workpiece by selective laser sintering/melting [SLS/SLM].

1.b



Step 2: Hot isostatic pressing after SLS/SLM to increase the density of the workpiece.

References

Limiting references

This place does not cover:

Control of energy beam parameters for post heating	B22F 10/364

Informative references

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

Sintering	B22F 3/10
Removal of binder or filler	B22F 3/1021
Hot isostatic pressing	B22F 3/15
Both compacting and sintering in successive or repeated steps	B22F 3/16
Thermal after-treatment of workpieces or articles	B22F 2003/248

Special rules of classification

In this group, C-Sets are used. The detailed information about the C-Sets construction and the associated syntax rules are found in the Special rules of classification in B22F.

For example, after-treatments corresponding to specific processes in B22F 3/00, e.g. hot isostatic pressing [HIP] in B22F 3/15 or removal of binder in B22F 3/1021, should also be classified with a C-Set of the following type, the example being for SLM followed by HIP: (B22F 2998/10, B22F 10/64, B22F 3/15).

B22F 10/66

by mechanical means

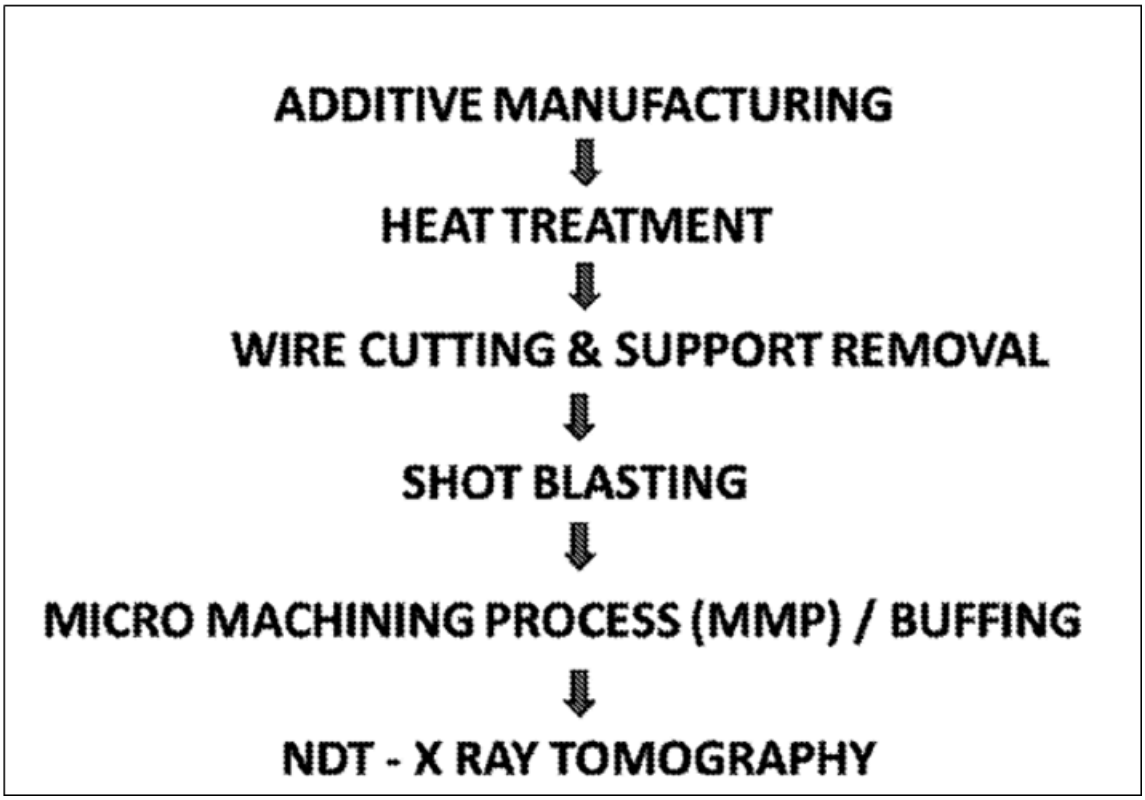
Definition statement

This place covers:

Process aspect relating to mechanical treatments applied to the workpiece after its manufacture to serve a specific purpose such as to modify the shape, surface finish, mechanical properties or microstructure of the workpiece.

Typical mechanical treatments applied to the workpiece may include removing material such as by grinding, polishing, sand blasting or local deformation of the workpiece surface such as shot peening, laser shock peening or ultrasonic peening.

Illustrative example of subject matter classified in this place:



References

Informative references

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

Partial deformation or calibration in the successive or repeated steps of manufacture of metallic workpieces or articles from metallic powder	B22F 3/164
Making recesses, grooves etc. on the surface by removing material	B22F 2003/245
Removing material: carving, cleaning, grinding, hobbing, honing, lapping, polishing, milling, shaving, skiving or turning the surface	B22F 2003/247

Special rules of classification

When classifying the treatment of the workpieces in B22F 10/66, the after treatments corresponding to specific processes in B22F 3/00 should also be classified there, e.g. removing material should be classified in B22F 2003/247.

B22F 10/68

Cleaning or washing

Definition statement

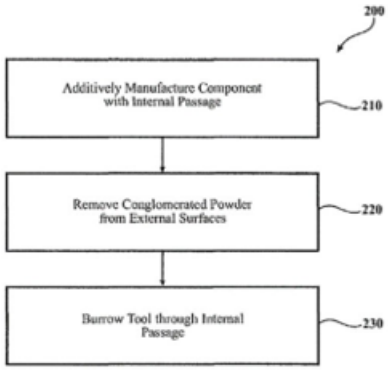
This place covers:

Process aspects relating to cleaning or washing operations performed on the workpiece after its manufacture.

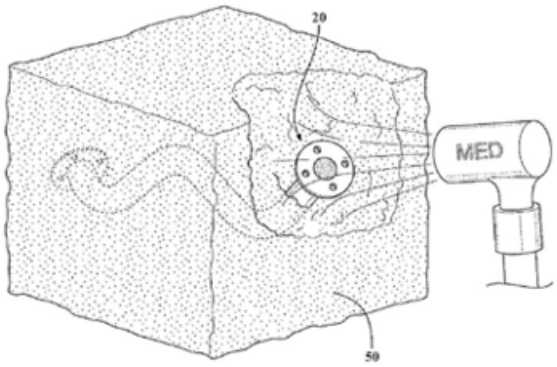
Depowdering, i.e. cleaning or washing operations relating to the removal of residual powder within or on the workpiece.

Illustrative examples of subject matter classified in this place:

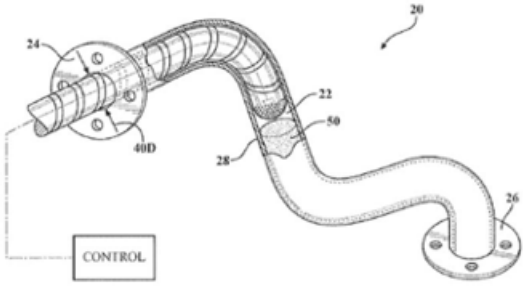
1.



2.



3.



References

Informative references

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

After-treatment of metallic workpieces or articles by removing material: carving, cleaning, grinding, hobbing, honing, lapping, polishing, milling, shaving, skiving or turning the surface	B22F 2003/247
Cleaning in general; Prevention of fouling in general	B08B

B22F 10/70

Recycling

Definition statement

This place covers:

Process aspects relating to recycling operations, which may occur before, during or after the additive manufacture of the workpiece.

B22F 10/73

of powder

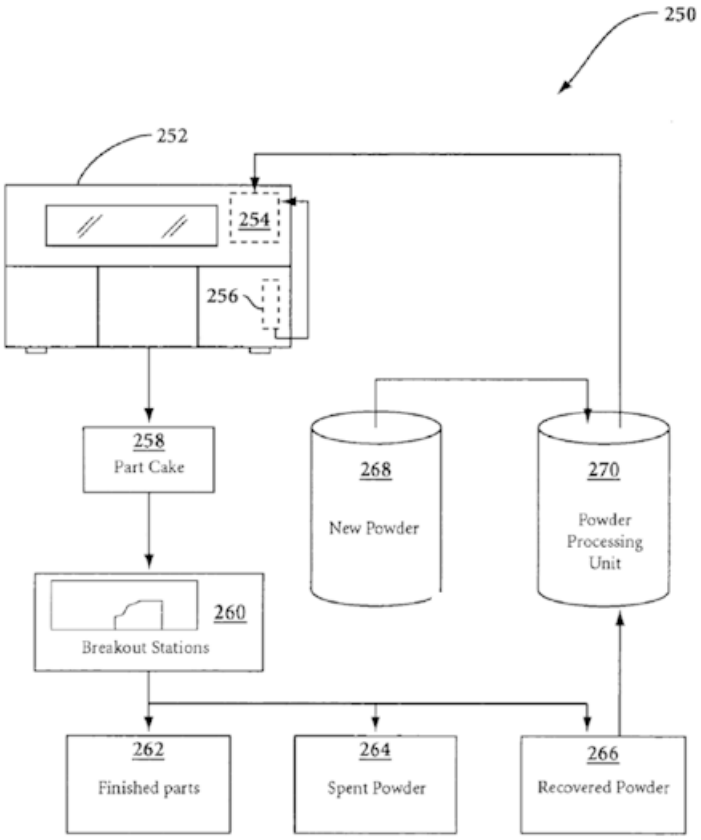
Definition statement

This place covers:

Process aspects relating to recycling operations of the powder used for the additive manufacture of the workpiece. The process aspects may relate to operations such as recycling powder overflow when

laying down a layer of powder in selective laser sintering [SLS] or selective laser melting [SLM], or to recycling of powder resulting from cleaning operations of the workpiece after build-up.

Illustrative example of subject matter classified in this place:



B22F 10/77

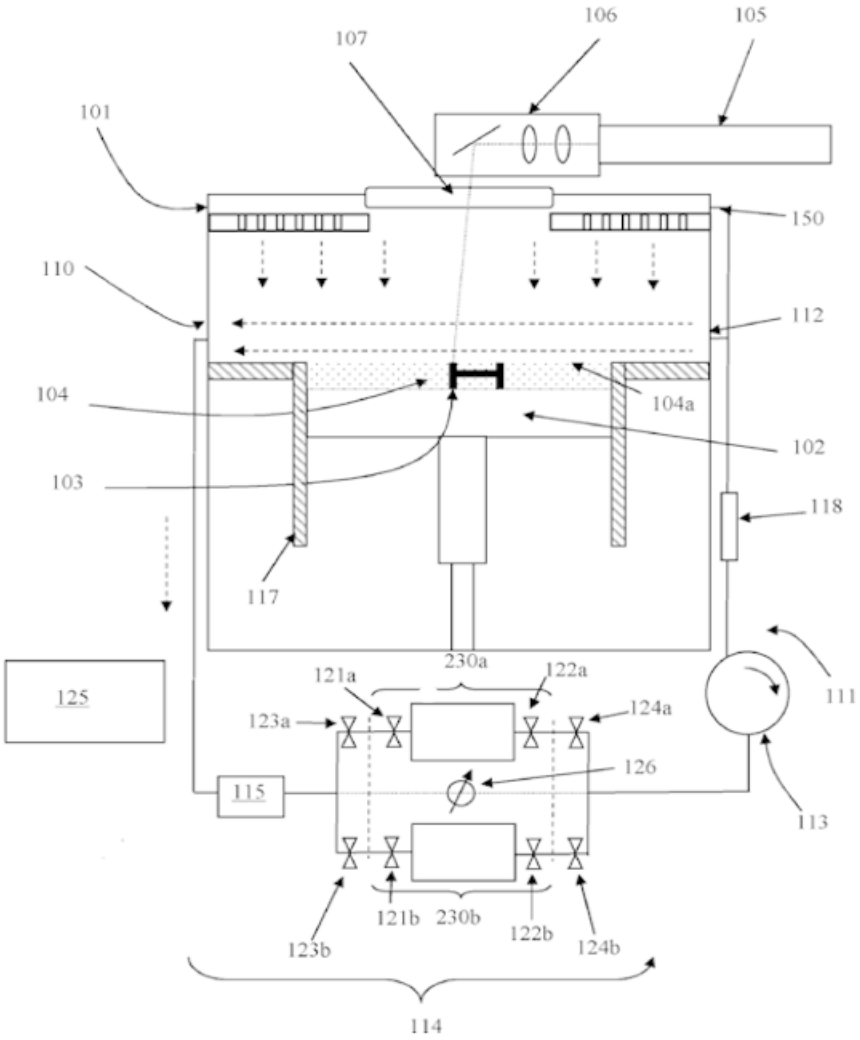
of gas

Definition statement

This place covers:

Process aspects relating to recycling operations of gas used for the additive manufacture of the workpiece. The process aspects may relate, for example, to filter arrangements for cleaning the process gas from fumes or particles generated by the selective irradiation of powder in SLM or SLS.

Illustrative example of subject matter classified in this place:



SLS/SLM apparatus with filter system (114). Process emissions, such as spatters and condensates are removed from the process gas by the filter system (114) before gas recirculation within the build chamber (101).

B22F 10/80

Data acquisition or data processing

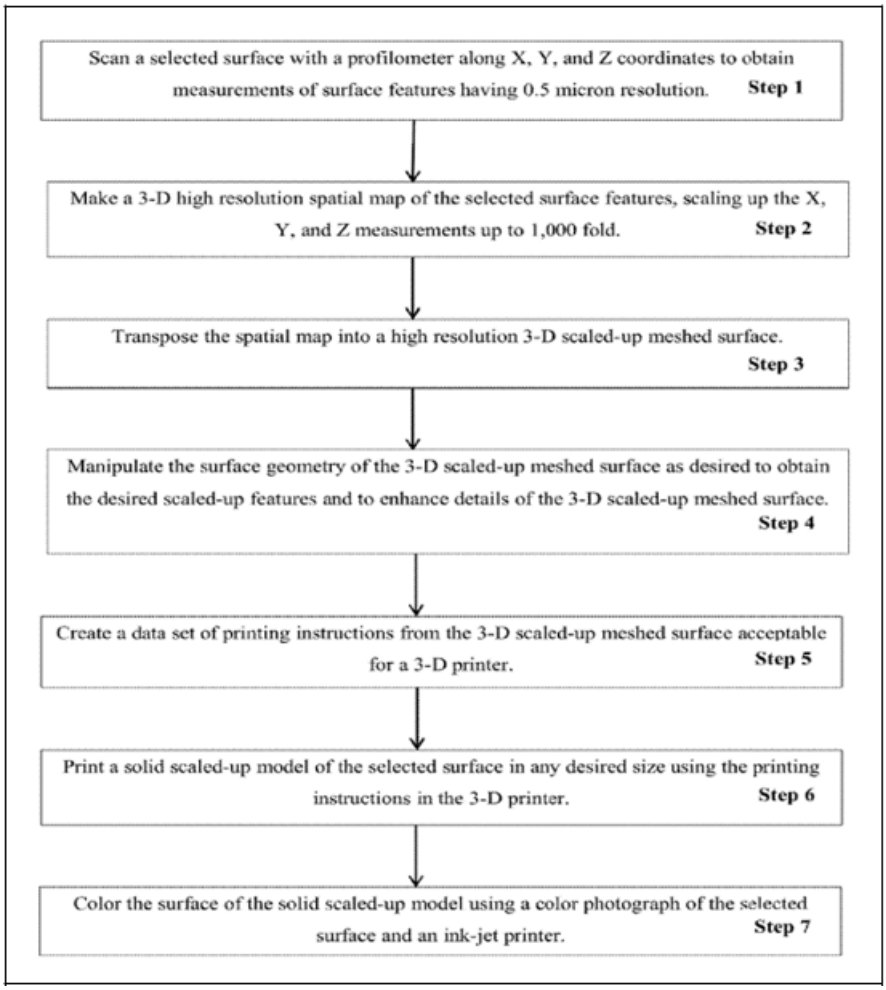
Definition statement

This place covers:

Process aspects relating to data acquisition or data processing, which take place before, during or after the additive manufacture of the workpiece.

Simulation steps for generating a three-dimensional model of the workpiece to be manufactured.

