C. W. CARTER.

PROCESS OF DRYING GRANULAR MATERIAL.

APPLICATION FILED APR. 22, 1918. RENEWED DEC. 27, 1920.

1,384,047. Patented July 12, 1921.

2 SHEETS—SHEET 1.

Fig. 1

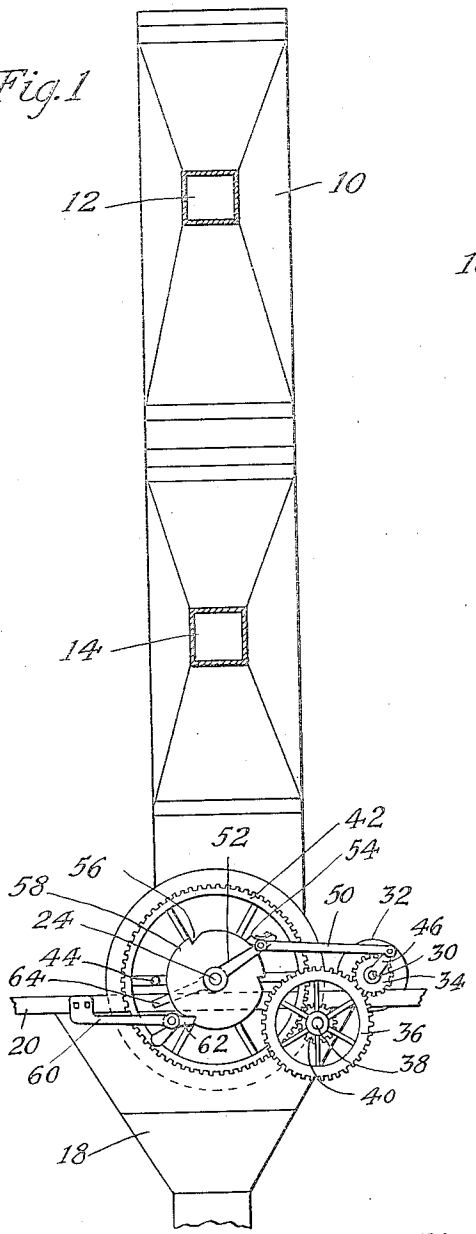


Fig. 2

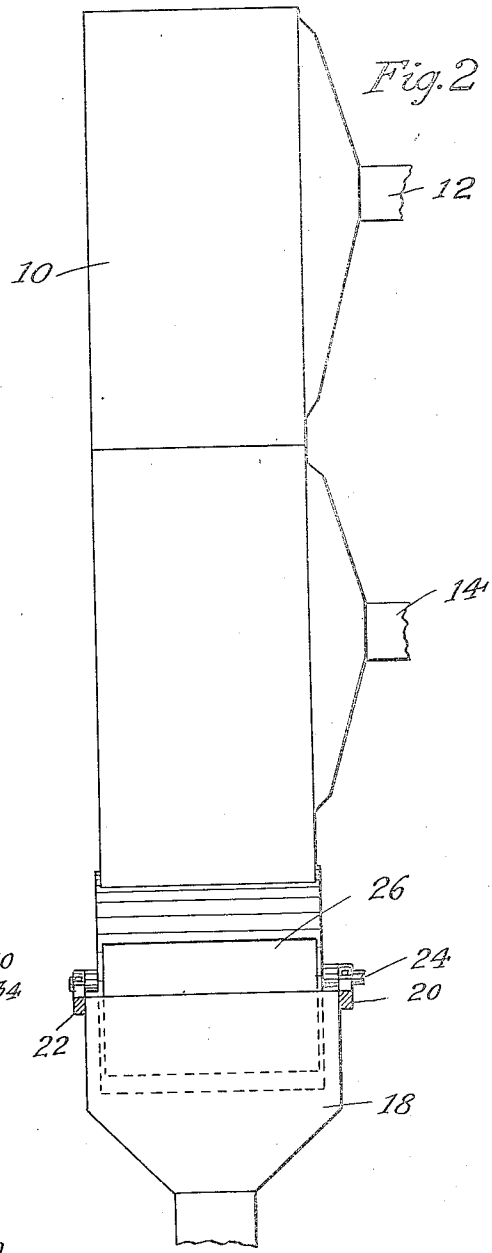
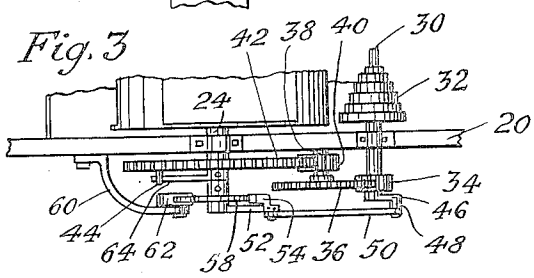


Fig. 3



Inventor:
Clarence W. Carter.
By Whiteley and Ruckman
his Attorneys.

