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SHREDDING AND MIXING MACHINE

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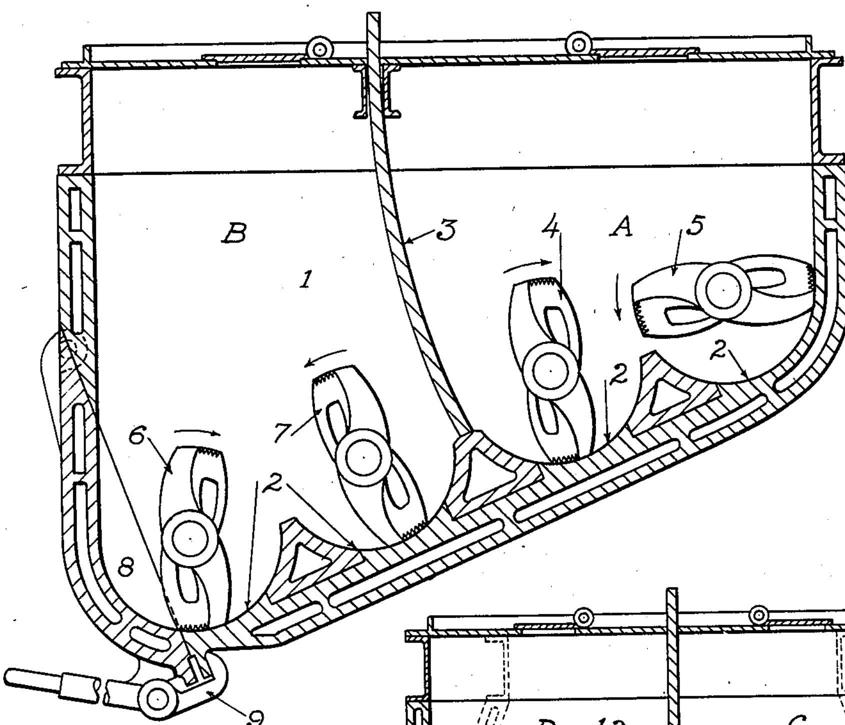

Fig. 1

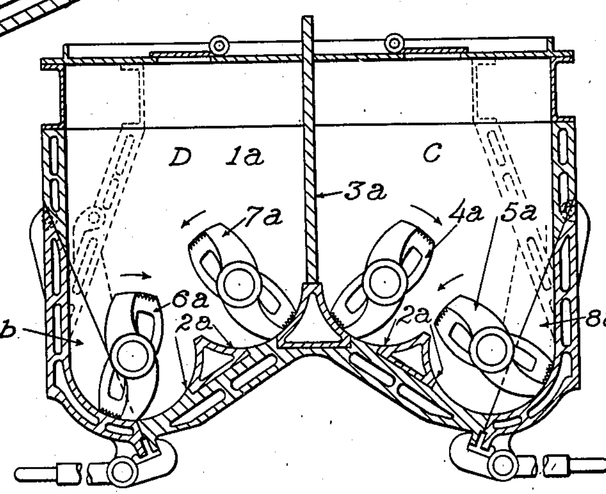

Fig. 2

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SHREDDING AND MIXING MACHINE

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1 Claim. (Cl. 92—20)

This invention has to do with shredding and mixing machines which are used for breaking down, mixing, and dissolving materials such as wood, cotton, or scrap-paper cellulose and the like, for the manufacture of rayon.

Heretofore an operation of this nature usually has been performed in one stage in a single large mixer of the well-known type having a pair of blades rotating toward each other on parallel axes in semi-cylindrical halves of the trough bottom, co-operating with a ridge or saddle separating the halves. In the treatment of raw cellulose in machines of this type certain natural limitations are encountered. First, a large capacity mixer of this type has, in proportion to its volume, a relatively small water-cooled surface area. A great deal of heat is generated by the shredding operation, and cellulose batches as well as mixtures of other materials are variously limited as to the temperature to which they may be heated without spoiling the product. Therefore, the power input and consequently the rate or speed of operation has been limited heretofore by the ability of the cooling means to carry away the heat created by working the batch.

Mechanical limitations also affect the rate of output when the initial disintegration of large pieces and the final reduction of the mass to small particles are performed in a single machine. Rather large working clearances between the blades, the trough walls, and the saddle are required for the most effective breaking down of large pieces. If the blades are provided with cutting and tearing teeth, as is desirable for working fibrous material, the initial disintegration of large pieces is performed best with relatively large, coarse teeth. Also, for the most efficient breaking up of large pieces, a slow speed of operation of the blades is necessary, due to the great power required and the aforesaid temperature limit which cannot be exceeded without spoiling the material. The final comminution of the moderately reduced material can be performed best by blades having a slight clearance from the co-operative trough surfaces, having fine shredding teeth, if any, and operating at high speed.

Necessarily, therefore, a single machine used for the entire operation must be a compromise between those dimensions and operating characteristics of the working elements best suited for the initial and final stages of the operation. It is necessary also to provide speed-changing means in the driving mechanism for the blades so that different working speeds are available for the various stages in the treatment of each batch.

