

[Document Name] Description

[Title of Invention] OPERATION CONTROL SYSTEM FOR GRINDER AND
DIAGNOSIS DEVICE

[Technical Field]

The present invention relates to an operation control system of a grinder for a wide application range which can perform shearing, grinding, pulverizing, dispersing, emulsifying, fibrillation of any material from a material for food products to an industrial material at the same time and to a diagnosis device for a grinder for monitoring of a grinding value by oscillation measurement of the grinder such as a stone mill grinder, a shark mill, a hammer mill and the like and diagnosing of a failure.

[Background Art]

The stone mill grinder applying a principle of a stone mill is to grind a material to ultrafine particles by an impact, a centrifugal force, and a shearing force generated when passing through a clearance between two grindstones, that is, upper and lower ones as described also in the following Patent Literature.

[Citation List]

[Patent Literature]

Patent Literature 1: Japanese Patent Publication No.
6-15573

As illustrated in a stone mill grinder in Figs. 10 and 11, a grinder 1 has a grinder body 3 provided below an upper cover 5 on which a supply hopper 2 is mounted at a center.

The grinder body 3 uses a heavy-pressure grindstone and fixes a ring-shaped fixed grindstone 6 having a flat grinding surface on an outer peripheral portion directed downward on the upper cover 5 and a truncated cone portion formed with a central hollow shape on an inner side continuing to the flat surface and fixes a rotary grindstone 7 having a flat grinding surface

directed upward by facing the fixed grindstone 6 and a truncated cone portion similarly formed with a central hollow shape to a driving shaft 9 rotated/driven by a motor 8. Reference numeral 10 in the figure denotes a duct for taking out a ground article.

The ground article charged from the supply hopper 2 above is ground to ultrafine particles at a pressure-contact portion of both the ring-shaped fixed grind stone 6 and a rotary grindstone 7 and is discharged out of the duct 10 for taking-out.

The rotary grindstone 7 is provided capable of elevation with respect to the ring-shaped fixed grindstone 6, and this elevation is driven by a servomotor 11 or a manual adjustment handle 12.

Fig. 12 illustrates details of this elevation mechanism, in which the servomotor 11 is mounted on a body device by a servomotor mounting flange 13, and a worm shaft 15 for a universal joint is connected through a universal joint 14. On this worm shaft 15 for universal joint, a worm gear 17 is installed through a key 16, and this is meshed with a helical gear 18.

As illustrated in Fig. 13, the helical gear 18 is a gear for rotating an adjust 19 which is an elevation shaft of the rotary grindstone 7, and rotation of the servomotor 11 is transmitted in the order of the worm gear 17 -> the helical gear 18 -> the adjust 19, and rotation of the adjust 19 to right and left elevates the rotary grindstone 7 with respect to the ring-shaped fixed grindstone 6, whereby a clearance between the rotary grindstone 7 and the ring-shaped fixed grindstone 6 is changed.

The manual adjustment handle 12 is provided on a side opposite to the servomotor 11 of the worm shaft 15 for universal joint, and a mounting portion of this manual adjustment handle 12 of the worm shaft 15 for universal joint is rotatably supported by a spherical bush 22 in a spherical bush case 21 mounted on a machine body by an end support 20. Reference numeral 23 in the figure is a worm clamp.

Moreover, in order to prevent breakage of a device by the servomotor 11, photo sensors 31a (upper limit) and 31b (lower limit) are provided in a casing.

The ground article charged from the supply hopper 2 above is ground to ultrafine particles at the pressure-contact portion of both the ring-shaped fixed grindstone 6 and the rotary grindstone 7 and is discharged out of the duct 10 for taking-out.

By grinding to ultrafine particles as above, food products such as beam jam, soup, juice and the like which make flavors and yields favorable are obtained. This grindstone may be used for industrial products such as pigments/paints and the like.

