



US 20160016288A1

(19) **United States**
(12) **Patent Application Publication**
KAMEI

(10) **Pub. No.: US 2016/0016288 A1**
(43) **Pub. Date: Jan. 21, 2016**

(54) **ABRASIVE GRAIN JET GRINDING DEVICE**

Publication Classification

(71) Applicant: **KAMEI TEKKOUSHO LTD,**
Higashiosaka-shi, Osaka (JP)

(51) **Int. Cl.**
B24C 5/06 (2006.01)

(72) Inventor: **Haruo KAMEI,** Osaka (JP)

(52) **U.S. Cl.**
CPC **B24C 5/06** (2013.01)

(21) Appl. No.: **14/773,777**

(57) **ABSTRACT**

(22) PCT Filed: **Feb. 14, 2014**

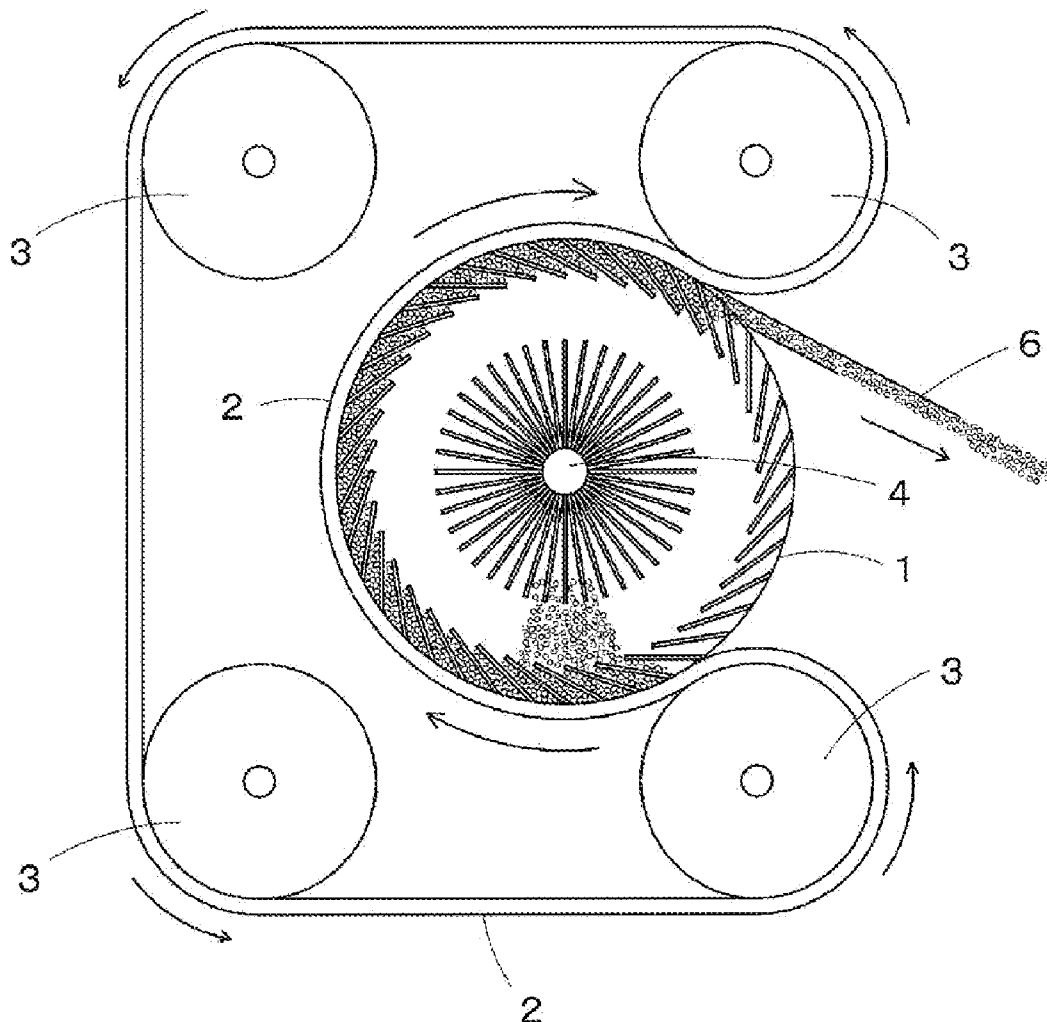
An abrasive grain jet grinding device having a belt partially wrapped around an impeller with blades between a shaft-side disc and an open disc and an open peripheral surface between the blades, a nozzle tangential to the disk at the point of separation between the belt and the peripheral surface, wherein the blades held between the shaft-side disc and the open disc are formed from thin plates to finely partition the circumference of the discs, are inclined forward in the direction of rotation of the discs, are provided densely so that multiple adjacent blades overlap each other, and are set with narrow gaps between the blades to form a large number of storage chambers for the abrasive grains.

