Patent Claims

1. A machine for additive manufacturing of three-dimensional objects comprising a vacuum chamber inside which at least two sources of particles with mass are placed, each source emitting one beam and each source equipped with a system of magenetic lenses, said system of magnetic lenses for adjusting divergence and deflection of said beam,
characterized in that
a conductive needle is positioned in the vacuum chamber so that it reaches up to an initial print point inside a melting area, wherein said conducting needle is connected to a switch 111, a switch 112 and a switch 113 which are operated with a control signal CTRL F1 via control unit CT F1, and where at the switch 111 grounds the electric needle, the switch 112 is connected to a higher electrical potential than the at least two sources of particles with mass, and the switch 113 is connected to a lower electrical potential than the at least two sources of particles with mass;
powder material for manufacturing of the said object is transported to the melting area with the use of
- magnetic levitation enabled by a magnetic field (B) achieved with at least two windings (105, 106, 205, 206, 207, 208), or
- electrostatic pull between the conductive needle and the powder material, or
- a vector sum of momentum of particles emitted from at least two sources which creates a push force onto the powdered material,
and wherein the control unit CT1 and control unit CT2 are arranged to control the divergence and the deflection of the at least two beams so that the intersection of the at least two beams is a melting area defined as a curved volume, wherein the curved volume is not a two-dimensional layer with a specific height and not small point with a permanently fixed size.

2.. A machine for additive manufacturing of three-dimensional objects according to claim 1, the machine comprising:
a first source (11) of particles with mass emitting a first beam (E_1); a first system of magnetic lenses (18) for determining divergence (α) and deflection of said beam (E_1); a first control signal (CTRL 1) which manages the first source (11) of particles with mass via a control unit (CT 1) and causes the creation of the said predetermined beam (E_1); a second source (12) of particles with mass emitting a second beam (E_2); a second system of magnetic lenses (19) for

determining divergence (β) and deflection of said second beam (E_2); a second control signal (CTRL 2) which manages the second source (12) of particles with mass via a control unit (CT 2) and causes the creation of said predetermined beam (E_2), all installed in a vacuum chamber (116);
characterised in that

two or more predefined clusters (160,170) emitted from different sources (11,12) overlap in a predefined volumetric part of a printing space (2) of the machine (1) and in this way create a curved three-dimensional intersection volume (28) of which the outer surface is curved and inside of the said volume (28) a melting volume (280) is defined as a curved volume corresponding to the intersection of at least two particle beams (E_1, E_2) emitted from at least two sources (11, 12), where the sum of energies of the predefined individual clusters (160,170) exceeds the energy threshold required for melting of a powdered material (102) which can be transported to the melting volume (280), by

- magnetic levitation enabled by a magnetic field (B) achieved with at least two windings (105, 106, 205, 206, 207, 208), or

- electrostatic pull between the powdered material (102) and an already printed object part (1000) using a control signal (CTRL F1) and a control unit (CT F1) controlling a switch (112) for creating electric connection between a conductive needle (115) and higher electric potential (W_1) or a switch (113) for creating electric connection between the conductive needle (115) and lower electric potential (W_2) or
- with the use of a vector sum of momentum of particles emitted from two or more spatially arranged sources (11, 12) and which creates a push force onto the powdered material (102), and said sum of energies therefore causes melting of the powdered material (102).

3. The machine according to claim 1 or claim 2, characterised in that the machine comprises more than two particle sources (11, 12, 61, 62, 63, 64), more than two control signals (CTRL 1, CTRL 2, CTRL 3, CTRL 4, CTRL 5, CTRL 6) and more than two control units (CT 1, CT 2, CT 3, CT 4, CT 5, CT 6).

4. The machine according to any preceding claim, characterised in that the first source (11) and the second particle source (12) are spatially arranged so that a geometrical axes (13) of the first source (11) and a geometrical axes (14) of the second source (12) intersect at an intersection

point (15) at an angle between 0-360 degrees, and that a distance (20) from the first source (11) to the intersection point (15) and distance (21) from the second source (12) to the intersection point (15) are in the range from 10 cm to 20m; or.

a plurality of particle sources (11, 12, 61, 62, 63, 64) is spatially arranged so that the geometrical axes of said sources (11, 12, 61, 62, 63, 64) intersect in an intersection point (15) or in a plurality of intersection points at angles between 0-360 degrees and that distances from all sources (11, 12, 61, 62, 63, 64) to the intersection point (15) or the plurality of intersection points are in the range from 10 cm to 20m.

5. The machine according to any of the preceding claims, characterised in that the particles with mass emitted from sources (11, 12, 61, 62, 63, 64) are electrons.

