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SAMPLE SCRIPT A

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AN APPARATUS AND METHOD FOR VAPOUR DEPOSITION OF ALLOYS

The invention relates to an apparatus and method for vapour deposition of alloys. In particular the invention relates to an apparatus for vapour deposition of alloys comprising a peening device.

A know apparatus for vapour deposition of aluminium alloys comprises an evaporator source and a collector drum. The evaporator source is fed with a molten alloy mix; the proportions of which are arranged to provide exactly the desired alloy when deposited. The evaporator source heats the molten alloy mix to form an alloy vapour.

The collector drum is positioned above the evaporator source so that the alloy vapour is collected and condensed on the collector drum to form a deposited alloy layer.

The collector drum is cooled to 250°C and rotates at a rate, typically of the order of 10rpm, so that within a 3 metre diameter drum, a layer of alloy about 5μm thick is formed on the collector drum during each revolution, until a desired thickness of alloy is obtained.

The chamber in which all the components are located and the process takes place is kept at a high vacuum with a residual pressure of approximately 4×10^{-5} torr; so that oxidation of the newly-formed layer by exposure to residue oxygen and water in the vacuum chamber will be minimised.

The deposited alloy is removed from the collector drum once a sufficient thickness has been built up. The newly-formed aluminium alloy is then mechanically worked to improve the properties of the alloy. The removed strips of deposited alloy are mechanically worked by being passed between opposed pressure rollers whilst the alloy is still relatively warm and malleable. This causes renucleation of the growing metal crystals and controls preferential crystal facet growth. All this results in fine grain size, high density and a lack of residual tensile stresses; which might otherwise lead to a cracking of the alloys in use.

In one embodiment of the invention an apparatus for vapour deposition of alloys as claimed in claim 1 is provided.

This apparatus is advantageous over the know apparatus as the deposited alloy does not need to be removed from the collector drum prior to mechanical working. Therefore the time taken to manufacture the alloy is reduced.

In another embodiment of the invention an apparatus for vapour deposition of alloys as claimed in claim 2 is provided.

This apparatus is advantageous over the know apparatus as each layer of deposited alloy can be mechanically worked prior to application of the next layer.

In another embodiment of the invention a method for vapour deposition as claimed in claim 12 is provided.

A detailed description of the invention will now be given with reference to the accompanying drawing in which

figure 1 illustrates the apparatus of the invention;

figure 2 illustrate one embodiment of a peening device of the apparatus of the invention

figure 3 illustrates a cross section of the peening device of figure 2 taken along lines III

figure 4 illustrates a cross section of the housing mouth of the peening device taken along line IV of figure 3

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An apparatus for vapour deposition of alloys of the invention comprises an evaporator source 101, a collector drum 103 and peening device 105 as illustrated in figure 1.

The evaporator source 101 is fed with a molten alloy and heats the alloy to form an alloy vapour.

The collector drum 103 is positioned above the evaporator source 101 so that the alloy vapour is collected and condensed on the collector drum 103 to form a deposited alloy layer 107.

The peening device 105 is positioned adjacent to the collector drum 103 and directs shot onto the surface of the newly deposited alloy layer 107.

As illustrated in figure 2, the peening device 105 has a rotor 201 with blades 203 arranged to be rotated in a housing 205. The housing has a well 207 beneath the rotor 201 to form a reservoir of small hard balls, known as shot 300.

The housing 205 is arranged and shaped to project the shot 300 onto the surface of the newly deposited alloy 107 on the collector 103. It is extremely undesirable for any shot 300 to drop down into the evaporator source 101. Therefore, the housing mouth is

surrounded by a row of wire brushes 209 to seal against the collector 103 and direct stray shot 300 back onto the housing 205.

The blades 203 extend across the width of the housing 205 with a running clearance both between the blades 203 and the housing sides and between the blade tips 204 and the housing well 207. The running clearance is smaller than the diameter of the shot 300; to abviate shot 300 from jamming the rotor 201 in the housing 205.

The blades 203 may have rubber tips 204 or may be entirely of rubber.

The shot material has to be resistant to fracture under operating conditions and may be made, for example, of quartz, which has a relatively low density, approximately 2.64 x 10^3 kg/m^3 or tungsten which has a relatively high density approx 1.96 x 10^4 kg/m^3.

Preferably, the shot material is steel, which has a high density of approximately 7.90 x10^3 kg/m^3.

Furthermore, it is preferably that the shot has a diameter in the range of between 0.9mm and 1.6mm. More preferably, the shot has a diameter of about 1.2mm.

As illustrated in figure 4, the housing mouth 400 is narrower than the width of alloy deposited on the collector, this means that only a portion of the deposited alloy can be shot peened by the peening device105. Peening of the whole width of the deposited alloy is achieved either by providing multiple peening devices 105 arranged to peen overlapping portions of deposited alloy or by moving the peening device 105 across the collector drum 103 as the collector drum rotates.

In use, the shot is bombarded against the surface of the newly deposited alloy 107 by the rotating blades and blade tips 203, 204 at high velocity to increase the resistance of the alloy to fatigue failure by adding dislocations and hardening the surface. The surface of the alloy is impacted a plurality of times by the shot 300.

For a 60mm wide rotor 201 rotating at 1750 rpm between 6000 and 12000 shots are sufficient to harden the surface of the alloy.

A rotor substantially wider than 60mm risks the migration of shot to one side or the other of the well. However, this can be impeded by using internal well dividers.

In an alternative embodiment the peening device may comprise a rotor having metal flails which are used to harden the surface of the alloy, by impacting the surface of the alloy a plurality of times. However, the flails must be adjusted so that the surface is not worked too regularly and consequently the working of the surface is inadequate.

The apparatus of the invention is located within a vacuum.

CLAIMS

1) Apparatus for vapour deposition of alloys comprising:-

an evaporator device for heating an alloy to form an alloy vapour;

a collector device having a surface upon which the alloy vapour from the evaporator device is capable of being condensed to form a layer of deposited alloy; and

a peening device for mechanically working the deposited alloy by impacting a surface of the deposited alloy a plurality of times with impacting means.

2) The apparatus according to claim 1, wherein the layer of deposited alloy comprises a plurality of sublayers, and the surface of each sublayer of deposited alloy is impacted a plurality of times by the impacting means.

3) The apparatus according to claim 1 or claim 2, wherein the peening device comprises:-

a rotor provided with blades and capable of rotation within a housing, and wherein the impacting means is a plurality of shot.

4) The apparatus according to claim 3, wherein the shot is steel shot having a diameter between substantially 0.9mm and substantially 1.6mm.

5) The apparatus according to claim 4, wherein the shot has a diameter of substantially 1.2mm.

6) The apparatus according to claims 3 to 5, wherein the housing comprises internal dividers capable of impeding migration of the shot to one side or another side of the housing.

7) The apparatus according to claim 3 to 6, wherein the peening device further comprising:-

Sealing means surrounding an opening in the housing, the sealing means capable of preventing the shot from leaving the housing.

8) The apparatus according to claim 1 or claim 2, where in the peening device comprises:-

a rotor provided with flails, and wherein the impacting means is the flails.

9) The apparatus according to any preceeding claim, wherein the peening device is movable with respect to the collector device.

10) The apparatus according to any preceding claim, wherein the collector device is a drum.

11) The apparatus according to any preceding claim, wherein the apparatus is located within a vacuum.

12) A method for vapour deposition of alloys comprising:-
heating an alloy to form an alloy vapour;
condensing the alloy vapour on a collector device to form a layer of deposited alloy; and impacting a surface of the deposited alloy a plurality of times with impacting means to mechanically work the deposited alloy.

13) The method according to claim 12, wherein the layer of deposited alloy comprises a plurality of sublayers, and the surface of each sublayer of the deposited alloy is impacted a plurality of times with the impacting means.

14) The method according to claim 12 or claim 13, further comprising:-
removing the worked alloy from the collector device.

15) Apparatus for vapour deposition of alloys as hereinbefore described and with reference to any one of figures 1 to 4.

16) A method for vapour deposition of alloys as hereinbefore described.