(86) PCT No.: **PCT/JP2014/053437**

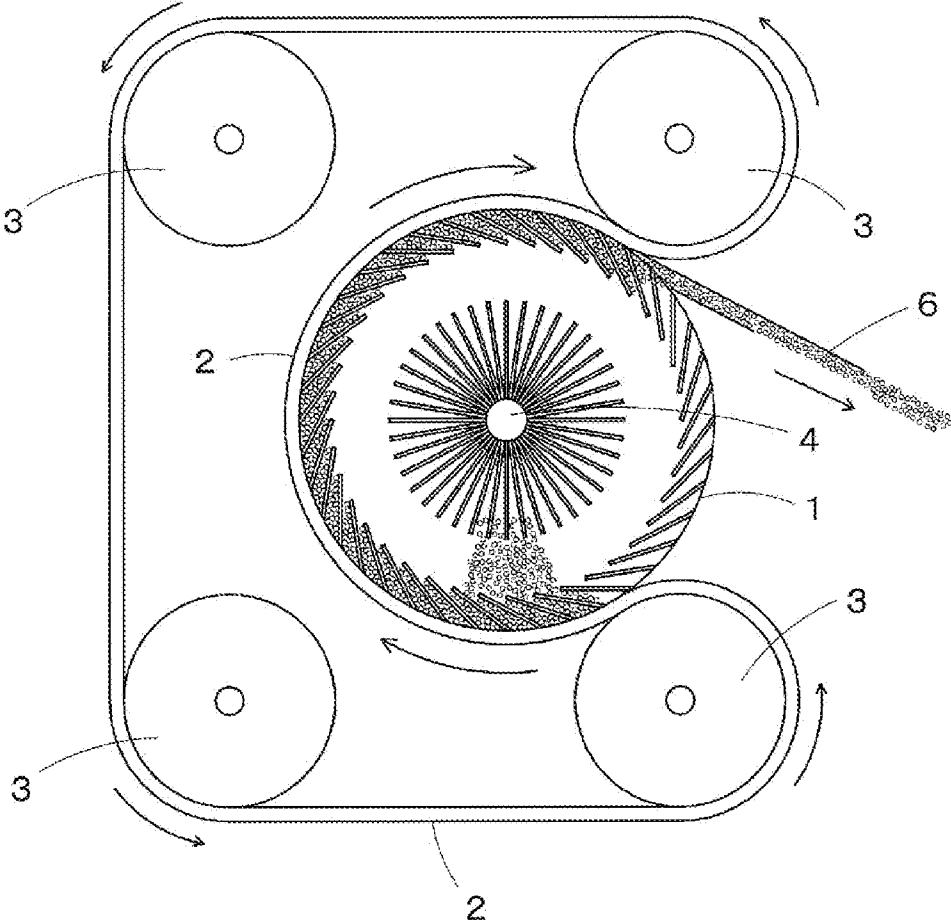
§ 371 (c)(1),
(2) Date: **Sep. 9, 2015**