Illustrative example of subject matter classified in this place:



References

Informative references

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

Electric digital data processing	G06F
Computer-aided design applied to additive manufacturing	G06F 2113/10

B22F 10/85

for controlling or regulating additive manufacturing processes

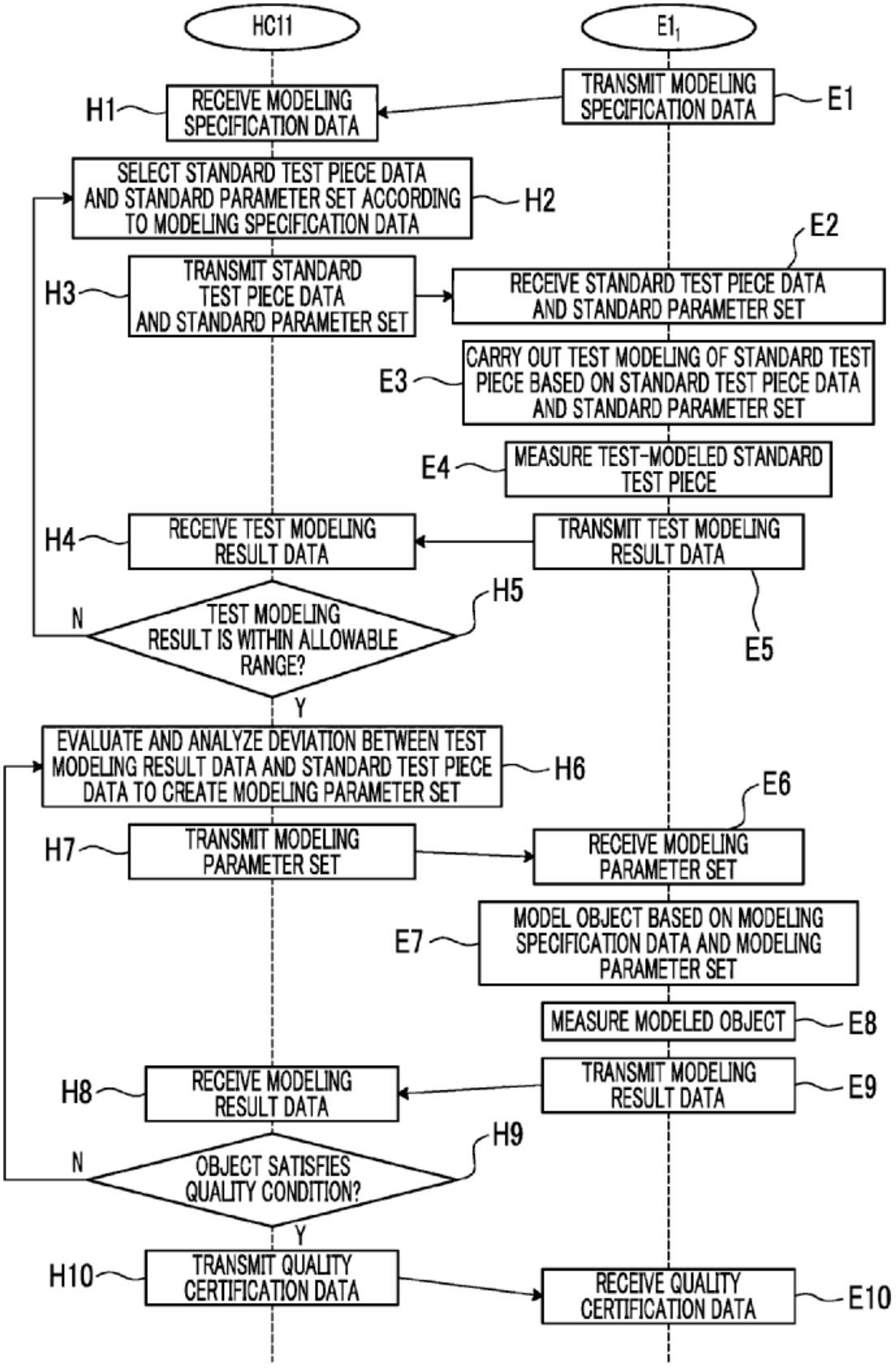
Definition statement

This place covers:

Process aspects relating to data acquisition or data processing for controlling the additive manufacture of the workpiece. For instance, using a database of previous manufacturing runs to determine process parameters.

Data acquisition for quality checks of the workpiece and/or the functioning of the manufacturing apparatus itself during or after build-up.

Illustrative example of subject matter classified in this place:



B22F 12/00

Apparatus or devices specially adapted for additive manufacturing; Auxiliary means for additive manufacturing; Combinations of additive manufacturing apparatus or devices with other processing apparatus or devices

References

Informative references

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

Apparatus for additive manufacturing of plastics or material in a plastic state; Details thereof or accessories therefor	B29C 64/20
Apparatus for additive manufacturing; Details thereof or accessories therefor	B33Y 30/00
Typewriters or selective printers for marking on special material	B41J 3/407
Electron guns	H01J 3/02
Discharge tubes for applying thin layers on objects	H01J 37/00
Electron sources; Electron guns, arrangements of electrodes and associated parts for generating or controlling the discharge,with provision for introducing objects or material to be exposed to the discharge	H01J 37/06
Devices using the process of light amplification by stimulated emission of radiation [laser] to amplify or generate light; Devices using stimulated emission of electromagnetic radiation in wave ranges other than optical	H01S
Apparatus or processes for manufacturing printed circuits using printing techniques to apply the conductive material	H05K 3/12

B22F 12/10

Auxiliary heating means

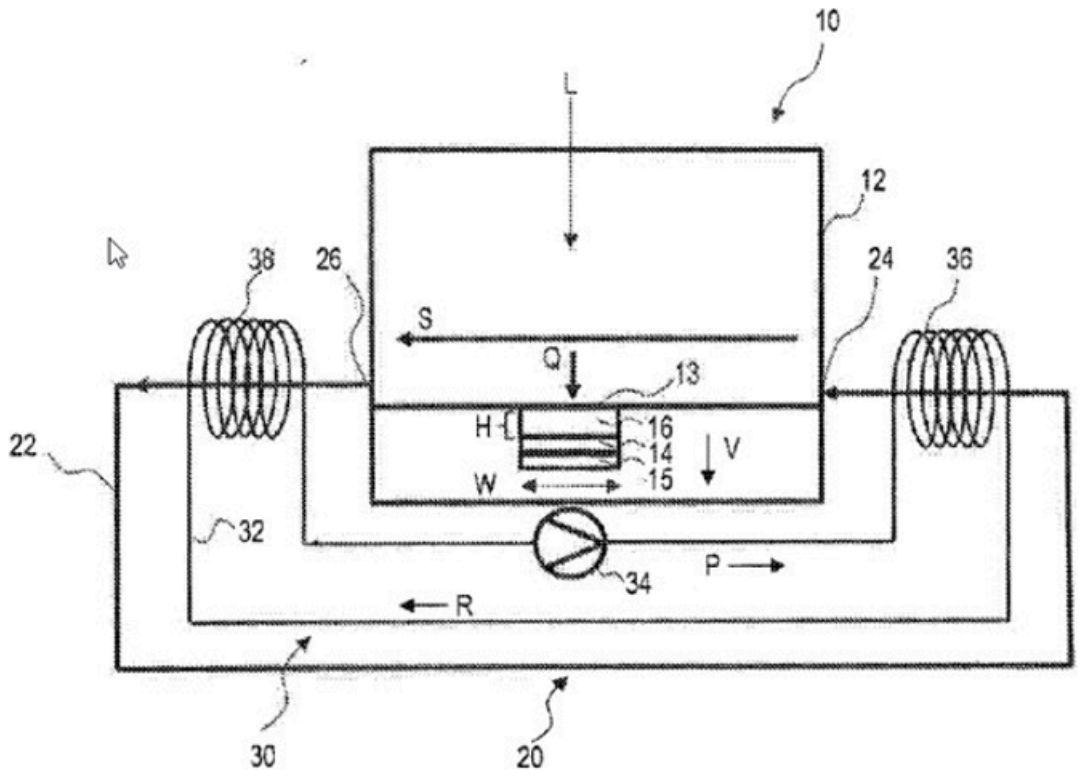
Definition statement

This place covers:

Devices comprising auxiliary heating means for a purpose other than preheating the powder material or heating the build chamber or build platform. The auxiliary heating means may relate to heating means for heating a process gas or the manufactured article, for example.

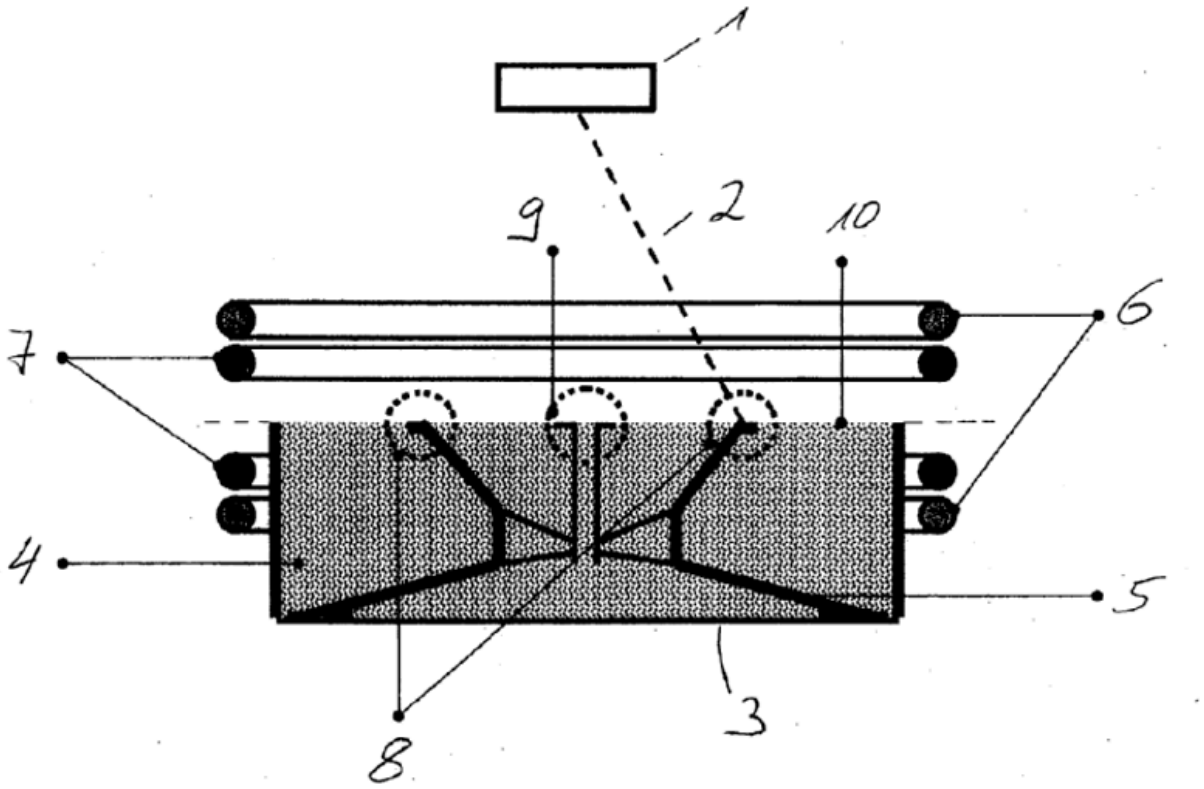
Illustrative examples of subject matter classified in this place:

1.



Heating means (36) to heat the process gas.

2.



Induction heating coils (6, 7) and heating component (5) in powder bed in container (3).

B22F 12/13

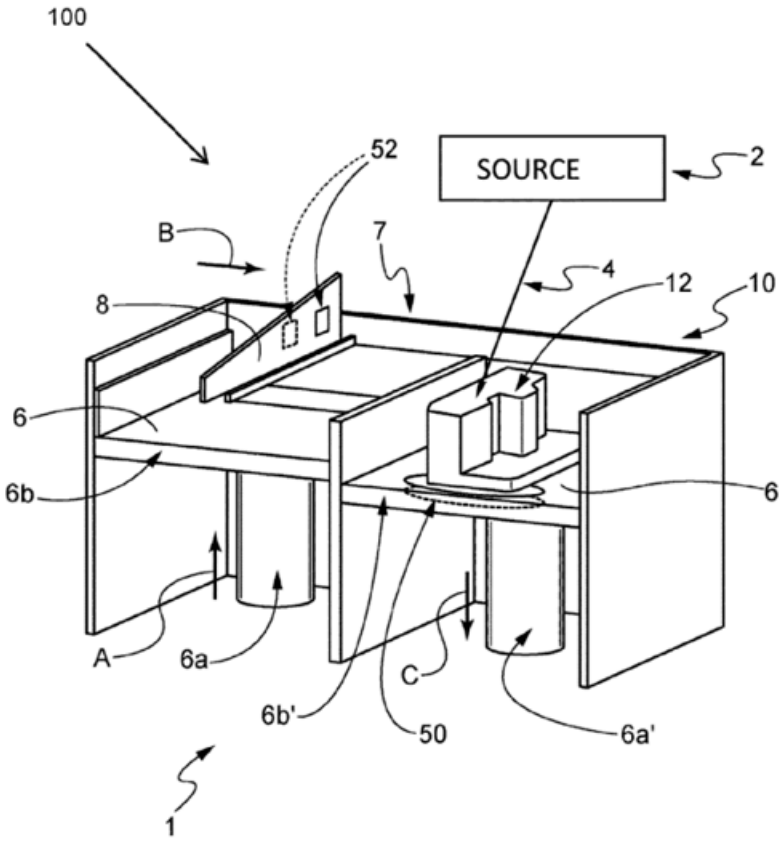
to preheat the material

Definition statement

This place covers:

Devices comprising auxiliary heating means for directly preheating the powder material used to additively manufacture a workpiece. For instance, lamps or coils above the powder bed. Auxiliary heating means for heating a material in the powder feeding device, e.g. hopper.

Illustrative example of subject matter classified in this place:



Illuminators (52) to preheat the powder in the powder bed (6), where the manufacture of the workpiece (12) takes place.

B22F 12/17

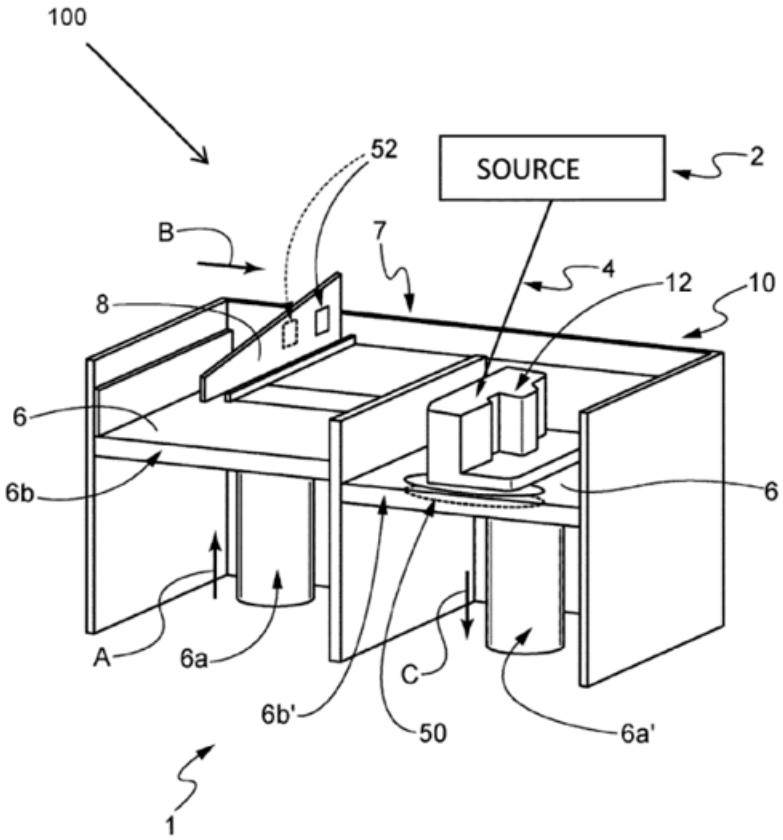
to heat the build chamber or platform

Definition statement

This place covers:

Devices comprising auxiliary heating means for heating the build chamber or platform.

Illustrative example of subject matter classified in this place:



Induction system (50) to heat the build platform (6b').