[4 pages of drawings follow]

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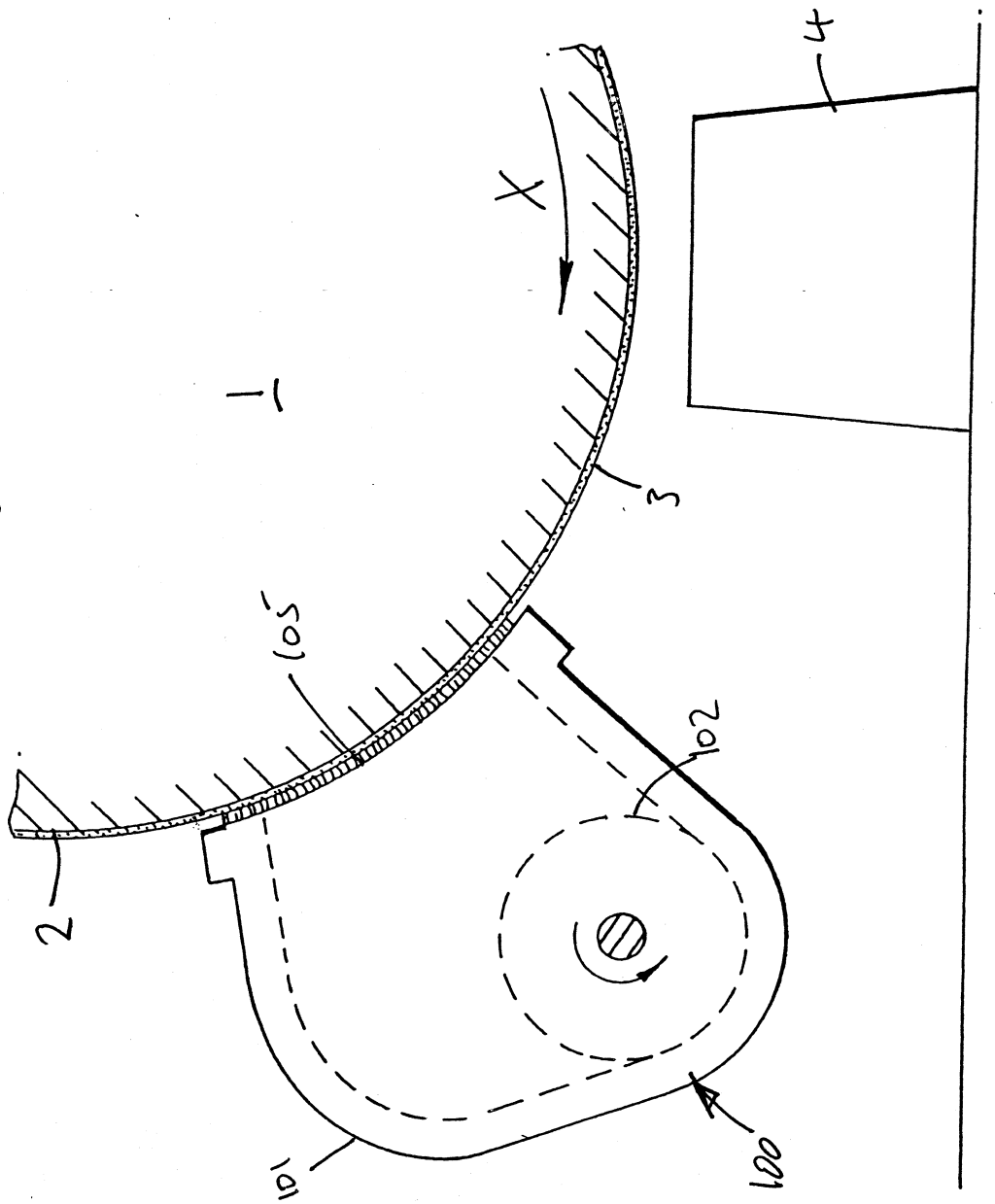