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2 SHEETS—SHEET 2.

Fig. 4

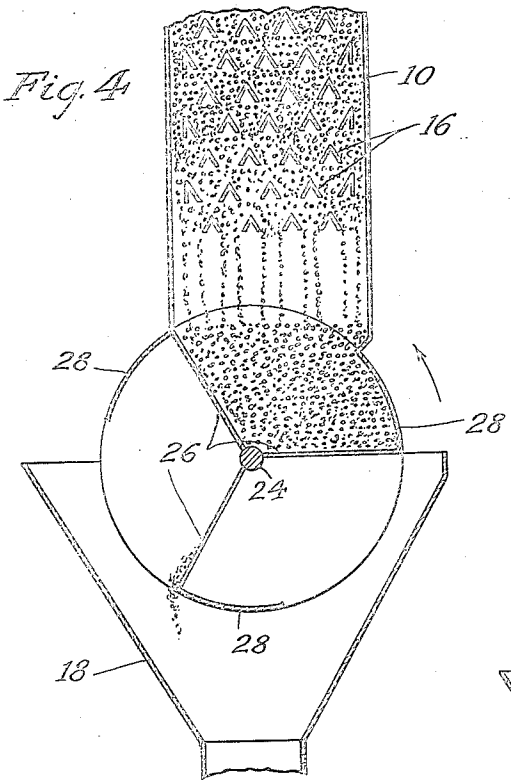


Fig 5

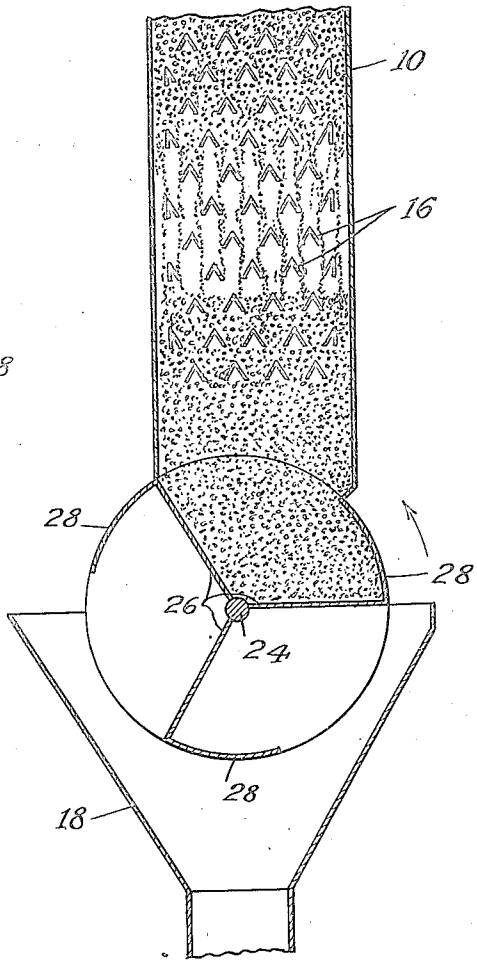
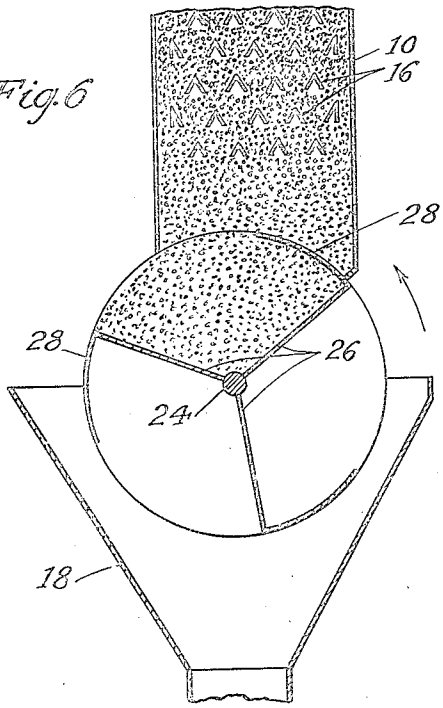


Fig. 6



Inventor:
Clarence W. Carter.
By Whiteley and Ruckman
his Attorneys

UNITED STATES PATENT OFFICE.