Glossary of terms

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

build chamber	powder bed sleeve

B22F 12/20

Cooling means

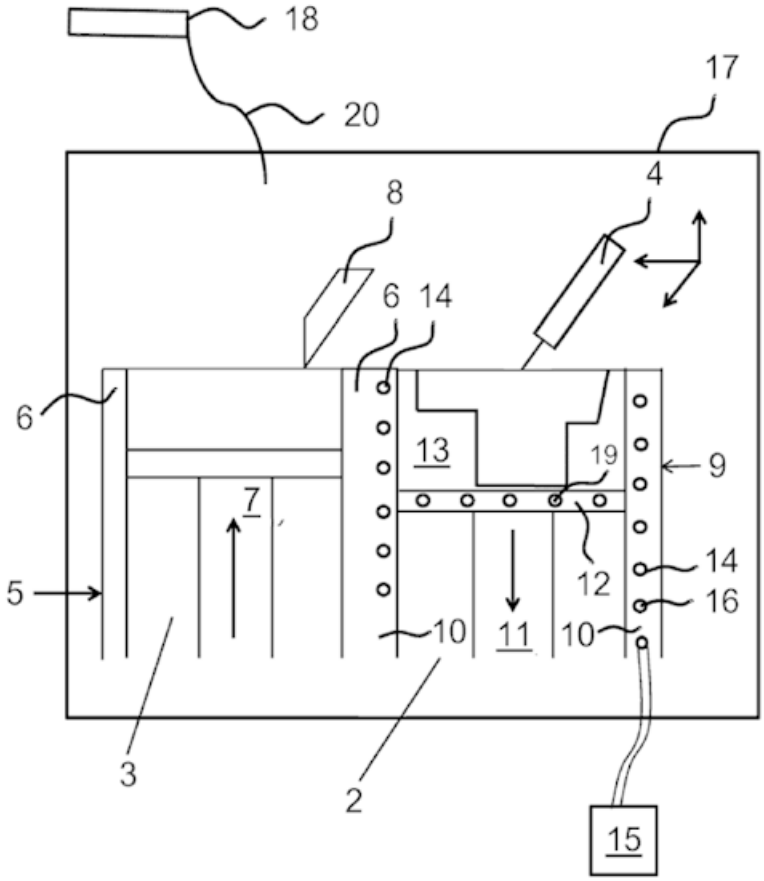
Definition statement

This place covers:

Devices comprising cooling means such as cooling fluid circuits in the build platform or build chamber housing in selective laser sintering [SLS] or selective laser melting [SLM] devices or cooling fluid nozzles above the powder bed.

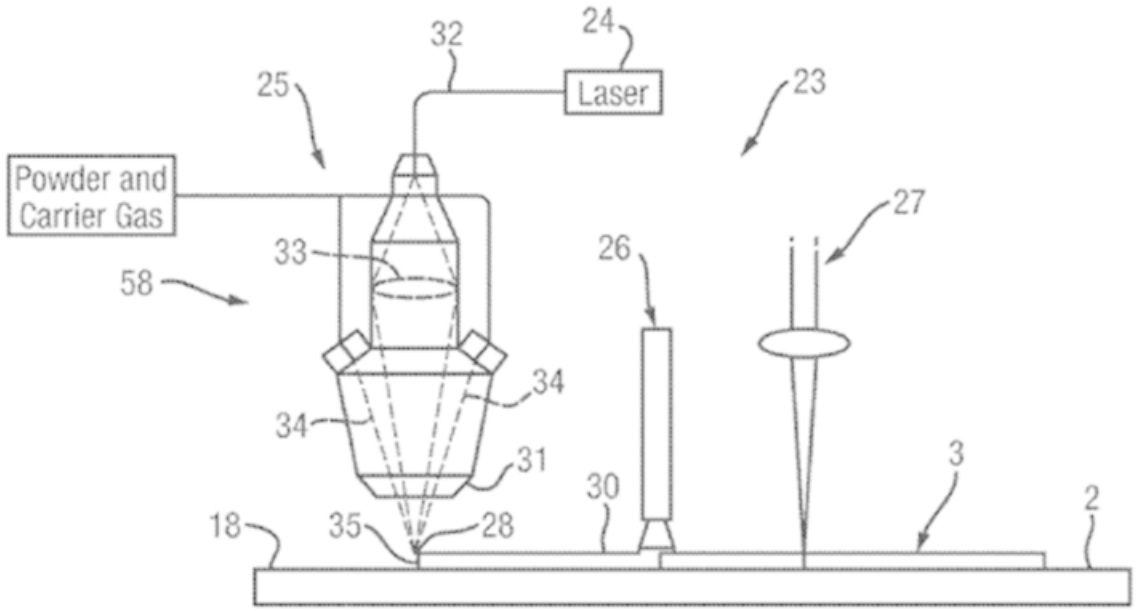
Illustrative examples of subject matter classified in this place:

1.



Cooling chamber (14) in the wall (10) of the build chamber of an SLS/SLM apparatus.

2.



Direct energy deposition (25) of metallic powder with subsequent cryogenic quenching treatment (26).

B22F 12/22

{Driving means}

Definition statement

This place covers:

Driving means capable of motion along all directions, possibly including rotation.

Illustrative example of subject matter classified in this place:

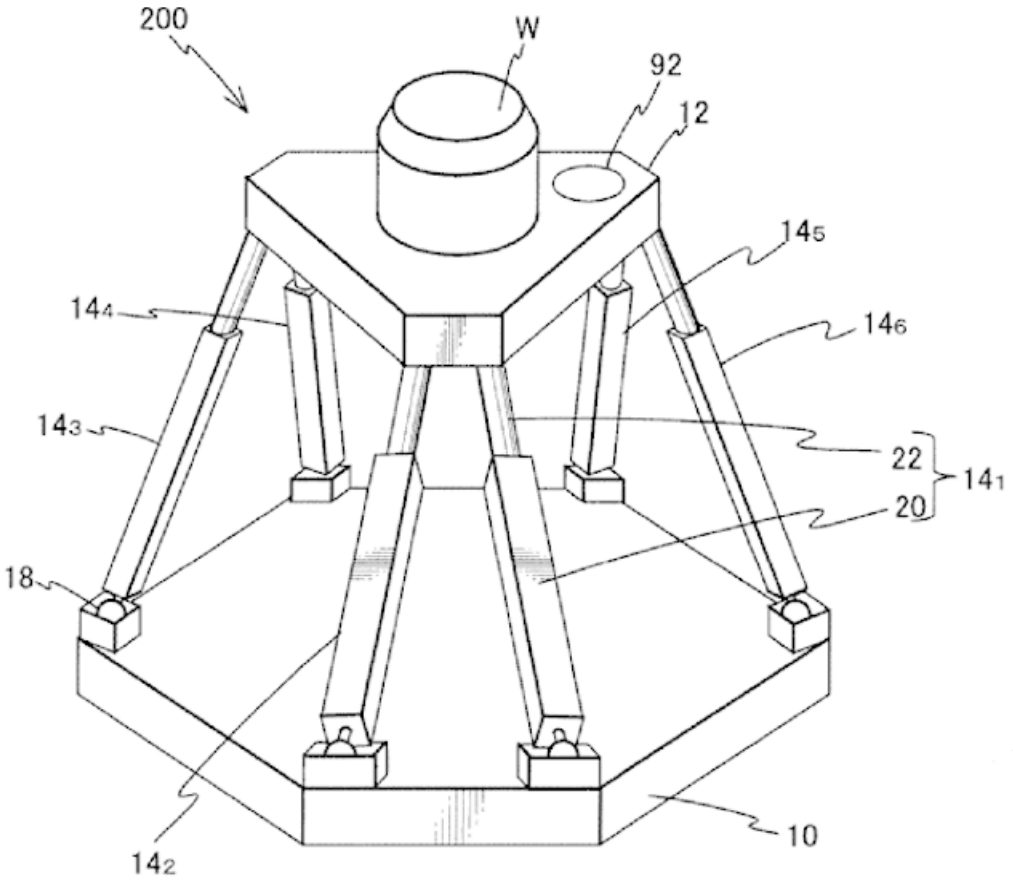


Table (12) for holding workpiece (W), positionable with 6 degrees of freedom by pneumatic control of rods (14).

Special rules of classification

In this group, C-Sets are used. The detailed information about the C-Sets construction and the associated syntax rules are found in the Special rules of classification in B22F.

For example, a type of motion of the radiation means or platform not provided for in the respective subgroups and motion of other components can be classified using a C-Set. A cooling means with vertical motion is classified as (B22F 2999/00, B22F 12/20, B22F 12/222).

When the invention is in the construction of the driving means for moving a platform or radiation means, the appropriate group(s) under B22F 12/22 should be given in addition to the groups related to movement of those components in general:

- Translatory movement of the radiation means is covered by B22F 12/46.

- Movement of the platform by translation in the deposition place is covered by B22F 12/33 and rotation of the platform by B22F 12/37.

B22F 12/222

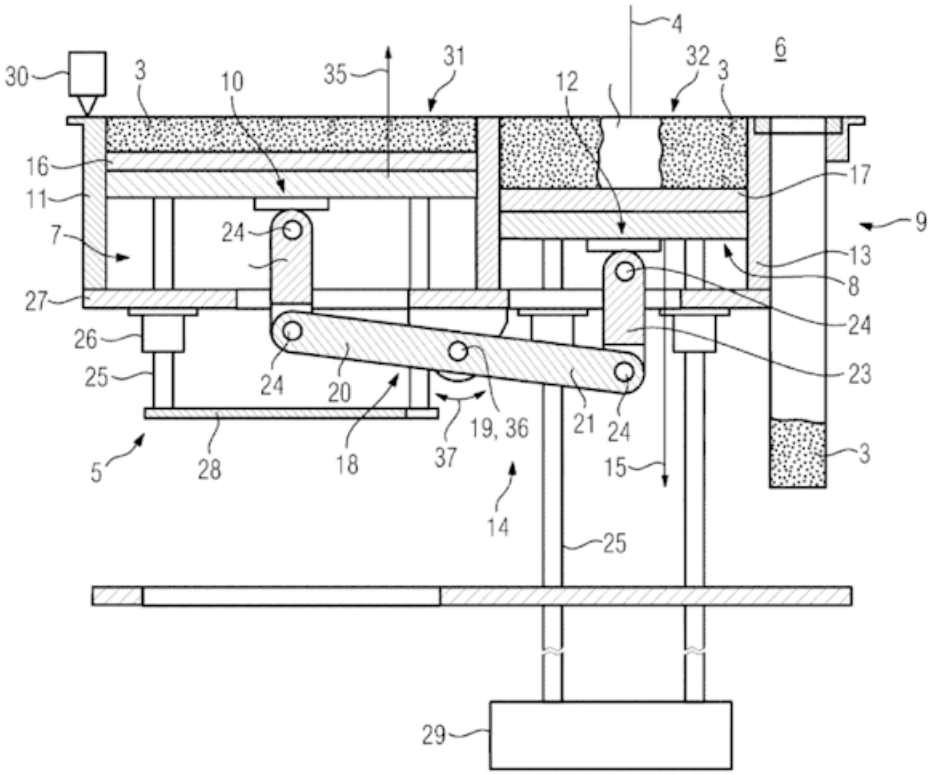
{for motion along a direction orthogonal to the plane of a layer}

Definition statement

This place covers:

Devices comprising driving means for motion along a direction orthogonal to the plane of a build layer.

Illustrative example of subject matter classified in this place:



Lever device (14) providing vertical motion of build plate carrier (12) and dose plate carrier (10) in a selective laser sintering melting [SLS/SLM] apparatus.

B22F 12/224

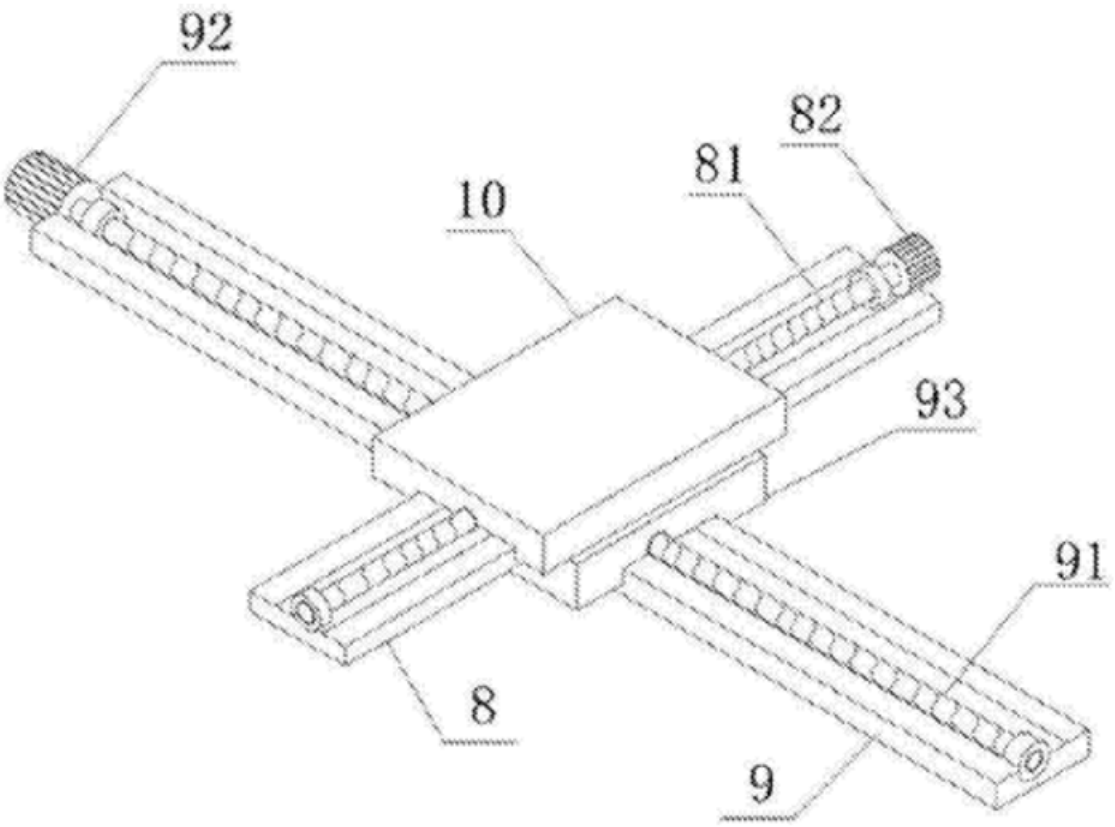
{for motion along a direction within the plane of a layer}

Definition statement

This place covers:

Devices comprising driving means for motion along a direction within the plane of a build layer.

Illustrative example of subject matter classified in this place:



A platform (10) movable in the deposition plane using screw motors (82, 92).

B22F 12/226

{for rotary motion}

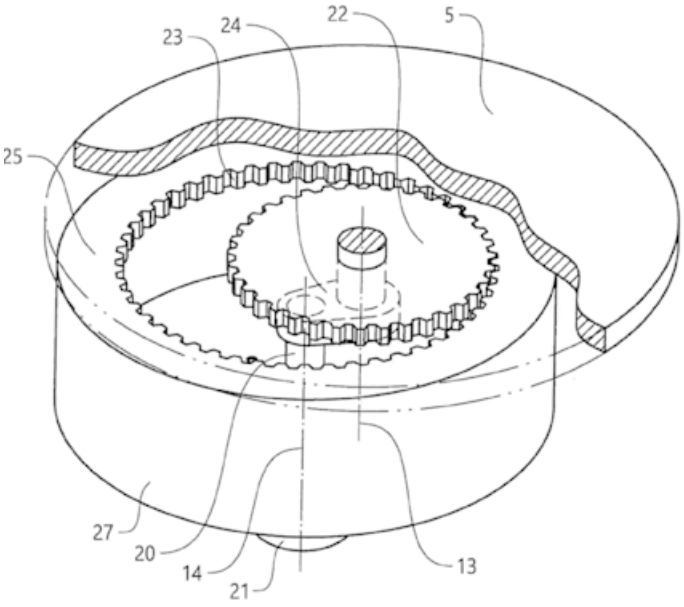
Definition statement

This place covers:

Devices comprising driving means for rotary motion.

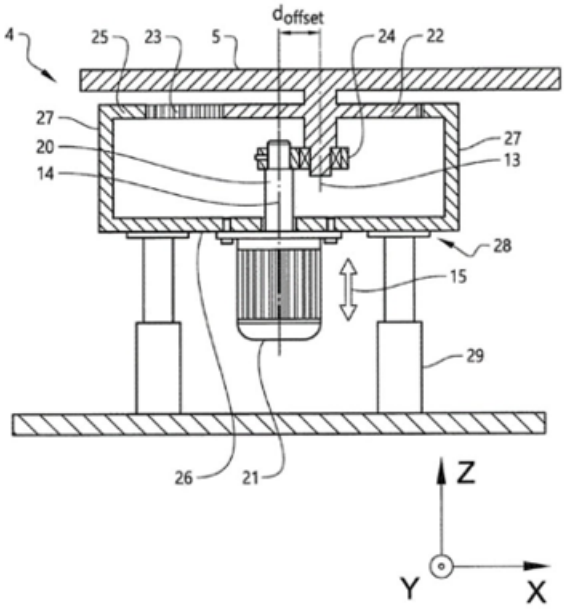
Illustrative examples of subject matter classified in this place:

1.