Fig. 1

Fig. 2

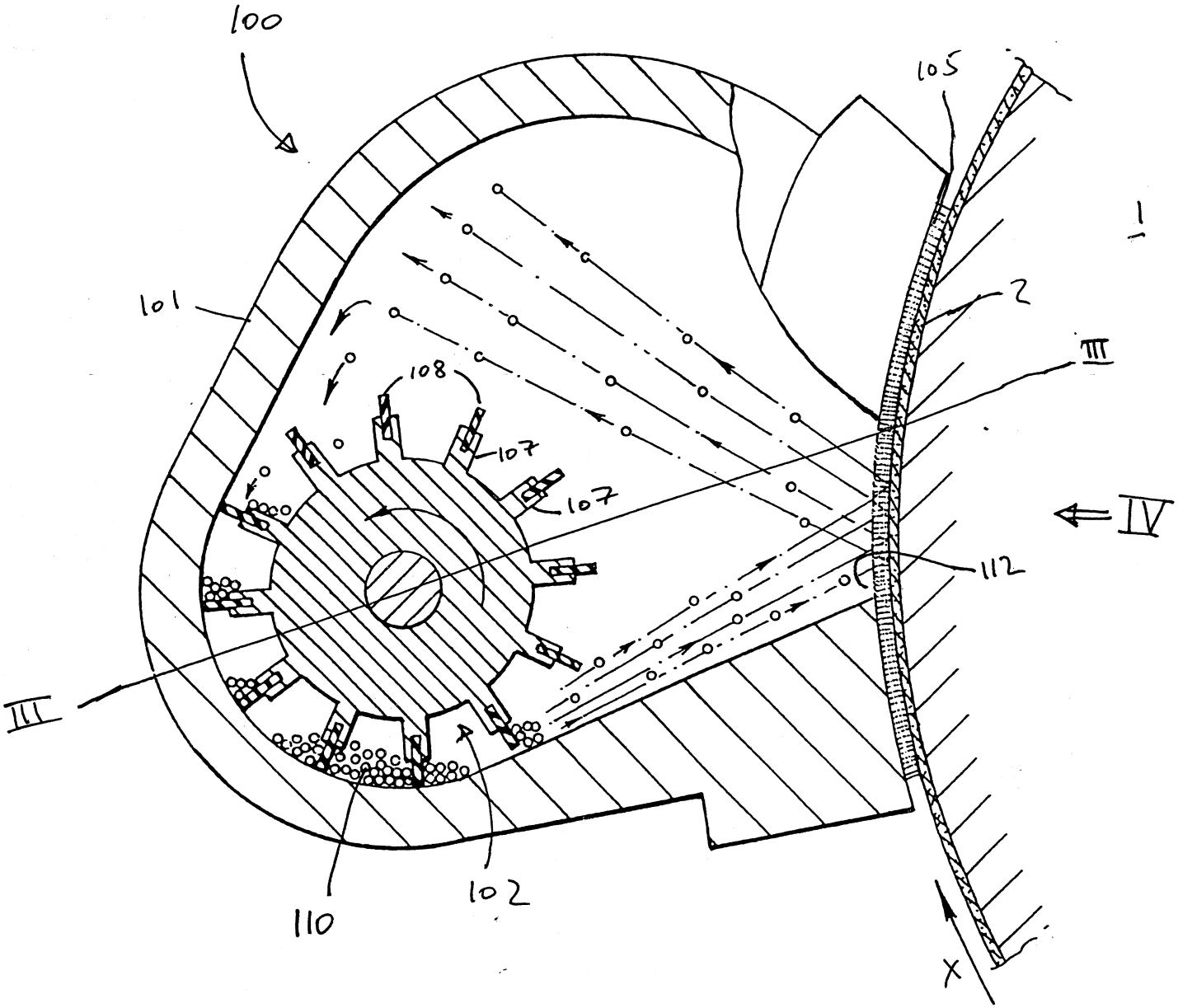


Fig. 3

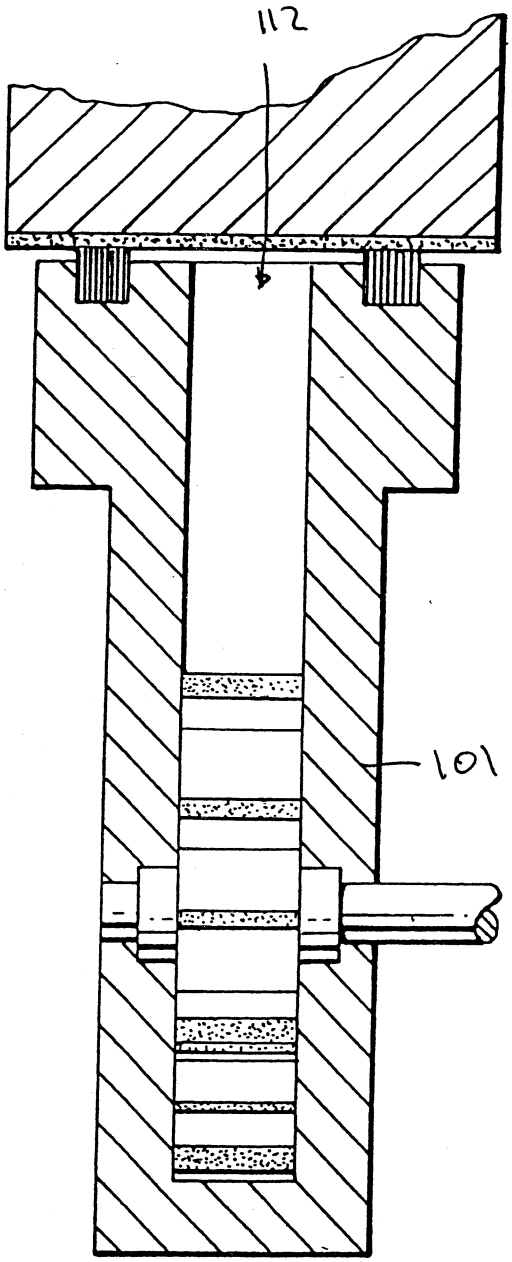
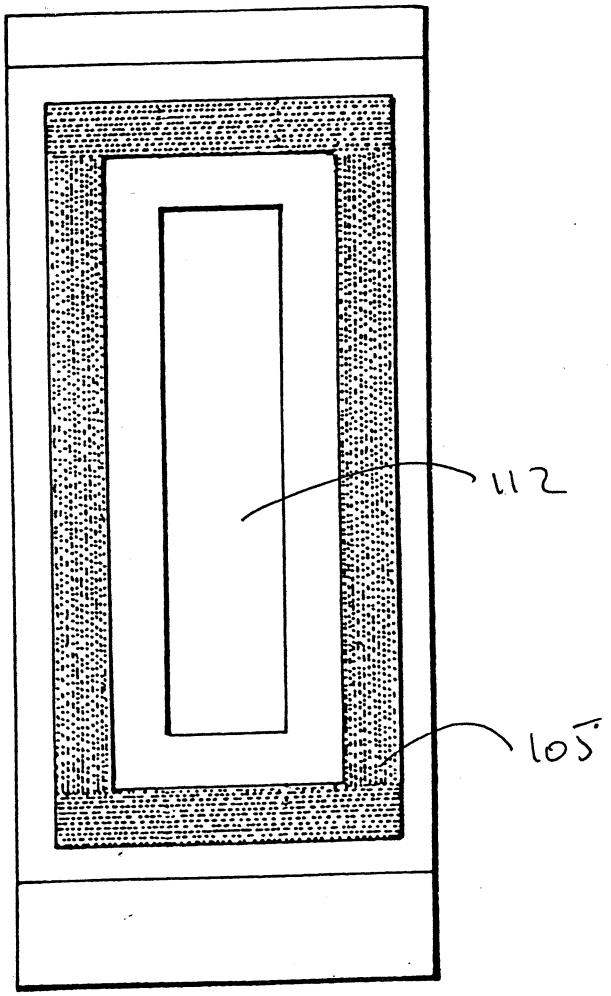


Fig. 4



2005 PAPER P3
SAMPLE SCRIPT B

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IMPROVED ALLOY PRODUCTION

The invention relates to alloy production, in particular to vapour deposition of alloys.

Vacuum deposition of vaporised aluminium alloys is a well-known technique.

It is also well-known to mechanically work these newly formed aluminium alloys once they have been removed from the apparatus on which they are first formed.

For example, strips of deposited alloy are taken from the collector where they are initially formed by condensation and passed between opposed pressure rollers whilst the alloy is still relatively warm and malleable.

Such mechanical working improves the properties of the resultant alloy.

Thus, in the art, there is a requirement to first build up the alloy to its desired thickness and then rapidly remove the alloy and mechanically work the completed alloy in a separate process.

The present invention provides [claim 1]. This method is much more convenient since the alloy is mechanically worked as it is being formed and thus ensures a convenient process in which the alloy is guaranteed to be warm and malleable and therefore most susceptible to working to produce a superior product.

Preferably [claim 2]. Layer by layer working of the alloy is also considered to provide an improved product since each layer is worked under optimal conditions as opposed to the final alloy being worked in a separate process.

In specific embodiments, [claims 3 to 12] Thus, peening is the preferred method of working each layer of the alloy. Steel shot of about 1.2mm diameter has been shown to be particularly effective.

Preferably, the peening device as described herein has a 60mm wide rotor which rotates at 1750 rpm. Under these conditions, using 6,000 to 12,000 shot balls works well.

In a second aspect, the invention provides [claim 13 and 14].

Alloys in which each layer has been mechanically worked is expected to produce an alloy having superior properties.

In a third aspect there is provided [claims 15 to 36]. Thus, this apparatus is useful for producing alloys according to the method of the invention.

In a fourth aspect, the invention provides [claim 37].

Thus, the preferred peening device may be supplied as a separate component to use in existing vapour deposition of alloy systems.

The invention will now be described in a non-limiting example with reference to the accompanying drawings in which

fig 1 shows a side view of an apparatus of the invention including a peening device.

fig 2. shows a detailed cross sectional side view of the peening device

fig 3 shows a cross sectional view along the line III-III in fig 2. Note, the shot is not shown here for clarity

fig 4 shows an end view of the peening device in the direction of arrow IV in fig 3. Here the collector drum and rotor are not shown.

Referring to fig 1, a collector drum 1 is positioned above an evaporator source 2 for an alloy mix. The alloy condenses on the collector drum 1 to form a deposited alloy layer 3.

A peening device 4 is located in sealed engagement with the collector drum thanks to a seal 5. The peening device is a rotor 6.

As shown in fig 2, the rotor 6 comprises blades 7 arranged to be rotated in a housing 8. The housing has a well 9 beneath the rotor 6 to form a resevoir for shot 10.

The blades 7 extend across the width of the housing 8 with a running clearance both between the blades 7 and housing 8 sides and between the blade tips 11 and the housing well 9. The running clearance is smaller than the shot diameter to prevent jamming of the rotor 6 by shot 10 in the housing 8.

The rotor 6 is driven by a rotor driveshaft 12.

The housing is arranged and shaped to form a ramp 13 for the shot 10. The housing 8 has a mouth 14, also shown in fig 3 which is surrounded by a row of wire brushes 15 which form the seal 5.

As shown in fig 4, the housing mouth 14 is narrower than the width of alloy deposited on the collector.

In use, alloy vaporised in the evaporator source 2 condenses on the collector drum 1 which rotates in the direction of the arrow, thus forming an alloy deposit 3 as a layer.

The alloy 3 is peened by peening device 4 as each layer is deposited on the drum 1.

The rotor drive shaft 12 drives the rotor 6 as shown by the arrow in fig 2. The blades 7 and blade tips 11 thus pick up shot 10 from the well 9.

Continued rotation projects the shot 10 up the ramp 13 in the housing 8 onto and against the alloy 3 deposited on the collector drum 1.

The seal 5 comprising wire brushes 15 acts to seal the housing mouth 14 against the collector 1 to prevent spillage of short 10 and also to direct shot 10 into the housing 8.

Thus, as the collector 1 continues to rotate each layer of alloy is peened as it is deposited to mechanically work it whilst it is warm and malleable.

Due to the housing mouth 14 being narrower than the width of alloy 3 deposited on the collector 1, only a portion of the alloy 3 can be shot peened by the peening device 4.

Peening of the whole alloy 3 width may be achieved by providing multiple peening devices 4 arranged to peen overlapping portions of deposited alloy 3 or moving the device 4 across the collector 1 as the collector 1 rotates (not shown).

The blades 7 and blade tips 11 are preferably made from rubber but metal flails are an alternative.

The shot 10 is preferably steel but may be tungsten or quartz for example.

It may be possible for the evaporator source 2 and peening device 4 to move relative to the collector 1 although rotation of the collector is preferable.

CLAIMS

1. A method of making an alloy comprising;

   (i) condensing an alloy vapour onto a collector surface to form a layer of condensed alloy on the surface; and

(ii) mechanically working the layer of condensed alloy whilst it remains on the collector surface.

2. A method of claim 1 wherein steps (i) and (ii) are repeated such that an alloy of a predetermined thickness is produced in which each layer of the alloy has been mechanically worked

3. The method of claim 1 or 2 wherein the collector surface is moved relative to an evaporator which provides the alloy vapour to allow continuous condensation to form the layer of condensed alloy on the surface.

4. A method of any preceding claim wherein at least the collector surface is in a vacuum.

5. A method of any preceding claim wherein the mechanical working of the layer of condensed alloy is achieved by bombarding the layer of condensed alloy with a plurality of projectiles.

6. A method of claim 5 wherein the bombarding of the layer of condensed alloy with a plurality of projectiles comprises peening.

7. A method of claim 6 wherein shot material is used.

8. A method of claim 7 wherein the shot material has a density of between approximately 2.64×10^3 kilogram per cubic metre and approximately 1.96×10^4 kilogram per cubic metre, preferably approximately 7.9×10^3 kilogram per cubic metre.

