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SEED FOR CRYSTAL GROWING
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FIG-1

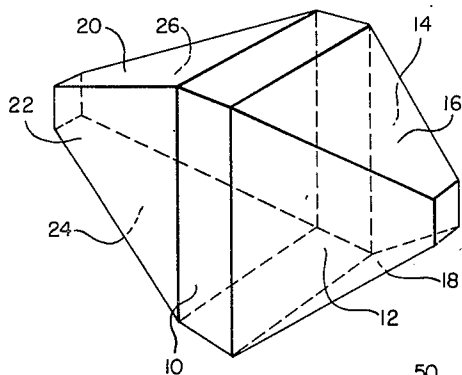


FIG-2

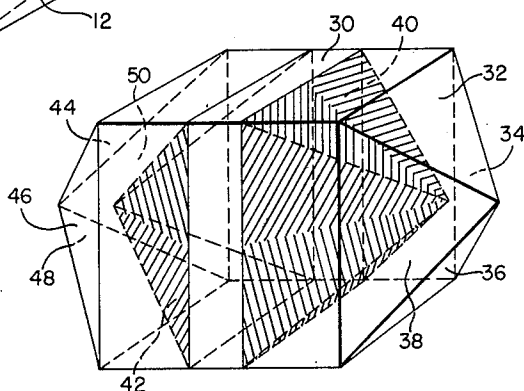
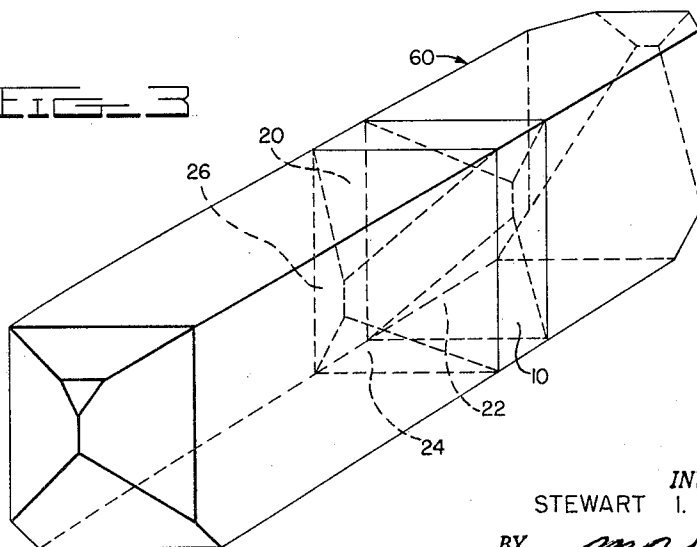


FIG-3



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SEED FOR CRYSTAL GROWING

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This invention relates to crystal growth and in particular to a type of seed crystal and the method of production thereof.

The general object of the invention is to provide a seed crystal which will promote a relatively rapid crystal growth from a crystallizing solution.

It is also an object of the invention to provide a seed crystal which will promote the growth of a crystal having a maximum of clear bar stock.

It is a further object of the invention to provide a seed crystal having a relatively short dimension parallel to the longitudinal axis of the crystal to be grown.

It is an additional object of the invention to provide a seed crystal which may be cut from the stock of the crystal grown thereon and which, by regrinding of the cap surfaces, may be re-used.

The attainment of these objectives and others such as the provision of seed crystals with a minimum of wastage of material will be apparent from the following description and from the drawings hereto appended both of which are merely illustrative and are not limitative beyond the scope as defined by the herewith appended claims.

In these drawings:

Figure 1 is an isometric view of a seed crystal formed in accordance with the applicant's invention.

Figure 2 is an isometric view of a seed crystal produced in accordance with conventional practice; and

Figure 3 is an isometric view of a crystal such as ammonium dihydrogen phosphate grown on a seed crystal of the applicant.

In the art of growing crystals of various salts it is the general practice to grow these crystals on seeds. These seeds generally consist of rectangular plates of the crystalline material cut from the bar stock of a crystal of the material at right angles to the longitudinal axis of the crystal, i. e. the "Z" axis. The seed plate may be originally cut from the crystal bar stock by cutting the latter at angles of forty-five degrees to its "X" and "Y" axes and then cutting a seed plate therefrom perpendicularly to the "Z" axis. A plurality of seed plates so cut are then mounted in the usual crystal growing containers in which is the crystallizing solution of the desired salt. Crystallization of the salt on the seed plates forms cap surfaces on the seed plates which at first may be opaque and more or less irregular. As soon as the seed forms completely regular crystal faces the operation is stopped and the perfect seeds are sorted from the defectively formed ma-

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terial. This initial growing operation requires from ten to twenty days. The perfect seeds are then mounted in the containers of the crystallizing solution and crystal growth proceeds until crystals of the desired size are grown. In growth from a plate this step is necessary in order to arrive at a seed which combine the optimum combination of edges and surfaces for subsequent crystal growth.

