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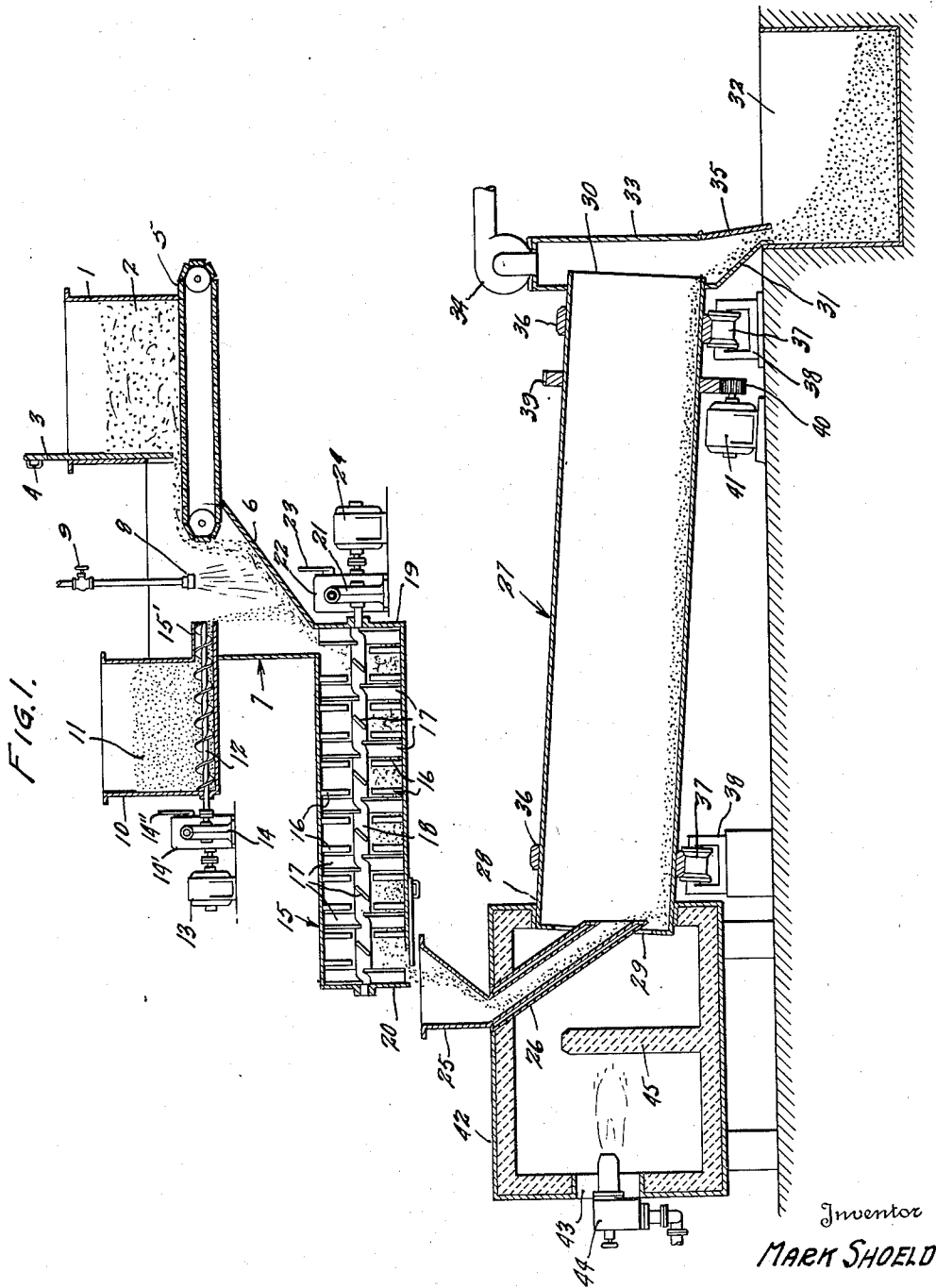
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2,232,145

METHOD OF GRANULATING SUPERPHOSPHATE

Filed June 15, 1938

4 Sheets-Sheet 1



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Feb. 18, 1941.