9. A method of claim 7 or 8 wherein the shot material comprises quartz and/or tungsten and/or steel, preferably steel.

10. A method of any of claims 7 to 9 wherein the shot material has a diameter of between approximately 0.9mm and 1.6mm, preferably approx. 1.2 mm.

11. A method according to any of claims 6 to 10 wherein peening is achieved by use of multiple peening devices arranged to mechanically work the entire layer of condensed alloy, or by use of a peening device which moves relative to the collector surface to mechanically work the entire layer of condensed alloy.

12. A method of any preceding claim additionally comprising;

(iii) removing the mechanically worked alloy from the collector surface.

13. An alloy comprising a plurality of layers, each layer having been individually mechanically worked.

14. An alloy of claim 13 wherein the alloy is produced by the method claim 12.

15. Apparatus for making an alloy comprising;

    (i) an evaporator for vaporising an alloy,

    (ii) a collector surface arranged to collect the vaporised alloy and allow a layer of condensed alloy to form thereon; and

    (iii) means for mechanically working the layer of condensed alloy on the collector surface.

16. An apparatus of claim 15 wherein the evaporator and collector surface are capable of movement relative to one another to facilitate layer upon layer condensation of alloy on the collector surface.

17. An apparatus of claim 16 wherein the means for mechanically working the layer of condensed alloy works each layer of condensed alloy built up on the collector surface.

18. An apparatus of claim 16 or 17 wherein the collector surface comprises a drum capable of rotation relative to the evaporator.

19. An apparatus of any of claims 15 to 18 which further comprises means for forming a vacuum around the collector surface.

20. An apparatus of any of claims 15 to 19 further comprising means to remove the mechanically worked alloy.

21. An apparatus of any of claims 15 to 20 wherein the means for mechanically working the layer of condensed alloy on the collector surface comprises a bombarding device for bombarding the layer of condensed alloy on the collector surface with a plurality of projectiles.

22. An apparatus of claim 21 wherein the bombarding device comprises a peening device.

23. An apparatus of claim 22 wherein the peening device comprises a rotor carrying a plurality of projecting members arranged so as to accelerate the projectiles onto the layer of condensed alloy on the collector surface.

24. An apparatus of claim 23 wherein the projecting members comprise blades and/or flails.

25. An apparatus of claim 24 wherein the blades comprise rubber, preferably at least

rubber tips and/or the flails comprise metal.

26. An apparatus of any of claims 21 to 25 wherein the projectiles comprise shot material.

27. An apparatus of claim 26 wherein the shot material has a density of between approximately 2.64×10^3 kilogram per cubic metre and approximately 1.96×10^4 kilogram per cubic metre, preferably approximately 7.9×10^4 kilogram per cubic metre.

28. An apparatus of claim 26 or 27 wherein the shot material comprises quartz and/or tungsten and/or steel, preferably steel.

29. An apparatus of any of claims 26 to 28 wherein the shot material has a diameter of between approximately 0.9mm and 1.6mm, preferably approximately 1.2mm.

30. An apparatus of any of claims 21 to 29 which further comprises a housing defining a resevoir for the projectiles.

31. An apparatus of claim 30 when depending from claims 26 to 29 wherein the projecting members have a running clearance in the housing which is less than the diameter of the shot material.

32. An apparatus of claim 30 or 31 wherein the resevoir comprises at least one divider to separate projectiles in the resevoir.

33. An apparatus of claim 30 to 32 wherein the housing is arranged to guide the projectiles onto the layer of condensed alloy.

34. An apparatus of claim 33 wherein the end of the housing where the projectiles exit includes sealing means to prevent spillage of the projectiles and to direct stray projectiles back into the housing.

35. An apparatus of claim 34 wherein the sealing means comprises a row of wire brushes sealing against the collector surface.

36. An apparatus of any of claims 15 to 35 which comprises a plurality of devices as defined in any of claims 21 to 35 arranged to cover substantially all of the width of the collector surface
or
which comprises a device as defined in any of claims 21 to 35 which is provided with movement means to allow movement across the collector surface.

37. A bombarding device for use in mechanical working of an alloy on a collector surface as defined in any of claims 21 to 36.

38. A method substantially as herein described with reference to the accompanying

drawings.

39. An alloy substantially as herein described with reference to the accompanying drawings.

40. An apparatus substantially as herein described with reference to the accompanying drawings.

41. A bombarding device substantially as herein described with reference to the accompanying drawings.

DRAWINGS (4 sheets) follow

NOTE TO EXAMINER

- Used “bombarding device” and “projectiles” to ensure not limited to only shot material in light of peening definitions provided ➜ skilled person likely to infer “shot” from “peening”.

- Specified particular shot types in apparatus claims for possible contibutory infringement purposes (may be sold separately).

- Put basis in description for claim to rotor width, speed and balls in case required (v narrow).

- Tried to claim alloy since client wants broadest possible protection.

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Fig. 1.