Driving means (20-25) to provide rotation and increase tangential speed at the centre region of the build platform (5) in a selective laser sintering/melting [SLS/SLM] apparatus.

2.



Driving means (20-25) to provide rotation of the build platform (5) in an SLS/SLM apparatus.

B22F 12/30

Platforms or substrates

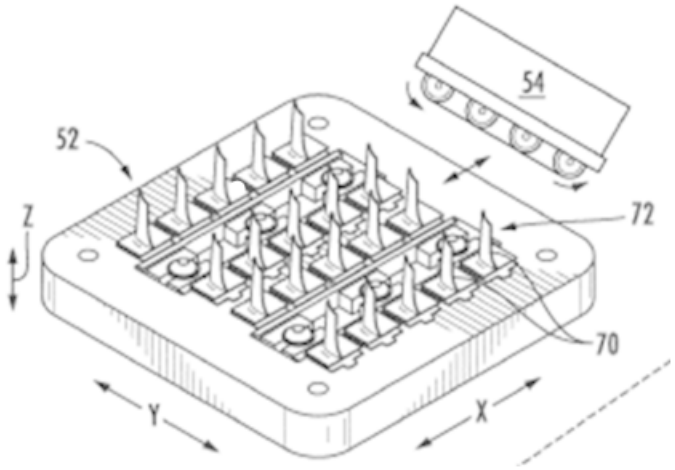
Definition statement

This place covers:

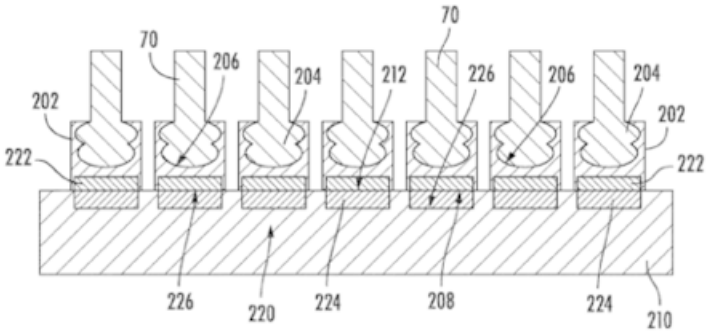
Means for receiving the material from which workpieces will be additively manufactured. Typical means are, for example, a build platform in an SLM or SLS device movable in a vertical direction.

Illustrative example of subject matter classified in this place:

1a.



1.b



Build platform (210) for powder bed based additive manufacturing gas turbine blades (70) comprising component fixtures (202) for holding worn air foils.

Special rules of classification

In this group, C-Sets are used. The detailed information about the C-Sets construction and the associated syntax rules are found in the Special rules of classification in B22F.

For platforms movable in a more complex fashion than translation and rotation, a C-Set together with groups B22F 12/22 - B22F 12/226 can be used. For example, a platform that is movable with 6 degrees of freedom is classified as (B22F 2999/00, B22F 12/30, B22F 12/22).

B22F 12/33

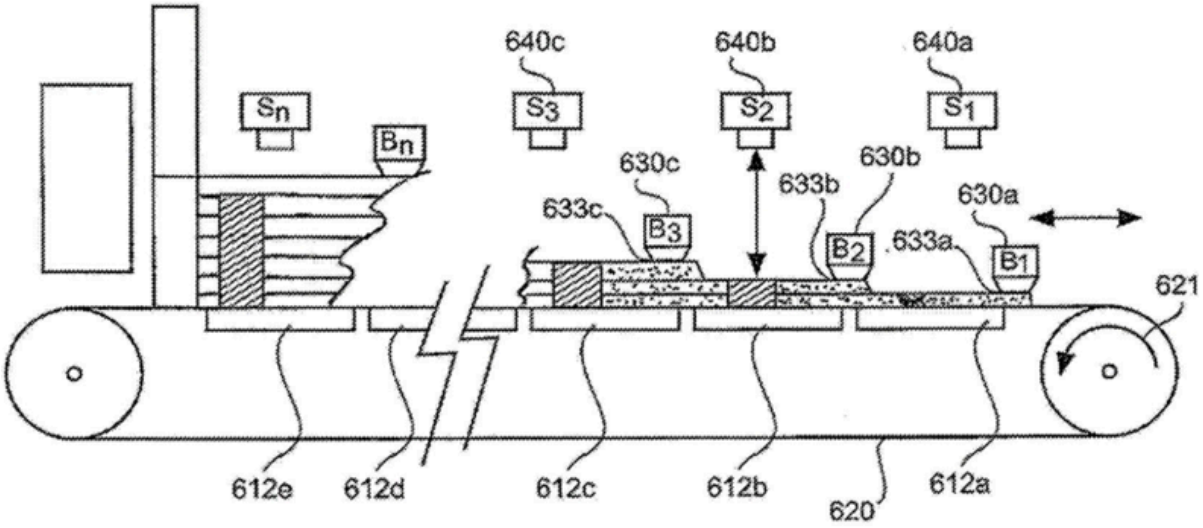
translatory in the deposition plane

Definition statement

This place covers:

Means for receiving the material from which workpieces will be additively manufactured and which are able to move in translation in the deposition plan, such as platforms moved by a belt.

Illustrative example of subject matter classified in this place:



Substrates (612a-e) in translator movement within deposition plane.

B22F 12/37

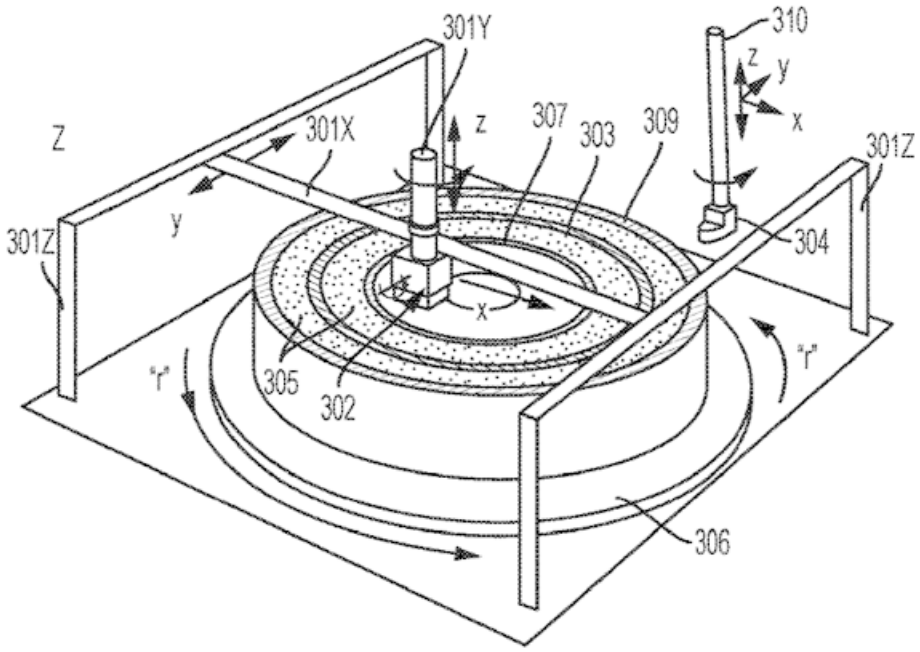
Rotatable

Definition statement

This place covers:

Means for receiving the material from which workpieces will be additively manufactured and which are rotatable or can be tilted. For example, a rotatable build platform in an SLS/SLM device.

Illustrative example of subject matter classified in this place:



Rotatable build platform (306) for powder bed fusion.

B22F 12/38

{Housings, e.g. machine housings}

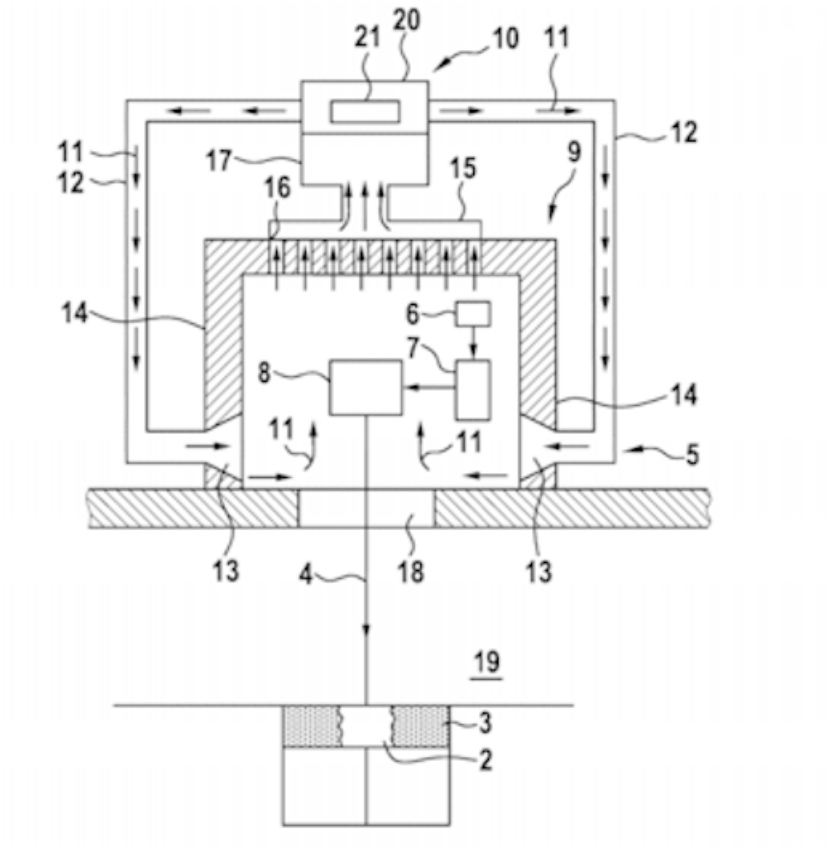
Definition statement

This place covers:

Specific features of any housing within the additive manufacturing apparatus, not just the housing of the apparatus as a whole. For example, the features may relate to the build chamber housing, the powder reservoir housing (build box) or the energy source housing.

The features of the housing may relate to aspects such as thermal insulation, gas- or powder-tightness or gas flow.

Illustrative example of subject matter classified in this place:



Housing (9) for irradiation device provided with stream inlet (13) and vents (16) for generating a gas stream.

B22F 12/41

characterised by the type, e.g. laser or electron beam

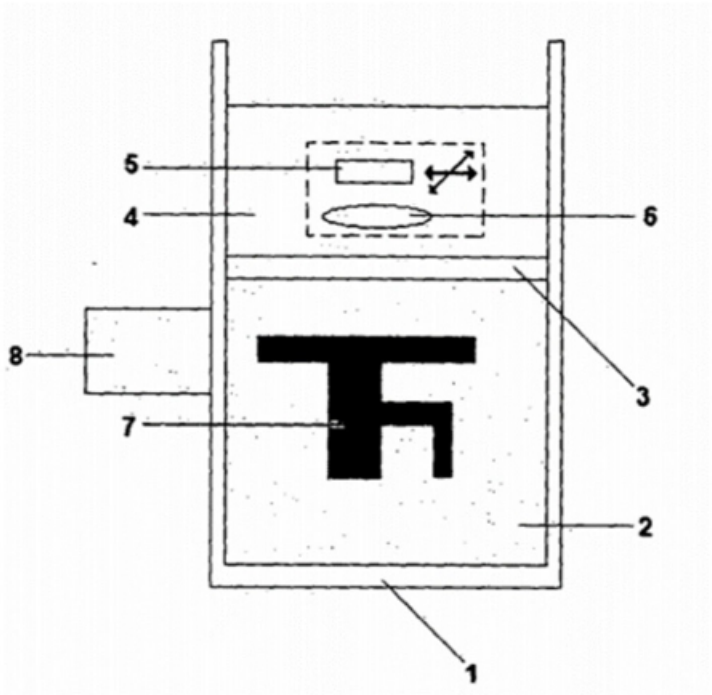
Definition statement

This place covers:

Device aspects relating to the type of radiation means for selectively fusing or binding particles together.

The radiation means may be of the electromagnetic type, such as laser, ultraviolet or infrared lamps, or of the particulate type, such as an electron beam, or of the acoustic type, such as ultrasound.

Illustrative example of subject matter classified in this place:



Focused ultrasound additive manufacturing powder bed (2) with ultrasound source (5) and ultrasound optics (6).

References

Informative references

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

Auxiliary heating means	B22F 12/10
Welding for purposes other than joining	B23K 10/027
Electron-beam welding for purposes other than joining	B23K 15/0086
Non-electric welding by making use of vibrations, e.g. ultrasonic welding	B23K 20/10
Build-up laser welding	B23K 26/342

B22F 12/42

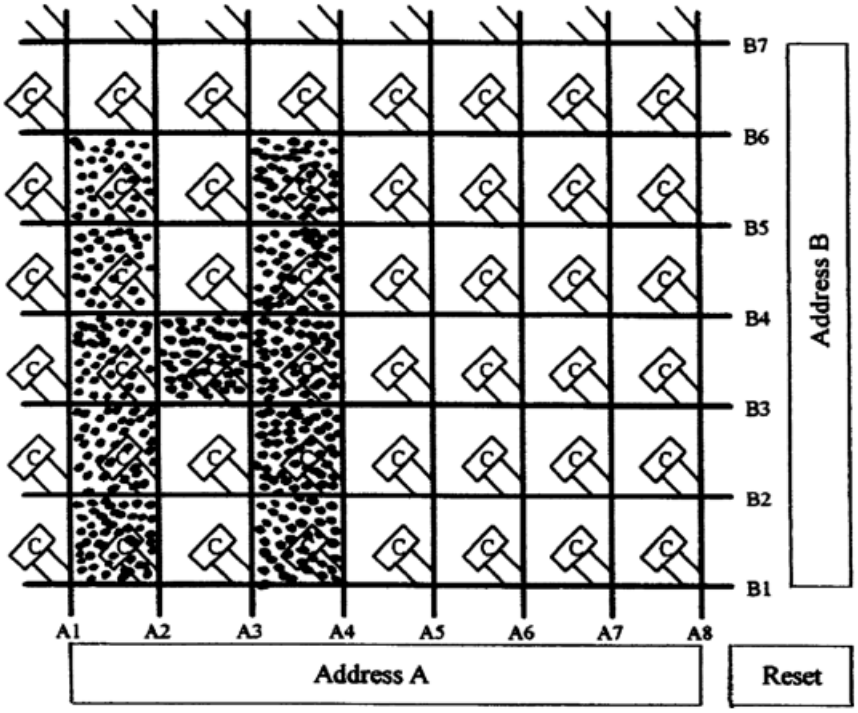
Light-emitting diodes [LED]

Definition statement

This place covers:

Devices comprising light emitting diodes [LED] as radiation means.

Illustrative example of subject matter classified in this place:



Programmable planar LED light source matrix for curing binder in a metal powder bed to bind the metallic powder in a selected area (H) at once to increase the build speed compared to a point-by-point illumination.