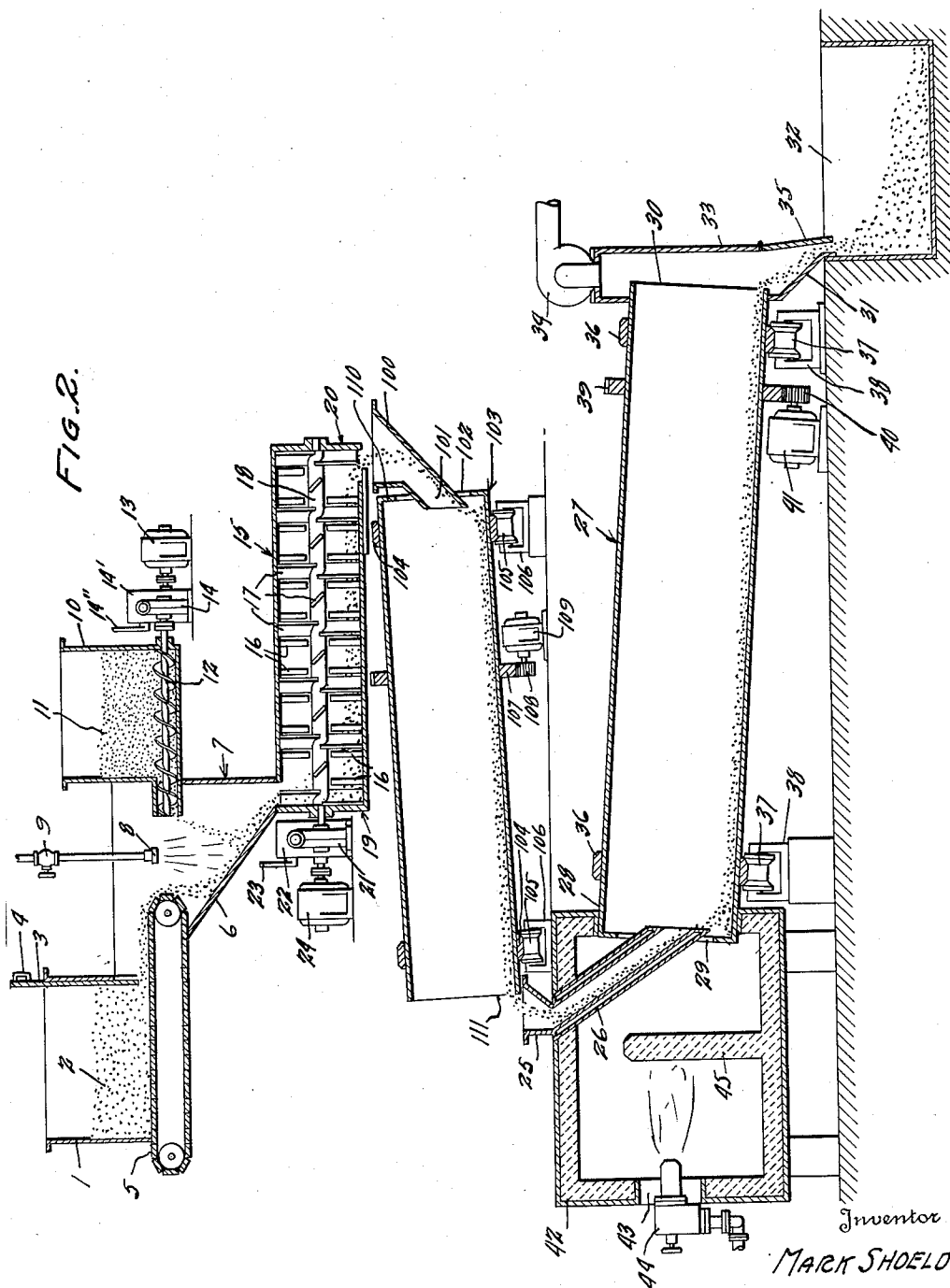
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METHOD OF GRANULATING SUPERPHOSPHATE