(30) **Foreign Application Priority Data**

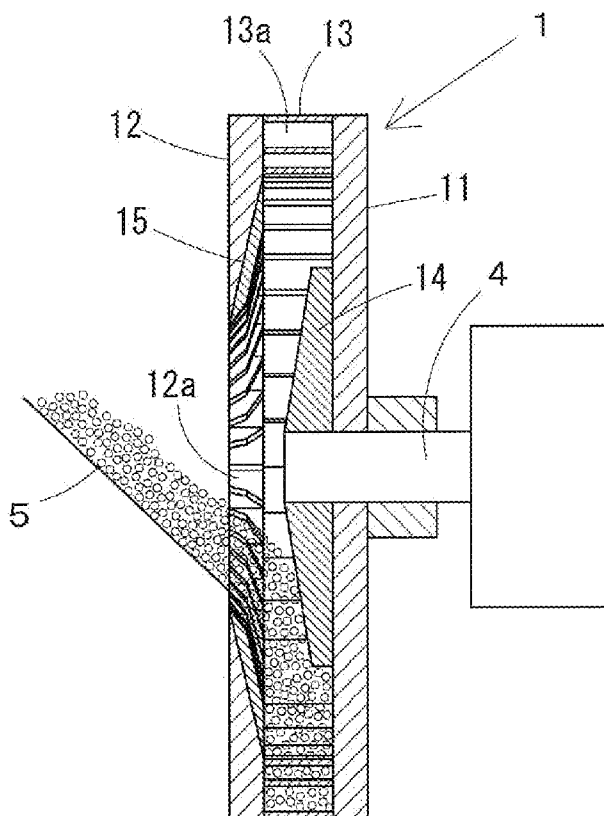
Mar. 15, 2013 (JP) 2013-053417



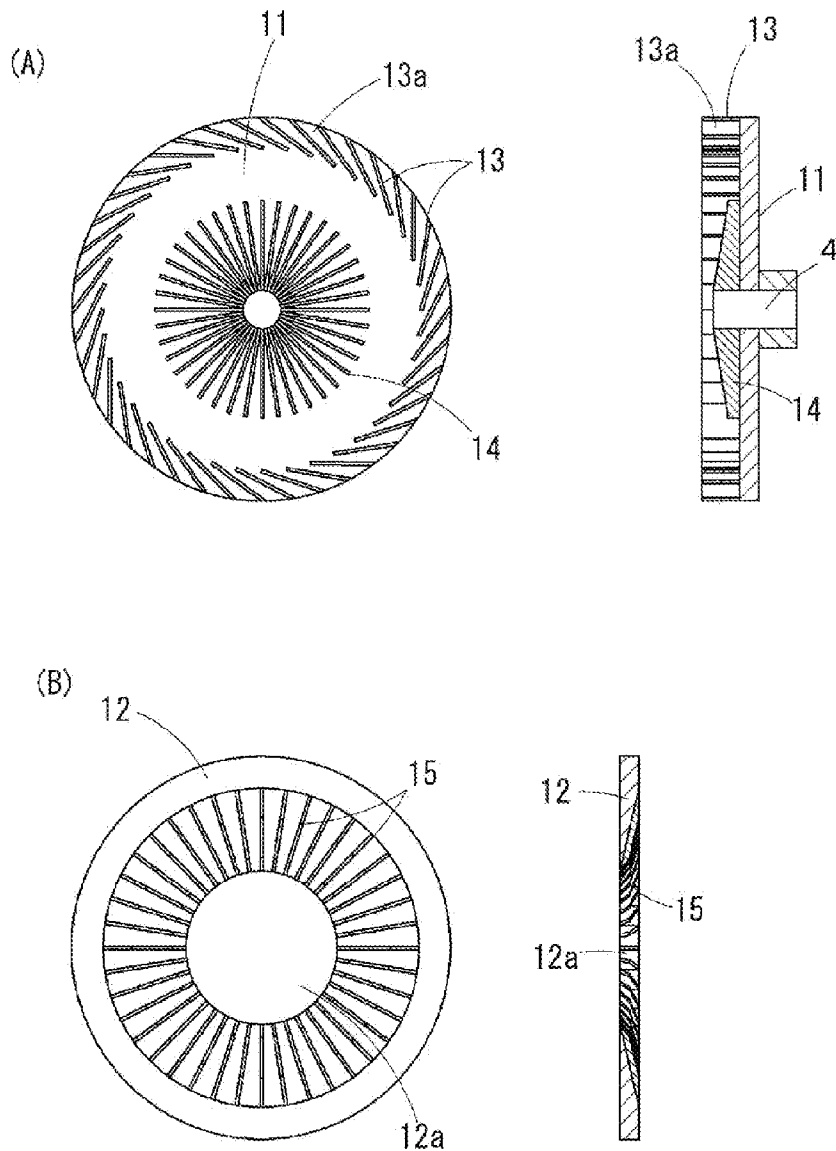
[FIG. 1]