B22F 12/43

pulsed; frequency modulated

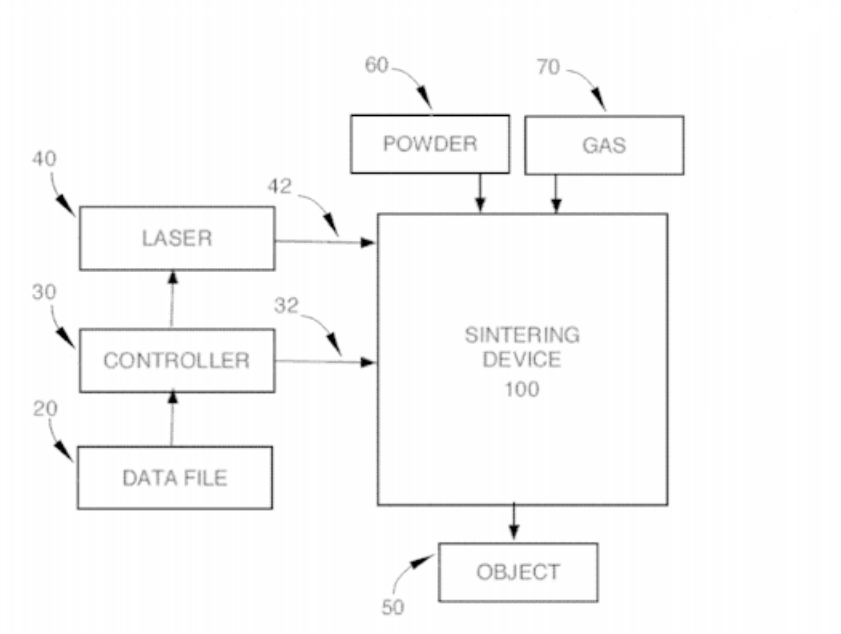
Definition statement

This place covers:

Devices comprising pulsed, frequency modulated radiation means such as, for example, pulsed laser for selectively fusing or binding particles together in selective laser sintering [SLS] or selective laser melting [SLM].

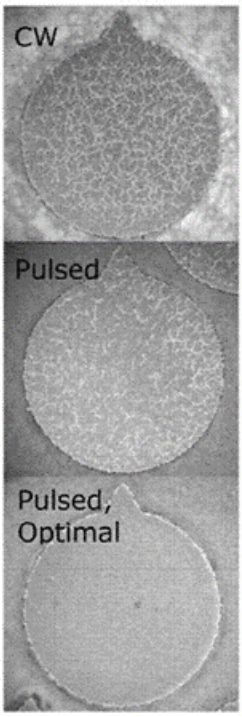
Illustrative examples of subject matter classified in this place:

1.



Selective laser melting/sintering [SLM/SLS] by pulsed laser (40) to reduce porosity or microcracks in Al alloys.

2.



Comparison of pulsed wave/continuous wave laser [CW] for Al alloys reduction of microcracks with pulsed wave laser.

B22F 12/44

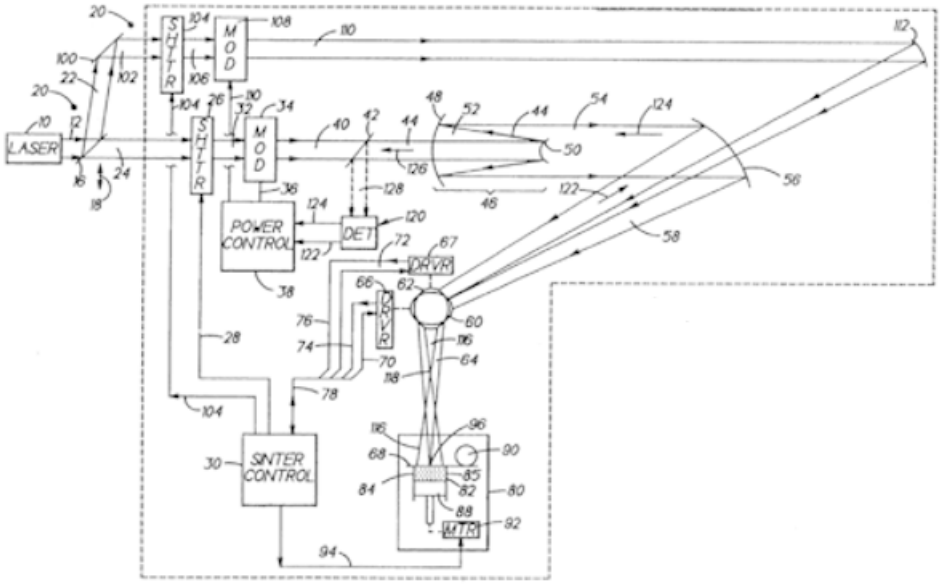
characterised by the configuration of the radiation means

Definition statement

This place covers:

Devices characterised by a spatial relation or features of the radiation means.

Illustrative example of subject matter classified in this place:



SLM apparatus with a laser source (10) and optics for creating a focused beam (58, 96) and an unfocused beam.

B22F 12/45

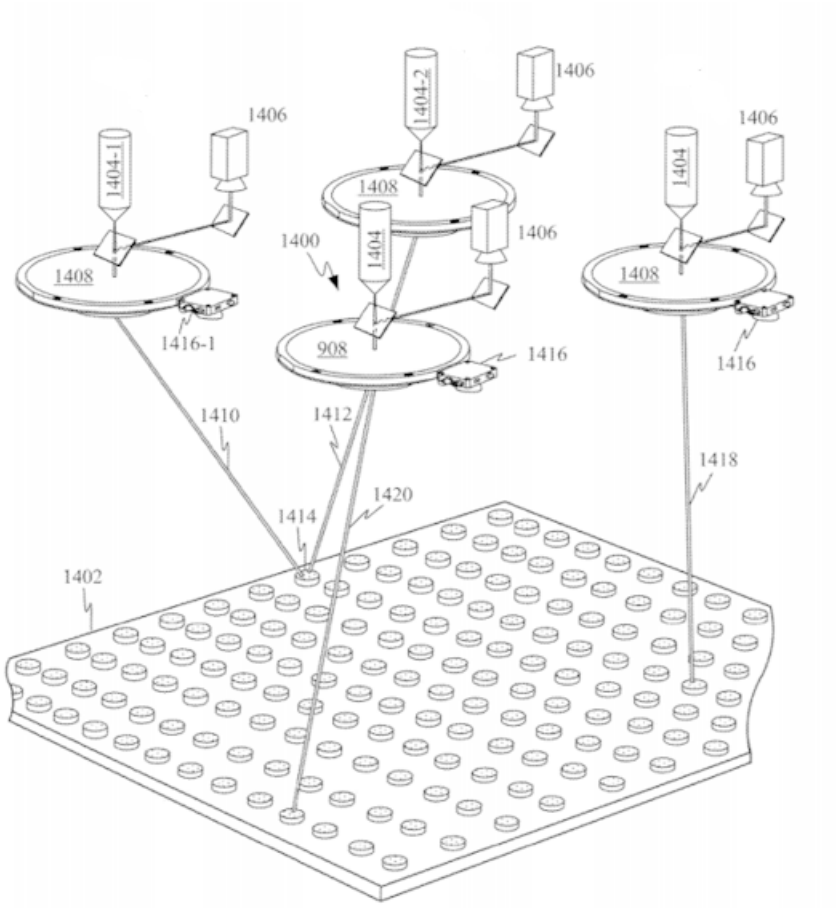
Two or more

Definition statement

This place covers:

Devices with multiple radiation means.

Illustrative example of subject matter classified in this place:



Selective laser melting [SLM] with multiple lasers (1404, 1404-1, 1404-2). Each laser is configured to fuse particles in a defined region of the build plane (1402).

B22F 12/46

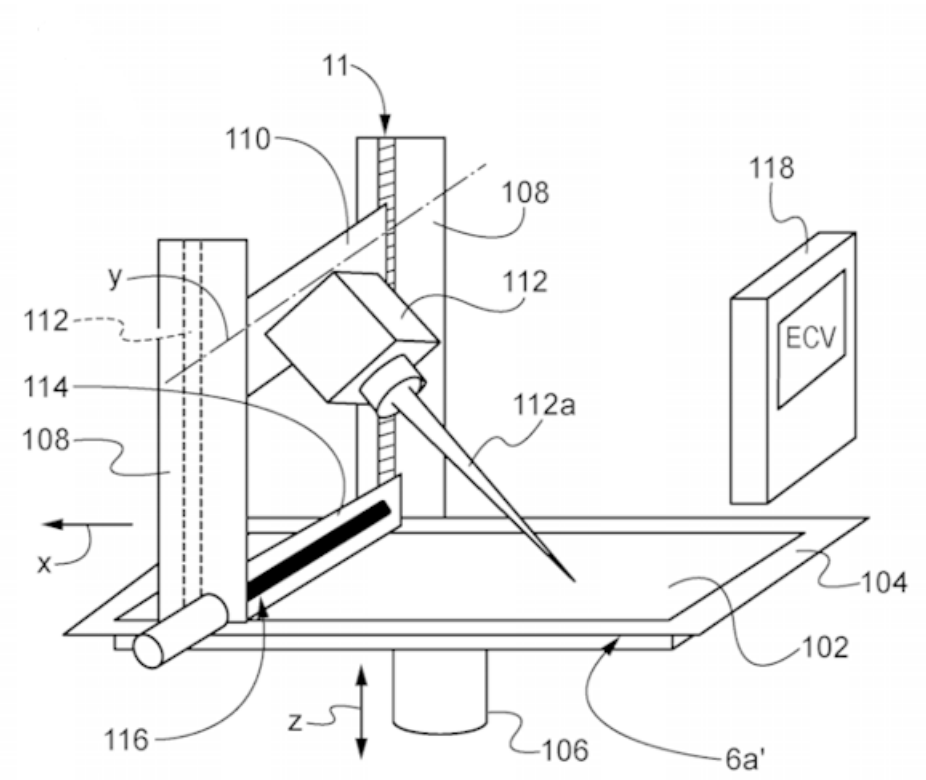
with translatory movement

Definition statement

This place covers:

Devices comprising radiations means able to move in translation.

Illustrative example of subject matter classified in this place:



SLM with a laser diode source (112) moving in translation along direction x and vertically by means of cross member (110).

Special rules of classification

In this group, C-Sets are used. The detailed information about the C-Sets construction and the associated syntax rules are found in the Special rules of classification in B22F.

For radiation means movable in a more complex fashion than translation, a C-Set together with groups B22F 12/22 - B22F 12/226 can be used. For example, a radiation means movable with 6 degrees of freedom is classified as: (B22F 2999/00, B22F 12/40, B22F 12/22).

B22F 12/47

parallel to the deposition plane

Definition statement

This place covers:

Devices comprising radiation means able to move in translation within the deposition plane, such as a laser moving in translation within the deposition plan in selective laser sintering [SLS], selective laser melting [SLM] or direct metal deposition [DMD].

B22F 12/48

in height, e.g. perpendicular to the deposition plane

Definition statement

This place covers:

Devices comprising radiation means able to move in the vertical direction, such as a laser moving vertically in selective laser sintering [SLS], selective laser melting [SLM], or direct metal deposition [DMD].

B22F 12/49

Scanners

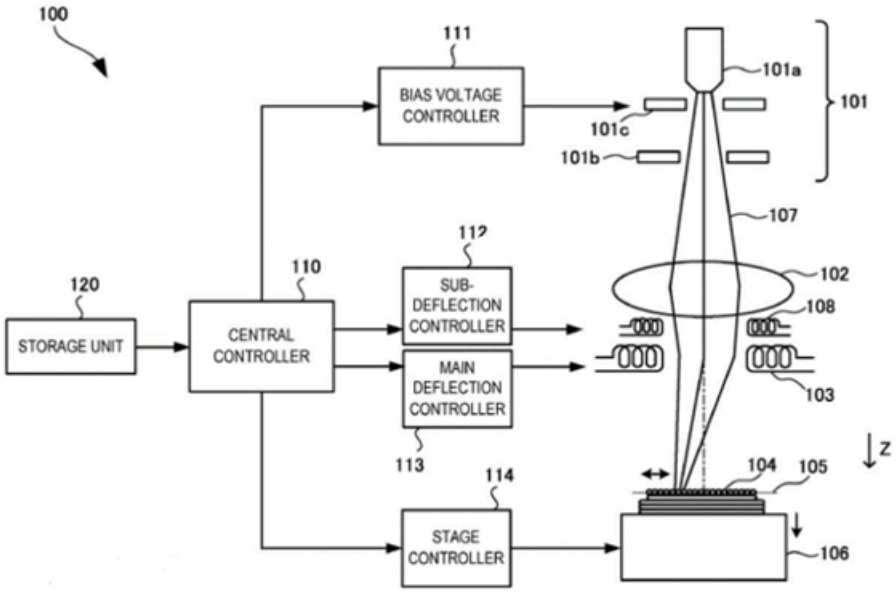
Definition statement

This place covers:

Devices for scanning an energy beam along the surface of, e.g. the powder bed.

Devices such as galvanometric scanners and digital micromirror devices.

Illustrative example of subject matter classified in this place:



Electron beam melting apparatus (100) with a main deflector (103) and a sub-deflector (108).

B22F 12/50

Means for feeding of material, e.g. heads

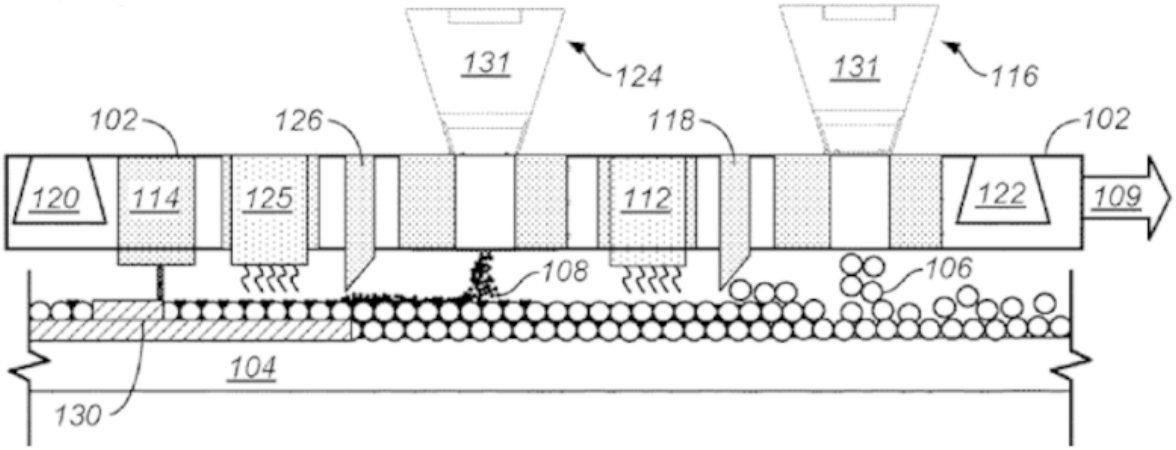
Definition statement

This place covers:

Means for feeding materials, e.g. build or support materials, to the process or apparatus.

For instance, containers alongside the powder bed build sleeve, from which powder is supplied to a recoater blade by raising the bottom of the reservoir.

Illustrative example of subject matter classified in this place:



Printhead (102) for powder bed devices comprising means for feeding material (131).

B22F 12/52

Hoppers

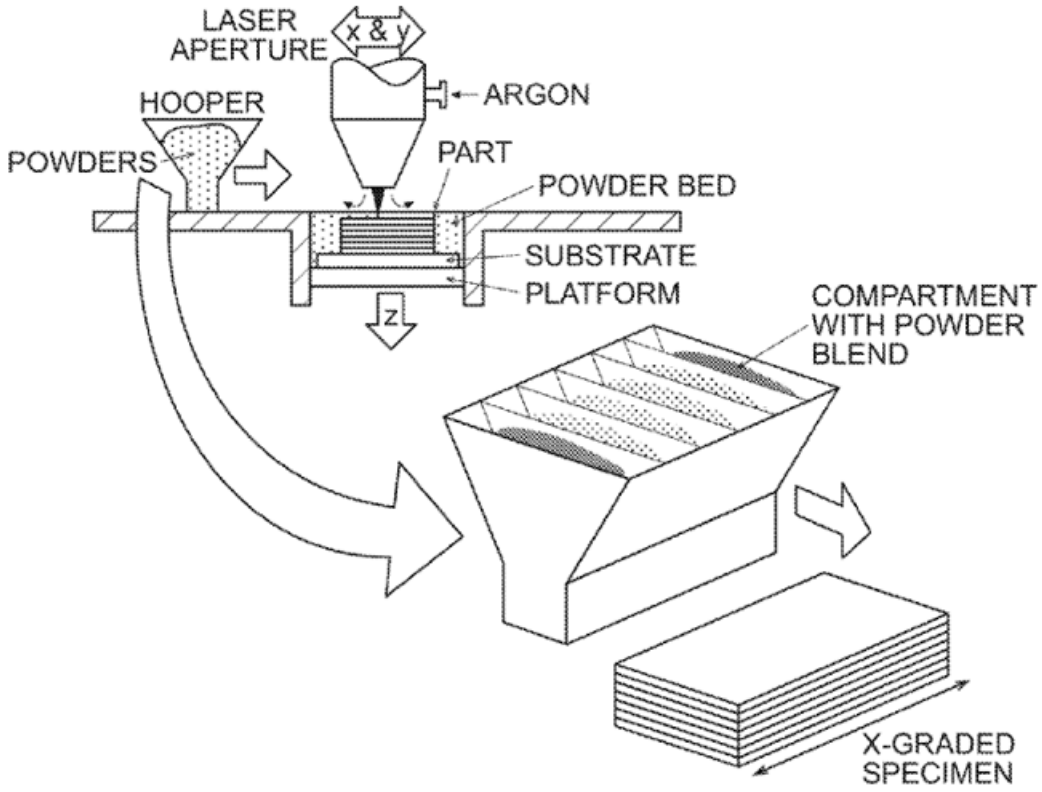
Definition statement

This place covers:

Hoppers for feeding, e.g. build or support material. For instance, in powder bed devices, the hoppers are reservoirs from which powder is supplied to a recoater blade by the powder being deposited on the working surface from above.