Filed June 15, 1938

4 Sheets-Sheet 2



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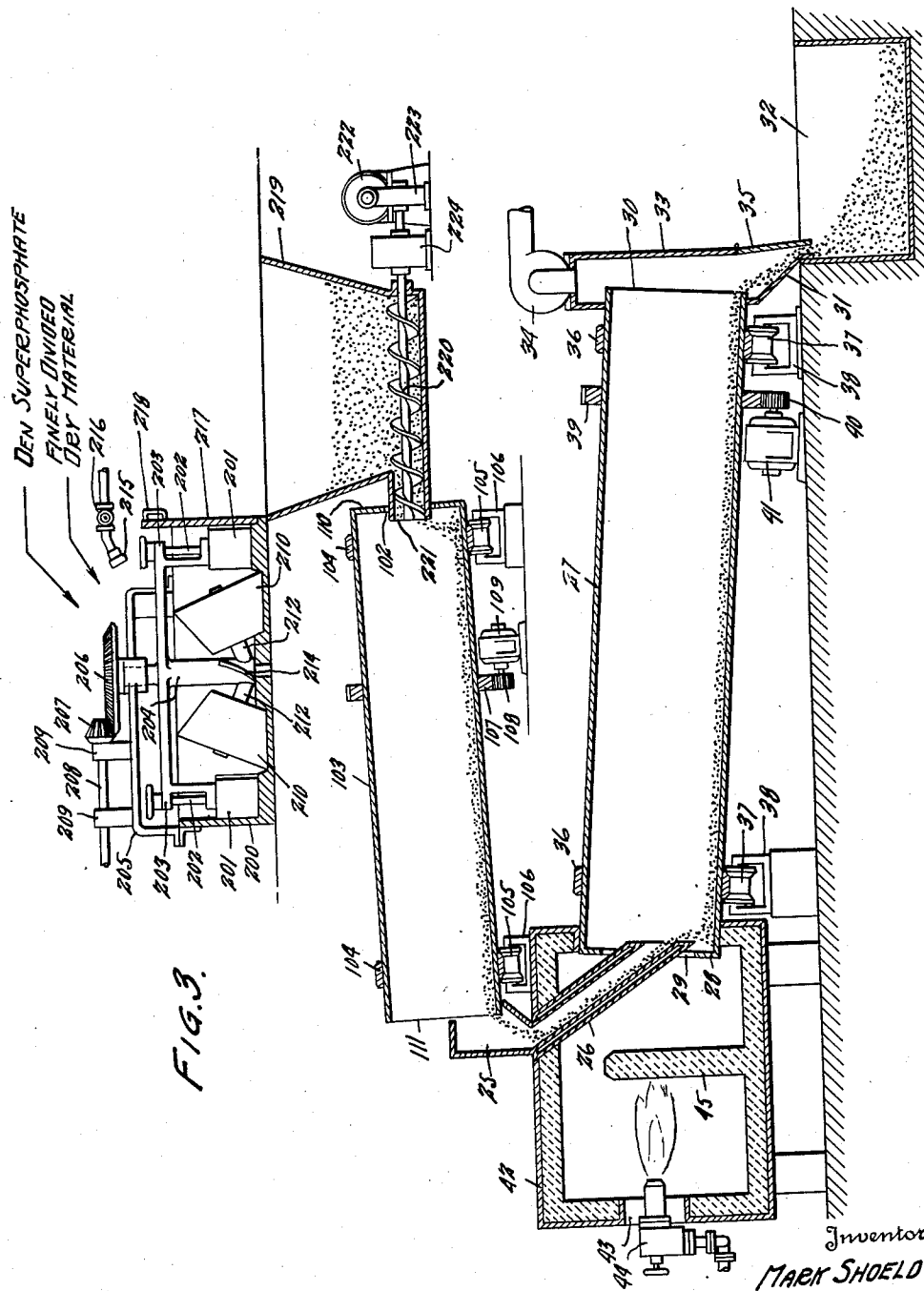
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2,232,145

METHOD OF GRANULATING SUPERPHOSPHATE

Filed June 15, 1933

4 Sheets-Sheet 3



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Feb. 18, 1941.