The stone mill grinder should enable continuous and stable obtainment of ultrafine particles with a constant grain size. Therefore, a clearance between the flat grinding surfaces of the upper and lower grindstones is extremely important, but the clearance has been set manually before start, and thus, the clearance could not be kept constant at all times in accordance with the material or required grain size.

Moreover, an initial clearance is changed due to abrasion of a grindstone surface by grinding of the material, and if a continuous operation is continued in this state, particles coarser than a desired grain size can be mixed in the product, and there is a concern that a product with a stable quality cannot be obtained.

Thus, manual clearance adjustment was needed every certain time, which made it a work particularly requiring a labor if a large number of units were operated at the same time or if an automation line was constituted.

Moreover, the machine body and the grindstone were thermally expanded due to a temperature of the material or a heat generated by friction at grinding, whereby the clearance was narrowed, and if this state lasted for a long time, strong friction between the grindstones continued, which caused abnormal abrasion on the grinding surface or a failure of the

machine due to an overload.

Furthermore, since it took time for expansion of the grindstone to be made stable, and manual adjustment of clearance little by little was needed, which has been a large burden for a worker.

The following Patent Literature is proposed as a device capable of automatic adjustment of a micro clearance between the flat grinding surfaces.

[Citation List]

[Patent Literature]

Patent Literature 2: Japanese Patent Publication No. 3-51464

The aforementioned Patent Literature 2 includes a converter for converting a change in an input current corresponding to a load of a main motor rotating/driving a rotary grindstone to a DC voltage and a controller for operating the driving device in accordance with a deviation of this DC voltage from a reference voltage and adjusting a clearance between the rotary grindstone and a fixed grindstone.

According to this Patent Literature 2, in a grinder, the rotary grindstone is constituted to be vertically moved by using a servomotor instead of a manual adjustment handle for vertically moving the rotary grindstone and moreover, a load of the main motor rotating/driving the rotary grindstone is detected at all times and a clearance is kept at a predetermined value by rotating the servomotor forward or backward in accordance with a size of the load.

[Summary of Invention]

[Problems to be Solved by Invention]

In the method in Patent Literature 2, the rotary grindstone on a lower part is rotated and then, the rotary grindstone is raised, and abnormality is detected by a change in a load of the main motor when it is brought into contact with

a fixed grindstone on an upper part.

The change in the load of the main motor when water is input to a space between the grindstones in order to set a reference state where the clearance between the upper and lower grindstones is zero and the rotary grindstone on the lower part is rotated and then, the rotary grindstone is raised and is brought into contact with the fixed grindstone on the upper part is approximately 7 kW even if the both upper and lower grindstones are brought into contact with each other strongly, while a change in the load when a resin is actually ground by the same grinder is changed at random from 2 to 20 kW, and detection of the zero state of the clearance by a load signal.

In order to solve such problems, in Japanese Patent Publication No. 8-1020, during operation of a grinder including a servomotor, an operation in which the servomotor is driven and the lower rotary grindstone is raised so as to bring a clearance between the flat grinding surfaces to zero, the servomotor is stopped by a torque signal of the servomotor at that time and immediately after that, the lower rotary grindstone is lowered to a predetermined clearance is repeated plural times intermittently.

The servomotor is a driving source for vertically moving the rotary grindstone, but according to its torque control function, when a torque applied to an output shaft of the servomotor becomes a torque value set in advance, the servomotor is stopped and its position is determined that the clearance is zero, and the servomotor is rotated backward from this position where the clearance is zero so as to lower the rotary grindstone until the predetermined clearance is reached so that a desired clearance is obtained.

However, in this method, an operation as above needs to be performed frequently for a change of the clearance caused by thermal expansion of the machine body or the grindstone or a change of the clearance caused by abrasion of the grindstone surface by grinding of the material, and since the change of the clearance caused by expansion of the grindstone is

particularly large particularly for approximately 30 minutes immediately after start of the operation, a time interval for repeating the aforementioned operation needs to be short.