6. The machine according to any of the preceding claims, characterised in that the control signal (CTRL 1) for controlling the first source (11) and the control signal (CTRL 2) for controlling the second source (12) are mutually arranged in a timely manner and the spatial location of the intersection volume (28) is controlled with the use of time delays t_f between at least two individual clusters emitted separately from at least two sources (11, 12).

7. The machine according to any of the preceding claims, characterised in that the size of the intersection volume (28) is controlled by modulating a divergence (α_1,) of beam emitted from the first source (11), a divergence (α_2) of beam emitted from the second source (12), a length (L_1) of the individual cluster (160) emitted from the first source (11) and a length (L2) of the individual cluster (170) emitted from the second source (12).

8. The machine according to any of the preceding claims, characterised in that the individual intersection volume (28) can be assembled from plurality of smaller volumes; that the powdered material (102) is kept in a container (101) with a stopper (103) before printing and that the exit of said container (101) is equipped with an actuator (104) for the purpose of dispersing powdered material (102) and said stopper (103) is controlled with the control unit (CT C1) via control signal (CTRL C1); that one (11) or plurality of particle sources (12,61) is geared with a linear mechanisation (117) enabling movement of said sources (11,12,61) and/or

circular mechanisation (118) enabling rotation of one (11) of said sources relative to the other said sources (12,61).

9. The machine according to any of the preceding claims, characterised in that excessive charge are removed from an already printed object part through a conductive needle (115) which is connected electrically to the surface of the already printed object part and controlled with a control unit (CT F1) via a control signal (CTRL F1).

10. Method for additive manufacturing of three-dimensional objects comprising the following steps: a print preparation (5) and a printing process (100) wherein during the print preparation (5) using a simulator (8) and based on print specifications (6) and machine specifications (7), a spatial division 50 of a digital file of the three-dimensional object (4) is conducted followed by creation of a control file (10) using a generator (9), said control file (10) managing all assembly part of the machine (1) with the use of dedicated control signals (CTRL 1-H) via control units (CT 1-H) for the purpose of gradual fabrication of the three-dimensional object (3), wherein final object is fabricated with gradual fabrication of individual constituent parts and with assembling of said constituent parts in a specific sequence until the final object is fabricated
characterised in that
an individual constituent part of final fabricated three-dimensional object is a three-dimensional curved volume, wherein the curved volume is not a two-dimensional layer with a specific height and not small point with a permanently fixed size;the powdered material (102) is melted in a predetermined curved melting volume (280) which is inside the intersection volume (28) of beams emitted from a plurality of particle sources (11, 12) wherein in the predetermined melting volume (280) the kinetic energy of particles emitted from a plurality of particle sources (11, 12) adds up and exceeds the threshold required to melt the material; and
wherein the powdered material (102) is transported into a melting volume with the use of:
- magnetic levitation achieved with a plurality of windings (105, 106) creating a magnetic field (B); or
- electrostatic pull between the conductive needle (115) and powdered material (102) wherein the electrostatic pull is created with an electrical connection of a higher electric potential (W_1) via a switch (112) to the conductive needle (115) or with an electric connection of a lower electric potential (W_2) via a switch (113) to the conductive needle (115) and wherein the

conductive needle (115) is connected electrically to the surface of the already printed object part (1000); or
the powdered material (102) is transported onto an already printed object part (1000) with the use of a vector sum of momentum of particles emitted from two or more spatially arranged sources (11, 12) and which creates a push force onto the powdered material (102).

11. Method for additive manufacturing of three-dimensional objects according to claim 10, characterised in that:
excessive electric charge is removed from surface of the already printed object part (1000) via a switch (111) creating an electrical connection between the conductive needle (115) or the already printed object part (1000) and a ground connection or a point with a lower electrical potential (W_2) or a point with higher electrical potential (W_1).

12. Method according to claim 10 or 11, characterised in that an individual curved print volume (1,2,3...Z) in a sequence (51) is assembled from a plurality of smaller print volumes (157,1570).

13. Method according to claim 12, characterised in that the plurality of smaller curved print volumes (157, 1570) assembling the individual print volume (1,2,3...Z) in the sequence (51) is fabricated in multiple printing directions at the same time.

14. Method according to claim 13, characterised in that an individual curved print volume (152) in a sequence (51) can be in the interior of a next print volume (153) in the sequence (51).

15. Method according to claim 13, characterised in that the surface of individual curved print volume (155) in a sequence (51) touches the surface of a next individual curved print volume (1570) in sequence (51).