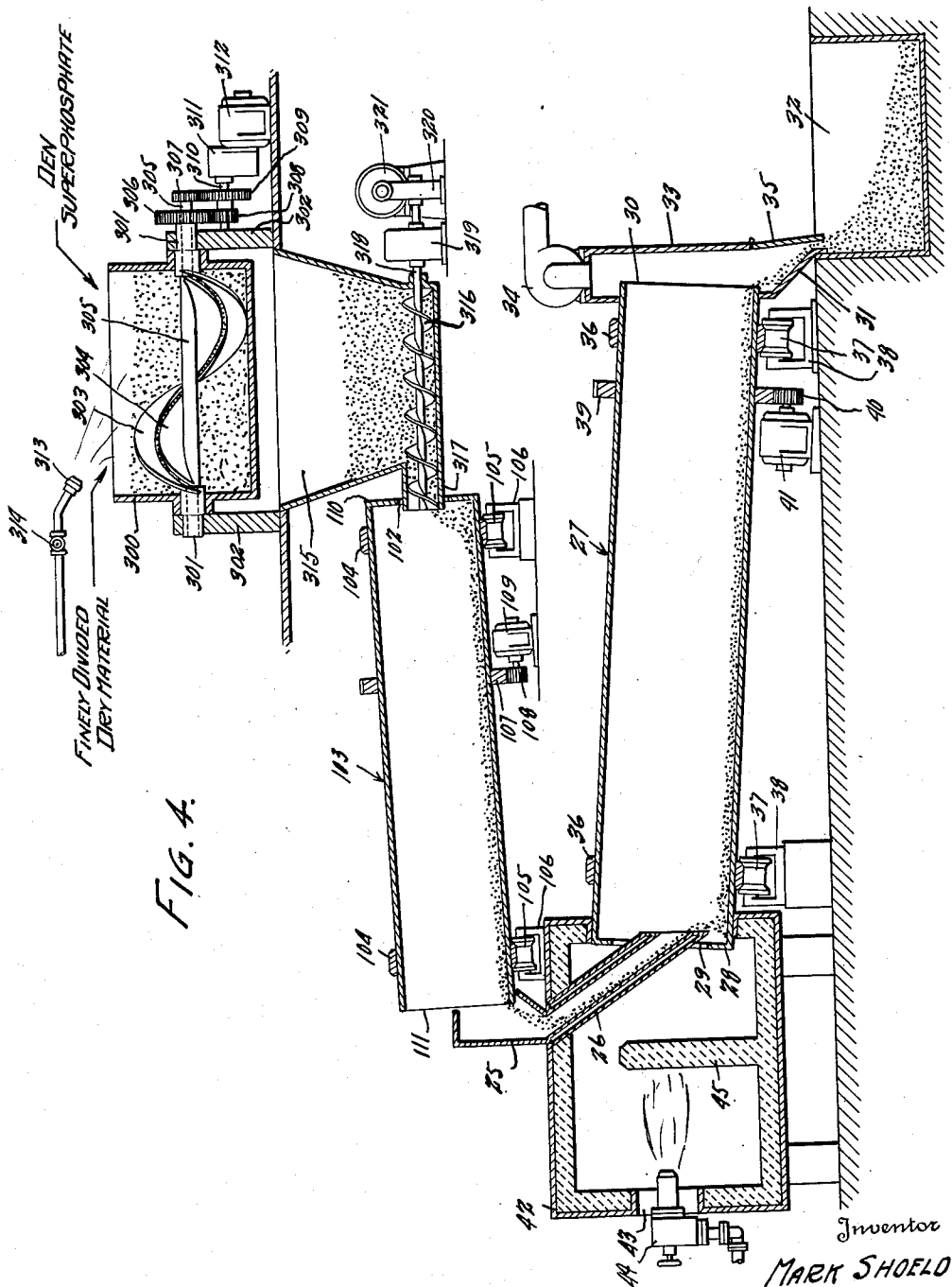
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METHOD OF GRANULATING SUPERPHOSPHATE

Filed June 15, 1938

4 Sheets-Sheet 4



UNITED STATES PATENT OFFICE

2,232,145

METHOD OF GRANULATING SUPER-PHOSPHATE

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Application June 15, 1938, Serial No. 213,927

1 Claim. (Cl. 71-40)

My invention relates to the manufacture of granular superphosphate.

In my co-pending application Serial No. 213,925, filed June 15, 1938, I have disclosed a process which involves the addition of dry granular material to the fresh den superphosphate to accurately regulate the character of the material passing to the conditioning step. Such material accurately regulated as to the moisture content passes to a conditioning step where the material is tumbled in a rotary cylinder to agglomerate it into granular particles. These particles are then passed to a drier. In the drier the granular particles are subjected to agitation by rotating the drum which comprises the drier and the final product is a granular superphosphate material having encrusted and indurated nodular globoid particles.

In the preferred form of this process, I use as the dry additional material prior to the conditioning step, classifier dust. That is to say dust which is formed by classifying or screening the granular material as it finally passes from the drier. The large nodules must be broken up, and it is desirable to have a uniform size of particles in the final product. The dust which is formed in this classifying step is returned as dry, fully cured superphosphate dust, or as it is called, "classifier dust." This dust is mixed with the fresh den superphosphate in the moisture conditioning step.