CLARENCE W. CARTER, OF MINNEAPOLIS, MINNESOTA.

PROCESS OF DRYING GRANULAR MATERIAL.

1,384,047. Specification of Letters Patent. Patented July 12, 1921.

Application filed April 22, 1918, Serial No. 229,910. Renewed December 27, 1920. Serial No. 433,432.

To all whom it may concern:

Be it known that I, CLARENCE W. CARTER, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Processes of Drying Granular Material, of which the following is a specification.

My invention relates to a process of drying granular material and in particular to a process of drying grain in which heated air is passed through a mass of grain having the form of a vertical column contained in large bins from the bottom of which the grain is drawn off after it has been dried. In processes of this kind in use before my invention the grain has been drawn off slowly at the bottom of the bin and the temperature to which it is feasible to heat the air is limited, since if the temperature goes much beyond a certain degree the grain is seriously damaged by the heat. It is well-known that if material which is being heated is thoroughly stirred at sufficiently short intervals of time, it can be subjected to a much greater degree of heat without injury than is the case where it is not stirred or is only slightly stirred. Before the time of my invention no satisfactory way of thoroughly stirring and agitating the grain had been devised, it not being practicable to introduce mechanical stirrers or agitators into the bins, and since the slow passage of grain out of the bottom causes but slight mixing of the mass, the temperature of the heated air has necessarily been restricted, as previously stated. Furthermore, it has previously been the custom to draw the grain through restricted openings at the bottom of the bins, and this produces currents in the mass, some portions thereof moving downwardly much faster than other portions. Therefore by the present manner of drying in bins, not only is an undue amount of time consumed but the grain is not uniformly dried. The object of my invention is therefore to overcome the above-mentioned defects in regard to drying, and I accomplish this object by making a radical change in the process. In short, I have devised a practical way of thoroughly stirring and agitating the mass at short intervals of time. I am therefore able to employ much higher temperatures than previously employed and thereby greatly shorten the time required to thoroughly dry the grain, and to also dry it much more uniformly than has been the case heretofore. I do this by causing the mass of grain to descend at intervals by a progressive showering action which produces a complete re-distribution of the kernels of grain such as is obtained by a stirring or agitating operation. In order to initiate this redistributing effect, I suddenly remove considerable portions of the mass from the bottom thereof and do this at intervals such that the time between successive removals of material is considerably longer than the time required for the removing operation. When the bottom portion of the mass is suddenly removed, a corresponding empty space is left at the bottom of the bin and the mass is therefore substantially unsupported except for such support as it may have by being in contact with the numerous air ducts which extend through the mass. On account of the frictional resistance offered by these air ducts, the mass when left unsupported at the bottom does not fall as a unit, but the bottom portion thereof falls first, then a portion above the same falls, and so on until the top of the mass is reached, thus producing a showering action starting at the bottom of the unsupported mass and running progressively up to the top thereof. This showering or redistributing effect is also aided by the fact that the grain is progressively moister from bottom to top and the dried grain at the bottom does not tend to cohere as much as does the grain farther up in the bin.

The full objects and advantages of my invention will appear in connection with the detailed description thereof and are particularly pointed out in the claims.

Referring to the drawings, which illustrate a suitable apparatus for carrying out my improved process,—

Figure 1 is an end elevation of a drying bin provided with means for carrying out my process. Fig. 2 is a side elevation thereof. Fig. 3 is a top plan view of the operating mechanism. Figs. 4, 5 and 6 are views in vertical section illustrating different positions assumed by the grain which is being dried and discharged by the discharge pockets.

In the drawings 10 designates one of the customary drying bins which are provided with upper conduits 12 for hot air and lower conduits 14 for cold air. The customary air ducts extending across the bins are designated by the character 16, The hopper into

