

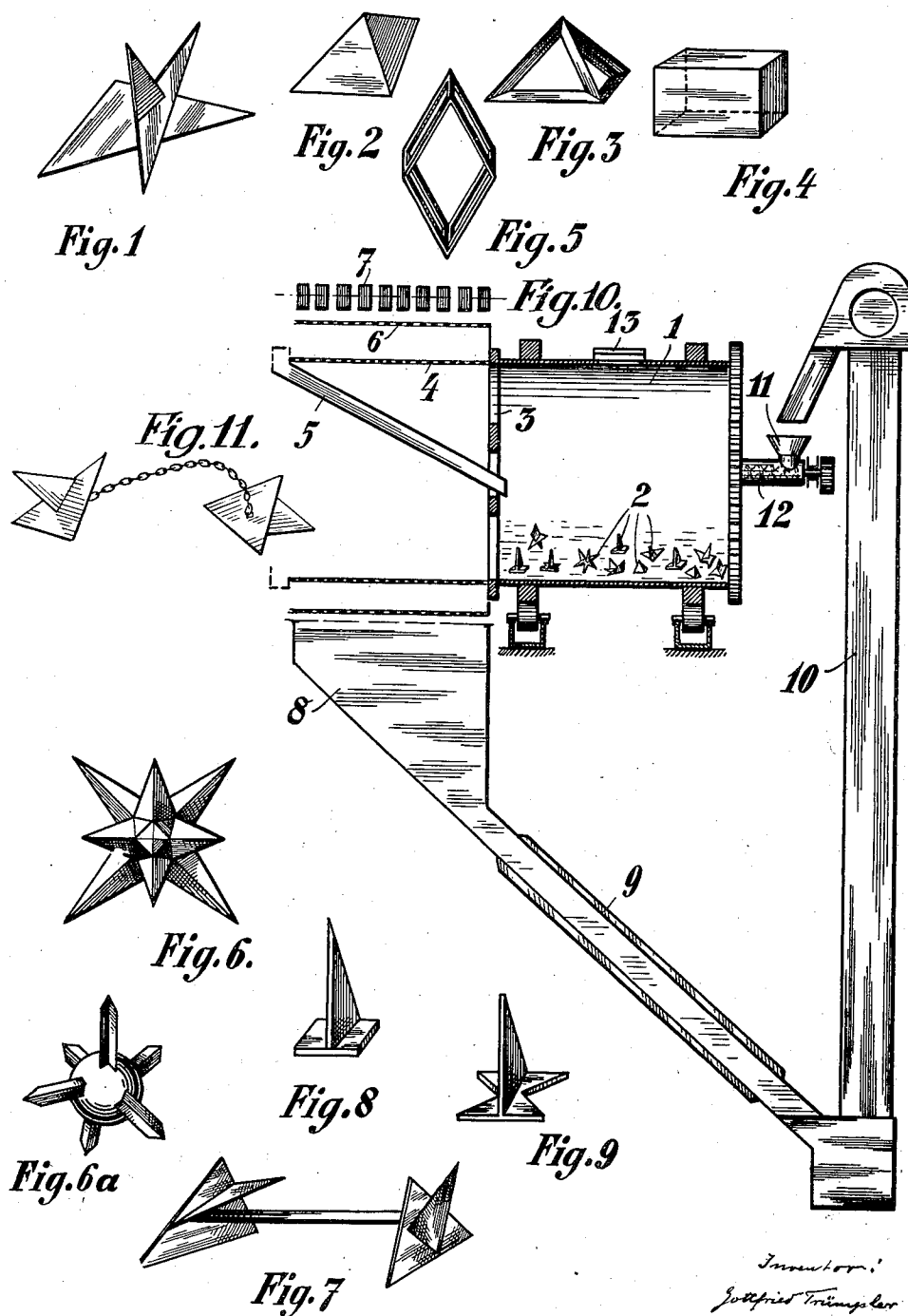
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APPARATUS AND PROCESS FOR DIVIDING VISCOUS MASSES

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APPARATUS AND PROCESS FOR DIVIDING
VISCOUS MASSES

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This invention relates to the dividing or disintegrating of semi-liquid substances, for example substances of viscous, pulpy, pasty or sticky consistency, especially for the treatment of substances which are in the state of solidifying.