[FIG. 2]

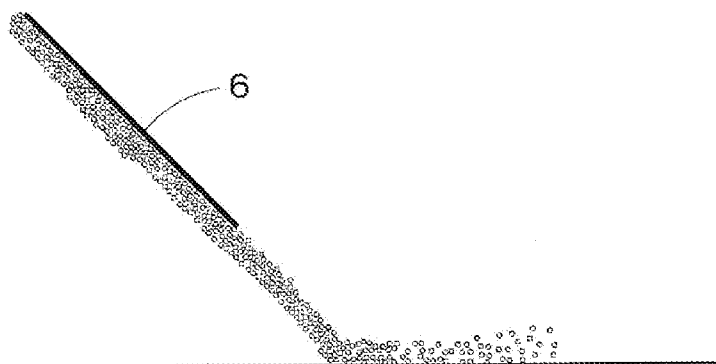


[FIG. 3]

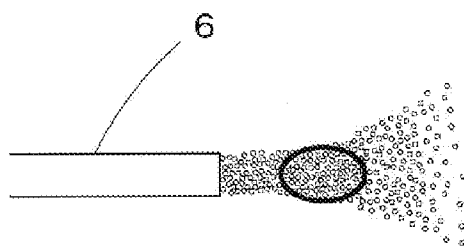


[FIG. 4]

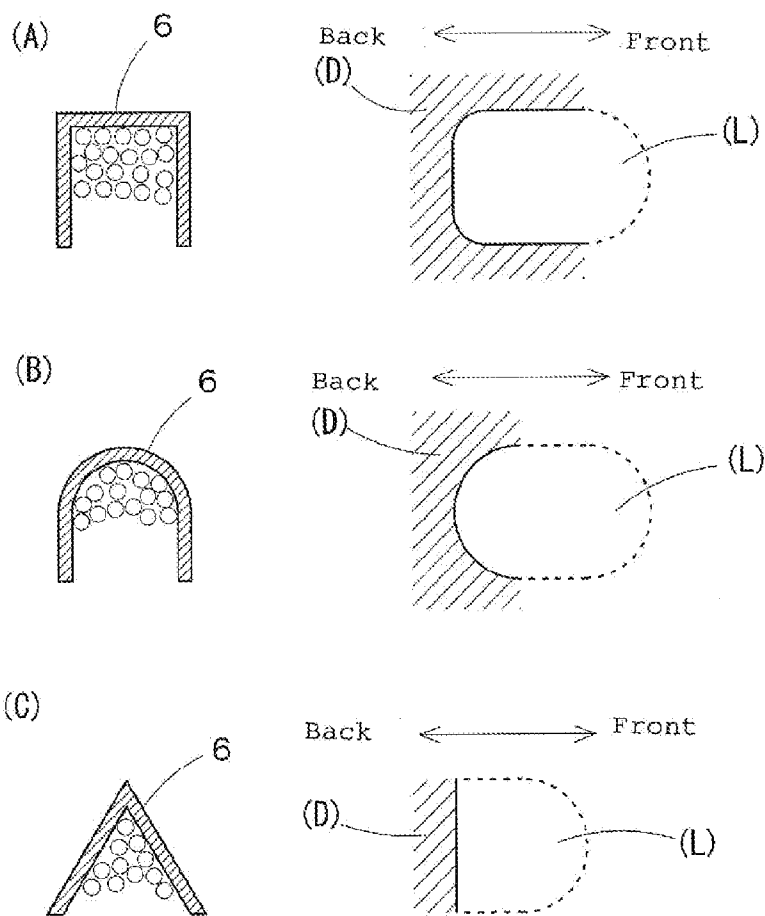
(A)



(B)



[FIG. 5]



ABRASIVE GRAIN JET GRINDING DEVICE

TECHNICAL FIELD

[0001] The present invention relates to abrasive grain jet grinding devices that grind and polish the surface of a workpiece by spraying abrasive grains onto the workpiece, and particularly relates to an abrasive grain jet grinding device that is useful in surface polishing of the workpiece.