An object of the invention is to disclose processes and apparatus which will permit the formation of substantial uniform size encrusted, indurated nodular globoid particles of superphosphate material with a small percent of H_2O in the material passing to the drying step. Thus there is a considerable saving effected in capacity of apparatus and cost of the process.

A further object is to permit utilization of all the classifier dust taken from the product after the final drying by returning all of the classifier dust to the fresh den superphosphate prior to the conditioning.

Other objects will appear from the ensuing description.

The purpose of this addition was to make it possible to use fresh superphosphate directly from the den and still make it practicable to obtain the necessary regulation of physical condition of the material from the conditioner to the dryer.

The amount of classifier dust added to the feed of the conditioner was approximately 10%

of the total feed as cited in the typical example in the disclosure of Serial No. 213,925.

The moisture content of the fresh superphosphate to the conditioner was 10½%. The material from the conditioner to the dryer also had a moisture content of 10½%. The granular material right from the unit contained about 5% moisture. Thus the moisture elimination in the dryer was about 5½%.

If the classifier dust content of the feed is increased beyond 10% of the amount required for satisfactory regulation, then the total capacity of the dryer drops down. The reason for this is that it requires more than 10½% moisture in the material from the conditioner to obtain the required physical condition of the material as it enters the dryer. The amount of water required in the conditioner when more than 10% classifier dust is used is approximately 15% of the extra classifier dust added. Thus if 20% instead of 10% classifier dust is used it means that the moisture content of the material from the conditioner to the dryer is increased 1½% or from 10½% to 12%. The moisture elimination in the dryer in this latter case will be 7% instead of the previous 5½%.

As the capacity of the dryer is practically a function directly proportional to the moisture elimination, the result is that with 20% classifier dust the capacity of the dryer is only 78% of that with 10% classifier dust.

In the past it has been the practice to dispose of excess classifier dust, not required in the process, by means of mixing it with run of pile regular superphosphate and sell it as such or cut to regular 16% superphosphate.

The amount of classifier dust produced by pneumatic separation is generally around 15 to 20% of the total production. With 10% going back into the process it means that 5% to 10% has to be disposed of separately or otherwise reworked, sacrificing capacity of the granular unit.

With more exact classification, using double screening, to obtain a final product substantially all within the range of minus 10 mesh and plus 20 mesh, by Tyler standard screen analysis, the amount of classifier dust is increased to about 20 to 30% of the total production.

By means of this invention it is possible to rework up to 30% classifier dust in the granulating unit without sacrifice of any net capacity. As a matter of fact the actual running capacity of the dryer is increased more than 50%.

This is accomplished in the following manner. Instead of using a rotary cylinder for the condi-

tioning of the material prior to drying, the material is worked more strenuously. This may be accomplished by means of a severe kneading action.

By means of the energetic kneading action it has been found possible to incorporate up to 30% dry dust in the fresh den superphosphate and still obtain the desired physical condition of the material as it enters the dryer.

In the drawings:

Figure 1 illustrates in cross section one form of apparatus, and one method of carrying out my process;

Figure 2 illustrates in cross section another form of apparatus and another method of carrying out my process;

Figure 3 illustrates in cross section yet another form of process and apparatus for carrying out my invention;

Figure 4 illustrates in cross section yet another form of apparatus and process for carrying out my invention.

Referring to Figure 1, I have shown a hopper 1 to which is delivered by a clam shell bucket, or other suitable means, fresh den superphosphate 2. There is provided a gate 3 with an operating handle 4 at one side of the hopper 1 for regulating the amount of fresh den superphosphate which may be discharged by a slat conveyor 5.

The slat conveyor 5 discharges the fresh den superphosphate on to a sloping wall 6 of a hopper 7. Located above the sloping wall 6 is a spray 8, which may be regulated by means of a valve 9, and by which aqueous medium may be discharged into the hopper 7. There is provided another hopper 10 having classifier dust 11 therein. In the bottom of the hopper is located a screw conveyor 12 driven by a motor 13 through a suitable reduction gearing 14, driven by a variable speed transmission 14' having a control handle 14'' mounted thereon. The screw conveyor 12 discharges classifier dust through a conduit 15' into the hopper 7. A skillful operator can regulate the mixture of classifier dust, fresh den superphosphate and the water so that the material passing out of the hopper 7 has a moisture content which may be approximately 8½%. This is a lower moisture content than has heretofore been possible. However, by my method I am able to have the material which passes to the conditioning step low in water, thus saving the size of apparatus and necessary heat units to evaporate the final product to the desired moisture content.