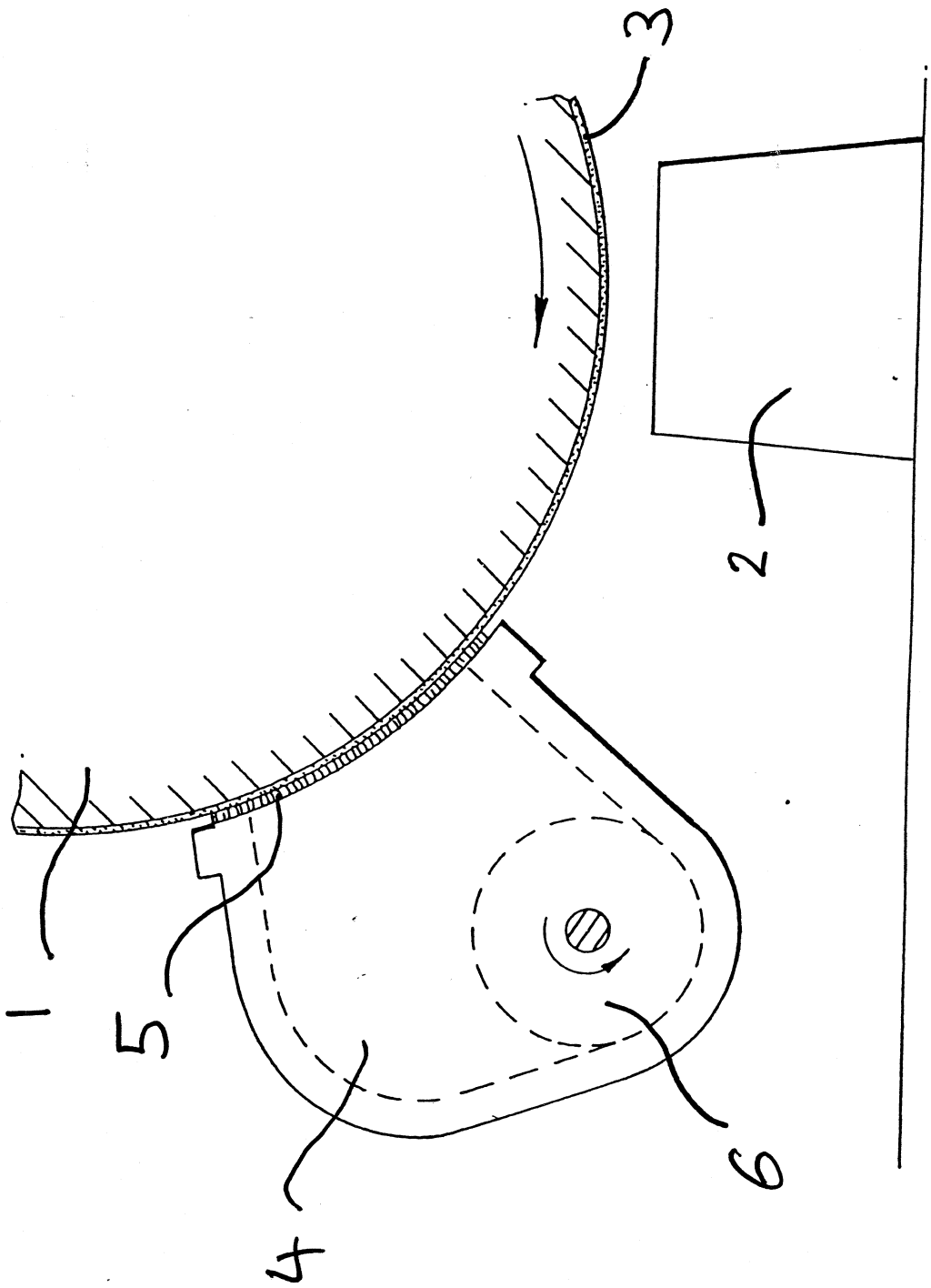

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fig. 2

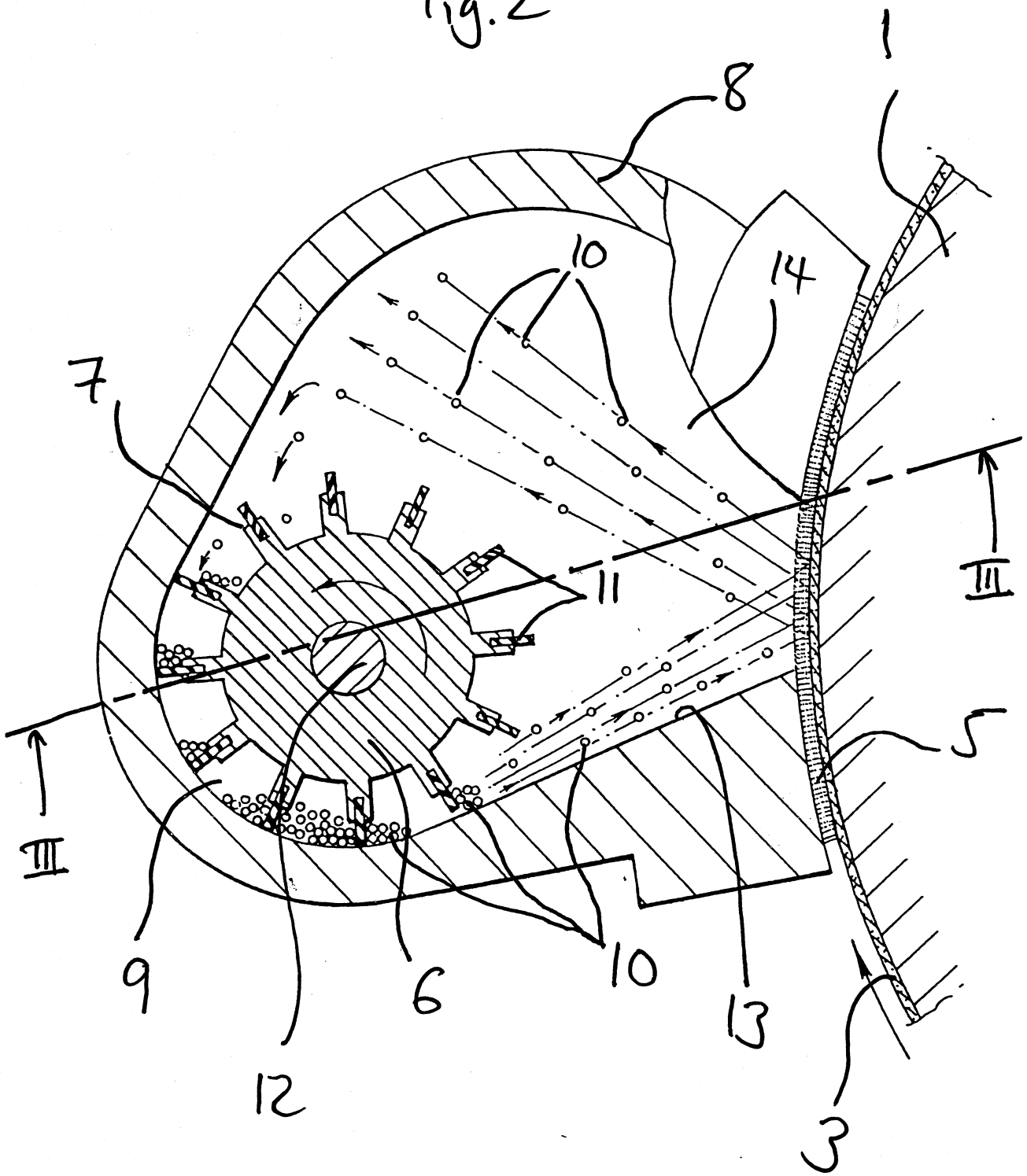

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fig.3

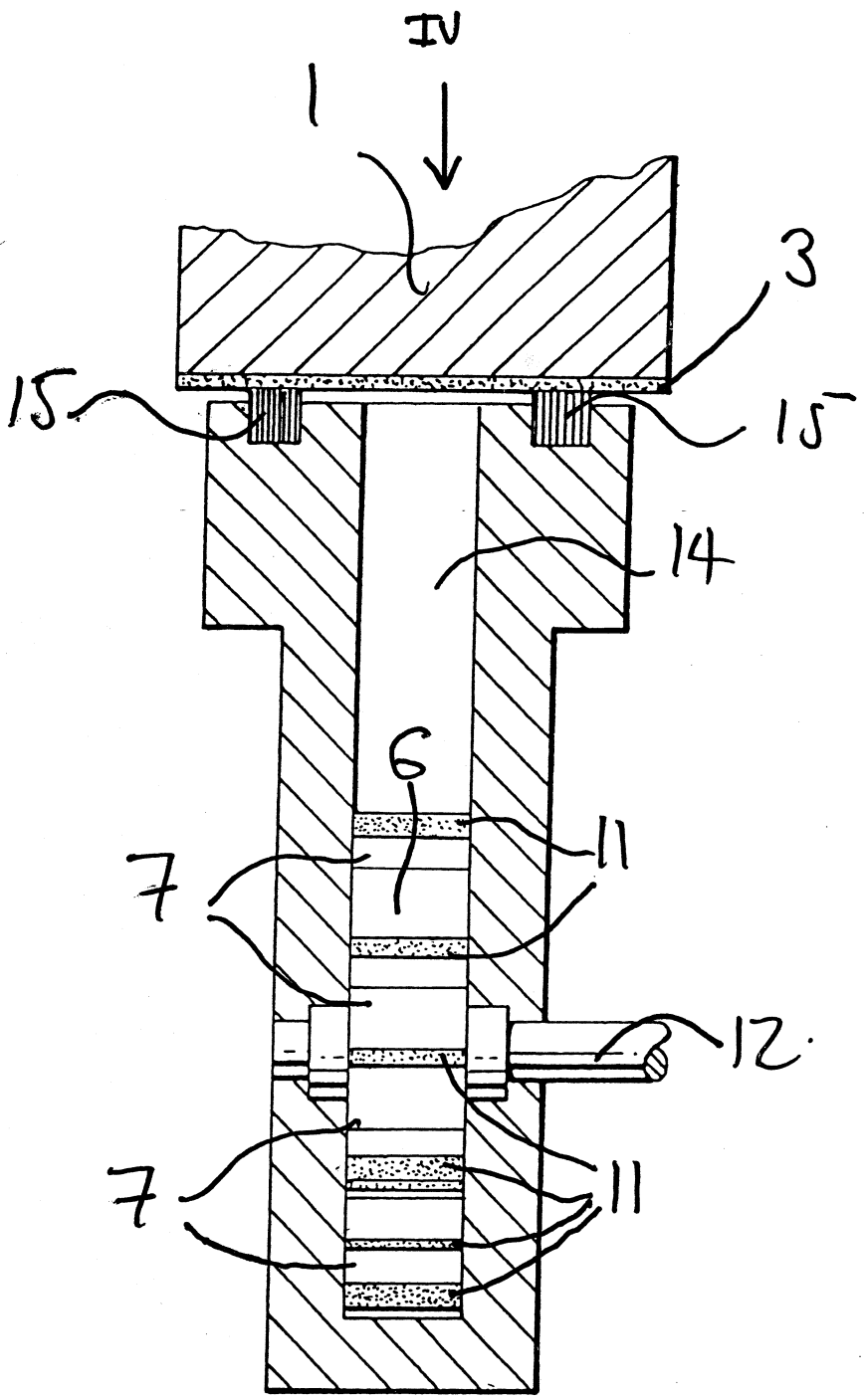

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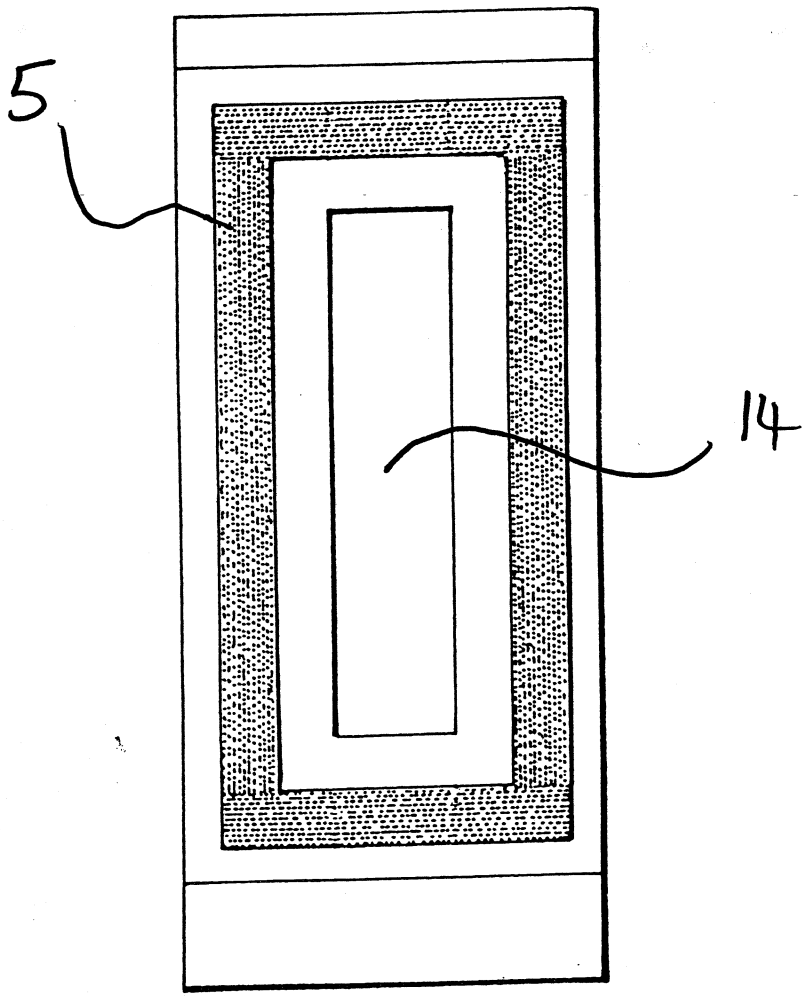
Fig. 4



2005 PAPER P3
SAMPLE SCRIPT C

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The present invention relates to a method of manufacturing an alloy, an apparatus for manufacturing an alloy, a peening device and shot for use in peening.

Techniques for vacuum deposition of vaporised aluminium alloys are well-known. In one example, a rotating drum, cooled to 250°C acts as the collector upon which an aluminium alloy is deposited. The chamber, in which all the components are located and the process takes place, is kept at a high vacuum, i.e. with a residual pressure in the region of 4×10^{-5} torr. Once a sufficiently-thick layer has built up on the collector, the deposited aluminium alloy is removed from the collector for further processing.

One such common process is to mechanically work the newly-formed aluminium alloy; for example, by passing the strips of deposited aluminium alloy removed from the collector between pressure rollers whilst still relatively warm and malleable.

Another known method of mechanically working a material is “peening”. Shot peening is when a material is bombarded with small, round steel shot at high velocities. Peening, in general, is the process of impacting the surface layer of a material a multitude of times; for example by bombarding it with a selected medium (such as round steel shot) under controlled conditions.

Mechanically working an alloy by passing it through pressure rollers is known to improve its properties, since it causes renucleation of the growing metal crystals and controls preferential crystal facet growth. This results in fine grain size, high density and a lack of residual tensile stresses; which might otherwise lead to cracking of the alloy in use.

Peening is known to have a similar effect, increasing a material’s resistance to fatigue failure by adding dislocations and hardening the surface, which is where a crack may begin due to surface flaws.

In view of this known art, a method for manufacturing alloys - not only of aluminium, but any suitable alloy, particularly those for use in aero-space applications - is proposed, along with an associated apparatus, that aims to improve on the known methods and techniques. Associated components of the apparatus are also disclosed.

A first aspect of the present invention is defined in Claim 1.

Such a method ensures that working of a newly-deposited alloy takes place as part of a single, efficient operation, without the need to remove the alloy from the collector surface before it is worked.

A second aspect of the present invention is defined in Claim 11.

An apparatus configured in this manner can efficiently continue producing worked alloy, without the need to continually halt the alloy deposition process before the alloy may be worked.

Both the method of Claim 1 and apparatus of Claim 11 are associated with a manufacturing process in which the material properties of the resultant alloy can be specifically determined by ensuring that the alloy is peened whilst still warm and malleable - i.e. before it has cooled to much after deposition onto the collector surface. This leads to associated improvement in the quality of the alloy manufactured by reducing the occurrence of defective batches.

A third aspect of the present invention is defined in Claim 23.

Such a peening device can produce a thorough and consistent peening effect over a predetermined target surface area of material to be peened, to ensure a uniform mechanical working across the full extent of that material.

A fourth aspect of the present invention is defined in Claim 30, which defines a previously unknown use for the two materials; in particular in relation to, or for use in conjunction with, the method, apparatus and device of the present invention.