Illustrative example of subject matter classified in this place:

Powder hopper for SLM



B22F 12/53

Nozzles

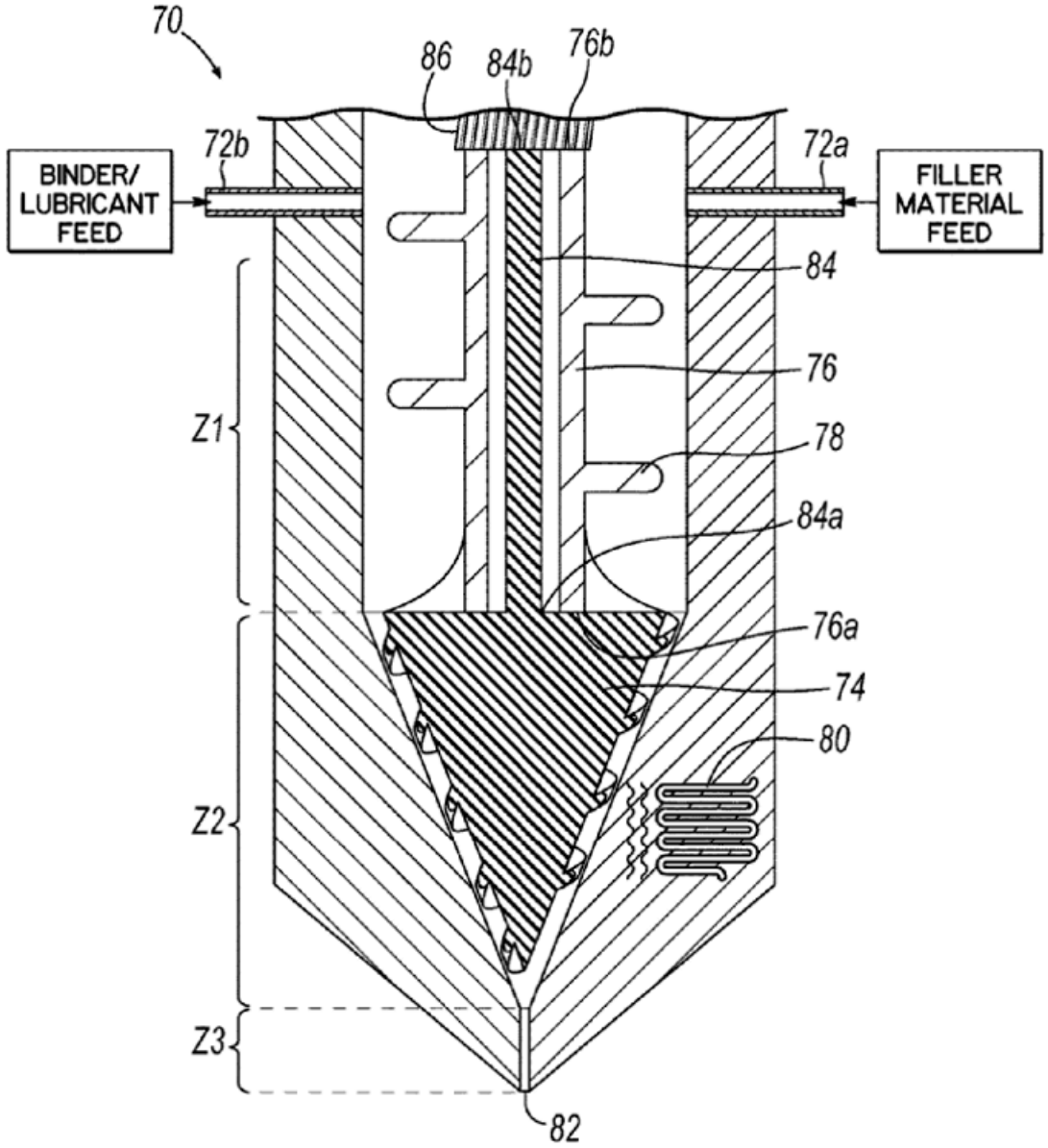
Definition statement

This place covers:

Nozzles for feeding of material. For instance, nozzles for depositing metallic particles, such as in DMD, molten metal or a mixture comprising metal particles and a binder, such as deposition by extrusion, onto a platform or substrate. Nozzles such as those for feeding organic binder in powder bed devices should also be classified here.

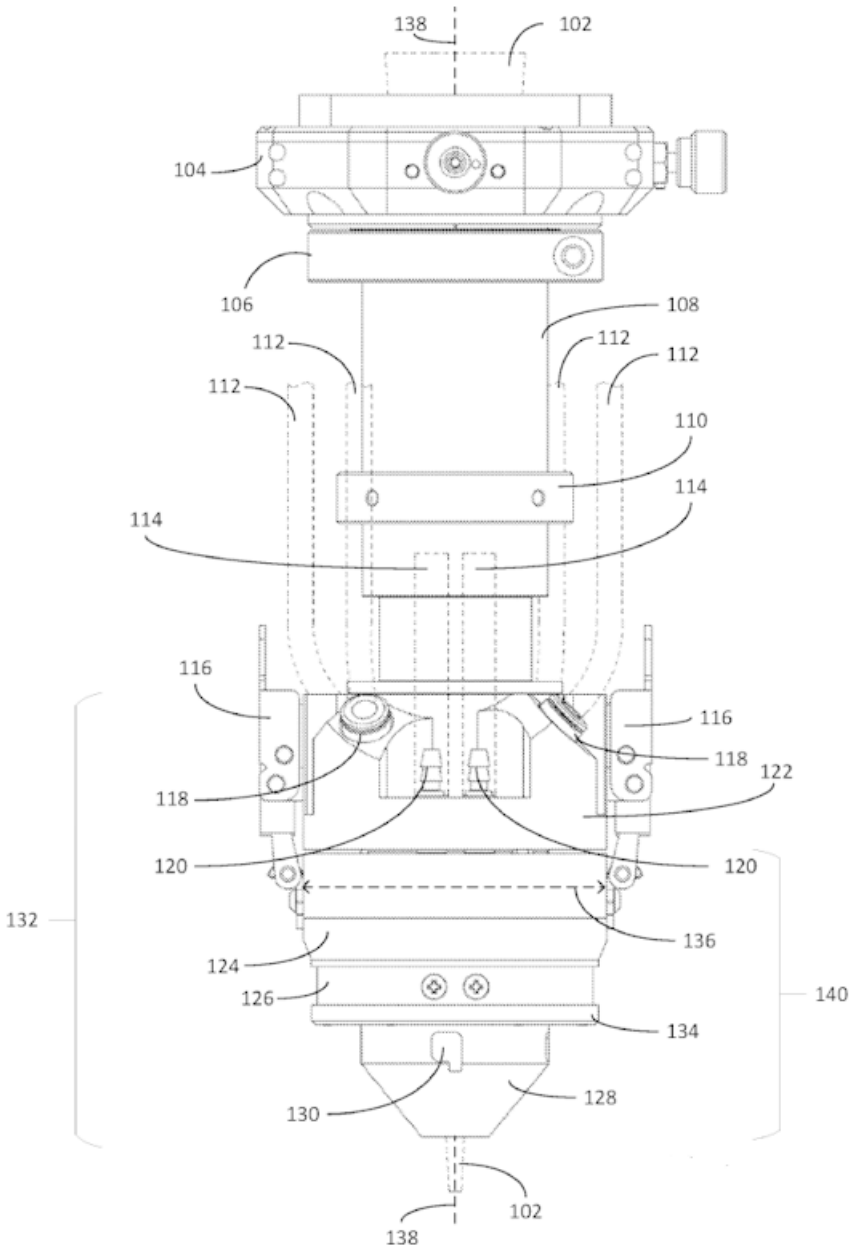
Illustrative examples of subject matter classified in this place:

1.



System assembly (70) for extruding material, comprising a binder and a filler. The assembly (70) comprises a mixing device (76, 78), a heating device (80) and an outlet nozzle (82).

2.



Laser metal deposition head (132) comprising a nozzle assembly (140). The powder is provided to powder inlets (118) and guided through the nozzle assembly (140) to the focal point of the laser beam (102).

References

Informative references

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

Spraying apparatus; Nozzles	B05B
Apparatus for applying fluent materials to surfaces	B05C
Heads, nozzles of additive manufacturing apparatus for plastics	B29C 64/209
Selective printing mechanisms, i.e. mechanisms printing otherwise than from a form	B41J

B22F 12/55

Two or more means for feeding material

Definition statement

This place covers:

Multiple means for feeding material. For instance, one feeding mean on each side of a build platform or substrate in powder bed devices.

B22F 12/57

Metering means

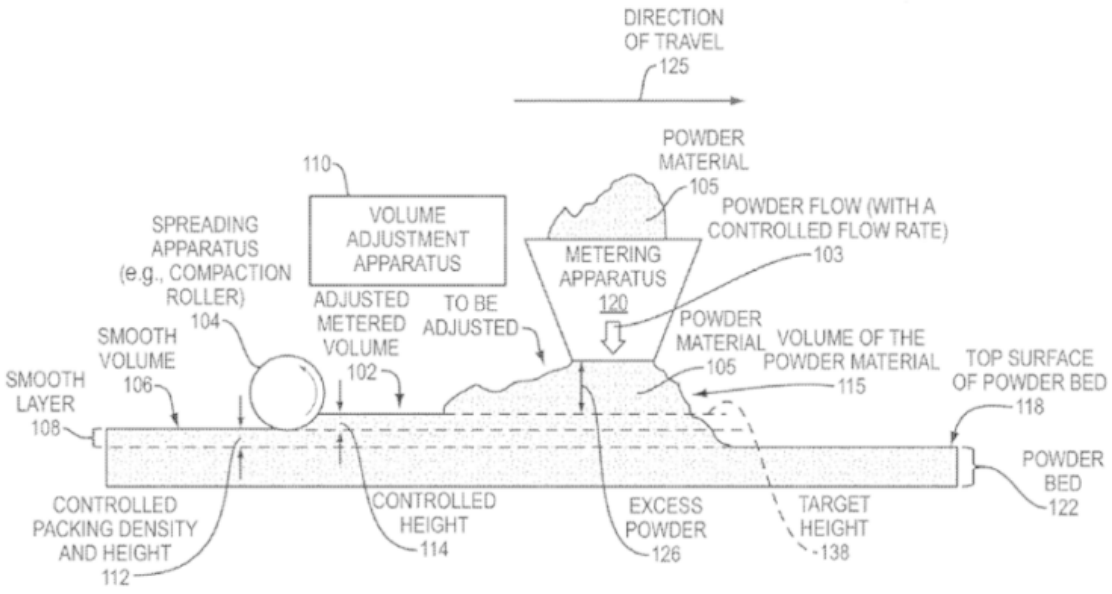
Definition statement

This place covers:

Means for metering material. For instance, means for metering powder material to be deposited onto a build platform or substrate in powder bed devices.

Illustrative example of subject matter classified in this place:

Powder bed device



The powder material (105) is metered onto the top surface (118) of the powder bed.

B22F 12/58

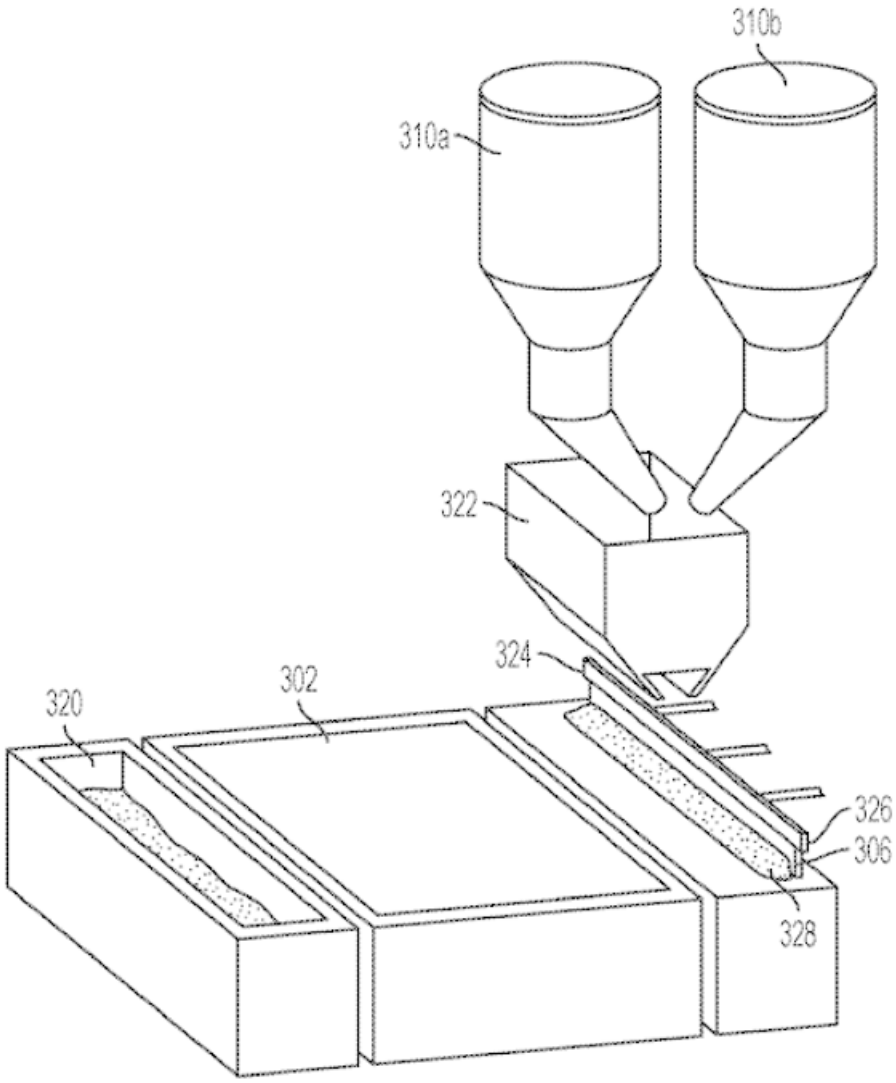
for changing the material composition, e.g. by mixing

Definition statement

This place covers:

Means for changing the material composition. For instance, means for mixing powder material to be deposited onto a build platform or substrate in powder bed devices.

Illustrative example of subject matter classified in this place:



Powder bed device comprising a first powder reservoir (310a) with a first powder composition and a second powder reservoir (310b) with a second powder and a dispenser (322) for receiving a blend of the first and second powder according to a desired composition of the blend.