From the hopper 7 the mixed classifier dust and fresh den superphosphate pass to a long cylindrical chamber 15 which has set in its walls a series of blades 16 which lie between a series of blades 17 mounted on a rotary shaft 18. The blades 17 on the shaft 18 have their surfaces inclined so that when the shaft 18 is rotated the material in the chamber 15 is fed forward from the entrance end 19 to the discharge end 20. The material in the chamber is subjected to a very severe kneading action. The shaft 18 is driven through reduction gearing 21 coupled to a variable speed transmission 22 having a control member 23. The variable speed transmission 22 is coupled to the shaft of an electric motor 24.

Under certain conditions of operation the mixing of the materials in the chamber 15 may be of such a nature as to cause sufficient agglomeration of the particles so that they may be readily discharged into a hopper 25 and pass thence

through a water-jacketed chute 26 into a dryer 27.

The dryer 27 has its axis inclined to the horizontal, and its high or intake end 28 is provided with an aperture 29 into which the lower end of the spout 26 projects. The lower end 30 of the rotary cylindrical dryer 27 discharges on to a chute 31, the material passing from thence into a receiving pit 32, from which it may be withdrawn by a clam shell bucket or other suitable means. The end 30 of the rotary dryer 27 is covered by an exhaust breeching 33 having a suction fan 34 in communication therewith. There is a hinged flap 35 formed at the bottom of the exhaust breeching which bears against the discharged dried granular superphosphate and prevents too much leakage of air into the exhaust breeching 33 past the stream of discharging phosphate granules.

In order to permit the dryer 27 to rotate, I have shown rings 36 mounted on either end of the dryer which travel in rollers 37 suitably mounted on supports 38. A ring gear 39 surrounds the exterior of the dryer 27, and may be driven by a pinion 40 mounted on a shaft of a motor 41. It is to be understood that reduction gearing may be used between the pinion 40 and the motor 41 in order to reduce the speed of rotation of the dryer 27. A fire clay lined breeching 42 is provided at the high end 28 of the dryer. There is an aperture 43 formed in one wall of the breeching 42 through which projects a burner 44 adapted to burn oil or gas. A baffle wall 45 is formed in the interior of the breeching 42 to prevent direct contact of the flame with the chute 26.

In operation the hot gases pass over the nodules which are in the dryer and remove moisture from them so that the final product has the desired moisture content.

An alternate form of the invention is shown in Figure 2. In this form of invention the action on the material in the elongated chamber 15 is not such as to properly coagulate particles of desired size for drying. Under such circumstances it is necessary to have a conditioning step between the chamber 15 and the dryer 27. The discharge end 20 of the chamber 15 discharges into a hopper 100 which, through a chute 101, feeds through an aperture 102 into a rotary cylindrical conditioner 103. The rotary cylindrical conditioner 103 is mounted on rings 104 which rest on rollers 105 carried by supports 106. To rotate the conditioner 103, I have provided a ring gear 107 driven by a pinion 108 mounted on the shaft of a motor 109.

The rotary conditioner 103 is mounted with its longitudinal axis at an angle to the horizontal so that the particles of material passing through the chute 101 pass from the high end 110 of the rotary conditioner 103 and are discharged at the lower end 111. In their passage through the conditioner the particles are agglomerated to the desired size to permit them to pass to the hopper 100 which feeds through chute 26 to the rotary dryer 27.

In either form of apparatus, Figure 1 or Figure 2, the desirable result is the same. That is to say, the agglomerated particles entering the dryer have little moisture content.

The moisture content of the mixture of fresh superphosphate and 30% classifier dust as it enters the dryer is approximately 8½%. The moisture content of the material from the dryer is 75

maintained at 5%. The moisture elimination in the dryer is therefore 3½%. Under standard operating conditions heretofore, the moisture elimination has been 5½%. In other words, by means of this invention, the capacity of the dryer is increased about 1.6 times.

Looking at the matter from a somewhat different angle, this invention makes it possible to rework all the classifier dust produced in the process, no matter how severe the classification operation is, without sacrificing any net capacity of the granulating equipment.