which the dried grain is discharged is designated by the character 18. Two beams 20 and 22 are secured to opposite ends of the hopper 18 and these beams are provided with journal bearings for a shaft 24. Secured to this shaft are three radial plates or partitions 26 which, in connection with segmental end plates, form discharge pockets. Each of the plates 26 is provided at its edge with a curved cover member 28 extending in the direction of forward movement from the plate, and these members serve as partial covers for the pockets. Mounted in journals in the beams 20 and 22 is a driving shaft 30 to which are secured a number of stepped driving pulleys 32 for changing the speed of operation of the device. Secured to the shaft 30 is a pinion 34 in mesh with a gear 36 which is secured to a stub shaft 38 to which shaft is also secured a pinion 40 in mesh with a gear 42 loosely mounted on the shaft 24. It is evident that a reduction gearing is thus provided between shaft 30 and the gear 42. On one of the spokes of this gear is a projecting lug 44 for a purpose which will presently appear. On the end of the shaft 30 is a crank arm 46 having a wrist pin 48 for operating a connecting rod 50 which is pivotally connected with an arm 52 loosely mounted on the shaft 24. On the outer end of said arm is a pawl 54 which is adapted at certain times to engage one of a series of three notches 56 provided in the periphery of a disk 58 secured to the shaft 24. At other times this pawl slides idly back and forth upon the periphery of the disk. A bracket 60 carries a stop pawl 62 which is adapted to successively engage the notches 56 to prevent backward movement of the shaft 24. Secured to the shaft 24 is an arm 64 disposed in the path of the lug 44 previously referred to and adapted to be engaged at times by said lug in the forward movement of the wheel 42. It is evident from this description that the pockets have a comparatively long period of dwell under the bottom of the bin, and they start to move with a slow turning movement which is soon converted into a quick turning movement to discharge the grain. This quick turning movement occurs as soon as the disk 58 has been turned sufficiently far to bring one of its notches within reach of the pawl 54. The partial cover members 28 prevent escape of the grain from the right-hand end, as will be evident from Figs. 4, 5 and 6.

The operation of the mechanism will be readily understood from the foregoing description. Upon applying the power to turn the shaft 30, the gear 42 will be rotated upon the shaft 24 at a greatly reduced speed. The rotation of the gear 42 of course imparts rotation to the shaft 24 only when the lug 44 comes into engagement with the arm 64. When this occurs, it is evident that the shaft 24 and the discharge pockets will at first be turned slowly. The connecting rod 50 is oscillated by the crank arm 46 and causes the pawl 54 to oscillate idly back and forth upon the periphery of the disk 58, except that when it is engaged with one of the notches 56 it imparts a rapid turning movement to the disk 58 and to the shaft 24, carrying the discharge pockets. It is evident from an inspection of Fig. 1 that the pawl does not oscillate sufficiently far to engage a notch in the position shown, and that it is necessary for the lug 44 to catch up with the arm 58 and impart a turning movement to the disk 58 until the pockets arrive at about the position shown in Fig. 6 before the pawl can engage one of the notches 56 and impart the rapid movement to the pockets. It is evident that when this occurs the arm 64 again gets ahead of the lug 44. A charge of the grain is thus suddenly removed from the bottom of the bin by the rapid movement of the pocket which has just been filled and the mass of grain in the bin is left substantially unsupported at the bottom. The pockets then remain at rest until the lug again catches up with the arm. It will thus be seen that a pocket remains in the filling position shown in Fig. 4 for an appreciable length of time and then moves slowly to about the position shown in Fig. 6. The pocket is then moved very quickly to discharging position and the next pocket brought into the filling position under the bin. When the mass of grain is left unsupported at the bottom, the space from which grain has just been removed is not instantaneously filled, since the mass is partially supported by the baffle plates previously referred to. A showering action results which is aided by the facts that the pressure at the bottom of this mass is greatest and the grain is drier and has less coherence than the grain higher up in the bin. The result is that the bottom portion of the mass falls first in the form of a shower, and a showering action extends progressively up to the top of the mass of grain. This manner of descent causes a thorough redistribution and mixing of the kernels of grain and prevents them from being acted upon injuriously by the high degree of heat which is employed. The timing of rotation of the pockets is such that each pocket remains at rest in filling position for a time considerably longer than is required to remove the charge before it is rotated into discharging position. As soon as the latter movement has been effected, it is evident from an inspection of Fig. 4 that the progressive showering of grain from the bottom to the top begins and that the pocket will be filled before the whole mass has fallen. Fig. 4 shows a pocket filled by the falling of the material left unsupported beneath the baffle

plates, while Fig. 5 shows the showering action occurring farther up in the mass.

I claim:

1. A process of drying granular material which consists in supporting a vertical column of said material at its bottom, passing heated air through said column, and periodically withdrawing said support to an extent sufficient to cause the entire column of material to move downward uniformly throughout its cross section.

2. A process of drying granular material which consists in supporting a vertical column of said material at its bottom, said column being of a predetermined length, passing heated air through said column throughout the principal part of the length thereof, periodically withdrawing said support to an extent sufficient to cause the entire column of material to move downward uniformly throughout its cross section, and regulating the intervals of time between each of said withdrawals so that the part of the material which moves past the point of support and is discharged from the column will have been suitably dried.

In testimony whereof I hereunto affix my signature.

CLARENCE W. CARTER.