Particularly for the material to be ground, a state of the clearance cannot be determined by continuously bringing the grindstone in contact, but the operation of lowering the lower rotary grindstone to the predetermined clearance should be repeated plural times intermittently immediately after the servomotor is stopped at the time when the clearance between the flat grinding surfaces is brought to zero.

That is, if the operation as above is not performed frequently, the clearance cannot be kept at a predetermined value at all times to the change of the clearance caused by thermal expansion of the machine body or the grindstone or the change of the clearance caused by abrasion of the grindstone surface by grinding of the raw material.

Conventionally, determination on proper clearance between the fixed grindstone and the rotary grindstone to the food material or a material to be ground has been made also by a sound when the rotary grindstone is moved. However, the state of the sound is different depending on the type of the food material or the material, and the determination requires experiences and thus, can be made only by a skilled technician holding a high skill, and ambient noises and the like make hearing difficult.

An object of the present invention is to solve nonconformity of the aforementioned prior-art examples and to provide an operation control system of a grinder which can rapidly obtain reliable determination by determining appropriateness of a contact state using reaction of an oscillation sensor not by an unstable factor such as a change in a load or by human determination through hearing the sound and enables sophisticated working without a skilled technician holding a high skill, which enables working of a food product which has not been worked easily.

A second object is to provide a diagnosis device for a

grinder in which an operation state is digitally displayed and can be used for assisting a stable operation, and since the clearance of the grindstone and the like can be adjusted, stability of a manufacturing quality can be ensured and moreover, detection of abnormality and failure determination of the bearing/motor and acceptability determination of the grindstone and a shift of the gravity center of the blade can be easily made, which can be also used for quality control.

[Means for Solving the Problem]

In order to achieve the aforementioned object, as an operation control system of a grinder, the present invention described in claim 1 has a gist that, in a stone mill grinder including a ring-shaped fixed grindstone having a flat grinding surface on an outer peripheral portion and a truncated cone portion formed with a central hollow shape on an inner side continuing to the flat surface and a ring-shaped rotary grindstone installed by facing these flat grinding surfaces to each other in a vertical direction and a servomotor for vertically moving the rotary grindstone, an oscillation sensor is provided on a machine body and movement of the rotary grindstone is controlled on the basis of reaction of this oscillation sensor.

The inventor has paid attention to the fact that, when the clearance between the upper and lower grindstones and the flat grinding surfaces is changed, the oscillation is also changed, and enables setting of an optimal clearance by digitizing it on the basis of the oscillation instead of the sound, and according to the present invention described in claim 1, an appropriate clearance can be set without using a human sense as a determination element by controlling movement of the rotary grindstone on the basis of the reaction of the oscillation sensor.

When the operation state is continued, components are expanded and the grindstones are brought into strong pressure-contact with each other, and the temperature of the

raw material rises or the material is baked, which needs adjustment. Conventionally, the adjustment was made on the basis of the sound or odor, which was subtle and could be performed only by a skilled technician with experiences.

According to the present invention described in claim 1, slight thermal expansion can be caught by the oscillation sensor as an increase in a numerical value and thus, a constant pressure-contact state can be kept at all times.

The present invention described in claim 2 has a gist that the rotary grindstone is moved to the fixed grindstone side while being rotated and brought into contact with the food material or a material to be ground, presence of oscillation is sensed by the oscillation sensor at the time of contact, and movement of the rotary grindstone is controlled on the basis of the numerical value.

In the present invention, the movement of the rotary grindstone is controlled by comparing a proper oscillation numerical value stored/set with the oscillation sensor making actual measurement, but according to the present invention described in claim 2, since a desired set value changes depending on a type and a condition of the raw material or the grindstone, an oscillation value can be determined by fineness, a temperature or a state of the raw material operated and processed manually in advance.