Such substances cannot be satisfactorily worked with the known disintegrating devices, such as percussion mills, disintegrators, edge runners, rotary drum mills, ball and rod mills, because such arrangements quickly become ineffective especially owing to incrustation. When employing rotary drums with preferably round elements, such as balls, round bars and the like, it has been found that the viscous, pasty substances are so-to-say directly rolled on the wall of the rotary drum and on to the grinding elements, so that after a short time no disintegration takes place.

The dividing up and disintegration of viscous substances into lumps, granular form and, if necessary, still further disintegration, for example into fine grained or pulverous state, is effected by subjecting the soft substances to the action of freely movable disintegrating elements in a rotary vessel, for example a rotary drum, which elements have projections, such as corners, edges and the like, and owing to their peculiar construction not only effect the desired dividing up and disintegrating of the substances, but also prevent the substance from adhering to the inner wall of the drum and to the disintegrating elements, or repeatedly free these from the adhering material.

During the rotation of the drum, the disintegration elements, owing to their projecting corners, edges and the like, exert beating, rubbing, piercing, cutting, scraping and scratching action on the material to be treated, on the inner wall of the drum and on one another. Thus, the treated material can, as has been proved, be divided and converted into products in the desired form, for example in granular form, whilst avoiding incrustations. For obtaining products in the form of lump or granular products an important feature is that the disintegrating elements employed according to the invention owing to their peculiar shape do not tend to settle close together.

Contrary to the known round, or preferably round grinding bodies, for example of spherical, ovoidal, circular rod shape, the disintegrating elements employed according to the invention have effective edges, corners or other projections, which do not allow the elements to uniformly, continually roll on one another and on the drum wall. It is evident, that the grinding elements

may also have round or rounded faces besides the effective corners, edges, points and the like. It has been found, for example, that circular discs, the flat side faces of which considerably exceed the circular surface, already act in the sense of the invention because the movement of such elements on the narrow round edge is absolutely unstable and consequently only takes place exceptionally during the grinding operation in the rotary drum. It has been further found that the disintegrating elements according to the invention are also effective when the points, corners, edges and the like have been partly rounded owing to the continual operation.

Several forms of construction of disintegrating elements according to the invention are illustrated by way of example in the accompanying drawing in which:—

Fig. 1 shows cornered plate-like disintegrating elements, two or more of which are connected so that they do not lie in a plane but are mutually inclined at an angle.

Figs. 2 to 5 show polyhedron elements which may be solid or perforated.

Fig. 6 shows a structure composed of stellate bodies produced for example by connecting elongated bodies terminating in points.

Fig. 6a shows a body produced by fitting, for example screwing, steel chisel sections into a carrier body.

Fig. 7 illustrates a complex grinding body which is produced by uniting two-cornered edged structures. In such bodies the connection may be rigid, for example by means of a rod, or flexible, for example by means of a chain. It is evident that such complex disintegrating bodies may also be formed of more than two single elements.

Figs. 8 and 9 show disintegrating elements which are relatively simple and cheap to produce and which may be easily cut from section iron, for example T—, H—, rolled plate section and the like. With elements of this kind excellent results have been obtained when working viscous, pasty substances.

Fig. 10 shows the use of these bodies in a disintegrating drum.

Fig. 11 shows the flexible interconnection of two disintegrating elements.

It is evident, that differently shaped disintegrating elements may be employed jointly. Moreover, if desired, other kinds of grinding elements, for example round, rounded or chiefly round grinding elements may be used in conjunction with disintegrating elements according to the in-

vention. The simultaneous employment of round or rounded grinding elements is advisable for example when the material is to be finely divided, for example to be converted into fine grained or pulverous state. The number, weight and type of disintegrating elements and also the speed of rotation of the drum can be adapted in each instance to the peculiarity of the material to be disintegrated.

The invention is suitable, among other things, for removing fertilizers from concentrated solutions or molten masses by solidifying proceedings, for example for converting molten concentrated calcium nitrate or products from trituration obtained by treating raw phosphates with nitric acid, with or without additional substances, into solid, preferably granular fertilizers. Other, viscous pulpy or pasty substances or mixtures of substances, for example salt substances or artificial compositions, solutions of colloid, such as rubber and the like, can be converted into products from disintegration and division of, for example, lumpy, bulky, coarse-grained, fine-grained or pulverous consistency.

The process has been very successful for converting into granular form the viscous, plastic substances obtained by the trituration of phosphorites with nitric acid. The disintegration of these substances while still in pasty condition, which could not be satisfactorily carried out with known means, could be easily and reliably effected with the aid of the invention.

