April 30, 1929. J. A. MICHAL 1,711,154

MIXING AND GRINDING DEVICE

Filed Dec. 30, 1926 2 Sheets-Sheet 1

Fig: 1.

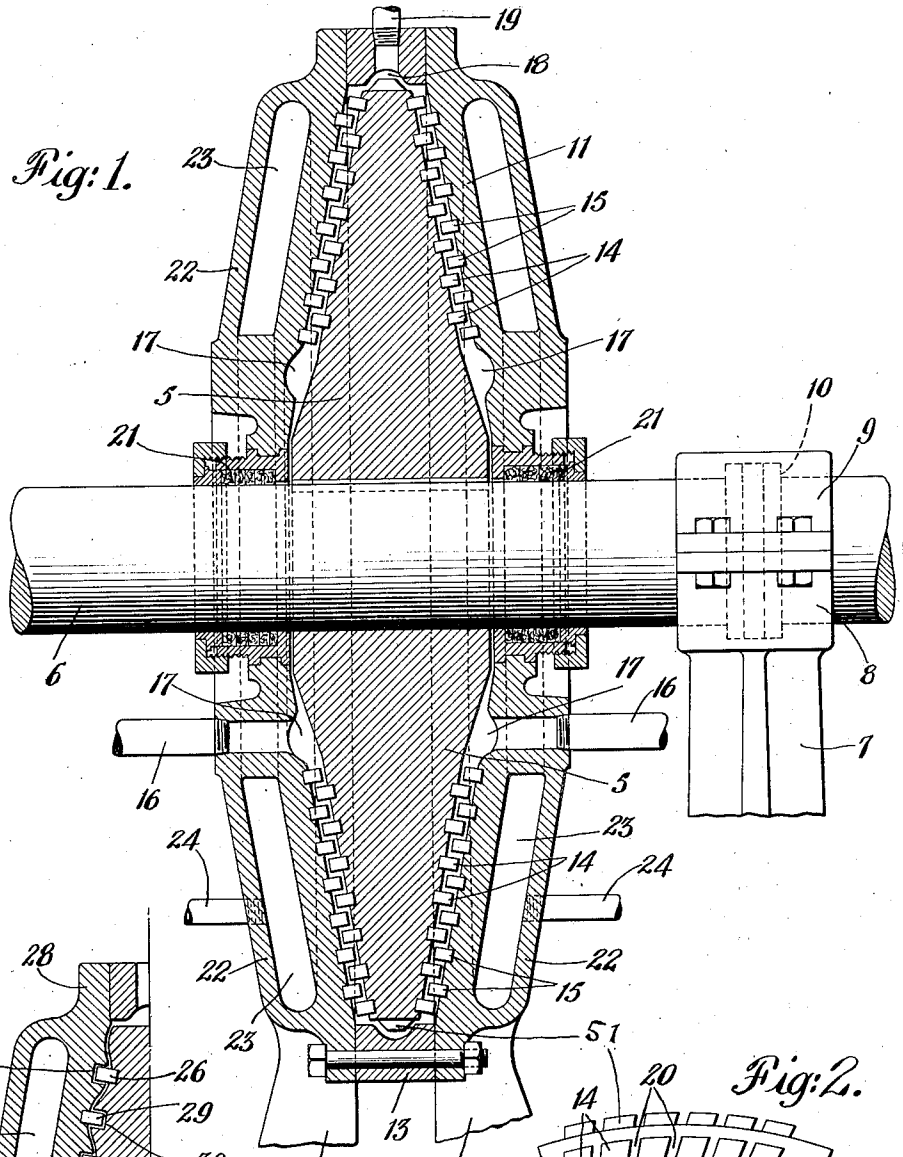


Fig: 2.

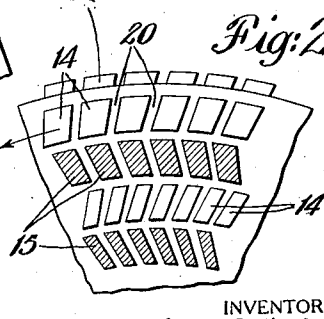
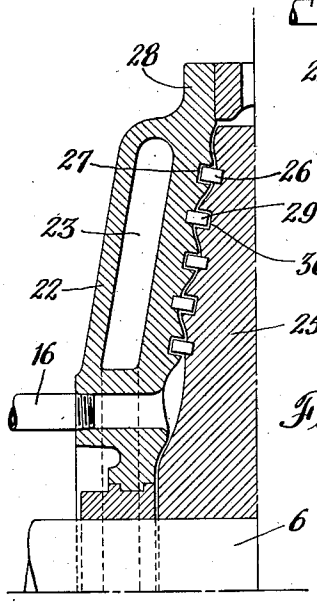


Fig: 3.