Our invention overcomes the disadvantages set forth above and provides a machine which will shred and disintegrate large quantities of material in much less time than could the previous single machines, thereby reducing the overhead cost per unit batch.

The invention by which these desired objects are attained consists of a mixing machine having a plurality of pairs of blades mounted on parallel axes, each blade within its co-axial semi-cylindrical trough, a ridge-shaped saddle between each pair of troughs, and a removable partition between each two adjacent pairs of troughs, so that in effect a series of small mixers are housed in a single machine. Each pair of blades is adapted to perform most efficiently its share of the progressive complete reduction of the material.

In a two-compartment machine according to the invention, one subdivision of the mixer has blades designed and/or driven at the moderate speed best for initially breaking down large pieces of raw material and effecting half the ultimate reduction in their size. This section of the mixer is arranged so that the rotating blades discharge the partly worked batch from the first into the second section of the machine when the partition between the two is removed. In the second trough the blades have working clearances and shredding teeth fine enough best to reduce the preliminarily shredded particles to their ultimate fineness. This second set of blades is driven at high speed best suited for the operation.

By reducing the diameter of the four blades and their trough sections as compared with the single pair of blades previously used, the surface area of the machine in proportion to its capacity is increased. Thus more effective cooling may be maintained, permitting the blades to be driven at increased speed, thereby reducing the overall working time for a batch of material.

A further advantage of the improved machine is that a more nearly continuous output of finished material is obtained, since a more frequent discharge of smaller batches is obtained, that is, disregarding the permissible increased operating speed, batches of half the size will be discharged twice as fast as in the case of a mixer of the same capacity employing one pair of blades.

In operation a batch of raw material is first placed in the compartment in which the slow-speed blades effect the initial coarse reduction of the particles. When this half of the operation is completed, the partition is removed, and the blades kick the initially sized material into the second sub-division of the machine, in which the other pair of blades operate. The partition is then replaced. A fresh batch of raw material is placed in the first compartment, and the semi-sized material is finely shredded and masticated by the second pair of blades, which are closely fitted and driven at the high speed suited for the purpose. Those two stages of the operation proceed simultaneously until the material in the second compartment has been completely disintegrated and mixed, when it is discharged from the machine in known manner. The discharge openings are closed, the partition is removed, the partly sized material in the first compartment is transferred into the second compartment of the machine, the partition is replaced, and a fresh batch of raw material is added.

Having set forth the general nature and mode of operation of my invention I will now describe the construction and operation of a preferred form of machine embodying its features, having reference to the accompanying drawing, in which Fig. 1 is a sectional side elevation.

Fig. 2 is a sectional side elevation of a modification of the machine shown in Fig. 1.

Referring to Fig. 1, a mixing trough 1, water-jacketed for cooling, has an inclined bottom provided with four semi-cylindrical trough sections 2 of conventional form. Trough 1 is divided by a removable partition 3 into two compartments A, B. In the mixing compartment A a pair of blades 4, 5 are mounted for rotation, each blade in a semi-cylindrical trough section 2. Blades 4 and 5 are provided with driving means, not shown, of known form.

The blades 4, 5 are so dimensioned and are provided at their working edges with shredding teeth appropriately shaped and of a size best adapted to break down large pieces of raw material into pieces of moderate size. The blades are driven toward each other as indicated by the arrows at a slow speed which will cause them to perform their function without excessively heating the material.

In the second finishing compartment B a pair of blades 6, 7 are mounted similarly to those in section A, but their working edges, the cutting teeth thereon, their working clearances from the trough walls, and the high operating speed are all selected to disintegrate and comminute the preliminarily sized particles of raw material and to complete dissolving the batch most effectively and rapidly.

Discharge from section B of the trough is effected through a horizontally hinged swinging door 8 in the lower wall of the mixer, which is provided with a clamping latch 9 of known form.

The operation of the machine is as follows:

The raw ingredients of the first batch are charged into section A of the trough. Blades 4, 5 operate on it at slow speed until all the large pieces are broken down to the desired maximum size. Preferably one-half of the overall reduction of the batch is performed in section A. The partition 3 is then raised from the position in which it is shown, and the material flows and is kicked by blade 4 over into compartment B. The partition 3 is lowered, a fresh batch of raw material is put into section A and the machine is operated until the batch in section B is ready for discharge. The discharge door 8 is then unlocked and swung open and the material is expelled by blade 6 in the usual manner. The gate 8 is then closed, the partition 3 is raised, and the material which has been treated in section A flows and is driven by blades 4, 5 into section B for the completion of its treatment. The partition is replaced, a fresh batch of raw material is put into section A, and the cycle of operations is repeated.

Fig. 2 shows a modification of the invention in which the axes of the two pairs of blades lie in two planes, inclined upwardly toward each other from the ends of the machine trough to its middle, where the inner trough sections of the compartment bottoms join in an elevated ridge. By this construction the overall height and the weight of the machine is reduced as compared with a machine of the same capacity according to Fig. 1.