The present invention described in claim 3 has a gist that the oscillation sensor is set on an upper cover on which a supply hopper is mounted at a center of the stone mill grinder.

According to the present invention described in claim 3, as an installation spot of the oscillation sensor, it is easy to detect oscillation and does not make obstruction, and the oscillation sensor can be mounted easily and can be also mounted later easily.

As the diagnosis device for the grinder, the present invention described in claim 4 has a gist that it is constituted by the oscillation sensor provided on a housing of the grinder and an auxiliary device which sets an EP (easy point) for keeping

a contact state or the clearance proper by catching and digitizing the oscillation of the grinder by the oscillation.

According to the present invention described in claim 4, by digitizing the oscillation value by the oscillation sensor with respect to the clearance of the grindstones, a stable clearance can be kept. The clearance changes any time by thermal expansion or abrasion of the grindstone. It has been determined by a sense. However, by digitizing the oscillation value, even those not skilled in the art can accurately set the clearance.

The oscillation sensor detects abnormality of the bearing/motor and determines a failure. At present, determination is made by sound or abnormal sound/oscillation felt by hands. Since the oscillation sensor can accurately digitize the oscillation, determination on a life of the bearing/motor can be made clearly.

The oscillation sensor digitally displays a shift of the gravity center of the grindstone and the blade and determines acceptability. The determination of acceptability on whether or not the shift in the gravity center is within an allowable range can be made accurately by using a change in a size of oscillation between when the grindstone is set and when not.

Moreover, the oscillation value can be recorded at the same time as elapsed time and can be used for quality control. Since the oscillation value can be a reference to keep the clearance of the grindstone constant, adjustment so that the oscillation value is constant can be led to a stable quality.

The present invention described in claim 5 has a gist that the oscillation sensor is provided on the upper cover on which the supply hopper is mounted in the housing.

According to the present invention described in claim 5, as an installation spot of the oscillation sensor, it is easy to detect oscillation and does not make obstruction, and the oscillation sensor can be mounted easily and can be also mounted later easily.

The present invention described in claim 6 has a gist that

an output cord is detachably connected to the oscillation sensor and can be fixed by a lock ring.

According to the present invention described in claim 6, the oscillation sensor sends a detection output to a controller such as a personal computer through the output cord, and this output cord is fixed by the lock ring and can be removed easily.

[Advantageous Effect of Invention]

As described above, in the operation control system of the grinder and the diagnosis device of the present invention, reliable determination can be rapidly obtained by determining appropriateness of the contact state by reaction of the oscillation sensor instead of an unstable factor such as a change of a load of the motor or human determination by hearing the sound, and sophisticated working can be realized without a skilled technician holding a high skill, and working of food products which has been difficult is enabled.

Moreover, digital display of the operation state can be used for assisting a stable operation, and since the clearance of the grindstone and the like can be adjusted, stability of a manufacturing quality can be ensured and moreover, detection of abnormality and failure determination of the bearing/motor and acceptability determination of the grindstone and a shift of the gravity center of the blade can be easily made, which can be also used for quality control.

[Brief Description of the Drawings]

[Fig. 1] Fig. 1 is a perspective view of an essential part of a stone mill grinder including an operation control system and a diagnosis device of the present invention.

[Fig. 2] Fig. 2 is a perspective view of the essential part of the stone mill grinder including the operation control system and the diagnosis device of the present invention and a state where an output cord is removed.

[Fig. 3] Fig. 3 is a perspective view of the essential part of the stone mill grinder including the operation control

system and the diagnosis device of the present invention and a state where the output cord is connected.

[Fig. 4] Fig. 4 is a perspective view of an end portion of the output cord.

[Fig. 5] Fig. 5 is an explanatory view of a test place where an effect is confirmed.

[Fig. 6] Fig. 6 is another explanatory view of a test place where the effect is confirmed.

[Fig. 7] Fig. 7 is a front view of a touch panel for operation of operation control.