INVENTOR

Jaroslav A. Michal

BY

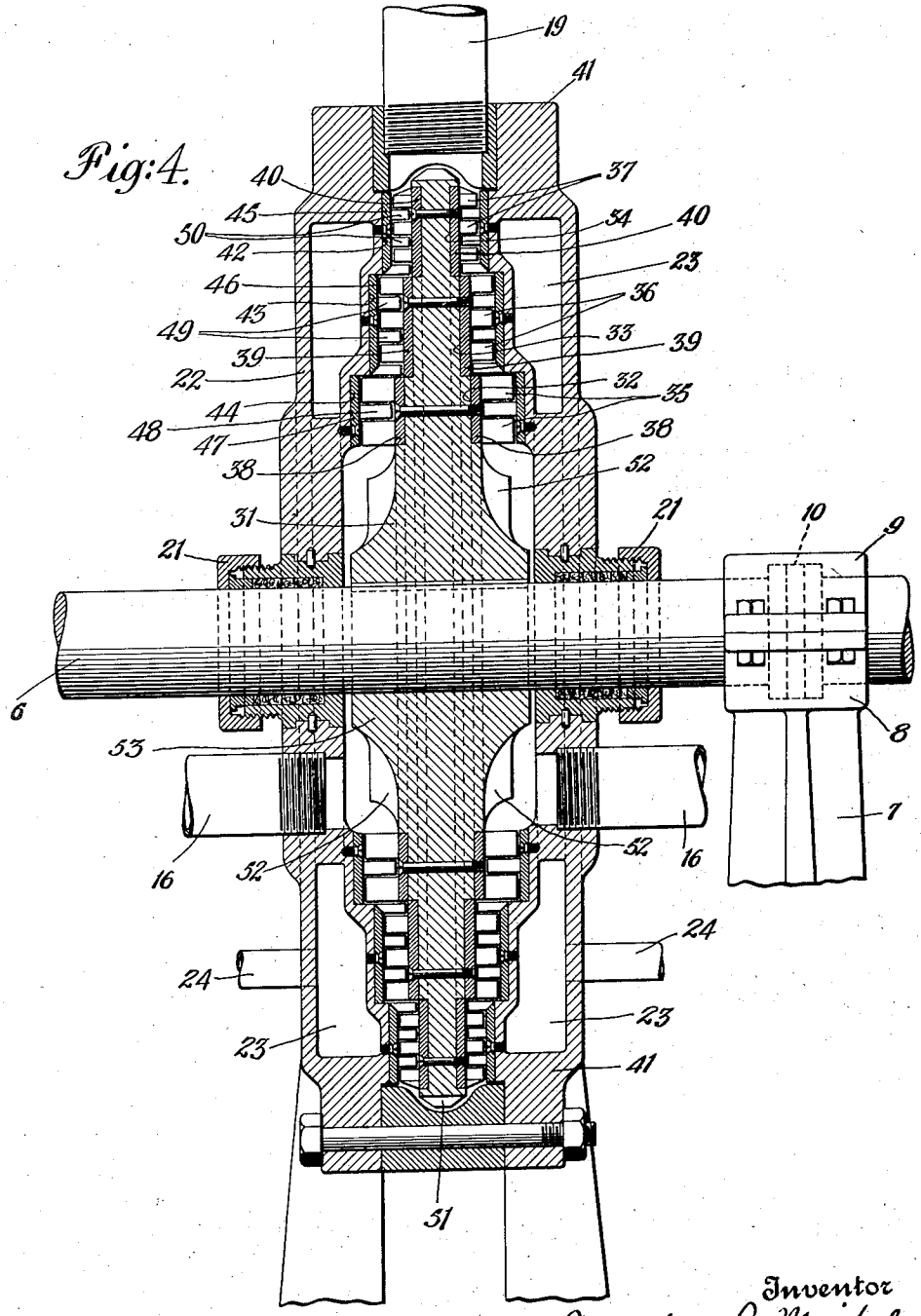
Abel L. Browning ATTORNEY

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Fig. 4.