Fig. 10 shows an arrangement, consisting of a grinding drum 1, in which the disintegrating elements 2 are situated. The material to be treated, for example a 90 to 95% pasty calcium nitrate composition or a pasty nitro-phosphate substance is fed by means of a hopper 11 and worm 12. The disintegrated material is discharged from the drum 1 through slits in the closing wall 3 through a sieve 4 which is so constructed that the material split up to the desired grain size can pass there-through with any fine material. Material which is not sufficiently disintegrated is returned into the drum in known manner, for example by a chute 5. The separating of the desired grain is effected by a sieve 6 which, like the sieve 4, is preferably directly connected to the drum and is rotated therewith. Rotary brushes 7 prevent the interstices of the sieve 6 from becoming clogged with dust. The dust passing through the sieve 6 is preferably returned to the disintegrating drum 1, where it unites with the pasty material. The conveying of the dust back into the drum, if necessary after being previously collected in a silo 8, is effected by an elevator 10, the dust passing through a cooling arrangement 9 on its way from the silo 8 to the elevator.

The disintegrating operation may take place continuously (as above described). However, it is also possible to work intermittently, the pasty material to be treated being then fed into the drum in charges through an aperture 13 to be closed by means of a lid.

As a rule the disintegrating operation consists in solidifying viscous or pulpy or pasty substances introduced in warm condition, by considerably cooling the same during disintegration.

The drum may, however, be provided with a heating device, so that the disintegrating work can take place entirely or partly under heat. Thus, it is possible to carry out at the same time an evaporation of volatile components, for example water. The addition of admixtures may

also be effected in the disintegrating drum. In many cases it has been found advantageous to add to the material to be disintegrated for example nitro-phosphate while still in pasty condition, pulverous additional substances, for instance dust of the same material, if necessary after previous cooling, and to thus favor the disintegration and conversion of the material into granular form.

Examples

1.—1000 kilograms Morocco phosphorite (about 34% P_2O_5 and 51% CaO) were treated in a kneading machine with 973 kilograms of a 72.5% nitric acid. At the termination of the trituration a viscous pasty mass was formed which, owing to the reaction heat, was heated to about 80° C. This mass was fed by means of a worm into a drum about 1.8 meters in diameter and about 3 meters long, accommodating about 2000 kilograms of different disintegrating elements according to the invention. At the same time about 3000 kilograms cooled dust of the same product emanating from a previous disintegration was charged into the disintegrating drum. Owing to the rotation of the drum the trituration masses are continually divided and disintegrated, the added dust exerting a cooling effect on the masses and prevents the re-caking of the divided masses. The mass is repeatedly prevented from adhering to the disintegrating tools and to the drum by the sharp projecting edges of the different disintegrating tools so that the mass is gradually disintegrated forming round grains. By means of a sieve-like device on the end of the drum the too coarse grains and the fine dust-like portions are separated from the grains of medium useful size (about 2-3 millimeters in diameter) and returned into the drum by suitable devices, if necessary after cooling. The solid grains rounded by the rotary motion continually leave the drum at a temperature of about 30° C. and, owing to their high melting point, due to the low content of water (about 2.5 gram molecules of water per 1 gram molecule of calcium nitrate), they can be immediately stored without caking. The product thus obtained represents an excellent fertilizer containing phosphoric acid and nitrogen and capable of being strewn and stored.

2.—1000 kilograms of Morocco phosphorite were treated with about 980 kilograms of a 72.6% nitric acid in a kneading machine and about 660 kilograms calcium nitrate were added to the trituration mass. The hot trituration mass, having a temperature of about 60° C., was fed, after being thoroughly kneaded, into the disintegrating drum together with cold dust of the finished end product and treated with the sharp edged disintegrating elements with projecting corners forming the subject matter of the invention, the mass being thereby converted into small bodies. The dust and the larger lumps formed during the treatment were separated, caught and returned to the drum as in Example 1. The medium size grain after cooling represents a fertilizer containing nitrogen, potassium and phosphoric acid, and capable of being strewn and stored.

3.—A technical calcium nitrate solution was evaporated under vacuum in a kneading machine, until a sandy-pasty mass containing about 92% $Ca(NO_3)_2$ was obtained. This mass was fed in hot condition into a drum containing disintegrating elements according to the invention. By insulating the drum or by heating same the mass was maintained at about 60 to 70° C. so that it was divided and converted into granular form in hot

condition. In this instance the too large and fine portions were also separated and returned into the drum as in Example 1. The medium-size grain, while still hot, is continually discharged from the drum and then allowed to cool. As final product an excellent fertilizer (calcium nitrate) capable of being strewn and stored is obtained in the form of hard grains consisting of 92% calcium nitrate.