[Fig. 8] Fig. 8 is an explanatory view of a setting screen of an oscillation value in an auxiliary device.

[Fig. 9] Fig. 9 is an explanatory view of a grindstone.

[Fig. 10] Fig. 10 is a longitudinal front view of the stone mill grinder.

[Fig. 11] Fig. 11 is a longitudinal side view of the stone mill grinder.

[Fig. 12] Fig. 12 is a longitudinal side view of the essential part of the stone mill grinder including the operation control system by the diagnosis device of the present invention.

[Fig. 13] Fig. 13 is a side view illustrating a detailed part of Fig. 12.

[Fig. 14] Fig. 14 is an explanatory view of an operation panel.

[Description of Embodiments]

An embodiment of the present invention will be described below in detail by referring to the attached drawings. Fig. 1 is a perspective view of an essential part of a stone mill grinder including an operation control system and a diagnosis device of the present invention, and the diagnosis device of the present invention is constituted by an oscillation sensor 27 and an auxiliary device which sets an EP (easy point) for keeping a contact state or a clearance proper by catching and digitizing oscillation of the grindstone by the oscillation sensor 27.

As illustrated in Figs. 10 and 11, the grinder 1 has a grinder body 3 provided below an upper cover 5 on which a supply hopper 2 is mounted at a center.

The grinder body 3 uses a heavy-pressure grindstone, fixes a ring-shaped fixed grindstone 6 having a flat grinding surface on an outer peripheral portion directed downward on the upper cover 5 and a truncated cone portion formed with a central hollow shape on an inner side and continuing to the flat surface and fixes a rotary grindstone 7 having a flat grinding surface directed upward and faced with the fixed grindstone 6 and a truncated cone portion similarly formed with a central hollow shape to a driving shaft 9 rotated/driven by a motor 8. Reference numeral 10 in the figure denotes a duct for taking out a ground article.

Then, the ground article charged from the supply hopper 2 above is ground to ultrafine particles at pressure-contact portions of the both ring-shaped fixed grindstone 6 and the rotary grindstone 7 and is discharged from the duct 10 for taking-out.

The rotary grindstone 7 is provided capable of elevation with respect to the ring-shaped fixed grindstone 6, and this elevation is driven by a servomotor 11 or a manual adjustment handle 12.

Fig. 12 illustrates details of this elevation mechanism, and the servomotor 11 is mounted on a body device by a servomotor mounting flange 13, and a worm shaft 15 for universal joint is connected through a universal joint 14. On this worm shaft 15 for universal joint, a worm gear 17 is installed through a key 16, and this is meshed with a helical gear 18.

As illustrated in Fig. 13, the helical gear 18 is a gear for rotating an adjust 19 which is an elevation shaft of the rotary grindstone 7, and rotation of the servomotor 11 is transmitted in the order of the worm gear 17 -> the helical gear 18 -> the adjust 19, and rotation of the adjust 19 to right and left elevates the rotary grindstone 7 with respect to the ring-shaped fixed grindstone 6, whereby a clearance between the

rotary grindstone 7 and the ring-shaped fixed grindstone 6 is changed.

The manual adjustment handle 12 is provided on a side opposite to the servomotor 11 of the worm shaft 15 for universal joint, and a mounting portion of this manual adjustment handle 12 of the worm shaft 15 for universal joint is rotatably supported by a spherical bush 22 in a spherical bush case 21 mounted on a machine body by an end support 20. Reference numeral 23 in the figure is a worm clamp.

Moreover, in order to prevent breakage of a device by the servomotor 11, photo sensors 31a (upper limit) and 31b (lower limit) are provided in a casing.