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Patented Apr. 30, 1929. 1,711,154

UNITED STATES PATENT OFFICE.

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MIXING AND GRINDING DEVICE.

Application filed December 30, 1926. Serial No. 158,097.

This invention relates generally to mixing, grinding, dissolving and emulsifying apparatus and more particularly to a mixing and grinding machine of the general type described and claimed in Letters Patent of the United States No. 1,487,208 granted to Cooke et al. March 18, 1924.

Mixing and grinding machines of this type are characterized by a construction somewhat similar to that of a steam turbine, and by a mode of operation resembling what would be accomplished were a turbine to be driven by the application of power to its shaft and with the turbine blades functioning to impel material from stage to stage through the machine. It has been found in actual practice that the treatment of liquid-suspended material in a mixing and grinding machine of this general nature provides a very satisfactory colloidal grinding or comminuting effect. The individual particles in the material are not only substantially reduced in size by impact with blade after blade in their travel through the machine, but the reduction in size of the particles is uniform throughout the mass of material treated.

It is a general object of the present invention to provide a mixing and grinding machine of the general type referred to in which the action of centrifugal force will be utilized to assist in feeding material through the device and also to produce a progressively increasing intensity of action on the material as it travels through the grinding zone of the machine.

The invention comprises a grinding machine of the general type referred to in which the travel of the material being treated is radially outward through concentric rows of oppositely inclined blades. The machine includes a rotor of disk-like formation and converging or tapering from its central portion to its outer periphery. The rotor is supported on a horizontal shaft and its lateral faces are provided with concentric rows of blades having their working faces set at suitable inclinations to propel both circumferentially and with a radially outward component of travel. The machine includes also a casing or housing for the rotor which is also provided with rows of blades which alternate with the rows of blades on the rotor and project therebetween. The inclination of the blades mounted in the housing is such as to cooperate with the blades on the rotor and deflect material from row to row toward the periphery of the machine. The deflection of material from row to row produces an impacting or disintegrating effect, creates the mass velocity of the material in the machine, and effects the desired grinding or reduction of particle size in the material.

Other features of the invention will be hereinafter described and claimed.

In the drawings, in which a preferred embodiment of the invention has been selected for illustration:

Fig. 1 is a view in the vertical section of a grinding and mixing machine embodying the invention;

Fig. 2 is a sectional view on an enlarged scale showing a detail of the material engaging portions of the machine;

Fig. 3 is a view similar to Fig. 1 showing a portion of a machine embodying a modified form of the invention;

Fig. 4 is a view similar to Fig. 1 of a modified form of the invention.

Referring to the drawings for a more detailed description of the invention, in Fig. 1 there is shown a grinding and mixing machine which includes a rotor 5 mounted on and for rotation with a shaft 6 supported on standards, such as is shown at 7, and driven from any suitable source of power. Standards 7, only one of which is shown, are provided with split bearing members 8 and 9 in which the shaft 6 is journaled, an enlargement 10 on the shaft rotating in corresponding grooves in the bearing members 8 and 9 to prevent longitudinal movement of the shaft 6.

The rotor 5 is housed in a stationary casing or housing 11 which is supported at its lower end on pedestal members 12. The housing 11 is made up of two parts circumferentially divided and adapted to be applied to an intervening spacing ring 13, the inner periphery of which is spaced a slight distance from the outer peripheral surface of the rotor 5.

The opposite faces of the rotor 5 and the inner faces of the housing 11 are provided with circular rows of blades 14 and 15, the

rows of blades on the different supports being arranged in alternation and having an overlapping or intermeshed relation with each other. In other words, the rows of blades on the rotor extend into positions between the inwardly projecting blades on the housing. The result is that the blades on the rotor, which are inclined in one directions, engage and deflect the material against the angular faces of the blades on the housing, which are set at the opposite angle. In this way material is deflected from row to row of blades in the operation of the machine.