B22F 12/60

Planarisation devices; Compression devices

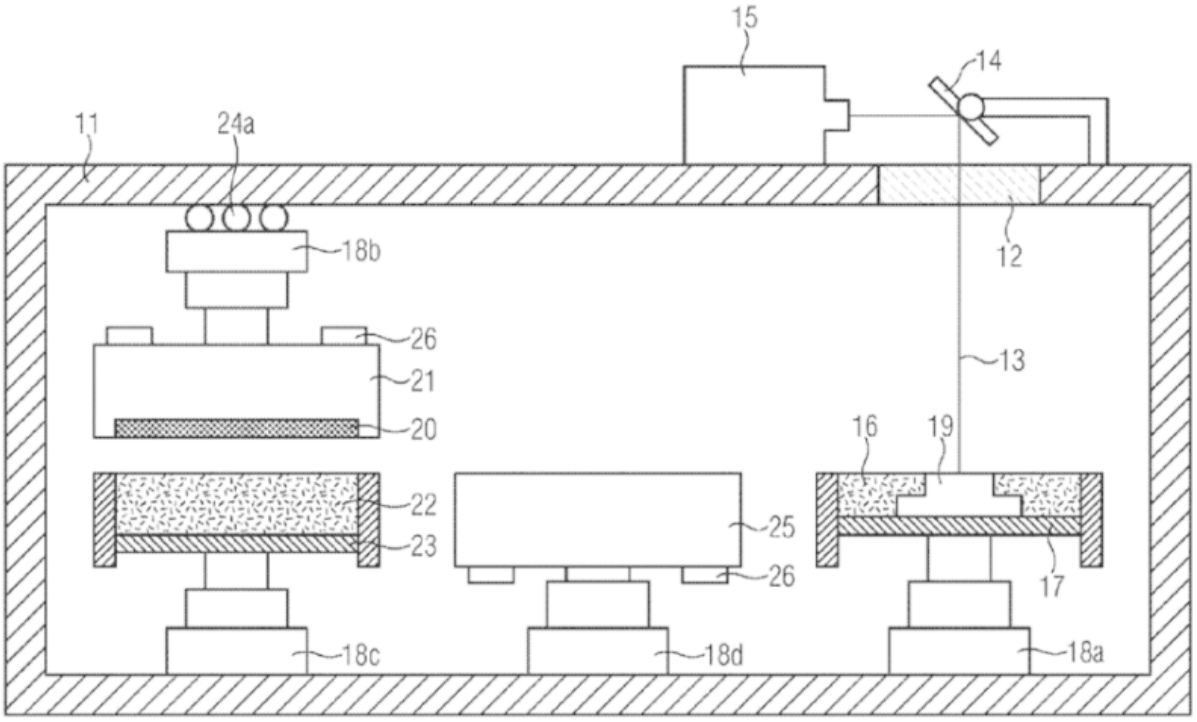
Definition statement

This place covers:

Planarisation or compression devices.

Illustrative example of subject matter classified in this place:

Selective laser melting [SLM]



Compacting plate (25) for compacting layer (20) in dosing device (21) before application of layer (20) on powder bed (16).

B22F 12/63

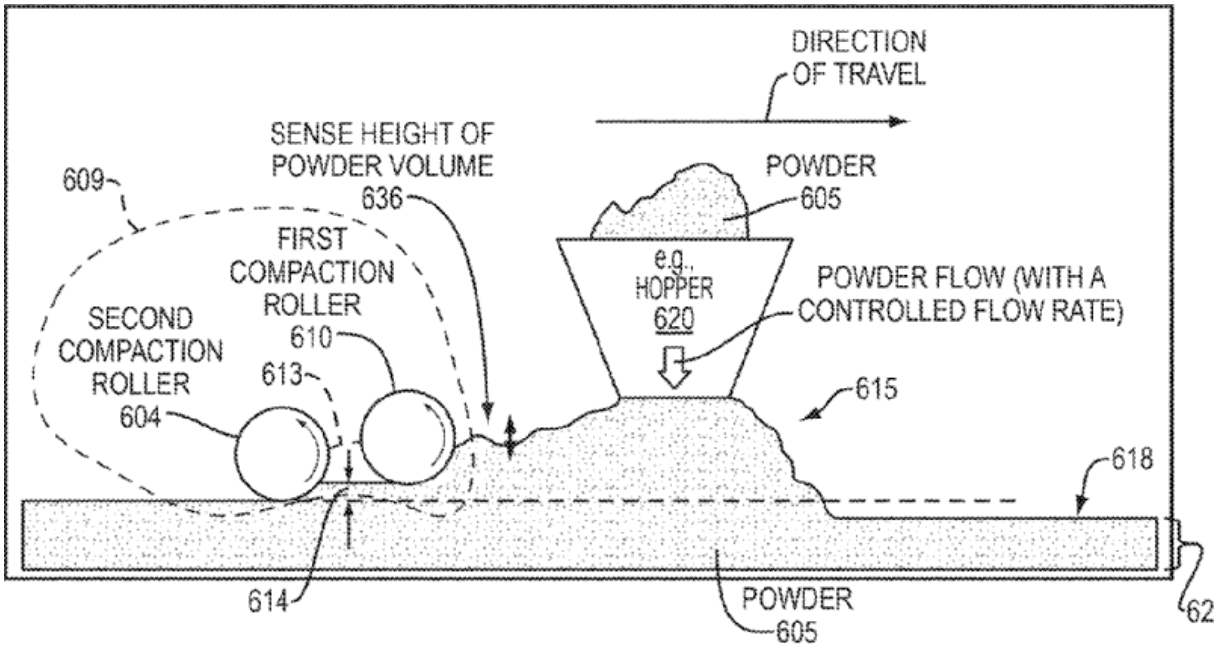
Rollers

Definition statement

This place covers:

Rollers for compressing the powder layer.

Illustrative example of subject matter classified in this place:



B22F 12/67

Blades

Definition statement

This place covers:

Arrangements where a recoater blade (doctor blade) is used to flatten the powder layer on the powder bed.

Illustrative example of subject matter classified in this place:

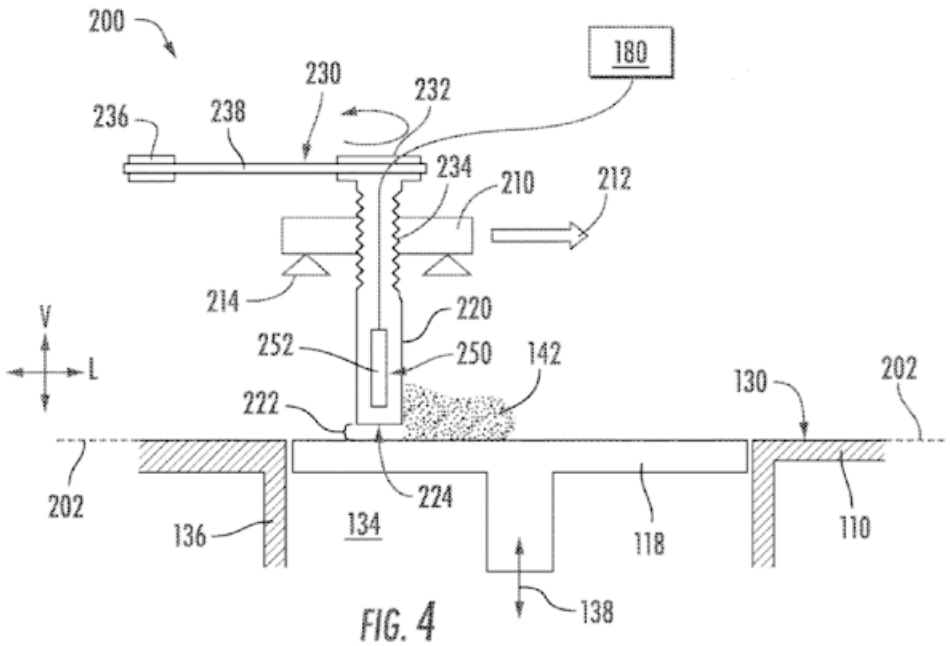


FIG. 4

Recoating assembly (200) with a recoater blade (220) movably coupled to a support beam (210).

B22F 12/70

Gas flow means

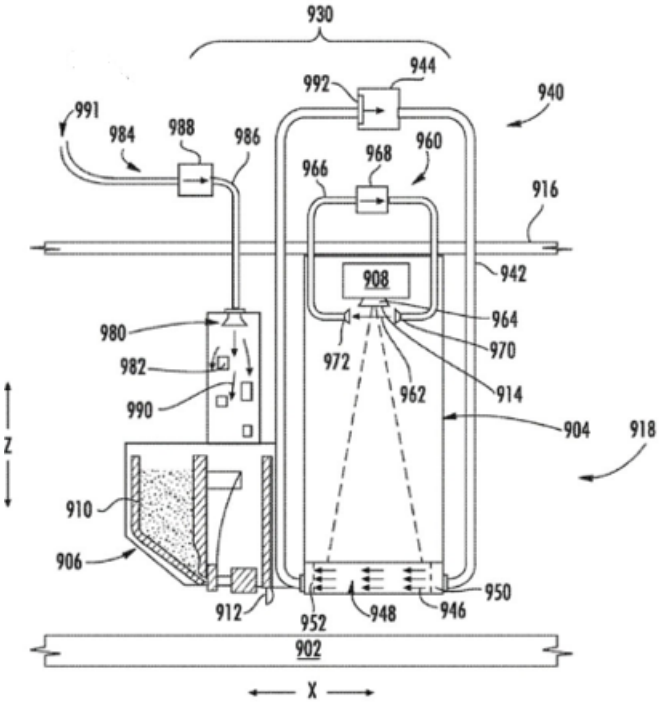
Definition statement

This place covers:

Units either within or connected to the additive manufacturing apparatus for gas flow.

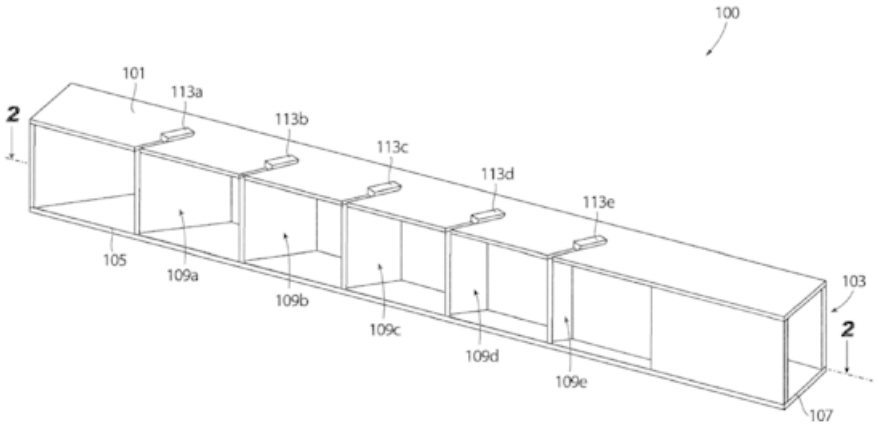
Illustrative examples of subject matter classified in this place:

1.



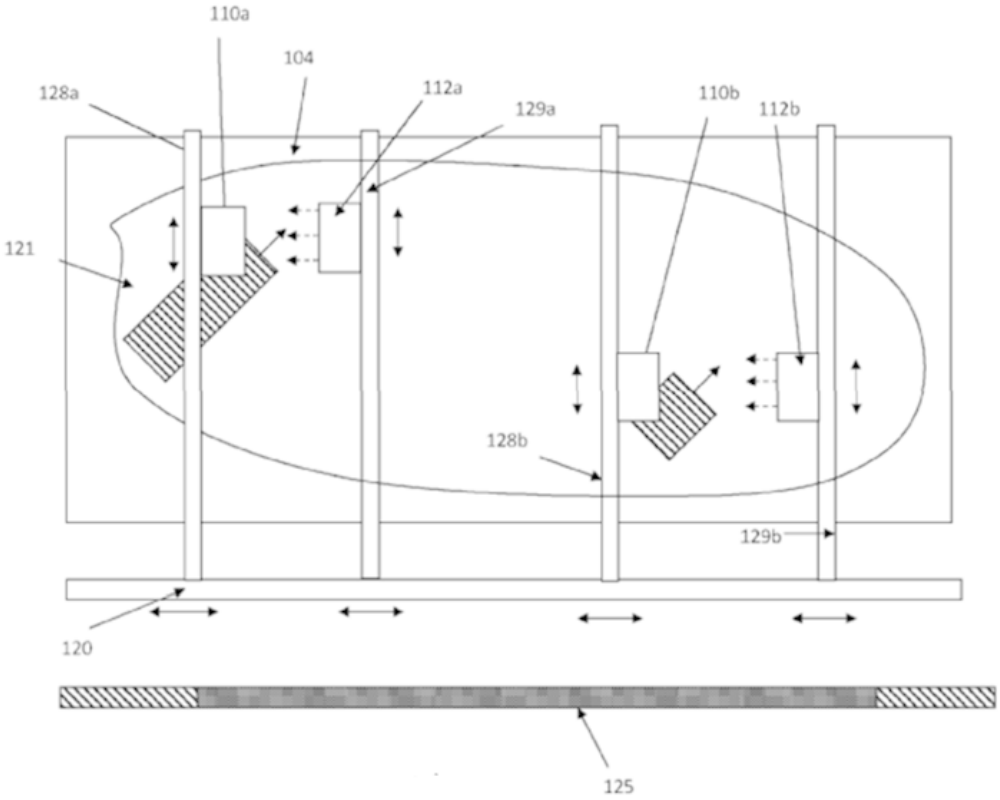
Gantry (916) movable above the build platform (902) having a condensate evacuation subsystem (940) circulating a first gas (946) through the build area (918) and a closed loop subsystem (960) for circulating a second gas (962) over a sensitive component (964).

2.



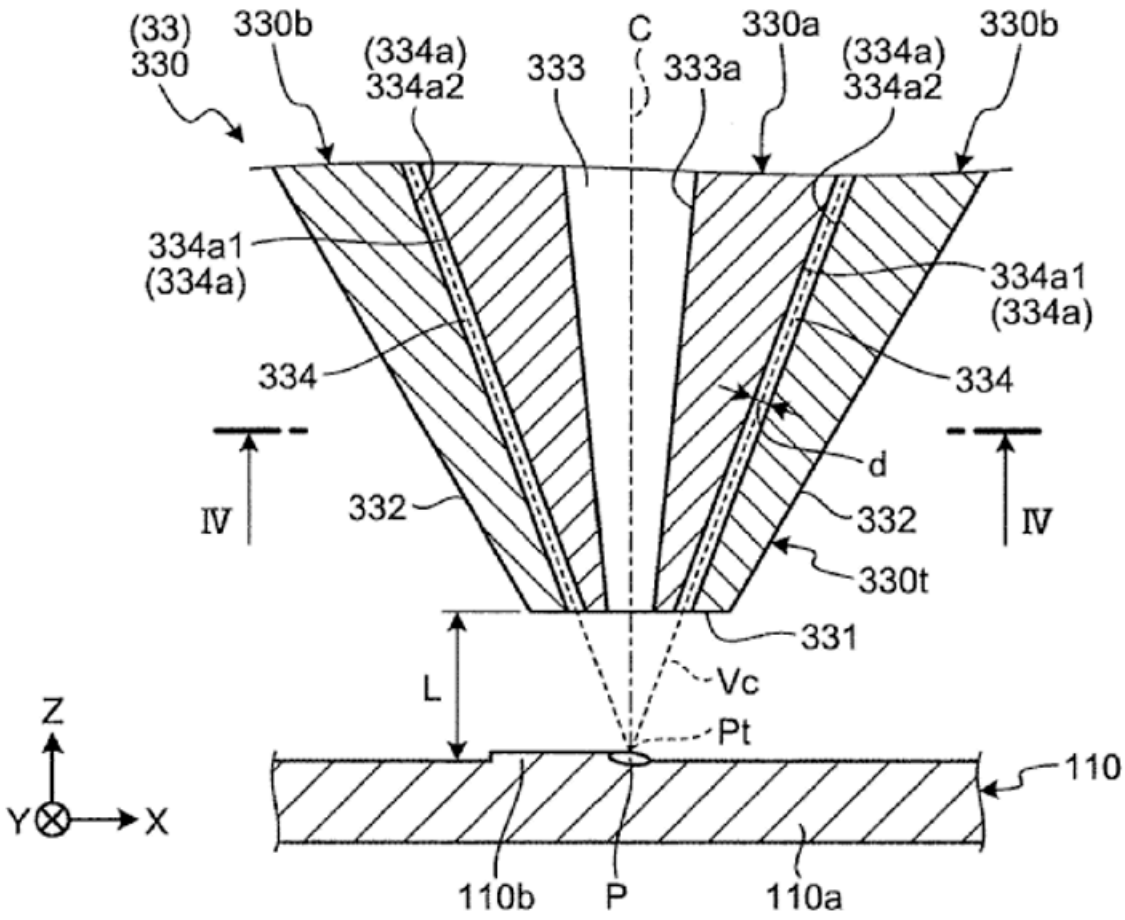
Additive manufacturing system comprising an exhaust manifold (100) with baffles (109a-e) movable with actuators (113a-e).

3.



Powder-bed-based additive manufacturing device comprising a movable pair of nozzles (112a and 112b) for blowing an inert gas, and a movable suction device (110a and 110b) for exhausting contaminated gas.

4.



Nozzle for direct metal deposition of metallic powder onto the surface of a base (110a) or onto the surface of an object (110) with constant gap (d) between body component (330a) and (330b) of the nozzle.

