CLAIMS

1 A method of manufacturing a component comprising the steps of

heating a working region of a substrate with a heating means;

directing a material into the working region to bring the material into a temporary molten state;

depositing said material on the substrate such that when the material solidifies it forms at least part of the component;

wherein the heating means power output, stand off, orientation, speed and direction of travel relative to the substrate are adjustable and controlled throughout the material deposition process to control the shape and/or size of the working region to thereby control the distribution and rate of heat delivery to the substrate.

2 A method as claimed in claim 1 wherein the rate at which material is delivered to the working region is adjustable and controlled throughout the material deposition process.

3 A method of manufacturing a component as claimed in claim 1 or claim 2 wherein the heating means stand off relative to the substrate is adjusted by varying the heating means distance relative to the substrate.

4 A method of manufacturing a component as claimed in claim 1, claim 2 or claim 3 wherein the heating means orientation relative to the substrate is adjusted by varying the angle of the heating means relative to the substrate in the direction of travel of the heating means relative to the substrate.

5 A method of manufacturing a component as claimed in any one of the preceding claims wherein the heating means orientation relative to the substrate is adjusted by varying the angle of the heating means relative to the substrate at an angle to the direction of travel of the heating means relative to the substrate.

6 A method of manufacturing a component as claimed in any one of the preceding claims wherein the orientation of the heating means is adjusted to substantially match the curvature of the substrate.

7 A method of manufacturing a component as claimed in any one of the preceding claims wherein the heating means speed relative to the substrate is adjusted by varying the speed of the heating means in the direction of travel.

8 A method of manufacturing a component as claimed in any one of the preceding claims wherein the direction of travel relative to the substrate is adjusted such that the path of the heating means is at least in part curved.

9 A method of manufacturing a component as claimed in claim 8 wherein the direction of travel relative to the substrate is adjusted such that the path of the heating means is at least in part curved and has a variable curvature.

10 A method of manufacturing a component as claimed in any one of the preceding claims wherein the direction of travel of the heating means is adjusted to substantially match the curvature of the substrate.

11 A method of manufacturing a component as claimed in any one of the preceding claims wherein the heating means comprises a means for generating an energy beam which is focussed and shaped to define a heating zone of constant size and geometry which is projected on the substrate to define the working region.

12 A method of manufacturing a component as claimed in claim 11 wherein the size of the working region of the substrate is controlled by adjustment of the heating means stand off and orientation relative to the substrate throughout the material deposition process thereby adjusting the cross-sectional area of the heating zone throughout the material deposition process.

13 A method of manufacturing a component as claimed in claim 11 or claim 12 wherein the shape of the working region of the substrate is controlled by adjustment of the heating means stand off, orientation and/or direction of travel relative to the substrate throughout the material deposition process thereby adjusting the cross-sectional shape of the heating zone throughout the material deposition process.

14 A method of manufacturing a component as claimed in any one of the preceding claims wherein the method comprises a laser weld deposition process.

15 Apparatus for manufacture of a component by a material deposition process comprising a heating means for heating a working region of a substrate wherein the heating means power output, stand off, orientation, speed and direction of travel are adjustable and controllable throughout operation of the apparatus during the material deposition to thereby control the distribution and rate of heat delivery to the substrate.

The invention claimed is:

1. A method of manufacturing a component comprising the steps of:

defining a component geometry model representative of the component to be manufactured, the component geometry model comprising a plurality of geometric features of the component;

for each geometric feature, using a lookup table comprising a library of known standard features to determine optimal values of a set of parameters comprising power output, position, orientation, speed and direction of travel of a heating means relative to a substrate and an optimal rate of powder delivery, to generate the feature using the known standard features;

heating a working region of the substrate with the heating means;

directing a material into the working region to bring the material into a temporary molten state;

depositing said material on the substrate such that when the material solidifies it forms at least part of the component;

controlling by a control unit through a plurality of links, throughout the material deposition process, wherein the set of parameters are controlled to correspond to the optimal values to control the shape and/or size of the working region to thereby control the distribution and rate of heat delivery to the substrate.

2. A method as claimed in claim 1 wherein the rate at which material is delivered to the working region is controlled throughout the material deposition process.

3. A method of manufacturing a component as claimed in claim 1 wherein the heating means stand off relative to the substrate is adjusted by varying the heating means distance relative to the substrate.

4. A method of manufacturing a component as claimed in claim 1 wherein the heating means orientation relative to the substrate is adjusted by varying the angle of the heating means relative to the substrate in the direction of travel of the heating means relative to the substrate.

5. A method of manufacturing a component as claimed in claim 1 wherein the heating means orientation relative to the substrate is adjusted by varying the angle of the heating means relative to the substrate at an angle to the direction of travel of the heating means relative to the substrate.

6. A method of manufacturing a component as claimed in claim 1 wherein the orientation of the heating means is adjusted to substantially match the curvature of the substrate.

7. A method of manufacturing a component as claimed in claim 1 wherein the heating means speed relative to the substrate is adjusted by varying the speed of the heating means in the direction of travel.

8. A method of manufacturing a component as claimed in claim 1 wherein the direction of travel relative to the substrate is adjusted such that the path of the heating means is at least in part curved.

9. A method of manufacturing a component as claimed in claim 8 wherein the direction of travel relative to the substrate is adjusted such that the path of the heating means is at least in part curved and has a variable curvature.

10. A method of manufacturing a component as claimed in claim 1 wherein the direction of travel of

the heating means is adjusted to substantially match the curvature of the substrate.

11. A method of manufacturing a component as claimed in claim 1 wherein the heating means comprises a means for generating an energy beam which is focused and shaped to define a heating zone of constant size and geometry which is projected on the substrate to define the working region.

12. A method of manufacturing a component as claimed in claim 11 wherein the size of the working region of the substrate is controlled by adjustment of the heating means stand off and orientation relative to the substrate throughout the material deposition process thereby adjusting the cross-sectional area of the heating zone throughout the material deposition process.

13. A method of manufacturing a component as claimed in claim 11 wherein the shape of the working region of the substrate is controlled by adjustment of the heating means stand off, orientation and/or direction of travel relative to the substrate throughout the material deposition process thereby adjusting the cross-sectional shape of the heating zone throughout the material deposition process.

14. A method of manufacturing a component as claimed in claim 1 wherein the method comprises a laser weld deposition process.

15. Apparatus for manufacture of a component by a material deposition process comprising:

a component geometry model representative of the component to be manufactured, the model comprising a plurality of geometric features of the component,

a heating means for heating a working region of a substrate, wherein each geometric feature is generated using known standard features based upon a lookup table comprising a library of the known standard features used to determine optimal values of a set of parameters comprising power output, position, orientation, speed and direction of travel of the heating means relative to the substrate and an optimal rate of powder delivery; and

a control unit for controlling the set of parameters through a plurality of links, throughout the material deposition process, the set of parameters being controlled to correspond to the optimal values to thereby control the distribution and rate of heat delivery to the substrate.