Material to be treated is caused to enter the device through the supply pipes 16 at points relatively near to the axis of rotation of the device. Material is discharged from the pipes 16 into annular channels 17 formed in the inner faces of the housing members 11 at a point located radially within the bladed areas of the housing and rotor so that the incoming material immediately enters the innermost rows of blades to begin its outward travel toward the periphery of the machine. It will be seen that a doubly effective feeding action is provided for causing the material to progress through the bladed section in which it is subjected to the desired mixing and grinding action. One of these feeding effects resides in the deflecting actions of the blades which are set at suitable angles for this purpose and which operate to move the engaged material from row to row of blades and in generally radially outward directions toward the circumference of the machine. Another feeding effect or action resides in the movement of the material which is produced by the effect of centrifugal action. This also tends to move the material outwardly toward the circumference of the machine.

It will be seen that the relation of the blades is such that no portion of the material under treatment can pass through the machine without being subjected to the action of the blades. In this respect the operation of the machine follows that of the device described in the prior patent referred to and in this respect this general type of machine differs in a substantial manner from prior mixing and grinding machines which have gone into commercial use. The type of machine herein described differs from the prior art in another respect also and that is in the impacting action which is produced on the material by the operation of the blades whereas in the older art it was the practice to subject the material to the grinding action of stone mills or to the disrupting action brought about by forcing the material between relatively moving surfaces separated by the thickness of a thin film.

When the material has reached the outer peripheral region of the rotor 5, it is forced into a channel 18 from which it enters a discharge pipe 19 and through which it is conveyed to a suitable receiving receptacle.

In order to overcome the tendency to produce a high vacuum in the movement of the material from the inner portion of the bladed area to the outer portion thereof in which the speed of travel of the blades is much greater than the speed of travel of the blades at the inner portion, the size of the blades is gradually increased toward the outer periphery of the machine. By thus increasing the size or circumferential width of the blades, the cross sectional area or the width and number of the passages 20 between the blades is maintained substantially the same throughout the peripheral extent of the bladed section. This relation of the blades and the intervening spaces to each other is illustrated in Fig. 2 of the drawings.

Not only is the tendency to produce a high vacuum in the swiftly moving blades at the outer portion of the section overcome by this action, but the increased size of the blades toward the outer section is helpful in providing the greater strength and resistance that is needed in this zone because of the greater velocity of movement of the parts. The result is that although the velocity of the moving parts is progressively increased toward the outer periphery of the machine, the density of the material engaged by the blades is substantially maintained so that the effectiveness of the grinding action is progressively increased as the material travels through the bladed sections. The increase in effectiveness of the action of the blades on the material as it travels through the bladed section is utilized in an effective way because the solid particles included in the material are progressively reduced in size as they travel through the bladed section, so that the more effective action in the outer zone is utilized in operating on particles of reduced size. The whole operation is efficiently performed because of the method of construction and the mode of actuation referred to.

The housing members 11 may be provided with packing glands 21 at their points of connection with the shaft 6 although the high speed at which the rotor is driven in operation practically precludes leakage of liquid through the glands 21 since the action of centrifugal force tends to prevent the accumulation of liquid at the central zone of the device.

A limited degree of adjustment of the housing members 11 toward and from each other in order to thereby produce a corresponding change in the character of the operation of the device on the material may be provided by interchanging the circumferential rings 13 and using rings of different width to provide the different adjustments

desired. The principal adjustment, however, is provided in the original setting of the machine and is based upon the inclination at which the blades 14 and 15 are set in their supporting members. This inclination, is, of course, different for different materials and is determined in accordance with the nature of the material which is to be handled by any given machine.

In order to provide either a heating or a cooling effect to accompany the operation of the machine, jacket members 22 are provided which provide chambers 23 through which a heating or cooling medium may be supplied by way of the pipe 24.

Referring to Fig. 3 of the drawings, a modified form of the invention is shown in which the rotor 25 is supplied with blades 26 which operate in grooves 27 formed in the housing member 28. In like manner, the blades 29, which are carried by the housing member 28, operate in grooves 30 provided in the rotor 25. It will be seen that in this form of the invention, the material is not deflected from one row of blades to another but is impacted against the surfaces of the channels in which the blades move.