Again re-stating it in a somewhat different manner, as the cost of the granulation is primarily a direct proportional function of the capacity of the granulating equipment, it makes it possible to produce substantially perfectly sized granules without any significant additional cost above that of primary granulation.

In Figure 3, I have shown a somewhat different form of apparatus which effects a desirable severe kneading action. Here I employ a container 200 in which are mounted plows 201, pivotally mounted by shafts 202 carried by support arms 203. The support arms 203 are driven by a shaft 204 which is journaled in a support spider 205 mounted on the top of the container 200.

The shaft 204 has a beveled gear 206 at its top which is driven by a beveled pinion 207 mounted on a shaft 208. The shaft 208 is journaled in supports 209 mounted on the support spider 205. A suitable motor, not shown, is adapted to rotate the shaft 208 and cause the plows 201 to revolve around the inside of the container 200, throwing in towards the center the mixed den superphosphate and finely divided dry material or classifier dust. As the material is thrown in towards the center of the container 200, heavy beveled rollers 210 pass over the material, crushing and kneading the material on the bottom of the container. These beveled rollers are carried on support shafts 212, which are attached to a central shaft 204. The shaft 204 may have a plow 214 at its bottom, to prevent accumulation of the material at the center of the apparatus. The purpose of this construction is to throw the material being treated directly in the path of the heavy beveled rollers 210 and to cause the material to be thoroughly and intimately crushed and kneaded.

If water is desired, it may be supplied through a nozzle 215 controlled by a valve 216. When the material has been thoroughly mixed and is in the proper condition, there is a sliding gate which may be raised by means of a handle 218. Then the inclination of the plows 201 is reversed and the material is discharged outwardly and through the gate 217 into a hopper 219.

From the hopper 219 the mixed den superphosphate and classifier dust, which is in the proper condition with the desired low moisture content, is discharged by the screw conveyor 220 which feeds through a conduit 221 into the aperture 102 of the conditioner 103. The screw conveyor 220 is driven by a motor 222 through

suitable reduction gearing 223. If desired, a variable speed transmission 224 may be employed to more accurately regulate the speed of rotation of the screw conveyor 220. In this form of apparatus the operation is somewhat of the batch type in that the initial treatment of the mixture is a batch treatment. There can be, however, a sufficient supply of material in the hopper 219 to insure continuous operation of the rest of the process.

Referring to Figure 4, I have shown a somewhat similar type of apparatus to that shown in Figure 3. That is to say, I have shown means for obtaining a mixture in a batch operation. Here I have a receptacle 300 mounted on a shaft 301 journaled in supports 302. The shaft 301 passes through the walls of the container 300 and carries a helical blade 303 which is mounted outside and in close proximity to a helical blade 304 which is carried by an interior shaft which passes through the shaft 301.

The shaft 301 is rotated by means of a gear 306 and the shaft 305 is rotated by a gear 307. These gears 306 and 307 are driven by means of pinions 308 and 309, respectively, mounted on a shaft 310 which projects from a reduction gearing 311, to which power is supplied by means of a motor 312. The ratio of the gearing is such that the interior blades 304 revolve at higher speed than the outer blades 303. A finely divided 30 material, such as classifier dust and den superphosphate, are fed to the container 300. Water may be added through a spray nozzle 313 controlled by a valve 314, if desired.

When the batch is properly mixed the container 30 is rotated on the shaft 301 and the batch is dumped into a hopper 315 from which the material is discharged by means of a feed screw 316, which discharges through a conduit 317 into the opening 102 of a container 103. The shaft 318 of the feed screw 316 is driven through a variable transmission 319 coupled to a reduction gearing 320 driven by a motor 321.

It will be seen that economies in size of apparatus and cost of process are achieved by the processes and apparatus herein described without sacrificing the quality of the granular superphosphate product.

I claim:

A process of treating den superphosphate to produce a granular superphosphate fertilizer that is in hard dry encrusted and indurated particles having several times the crushing strength of ordinary den superphosphate comprising adding 30% classifier dust to the fresh den superphosphate, adjusting the moisture content of the mixture to approximately 8½%, subjecting the mixture to a severe kneading action, forming the mixture into agglomerated particles, tumbling the agglomerated particles in a zone of hot gases until the moisture content of the particles is reduced to substantially 5% and then discharging the particles from the drying zone.

MARK SHOELD.