I claim:—

1. A process for separating fertilizers such as calcium nitrate, ammonium nitrate, nitrophosphate or mixtures thereof in granular form, consisting in subjecting the fertilizer as a hot, soft viscous to pasty mass in a progressive state of solidification to the action of freely movable disintegrating elements in a rotary drum, said elements having corners, edges and other projections to prevent a uniform rolling on one another and on the drum and an adhesion of the mass on this wall and on the disintegrating elements, and in continually disintegrating the mass while cooling and solidifying until grains are formed.

2. A process for separating fertilizers such as calcium nitrate, ammonium nitrate, nitrophosphate or mixtures thereof in granular form, consisting in subjecting the fertilizer as a hot, soft viscous to pasty mass in a progressive state of solidification with an admixture of solid fine grained to pulverous material to the action of freely movable disintegrating elements in a rotary drum, said elements having corners, edges and other projections to prevent a uniform rolling on one another and on the drum and an adhesion of the mass on this wall and on the disintegrating elements, and in continually disintegrating the mass while cooling and solidifying until grains are formed.

3. A process for separating fertilizers such as calcium nitrate, ammonium nitrate, nitrophosphate or mixtures thereof in granular form, consisting in subjecting the fertilizer as a hot, soft viscous to pasty mass in a progressive state of solidification with an admixture of already solidified and cooled fine grained to pulverous material obtained by sifting the product from distribution, to the action of freely movable disintegrating elements in a rotary drum, said elements having corners, edges and other projections to prevent a uniform rolling on one another and on the drum and an adhesion of the mass on this wall and on the disintegrating elements, and in continually disintegrating the mass while cooling and solidifying until grains are formed.

4. A process for separating fertilizers such as calcium nitrate, ammonium nitrate, nitrophosphate or mixtures thereof in granular form, consisting in subjecting the fertilizer as a hot, soft viscous to pasty mass in a progressive state of solidification to the action of freely movable disintegrating elements in a rotary drum, heated at least during a portion of the disintegrating process, said elements having corners, edges and other projections to prevent a uniform rolling on one another and on the drum and an adhesion of the mass on this wall and on the disintegrating elements, and in continually disintegrating the mass while evaporating water and solidifying until grains are formed.

5. A machine for disintegrating hot, dough-like to pasty fertilizers in progressive state of solidification, comprising a rotary drum having a closable charging aperture, disintegrating elements freely movable in said drum and adapted to divide and disintegrate the material, a partition at one end of said drum remote from said charging

aperture and having apertures for the passage of the material disintegrated in said drum, a sieve extending from said partition adapted to sift the material disintegrated in said drum to allow the passage of material up to a certain size of grain and to keep back the material of too large grain, a chute in said sieve adapted to return the too large grained material into said drum, a second sieve connected to and rotating with said drum and surrounding said first sieve with clearance adapted to allow the passage of material with too small grain and to hold back the material of the desired size of grain, a second chute below said second sieve adapted to lead off the fine material sifted through said second sieve, an elevator at the lower end of said second chute leading to the end of said drum remote from said partition, a hopper adapted to receive the material from said elevator, and a worm on the end of said drum adapted to receive the material from said hopper and return same into said drum.

6. A machine for disintegrating hot, dough-like to pasty fertilizers in progressive state of solidification, comprising a rotary drum having a closable charging aperture, disintegrating elements freely movable in said drum and adapted to divide and disintegrate the material, a partition at one end of said drum remote from said charging aperture and having apertures for the passage of the material disintegrated in said drum, a sieve extending from said partition adapted to sift the material disintegrated in said drum to allow the passage of material up to a certain size of grain and to keep back the material of too large grain, a chute in said sieve adapted to return the too large grained material into said drum, a second sieve connected to and rotating with said drum and surrounding said first sieve with clearance adapted to allow the passage of material with too small grain and to hold back the material of the desired size of grain, a second chute below said second sieve adapted to lead off the fine material sifted through said second sieve, a cooling arrangement surrounding said second chute adapted to cool the material passing there-through, an elevator at the lower end of said second chute leading to the end of said drum remote from said partition, a hopper adapted to receive the material from said elevator, and a worm on the end of said drum adapted to receive the material from said hopper and return same into said drum.