In Fig. 4 of the drawings there is shown an embodiment of the invention in which the rotor 31 is provided with stepped annular seats 32, 33, 34, to faces of which annular rows of toothed members 35, 36, and 37 are attached through the bolting of supporting rings 38, 39 and 40 to the rotor. The blades or teeth are formed integrally with the supporting rings, two rows of blades being formed with the innermost rings 38 and three rows of blades with the other rings 39 and 40.

The casing 41 is similarly provided with annular seats 42, 43 and 44, against which supporting plates 45, 46 and 47 are fastened to support inwardly extending seats of blades 48, 49 and 50.

It will be seen that the rows of blades on the rotor alternate with the rows of blades on the casing, as in the constructions previously described. The stationary blades, however, in this embodiment of the invention have a less radial width or depth than those shown in Figs. 1 and 2. By thus providing a greater width of radial projection on the moving blades than on the stationary blades, a more effective action is obtained in that the kinetic energy imparted to the material under treatment is not counteracted by engagement with stationary surfaces having the same areas as those of the moving surfaces which act to impel the material. The result is that the velocity of movement of the material is maintained at a point which will insure the carrying out of the impacting function which is an important characteristic of applicant's operation.

It will also be seen that the mounting of blades integrally formed with supporting rings directly on seats formed for the purpose on the rotor and casing provides a simple and inexpensive method of manufacture. The replacement of blades for any reason is also readily effected with this form of construction.

In order to prevent the formation of dead spaces in the casing adjacent the outer periphery of the rotor impeller blade members 51 are mounted on the edge of the rotor and have the effect of a centrifugal pump in causing the material to travel to the outlet port. In Fig. 4 of the drawings impeller blades 52 are mounted on the rotor at a point adjacent the hub portion 53, thereof, these blades serving to feed the material from its point of entry into the casing outwardly for engagement by the inner rows of blades.

The terms and expressions which I have employed are used as terms of description and not of limitation, and I have no intention, in the use of such terms and expressions, of excluding any mechanical equivalents of the features shown and described, or portions thereof, but recognize that various structural modifications are possible within the scope of the invention claimed.

What I claim is:

1. In a mixing and grinding machine, a rotor having a diameter of substantially greater length than its axial length, the opposite faces of the rotor being provided with substantially axially extending blades, a casing having blades projecting between the blades on the rotor, and means for feeding material into the casing at points adjacent the axis of rotation of the rotor and for delivering material from a point in the periphery of the casing.

2. In a mixing and grinding machine, a rotor having a diameter of substantially greater length than its axial length, the opposite faces of the rotor being provided with concentric rows of axially projecting blades, a casing for the rotor including sections mounted in confronting relation to the opposite faces of the rotor, said sections being provided with axially extending blades arranged to extend between the rows of blades on the rotor, and an annular spacing member interposed between said casing sections at their peripheries and having enclosing relation to the rotor.

3. In a mixing and grinding machine, a rotor having a disk-like formation and provided with axially extending blades on its opposite faces, a casing for the rotor including sections provided with axially extending blades extending between the blades on the rotor, an annular spacing member occupying a concentric relation to the rotor and to which the casing sections are attached at their peripheries, said casing sections being provided with material inlet ports ad-

jacent the axis of rotation of the rotor, and said annular spacing member being provided with a discharge port for the material.

4. In a mixing and grinding machine, a rotor having a disk-like formation and provided on its opposite faces with axially extending blades, said blades having material engaging surfaces arranged at inclinations such as to impel material outwardly toward the periphery of the rotor, a casing for the rotor including sections having faces arranged in confronting relation to the faces of said rotor, blades mounted on said casing sections and arranged to extend between the blades on the rotor, said blades on the casing sections having inclined surfaces in reverse of the inclinations of the blades on the rotor but arranged to impel material outwardly toward the periphery, whereby material is impelled from blade to blade by the action of the inclined faces and by the action of centrifugal force.

5. In a mixing and grinding machine, a rotor provided with a number of rows of blades extending substantially parallel to its axis, said blades having their surfaces set at inclinations to impel material in radially outward directions; and a casing for the rotor provided with a number of rows of blades extending substantially parallel to the axis of rotation of the rotor and alternating with the rows of blades thereon, said blades being set at inclinations in reverse of the inclinations of the blades of the rotor, the radial width of the blades on the casing being substantially less than the radial width of the blades on the rotor.

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