A fifth aspect of the present invention is defined in Claim 31 , which is directed to the appropriate form of peening balls for use in the method of apparatus of the present invention, or in conjunction with the device of Claim 23 . Balls of this construction have sufficient density to produce a mechanical working effect without damaging the material being worked, and are appropriately sized to give a good and even coverage across the surface of the material being worked.

To enable a better understanding of the invention, and to show how the same may be carried into effect, reference will now be made, by way of example only, to the accompanying drawings, in which :-

Figure 1 shows an embodiment of the apparatus of the present invention in schematic side view;

Figure 2 shows an embodiment of the peening device of the present invention in schematic cross-sectional view from the side;

Figure 3 shows the device of Figure 2 in the plane of line III; and

Figure 4 shows the device of Figure 2 in the direction of arrow IV.

In the apparatus of Figure 1, there is shown a collector drum 1, which has an outer circumferential collector surface 2 on which a thin layer of alloy 3 is deposited by an evaporator source 4. Such an arrangement is well known, and is typically surrounded by a vacuum maintained by a chamber in which these components are held (not shown).

The collector drum 1 rotates slowly so that the collector surface moves past the evaporator in direction of arrow X.

Adjacent a proximal part of the drum is located a peening device 100, which comprises a housing 101 in which is located a rotor 102, rotor 102 being arranged to rotate inside housing 101 . A portion of housing 101 forms a seal 105 with the collector surface 2 of collector drum 1, or with the surface of alloy layer 3 in preference thereto.

Turning now to Figures 2-4, the peening device 100 is disclosed in more detail.

The housing 101 is shaped and arranged to direct a plurality of peening balls 110 through a mouth 112.

A seal, here in the form a of number of rows of wire brush, is provided around the mouth, to ensure that no peening shots/balls 110 escape, which could interfere with evaporator 4. Because the brush is compliant, stray balls are deflected back into the housing 101 . Rotor 102 has a plurality of blades 107 which may themselves be formed of rubber, or may (as shown) have rubber tips 108.

Rotor 102 rotates to impart kinetic energy to balls 110 in order to fire the balls through mouth 112 onto the alloy surface. This mechanically works the alloy.

For a rotor with a blade-tip diameter (otherwise simply called the diamenter) of 60mm, an appropriate speed of rotation is approximately 1750 rpm. Suitable materials for forming the peening balls 110 are quartz, steel or tungsten. Any material may be used, however, providing that it is resistant to fracture and has sufficient density. Density of from 7.90×10^3 to 2.64×10^3 kg/m^3 is preferred, even more preferably 1.96×10^4 kg/m^3. The balls should have diameters of between 0.9mm and 1.6mm, preferably about 1.2mm.

An alternative to such a peening device in the apparatus of Figure 1 would be a rotor having metal flails, but accuracy of the working effect cannot be so accurately controlled.

CLAIMS

1. A method of manufacturing an alloy comprising the steps of:

depositing a layer of molten alloy on a moving collector surface; and

peening the layer of alloy as it is deposited on the collector surface to mechanically work the deposited alloy while it is warm and malleable.

2. The method of Claim 1, wherein the step of depositing a layer of molten alloy includes condensing an alloy vapour onto the collector surface.

3. The method of Claim 1 or 2, wherein the layer of molten alloy is deposited at a high vacuum.

4 The method of Claim 1, 2 or 3, wherein the step of peening the layer of alloy involves impacting the surface of the layer of alloy a multitude of times with a selected medium.

5 The method of Claim 4, wherein the selected medium has a density in the range of from 2.64 x 10^3 kg/m^3 to 1 .96 x 10^4 to kg/m^3, and preferably about 7.90 x 10^3 kg/m^3

6. The method of Claim 4 or 5, wherein the selected medium is one of quartz, steel or tungsten.

7. The method of any one of Claims 4, 5 or 6, wherein the process of impacting the surface a multitude of times includes bombarding the surface with round shot made of said medium at high velocities.