In the present invention, as position detecting means of the rotary grindstone 7 for digitizing and displaying a rotation result of the servomotor 11, an operation panel is illustrated in Fig. 14. Reference numeral 25 denotes a main screen of the touch panel, reference numerals 26 denote buttons, that is, a power supply switch 26a, an operation preparation switch 26b, a raising button 26c, a lowering button 26d, an all-stop button 26e, an emergency stop button 26f, a buzzer button 26h, and a buzzer stop button 26i.

The grinder 1 is capable of automatic operation performed while the clearance between the ring-shaped fixed grindstone 6 and the rotary grindstone 7 is held constant by setting the servomotor 11.

The oscillation sensor 27 constituting the diagnosis device of the present invention is provided on the machine body of the grinder 1, and movement of the rotary grindstone is configured to be controlled on the basis of reaction of this oscillation sensor 27.

This oscillation sensor 27 may be mounted in a machine body frame of the grinder 1 but as illustrated in Fig. 1, it is provided on the upper cover 5 on which the supply hopper 2 is mounted at the center.

The upper cover 5 is selected as a mounting position of the oscillation sensor 27 since the upper cover 5 has the grinder

body 3 provided below that and can easily detect the oscillation and does not make obstruction but can be mounted easily and moreover, can be mounted easily later even to the grinder 1 not including the device of the present invention.

To the oscillation sensor 27, an output cord 28 is detachably connected and is fixed by a lock ring 29.

An output of the oscillation sensor 27 is to catch and to digitize the oscillation so as to introduce it to the auxiliary device (personal computer) which sets the EP (easy point) for keeping the contact state or the clearance proper and to control rotation of the servomotor 11 on the basis of programming here.

Fig. 7 illustrates a screen example of the main screen 25. Moreover, Fig. 8 illustrates a setting screen of the oscillation value as the auxiliary device. This auxiliary device is to set the EP (easy point) for keeping the contact state or the clearance proper by catching and digitizing the oscillation of the grindstone by the oscillation sensor 27 and has a display lamp 32 constituted by a power supply lamp 32a and an installation value lamp 32b, a digital monitor 33, a mode key 34a, an UP key 34b, a DOWN key 34c, and a set key 34d.

The auxiliary device incorporates a personal computer as a controller and can be sold with the oscillation sensor 27 as a set.

As illustrated in Fig. 2, a screw hole 36 is drilled in the upper cover 5, and a screw 37 protruding to a lower side of the oscillation sensor 27 is screwed here so that the oscillation sensor 27 is installed upright.

To the oscillation sensor 27, the output cord 28 is detachably connected by a socket mechanism and is fixed by the lock ring 29.

Fig. 4 is a perspective view of an end portion of the output cord, and in the figure, reference numeral 39 denotes a socket hole on the output cord 28 side, reference numeral 38 denotes a keyway, and reference numeral 40 denotes a key of the oscillation sensor 27, and this key 40 is engaged with the keyway

38 and aligned, and the lock ring 29 is rotated, lowered and bridged.

A handle 41 is provided on the upper cover 5, and when the upper cover 5 is to be removed by hooking this handle 41 by a finger, the output cord 28 is removed from the oscillation sensor 27 so as not to obstruct the removal.

For a mounting position of the oscillation sensor 27, a housing 35 other than the upper cover 5, that is, an upper floor surface of the housing 35 in the vicinity of a cover receiver of the upper cover 5, for example, can be selected instead of the upper cover 5.

Subsequently, a method of use will be described. Fig. 9 is a trial view of an operation, in which a food material or a material 30 to be ground is input into the grinder 1, and the rotary grindstone 7 is brought into contact with the food material or the material 30 to be ground by being moved to the fixed grindstone 6 side while being rotated.

Position information of the grindstone and oscillation information of the oscillation sensor 27 in the servomotor 11 at this point of contact are determined.

Presence of oscillation is sensed by the oscillation sensor 27 at a point of time of contact, and appropriateness of the contact state is determined. This appropriateness determination is made by comparing an oscillation waveform detected by the oscillation sensor 27 with a proper oscillation waveform stored in the personal computer in advance so that a proper clearance between the ring-shaped fixed grindstone 6 and the rotary grindstone 7 is set in accordance with a size of the difference.