In contrast to this method of preparing seed crystals the applicant recognizes the advantage of providing this best combination of surfaces and edges and cuts a block of material out of the bar stock of a crystal at right angles to the "Z" axis thereof. He then cuts or grinds cap faces on this block approximately parallel to the cap faces of the crystal. The cap faces are slightly rough due to the method of grinding or cutting them. They may vary as much as plus or minus five degrees from true parallelism with the cap faces as grown. In the dimension as measured along the "Z" axis these cut seed crystals are from one-half to two and one-half inches shorter than the seed crystals on which the cap faces are grown as above described.

Referring to the drawings, Figure 1 shows a seed crystal for ammonium dihydrogen phosphate prepared in accordance with the applicant's method. This seed crystal comprises a polyhedron having twelve surfaces on eight of which (the cap surfaces) the ions coming out of solution deposit. The seed as shown comprises a body portion 10 on the lateral faces of which the cap faces 12, 14, 16, 18, 20, 22, 24 and 26 are cut. These cap faces, due to the manner of cutting them, are not perfectly smooth. They are scored with minute ridges and valleys which afford a large number of microscopic edges and corners on which the ions coming out of solution can form and build. They therefore induce growth at lower degree of super-saturation and with a minimum formation of veils.

Figure 2 shows a seed crystal on which caps such as 40 and 42 are grown on a seed plate 30. These cap surfaces grow on the faces of the seed plate which are perpendicular to the longitudinal axis of the original crystal from which the plate was cut. These cap faces grow and develop as the ions precipitating from solution pile up at the corners of the seed plate and along the edges thereof. Rough and irregular surfaces, parallel to the cap faces, gradually form. The crystallized material thus far precipitated is opaque due to the heterogeneous orientation of the ions. Gradually the precipitated material encloses the poor

quality growth parallel to the "Z" axis and when the cap faces are completely formed the end point of the seed growth is reached. The cap faces, as developed, are very smooth and regular and when the seed is used for further crystal growth there is a considerable formation of veils in the vicinity of these developed cap faces. The dimension of the seed crystal along the "Z" axis is therefore much greater than the completely ground seed crystal of the applicant.

Figure 3 is an isometric drawing of a crystal of ammonium dihydrogen phosphate grown on one of the applicant's seed crystals. In this figure body 10 of the seed crystal is indicated. Ground cap faces 20, 22, 24 and 26 are also indicated. The grown crystal is indicated generally at 60. There are no veils in the vicinity of the ground cap faces apparent, and the crystal is composed largely of clear transparent stock. The relative proportion of this clear stock in the grown crystal is much greater when the applicant's ground seed crystal is used than when a seed crystal of the type shown by Figure 2 is used.

The applicant has found that he can grow crystals of a wide range in composition by the use of his particularly ground seed crystal. Among the other crystallizable materials are, ammonium phosphate, ammonium arsenate, potassium phosphate, potassium arsenate, ammonium iodate, lithium sodium sulphate, lithium sulphate, magnesium sulphate, ammonium potassium thiosulphate, barium thiosulphate, potassium tungstate, lanthanum sulphate, triethyl ammonium nitrate, sodium divanadate tetrahydrate, benzil, hexachlorobenzene, N-chlorophthalimid, pentabromomethane and para-nitroacetanilid. All of these compounds develop caps in crystallization.

In general each salt requires a capped seed crystal on which the arrangement of the cap faces is peculiar to the particular salt being crystallized. Thus a quartz seed will be hexagonal in transverse section and there will be six cap faces on either side of the body part which (faces) will have a particular angular relationship to each other and with respect to the "Z" axis of the seed.

The advantages which inhere to the applicant's method of crystal growth are:

1. Because of the shorter length of the applicant's seed along the "Z" axis it is of a less volume as compared to the grown seed. More of his seeds can be mounted in a container of a definite volume and more crystals therefore are grown in a run.

2. Because of the relative roughness of the ground surfaces crystallization takes place at a lower super-saturation which reduces the tendency to flaw than with the surfaced grown seeds.

3. Because the ground surfaces remain sharply defined in the grown crystal and because of the lack of veils in the vicinity of the ground surfaces, the seed crystal can be reground and re-used. This is not possible when grown seeds are used, because of the small area of the clear crystal growth in the region near the original plate.

4. Elimination of the loss of caps due to a small amount of resolution.

5. Elimination of the seed growing step. As stated above this generally requires from 10 to 20 days. The crystal growing apparatus is thereby available for the continual growth of crystal material.

6. The yield of perfect crystals is much higher

with the applicant's ground seeds than with the grown seeds.