Another advantage of this machine is its adaptability and flexibility in service. Either compartment can be used alone as a mixer for economically preparing small batches of material in conventional manner. The other compartment and its blades can remain idle, or can be used at the same time to treat another mixture. Discharge doors for each compartment are provided in both end walls of the machine at the low ends of the compartment bottoms, whence the quickest and most complete discharge of mixed material is effected.

Referring to the drawing, the trough 1a is divided into two mixing compartments C and D, the bottoms of each comprising two semi-cylindrical parallel trough sections 2a of known form, the axes of each pair of sections lying in planes which are inclined upwardly from the ends of the trough 1a toward its middle. A removable vertical partition 3a separates the two compartments C and D. Blades 4a and 5a are rotatably mounted in the trough sections 2a of compartment C, blades 6a and 7a in compartment D. Discharge doors 8a and 8b are provided in the outer walls of both compartments for use when the sections C and D are employed as individual small mixers.

Only one of the discharge doors, as 8b, is used when the machine is operated in the manner of the machine of Fig. 1. For example, the raw material is placed in compartment C where it is partly broken down, the partition 3a is then removed and the batch passes into compartment D for its final shredding while a second batch of fresh material is being treated in compartment C. The completely reduced material is discharged from compartment D through door 8b.

Another feature of the machine is that the operating sequence of one of the two mixing compartments may be reversed, is desired. The initial breaking down of a batch can be done in compartment D, the final shredding in compartment C, and the batch discharged through door 8a.

To adapt the machine to these various modes of use the two pairs of blades or rotors 4a, 5a, 6a, 7a are preferably identical as to the size of their shredding teeth, if any, and have like clearances from their respective co-operative trough bottoms and saddles. The fundamental principle of the invention is retained, however, in that one pair of blades, as 4a, 5a, are driven at slow speed for initially treating coarse material, and the other set of blades 6a, 7a are driven at high speed by conventional means, not shown.

Either trough section may be used for the first stage of the mixing process, if desired. In this event both pairs of blades will be alike in design and working clearances, but whichever pair performs the first part of the mixing process will be driven slowly and the other pair will be driven at a higher speed.

To make this reversible use of the machine possible, two similar discharge doors 8a, 8b are provided, one at each end of the machine, permitting a discharge from either end of the trough sub-division. In operation of course only one of these doors will be employed at a given time.

Since the compartments are at the same level, with an elevated ridge between them, complete transfer of a preliminarily treated batch, as from section C into section D, may not be possible. Only a portion, say, half or two thirds, depending upon the size of the batch, will naturally pass from section C to section D when partition 3a is raised. This may not be objectionable in most cases, fresh raw material being added to the balance of the material remaining in the first section C after the partition 3a has been replaced. However, a more complete transfer may be effected by providing means for reversing the direction of rotation of one pair of blades, for example, 6a and 7a, during the discharge of material from section C into section D, so that the bulk of the material coming into compartment D will be moved to the left against the outer wall.

In practice the complete discharge of each batch, preliminarily treated in section C, into section D need not occur to obtain substantial benefits of the invention, since large pieces of raw material will be broken down in, say, section C of the machine, in which the blades are driven at a speed best suited to the task, and the final shredding of the partly reduced particles will be done in the other section D, wherein the blades can be driven at high speed for speedy and thorough completion of the disintegration and mixing of the material.

In the machines shown there is a tendency for the bulk of the material to flow into the lower semi-cylindrical trough, so that the upper of the pair of blades does not work as effectively as its lower mate. To overcome this difficulty by more evenly distributing the load over both blades, the end wall of the machine adjacent a lower blade may be inclined inwardly toward its top. This construction is illustrated by dotted lines.

Experimentation has shown that increased cooling surface in proportion to the capacity of the machine is made possible by our invention. For instance a 7000 liter, two-bladed machine has 11.8 square meters of cooling surface, or one square meter of cooling surface for each 732 liters capacity. In a four bladed machine, as shown and described, having a capacity of 7000 liters there are 14½ square meters of cooling surface, or one square meter for 265 liters capacity. In other words, the ratio of cooling surface to capacity has been increased 2½ times. Therefore, greater power-input to the rotors is permissible and greater output per hour is secured from a machine of given size.

Simplicity in driving mechanism and ease of operation is provided by the invention. Single machines previously used for shredding operations have required the provision of speed-changing means in the gear trains driving the blades, so that they could be operated at low speed upon the fresh material and then speeded up for the latter part of the operation. The machine attendant thus had to change the blade speed twice for each batch turned out. In the present invention each set of blades operates at a constant speed and may be directly driven, eliminating driving parts and reducing the amount of attendance required.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

In a shredding and mixing machine, two mixing compartments side by side, the bottom of each compartment having parallel intersecting semi-cylindrical trough sections whose axial planes are inclined upwardly from the end walls of the machine toward its middle, a rotor mounted in each trough section and coaxially therewith, power-actuated means for driving the rotors of adjacent compartments at different speeds, a removable partition between said compartments, and a discharge door in each end wall of the machine opening into the lower part of each of said compartments.

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