This proper oscillation waveform stored in advance is set by the following operation by using the auxiliary device of the present invention illustrated in Fig. 8 as operation preparation.

1. The servomotor 11 is manually operated, and a position where the rotary grindstone 7 is in slight contact with the ring-shaped fixed grindstone 6 (within a range that grindstone

powders are not generated by empty grinding) is searched.

2. The food material or the material 30 is input, and the operation (rotation of the grindstone) is started.

3. The servomotor 11 is manually operated, and the rotary grindstone 7 is raised until the output of the oscillation sensor 27 reaches a desired oscillation value on the digital monitor 33.

Since the desired set value changes in accordance with types and conditions of the raw material and the grindstone, the oscillation value is determined in accordance with fineness, a temperature, and a state of the raw material operated manually in advance and processed. Particularly, the oscillation value of the oscillation sensor 27 at the position of the rotary grindstone 7 where optimal particles are obtained is grasped by carrying out a trial to obtain the desired particle of the food material or the material 30, and the operation control is executed on the basis of this numeral value.

In the operation, a contact detection value according to the food material or the material 30 to be ground is input on the main screen 25 of the touch panel.

Operation is performed by an inverter board, and an inverter rotation number is adjusted. Elevation is performed to the vicinity of an initial position by pressing the raising/lowering buttons. By rotating the rotary grindstone 7 during the operation as above, it is moved to the fixed grindstone side and brought into contact with the food material or the material 30 to be ground, and the clearance between the rotary grindstone 7 and the fixed grindstone 6 is adjusted by using the position of contact as a zero point.

When the desired oscillation value is reached, the operation is changed to an automatic operation (touch panel). The operation panel is illustrated in Fig. 7.

After that, the grindstone is moved up/down automatically and the operation is continued so as to be contained within a range of the desired numerical value (arbitrary set value). As an example of the automatic operation, such control is executed

that, if the shaft is expanded by a temperature rise and contact between the grindstones becomes strong, the oscillation value is also raised and if it is deviated from the set range, the rotary grindstone is lowered so as to be contained within the set value.

Moreover, as the thermal expansion of the shaft ends and the grindstone is worn by the contact with the grindstone, the oscillation value is lowered, and operation control to raise the rotary grindstone 7 is executed this time.

When the automatic operation is to be finished as illustrated in Fig. 7, the automatic stop (touch panel) is pressed.

When the automatic operation is stopped, the all-stop button 26e in Fig. 1 is pressed.

The mounting position of the oscillation sensor 27 in the present invention is important, and any of the housing 35 including the upper cover 5 needs to be selected. In this case, contact with the fixed grindstone 6 or direct mounting are also included in options.

In order to confirm the effects of the present invention, experiments were conducted by changing the mounting position of the oscillation sensor 27 as illustrated in Figs. 5 and 6. The result is shown in the following Table 1. A casing 42 here constitutes an upper part of a machine body 4 and is located on the lower side of the housing 35.

[Table 1]

Position	Measured value	Result
1. Upper part of cover 5 (direct contact with fixed grindstone)	Measured value: 240 (set as reference value)	Changed by contact state of grindstone.
2. Housing 35	Measured value: 175	Changed by contact state of grindstone.
3. 20 mm below flange surface of casing 42	Measured value: 62	No change by contact state of grindstone.
4. 50 mm below flange surface of casing 42	Measured value: 60	No change by contact state of grindstone.

5. 100 mm below flange surface of casing 42	Measured value: 24	No change by contact state of grindstone.
6. Below casing 42	Measured value: 25	No change by contact state of grindstone.
7. Ceiling in casing 42	Measured value: 49	No change by contact state of grindstone.
8. Bottom plate in casing 42	Measured value: 20	No change by contact state of grindstone

The places where the change is caught and can be measured are 1 and 2.