7. Process for producing fertilizers, such as calcium nitrate, ammonium nitrate, nitrophosphate and mixtures thereof, in granular form, consisting in subjecting the fertilizers first as soft, dough-like to pasty substances during the cooling operation within the temperature range between 80–30° C. in rotating containers to the action of freely movable disintegrating elements having edges, corners and other projections adapted to prevent the said disintegrating elements from rolling on one another and on the wall of the drum to prevent the substances from adhering thereto and to the disintegrating elements, and continuing the disintegration of the substances during their progressive cooling and solidification until the said substances are converted into the form of grains.

8. Disintegrating elements for machines for converting into granular form hot, dough-like to pasty fertilizer substances in progressive state of solidification, each comprising at least two disc-shaped bodies of a thickness relatively small relatively to the surface area and bordered on

their periphery by edges and at least one pointed corner, said discs being rigidly interconnected in such a position that the planes extending through the surface of each disc intersect without encompassing a space and without a symmetry axis being formed by the line of intersection.

9. Disintegrating elements for machines for converting into granular form hot, dough-like to pasty fertilizer substances in progressive state of solidification, each comprising at least two disc-shaped bodies of a thickness relatively small relatively to the surface area and bordered on their periphery by edges and at least one pointed corner, said discs being rigidly interconnected in such a position that the planes extending through the surface of each disc intersect without encompassing a space and without a symmetry axis being formed by the line of intersection, at least one of said discs bearing with one longitudinal edge against the surface of another disc.

10. Disintegrating elements for machines for converting into granular form hot, dough-like to pasty fertilizer substances in progressive state of solidification, each comprising at least two triangular disc-shaped bodies of a thickness relatively small relatively to the surface area, said discs being rigidly interconnected in such a position that the planes extending through the triangle surface of each disc intersect without encompassing a space and without a symmetry axis being formed by the line of intersection.

11. Disintegrating elements for machines for converting into granular form hot, dough-like to pasty fertilizer substances in progressive state of solidification, each comprising at least one triangular disc and at least one polygonal disc of a thickness relatively small relatively to the surface area, said discs being interconnected in such a position that the planes extending through the surface of each disc intersect without encompassing a space and without a symmetry axis being formed by the line of intersection.

12. Disintegrating elements for machines for converting into granular form hot, dough-like to pasty fertilizer substances in progressive state of solidification, each comprising at least two separate elements interconnected flexibly with one another each consisting of at least two disc-shaped bodies of a thickness small relatively to the surface area and bordered on their periphery by edges and at least one sharp corner, said discs interconnected in such a position that the planes extending through the surface of each disc intersect without encompassing a space and without a symmetry axis being formed by the line of intersection.

13. A machine for disintegrating pasty masses, especially phosphates, comprising a rotary drum

having a closable charging aperture, disintegrating elements freely movable in said drum and adapted to divide and disintegrate the material, a partition at one end of said drum remote from said charging aperture and having apertures for the passage of the material disintegrated in said drum, a sieve extending from said partition adapted to sift the material disintegrated in said drum to allow the passage of material up to a certain size of grain and to keep back the material of too large grain, a chute in said sieve adapted to return the too large grained material into said drum, a second sieve connected to and rotating with said drum and surrounding said first sieve with clearance adapted to allow the passage of material with too small grain and to hold back the material of the desired size of grain at least one of the sieves being provided with rotary brushes adapted to prevent the interstices of the sieve from becoming clogged, a second chute below said second sieve adapted to lead off the fine material sifted through said second sieve, an elevator at the lower end of said second chute leading to the end of said drum remote from said partition, a hopper adapted to receive the material from said elevator, and a worm on the end of said drum adapted to receive the material from said hopper and return same into said drum.

14. Disintegrating elements for machines for converting into granular form hot, dough-like to pasty fertilizer substances in progressive state of solidification, each comprising at least two separate elements interconnected rigidly with one another each consisting of at least two disc shaped bodies of a thickness small relatively to the surface area and bordered on their periphery by edges and at least one sharp corner, said discs interconnected in such a position that the planes extending through the surface of each disc intersect without encompassing a space and without a symmetry axis being formed by the line of intersection.

15. Disintegrating elements for machines for converting into granular form hot, dough-like to pasty fertilizer substances in progressive state of solidification, each comprising at least two separate elements interconnected rigidly with one another, each element consisting of at least two disc-shaped bodies of a thickness small relatively to the surface area and bordered on their periphery by edges and at least one sharp corner, said discs interconnected in such a position that the planes extending through the surface of each disc intersect without encompassing a space and without a symmetry axis being formed by the line of intersection.

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