B22F 12/80

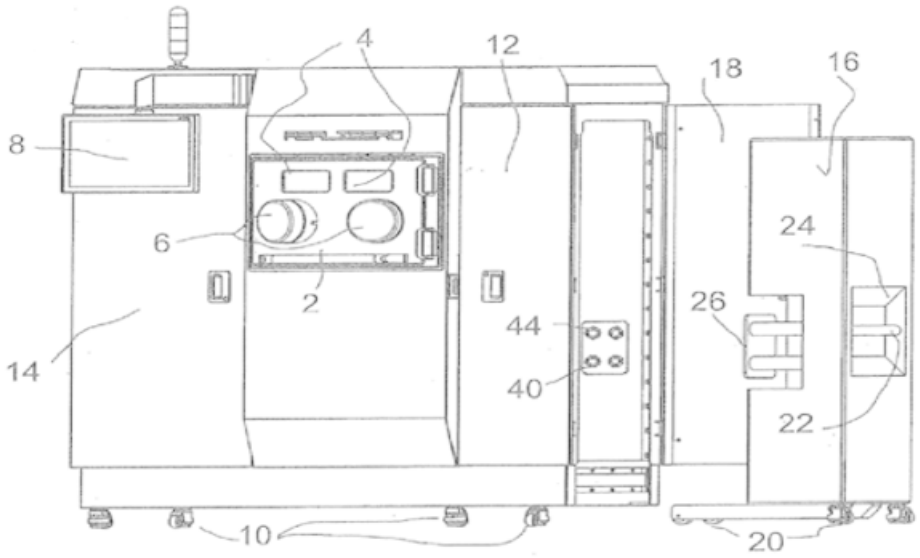
Plants, production lines or modules

Definition statement

This place covers:

Additive manufacturing [AM] production plants and production lines, modular designs for AM systems.

Illustrative example of subject matter classified in this place:



AM apparatus with an interchangeable module (16) incorporating a powder supply and recovery apparatus.

B22F 12/82

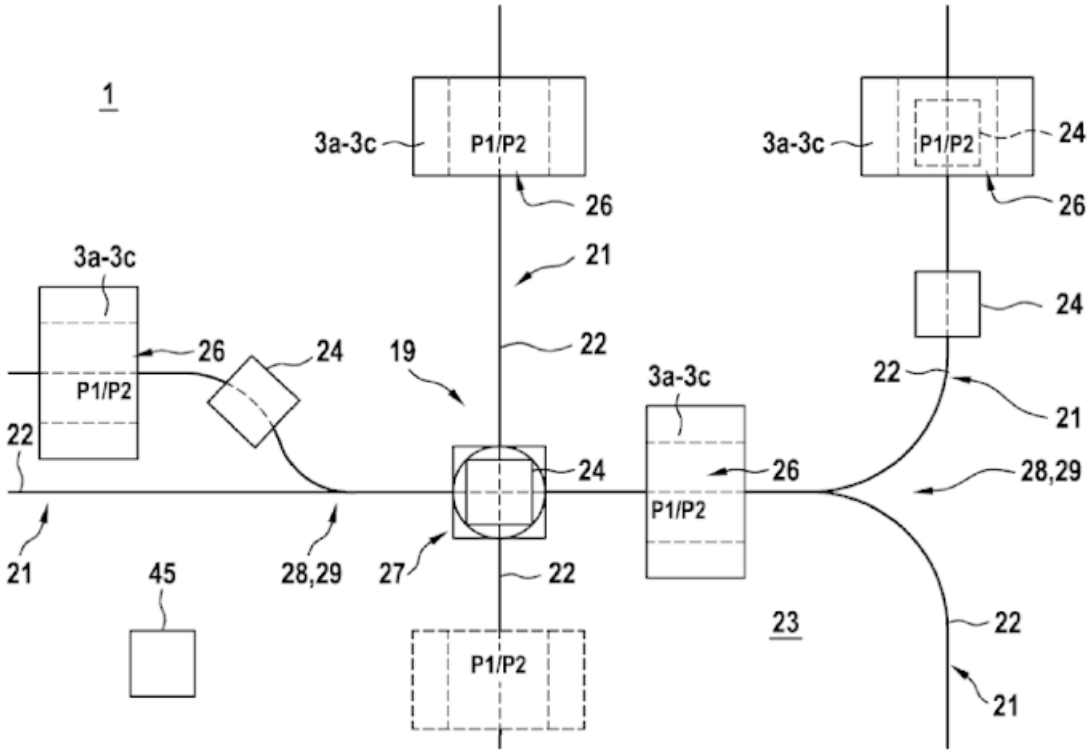
Combination of additive manufacturing apparatus or devices with other processing apparatus or devices

Definition statement

This place covers:

Systems where an additive manufacturing apparatus or device is combined with other processing devices.

Illustrative example of subject matter classified in this place:



Plant (1) with several machines (26) with process stations for preprocessing (3a), additive manufacturing (3b) and post-processing (3c).

B22F 12/84

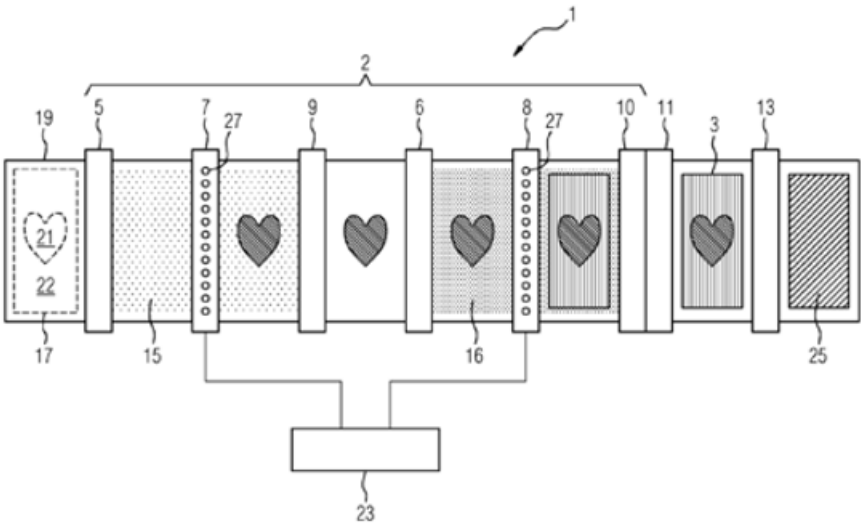
Parallel processing within single device

Definition statement

This place covers:

Systems where additive manufacturing and other processing of articles can be performed in parallel within a single device.

Illustrative example of subject matter classified in this place:



Additive manufacturing apparatus (1) with deposition (5), fusing (7) and powder removal (9) units for first material (15) and corresponding units (6,8,10) for second material (16), followed by sintering (11) and coating (13) units.

B22F 12/86

Serial processing with multiple devices grouped

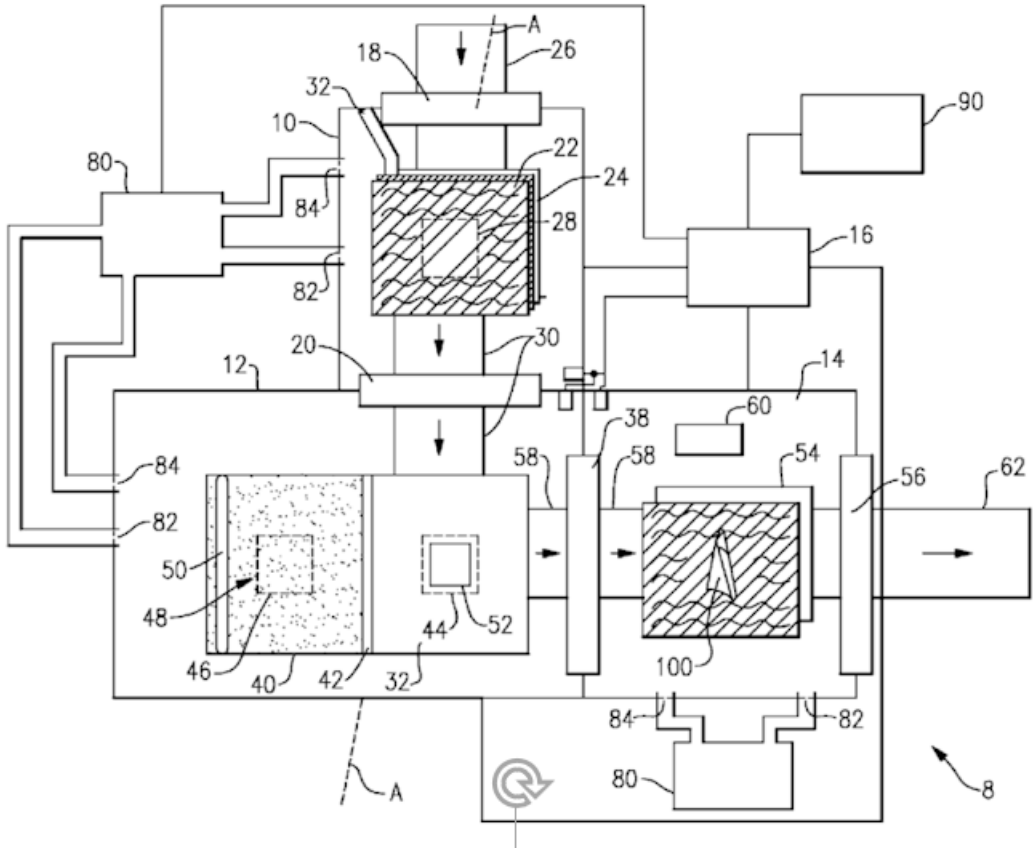
Definition statement

This place covers:

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

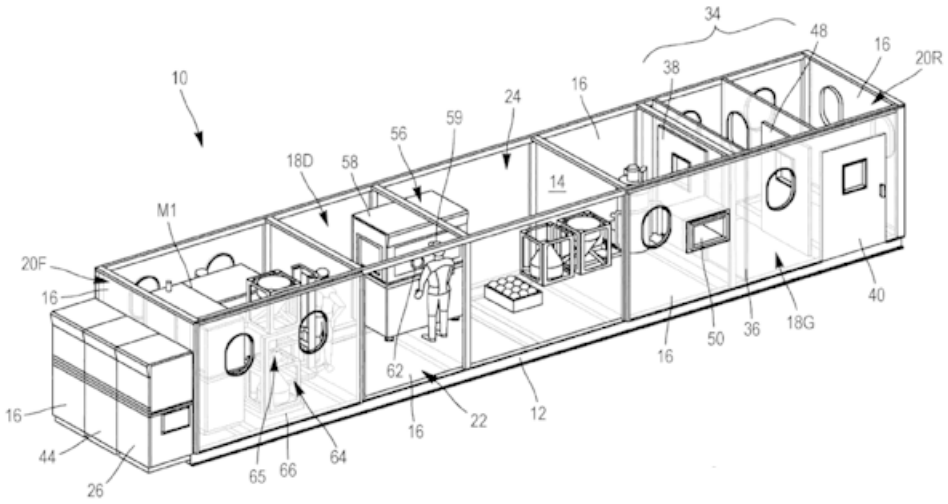
Illustrative examples of subject matter classified in this place:

1.



System (8) where a component (100) is formed in the chamber (12) and undergoes post-processing in the chamber (14). It is transferred between the chambers (10, 12, 14) by means of belt or conveyor (30, 58, 62).

2.



Mobile AM installation (10) with an AM machine (M1) and auxiliary functions.

B22F 12/88

Handling of additively manufactured products, e.g. by robots

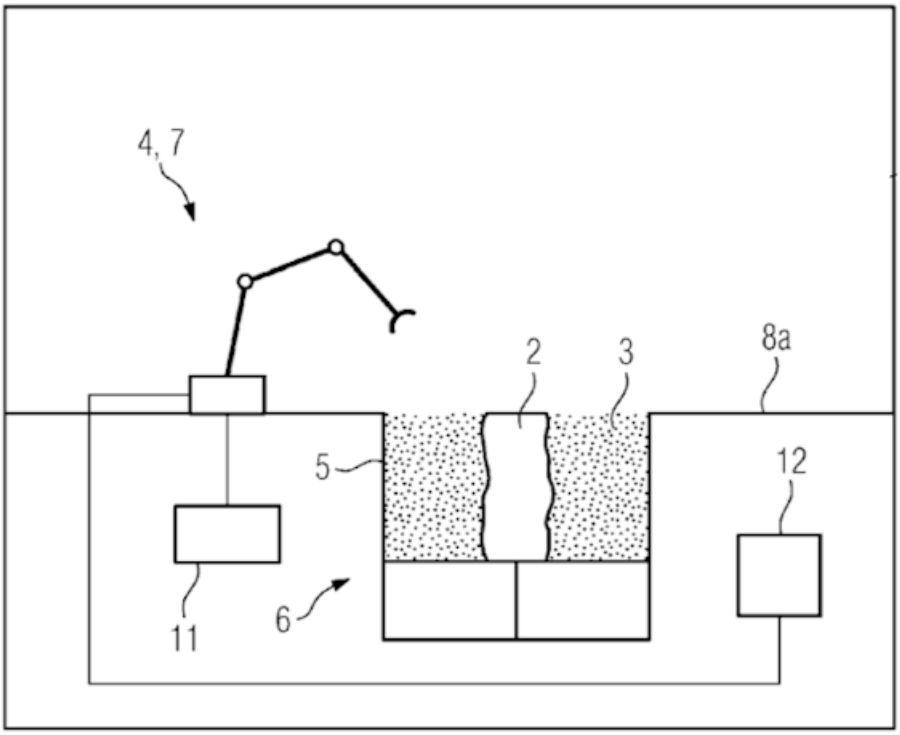
Definition statement

This place covers:

Moving and handling of additively manufactured products.

Also, unpacking devices and devices for removing leftover powder by rotating and/or vibrating the article after manufacturing. Unpacking devices may comprise any manipulation devices (e.g. robot, crane or gantry) configured to grasp/seize the three-dimensional article after manufacturing and to release it from surrounding unused build material.

Illustrative example of subject matter classified in this place:



Unpacking device (4) for unpacking article (2) from unsolidified construction material (3).

B22F 12/90

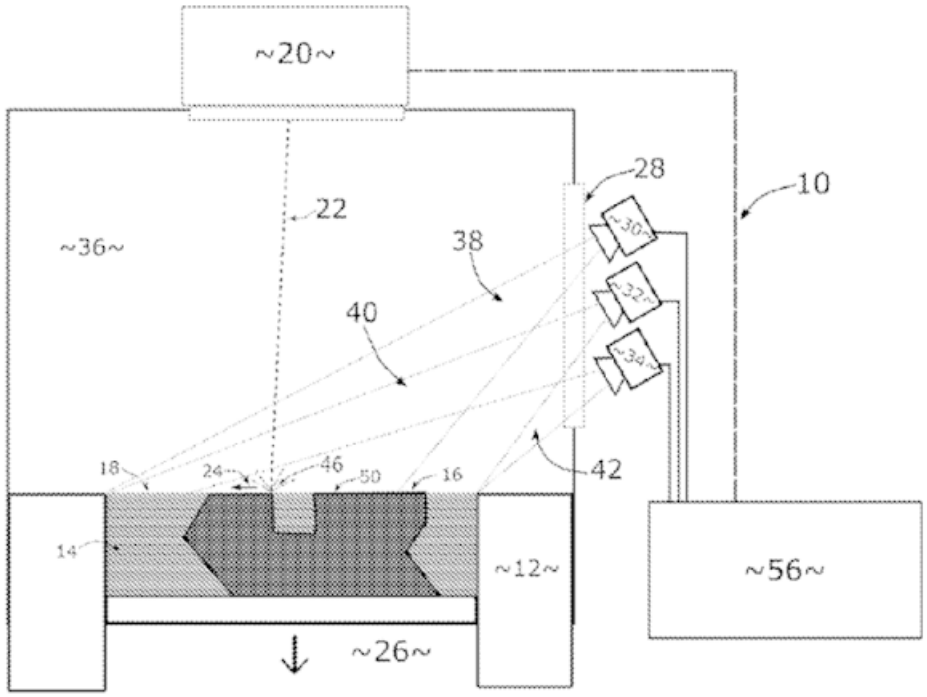
Means for process control, e.g. cameras or sensors

Definition statement

This place covers:

Arrangements of sensors for monitoring or process control.

Illustrative example of subject matter classified in this place:



A plurality of image sensors (30, 32, 34) and a processor (56) for combining the fields of view of the sensors to a single image.

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).