8. The method of any one of Claims 4 to 7, where in the process of impacting the surface a multitude of times includes impacting the surface with metal flails on a rotor.

9. An apparatus configured and arranged to perform the method of any one of Claims 1 to 8.

10. Use of the alloy manufactured by the method of any one of Claims 1 to 8 in an aero-space application.

11 . An apparatus for manufacturing an alloy comprising:

collecting means having a collector surface;

means for depositing a layer of molten alloy on said collector surface; and

means for peening said layer of alloy on said collector surface, the apparatus being configured and arranged so that, in use of the apparatus, the means for peening mechanically works the alloy layer as it is deposited on the collector surface while the alloy is warm and malleable.

12. The apparatus of Claim 11, wherein said collecting means is a collector drum, and said collector surface is the outer circumferential surface of said collector drum.

13. The apparatus of Claim 11 or 12, wherein said means for depositing a layer of molten alloy includes an evaporator source arranged to direct alloy vapour onto said collector surface.

14. The apparatus of Claim 11, 12 or 13, wherein said means for peening includes a rotor arranged to rotate in a housing for providing kinetic energy to a medium to be impacted on the surface of a layer of alloy deposited on said collector surface.

15 The apparatus of Claim 14, wherein the housing includes a mouth for directing said medium onto the surface of the alloy layer.

16 The apparatus of Claim 15, wherein the mouth is narrower than the layer of the alloy to be peened.

17 The apparatus of Clairn 15, wherein the means for peening is mobile so as to enable translation of the mouth across the width of the layer of alloy to be peened.

18 The apparatus of Claim 15, wherein said means for peening includes two or more rotors arranged in housings of a similar type arranged across the width of the collector surface to enable the entire width of the layer of alloy to be peened.

19 The apparatus of any one of Claims 11 to 18, wherein said means for peening includes a plurality of balls of shot to be fired at said alloy layer.

20 The apparatus of any one of Claims 11 to 19, wherein said means for peening includes metal flails on a rotor.

21 The apparatus according to any one of Claims 14 to 18 or 19 as dependent upon Claims 14 to 18, wherein said housing or housings are disposed adjacent said collector surface, and a seal is provided between each housing and said collector surface in order to retain any loose material within the housing or housings.

22 The apparatus of Claim 21 , wherein each seal is a compliant brush seal.

23 A peening device comprising a rotor, said rotor operable to provide kinetic energy to impacting means, and said device being configured and arranged to direct said impacting means with kinetic energy onto a surface to cause the impacting means to impact on said surface a multitude of times.

24 The peening device of Claim 23, further comprising a housing within which said rotor is arranged to rotate, said housing being arranged and shaped to direct the impacting means onto the respective surface.

25 The peening device of Claim 23 or 24, wherein said rotor further comprises a plurality of blades for imparting kinetic energy to peening shot.

26 The peening device of Claim 25, wherein the blades comprise at least a portion that is of rubber.

27 The peening device of Claims 23 to 26, wherein said peening device is sized and shaped to contain between 6000 and 12000 balls of peening shot.

28 The peening device of any one of Claims 23 to 27, wherein the rotor is rated to rotate at about 1750 rpm and has a diameter of about 60mm.

29 The peening device of any one of Claims 23 to 28, wherein the impacting means with kinetic energy are directed onto said surface through a mouth, and wherein the device further includes a seal around said mouth for sealing between said peening device and the surface.

30. Use of tungsten or quartz as a medium for shot peening.

31. Balls for shot peening having a density of between about 7.90 x $l0^3$ kg/m^3 and about 2.64 x $l0^4$ kg/m^3, preferably about 1.96 x $l0^4$ kg/m^3 , and each having a diameter in the range of between 0.9mm and 1 .6mm, preferably about 1.2mm.

32. A method substantially as described hereinbefore with reference to the accompanying drawings.

33. An apparatus substantially as described hereinbefore with reference to the accompanying drawings.

34. A peening device substantially as described hereinbefore with reference to the accompanying drawings.

35. Peening shot substantially as hereinbefore described in the description of specific embodiments.

4 pages of drawings follow

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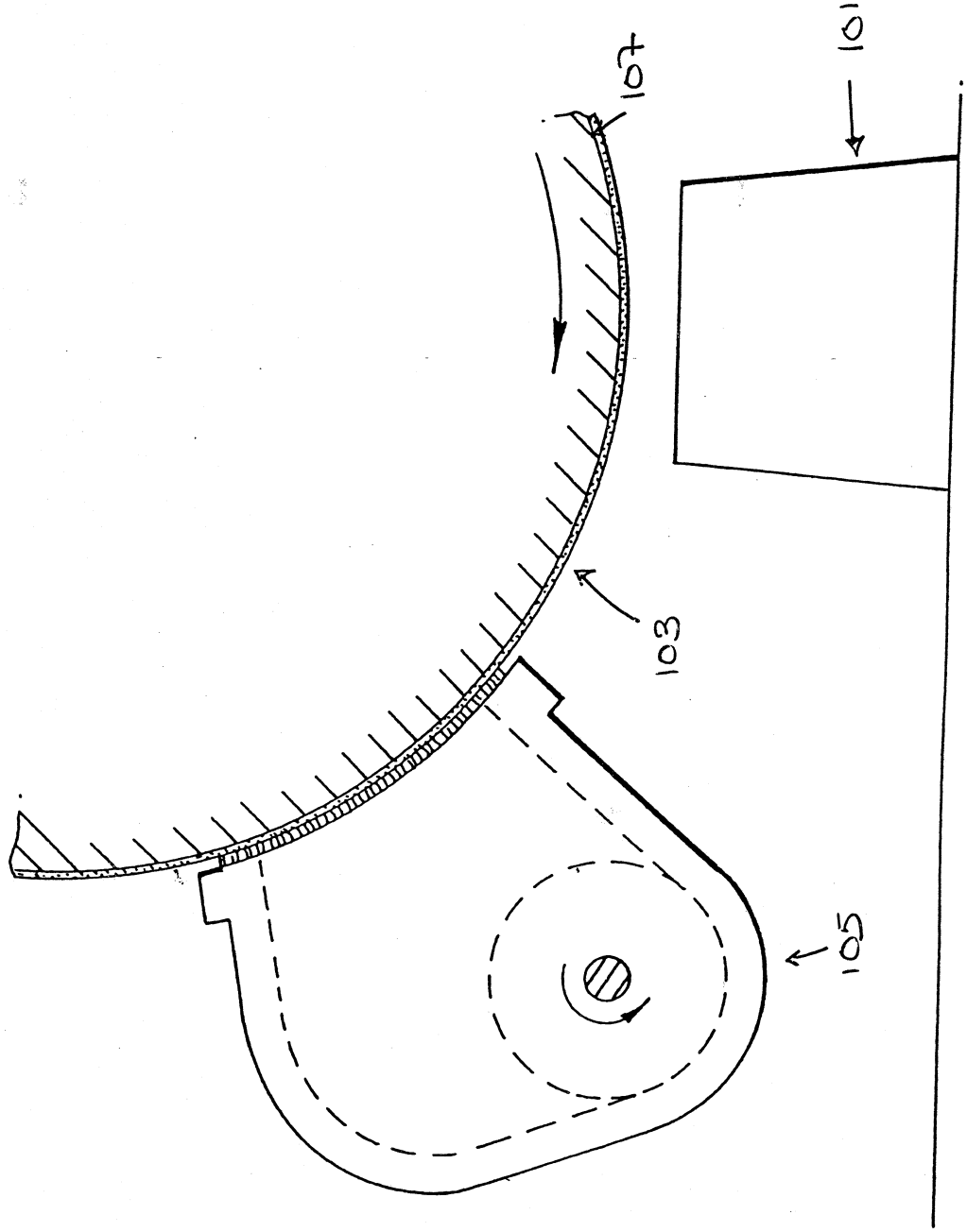