The diagnosis device of the present invention has been described by the example used in the stone mill grinder, but the present invention can be also used as the diagnosis device of other grinders such as a shark mill, a hammer mill and the like.

[Reference Signs List]

- 1 grinder
- 2 supply hopper
- 3 grinder body
- 4 machine body
- 5 upper cover
- 6 ring-shaped fixed grindstone
- 7 rotary grindstone
- 8 motor
- 9 driving shaft
- 10 duct
- 11 servomotor
- 12 manual adjustment handle
- 13 servomotor mounting flange
- 14 universal joint
- 15 worm shaft
- 16 key
- 17 worm gear
- 18 helical gear

19 adjust
20 end support
21 spherical bush case
22 spherical bush
23 worm clamp
25 main screen
26 buttons
26a power supply switch
26b operation preparation switch
26c raising button
26d lowering button
26e all-stop button
26f emergency stop button
26h buzzer button
26i buzzer stop button
27 oscillation sensor
28 output cord
29 lock ring
30 material
31a, 31b photo sensor
32 display lamp
32a power supply lamp
32b set value lamp
33 digital monitor
34a mode key
34b UP key
34c DOWN key
34d set key
35 housing
36 screw hole
37 screw
38 keyway
39 socket hole
40 key
41 handle
42 casing

Claims

[Claim 1]

An operation control system for grinder, characterized in that:

in a stone mill grinder including a ring-shaped (annular) fixed grindstone having a flat grinding surface on an outer peripheral portion and a truncated cone portion formed with a central hollow shape on an inner side continuing to the flat surface and a ring-shaped (annular) rotary grindstone having a truncated cone portion formed with a central hollow shape on an inner side continuing to a flat surface installed by facing these flat grinding surfaces to each other in a vertical direction and a servomotor for vertically moving the rotary grindstone,

an oscillation sensor is provided on a machine body, the rotary grindstone is moved to the fixed grindstone side while being rotated and brought into contact with a food material or a material to be ground, presence of oscillation is sensed by the oscillation sensor at time of contact, and movement of the rotary grindstone is controllable on the basis of reaction of the oscillation sensor, and further based on a comparison of a measured oscillation numerical value and a predetermined oscillation numerical value,

wherein the predetermined oscillation numerical value is variable based on type and condition of the raw material or the grindstone.

[Claim 2]

The operation control system for grinder according to claim 1, wherein

the oscillation sensor is set on an upper cover on which a supply hopper is mounted at a center.

[Claim 3]

A diagnosis device of grinder, comprising:

in a stone mill grinder including a ring-shaped (annular) fixed grindstone having a flat grinding surface on an outer peripheral portion and a truncated cone portion formed with a central hollow shape on an inner side continuing to the flat surface and a ring-shaped (annular) rotary grindstone having a truncated cone portion formed with a central hollow shape on an inner side continuing to a flat surface installed by facing these flat grinding surfaces to each other in a vertical direction and a servomotor for vertically moving the rotary grindstone,

an oscillation sensor provided on a housing of the grinder and an auxiliary device which sets an EP (easy point) for keeping a contact state or the clearance proper by catching and digitizing oscillation of the grinder by the oscillation sensor,

wherein movement of the rotary grindstone is controllable on the basis of the reaction of the oscillation sensor, and further based on a comparison of a measured oscillation numerical value and a predetermined oscillation numerical value,

further wherein the predetermined oscillation numerical value is variable based on types and conditions of the raw material or the grindstone.

[Claim 4]

The diagnosis device of grinder, according to claim 3, wherein

the oscillation sensor is provided on the upper cover on which the supply hopper is mounted in the housing.

[Claim 5]

The diagnosis device of grinder, according to claim 3 or 4, wherein

to the oscillation sensor, an output cord is detachably connected and fixed by a lock ring.