7. The yield of usable material is much higher per crystal and there is a corresponding reduction in the amount of waste material per crystal.

While the foregoing description has been limited to the growing of crystals of ammonium dihydrogen phosphate on a seed crystal having ground cap faces, it is not desired to be closely restricted thereto since as above indicated the applicant has grown crystals of many different compositions on seeds having cap faces ground thereon peculiar to the arrangement of the cap faces of the particular material being crystallized. Such variations would be apparent to one skilled in the art and are intended to be included within the scope of the invention to the extent defined by the herewith appended claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without payment of any royalties thereon or therefor.

What is claimed is:

1. The method of making capped seed crystals for promoting the relatively rapid growth of crystals in a crystallizing solution comprising cutting a block of material from the bar stock of a crystal of the type developing capped ends, said block cut from said bar stock at right angles to the "Z" axis of said crystal, and grinding cap faces approximately parallel to the cap faces of the crystal to be grown on the sides of the block extending at right angles to said "Z" axis.

2. The method of making capped seed crystals for promoting the relatively rapid growth of ammonium dihydrogen phosphate crystals from a crystallizing solution thereof, comprising cutting a block of material from the bar stock of a crystal of ammonium dihydrogen phosphate at right angles to the "Z" axis of said crystal and grinding cap faces approximately parallel to the cap faces of the ammonium dihydrogen phosphate crystal to be grown on the sides of the block extending at right angles to said "Z" axis.

3. The method of making capped seed crystals for promoting the relatively rapid growth of iodic acid crystals from a crystallizing solution thereof, comprising cutting a block of material from the bar stock of a crystal of iodic acid at right angles to the "Z" axis of said crystal and grinding cap faces approximately parallel to the cap faces of the iodic acid crystal to be grown on the sides of the block extending at right angles to said "Z" axis.

4. The method of making capped seed crystals for promoting the relatively rapid growth of quartz from a crystallizing solution thereof comprising cutting a block of material from the bar stock of a crystal of quartz at right angles to the "Z" axis of said crystal and grinding cap faces approximately parallel to the cap faces of the quartz crystal to be grown on the sides of the block extending at right angles to said "Z" axis.

5. In the method of growing crystals on seed crystals from a crystallization solution the step of mounting in said solution seed crystals having ground cap faces approximately parallel to the cap faces of the crystal to be grown.

6. A capped seed crystal for promoting the relatively rapid growth of a crystal by crystallization from a crystallizing solution comprising a polyhedral block of the material to be crystallized having crystallizing surfaces, and cap surfaces ground on said block extending approxi-

mately to said crystallizing surfaces and substantially parallel to the cap surfaces of the crystal to be grown.

7. A method for the dry preparation of capped seed crystals of a minimum size from a minimum quantity of material comprising, cutting a block of material from bar stock of a crystal of the type to be seeded, and grinding faces on said block at angles with the direction of crystal growth substantially equal to the angles which the respective natural cap faces of the potential crystal will form with said direction.

8. A method of dry preparation of capped, rapid-growing seed crystals of a minimum size from a minimum quantity of material, comprising, cutting a block of seed material from bar stock of a crystal of the type to be seeded, the direction-of-desired-crystal-growth dimension of said block being just large enough with respect to the dimensions normal thereto and with respect to the angle which cap faces naturally form therewith to permit full, symmetrical development of said cap faces, and grinding cap faces on said block at angles with the said direction of growth substantially equal to the angles which cap faces naturally form therewith.

9. The method of treating a cap face of a seed crystal to increase the rate of crystal growth from solution thereon and to substantially reduce the distance from said seed crystal cap face into the resulting grown crystal in which imperfect grown material occurs, comprising, reducing the lower limit of supersaturation at which crystallization will occur by roughening the surface of said cap faces.

10. A method for the large-scale, continuous production of grown bar crystals having a mini-

mum proportion of waste material comprising, preparing a seed crystal according to the method of claim 8, growing a crystal bar thereon by conventional processes said crystal having as waste material only that center portion thereof corresponding to the length of the seed crystal, and repeating the cycle by cutting from said grown crystal bar a block of said center portion and re-grinding cap faces thereon according to the method of claim 8.

11. A compact, capped seed crystal for the growing of crystal bars comprising a polyhedral block of material to be crystallized wherein approximately all of the surface area of the block consists in ground cap faces which form angles with the direction of crystal growth substantially equal to the angles which natural, grown cap faces form therewith.

12. A seed crystal as defined in claim 11 having roughened cap faces.

13. A capped seed crystal for the growing of crystal bars comprising a polyhedral block of material to be crystallized having roughened cap faces which form angles with the direction of crystal growth substantially equal to the angles which natural grown cap faces form therewith.

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