FIGURE 1

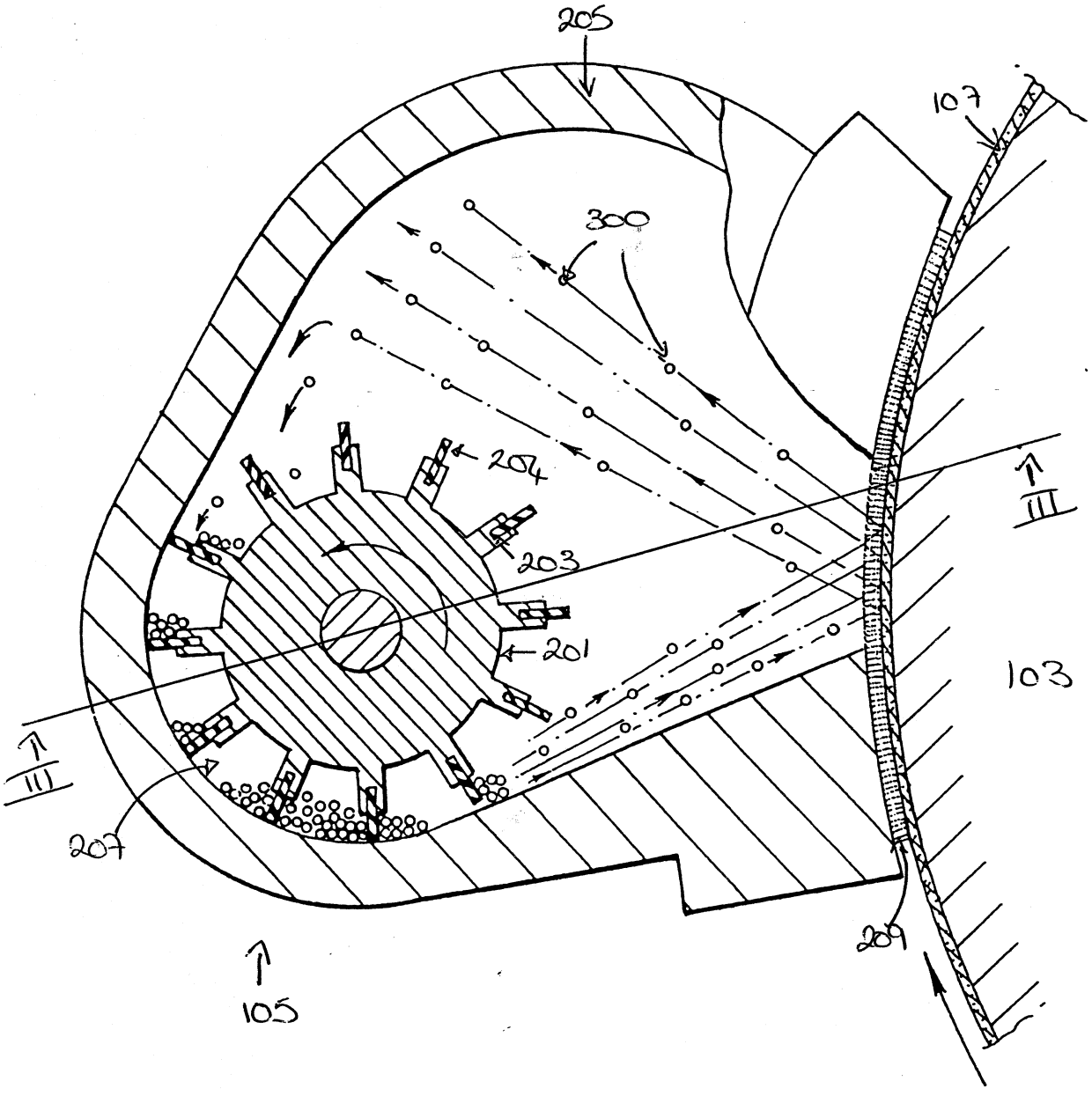
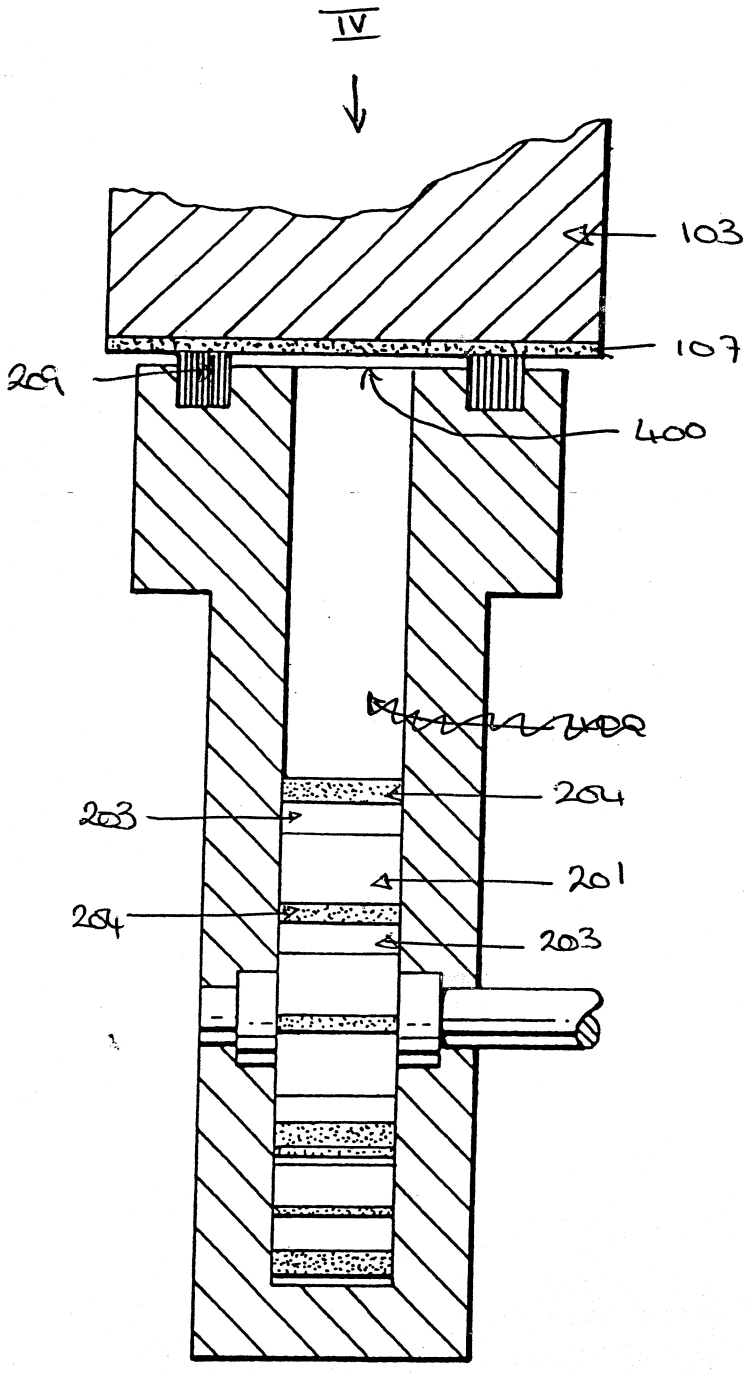


FIGURE 2



~~Section~~

FIGURE 3

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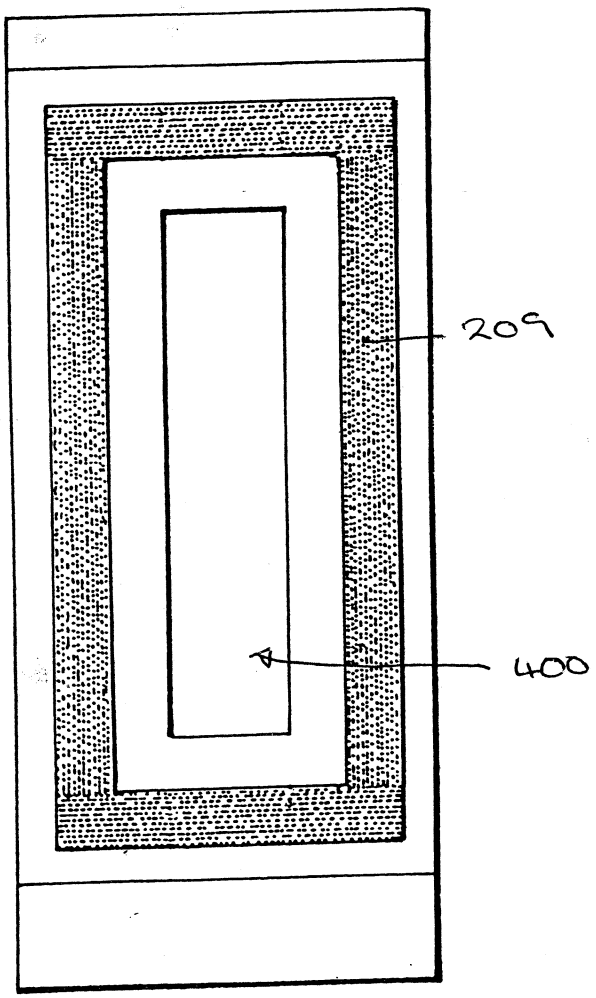

FIGURE 4