BACKGROUND ART

[0002] In the final surface finishing of a product (workpiece), the surface of the workpiece needs to be finished to be fine and smooth. For example, a dental prosthesis has a complex irregular surface, and it is time consuming to polish the surface thereof. As described in Prior Art 1, the applicant of the invention discloses the device that surface-finishes a workpiece by spraying numerous abrasive grains in an oblique direction onto the surface of the workpiece. More specifically, sliding the abrasive grains on the surface of a workpiece achieves almost the same final finishing effect as the polishing with a sandpaper. In such a case, a cluster of abrasive grains having a certain degree of density and some thickness is preferably impacted onto the workpiece surface in an oblique direction. To increase smoothness of the workpiece surface, the cluster of abrasive grains needs to be ejected continuously in a densely aggregated state at a predetermined grain density when the cluster is impacted onto the workpiece surface.

[0003] In abrasive grain jet grinding devices of related art, the abrasive grains ejected from an impeller are slightly scattered. For this reason, the abrasive grains need to be aggregated together again before being impacted onto the workpiece. The shape of an ejection nozzle has room for improvement in view of this problem and the necessity to eject the abrasive grains continually in a densely aggregate state.

CITATION LIST

Prior Art

[0004] Prior Art 1: Japanese Unexamined Patent Application Publication No. 11-347945

SUMMARY OF INVENTION

Technical Problem

[0005] Since spacing between blades equally spaced on an impeller is relatively wide in the device disclosed in Prior Art 1, the abrasive grains from the impeller are ejected not continuously but intermittently. Since in such a case, the abrasive grains impacting on the workpiece are not densely aggregated, the abrasive grains are repelled and bounced in a direction instead of impacting in a direction of grinding and polishing the surface of workpiece. Sufficient polishing may thus be unachieved. This is because in the case of a continuous cluster of mutually closely aggregated numerous abrasive grains, the abrasive grains interfere with each other when the cluster impacts onto the workpiece, and flow in a cluster on the workpiece. The degree of gloss of the polished surface of the workpiece becomes fine. If the abrasive grains are not densely aggregated, the abrasive grains, when impacted on the workpiece, are repelled and the direction of bounce is not

stabilized. The polishing efficiency is low, and the polished surface is low in the quality of gloss.

[0006] In view of the above problem, the present invention has been developed. The present invention is directed to provide an impeller and a nozzle appropriate that polish a workpiece surface by impacting the abrasive grains in the form of a continuously and densely aggregate cluster.

Solution to Problem

[0007] To solve the above problem, the present invention provides an abrasive grain jet grinding device. The abrasive grain jet grinding device includes a grain jet ejector including an impeller that includes blades held between a shaft-side disk rotatable by a drive shaft and an open disk having an opening at a center thereof, and includes a circumference surface having open slits between the blades, and a belt that is entrained between pulleys and the impeller such that part of the circumference surface is closed such that a plurality of storage chambers for abrasive grains are formed while the impeller is rotated, a feeder that feeds the abrasive grains into the impeller via the opening, and a nozzle that is arranged in a tangential direction of the disks at a point of separation between the belt and the circumference surface of the impeller to spray the abrasive grains onto a workpiece. The blades held between the shaft-side disk and the open disk are thin plates to finely partition the circumference surface of the impeller, are inclined obliquely forward in a direction of rotation of the disks, and are arranged densely with spacing between adjacent blades set to be narrow to cause the adjacent blades overlap each other in a manner such that the storage chambers are formed for the abrasive grains.

[0008] In the above configuration, the number of storage chambers of the abrasive grains and the number of open slits around the circumference surface of the impeller configured to eject the abrasive grains are much larger than those in the grinding device of related art. Since the number of times for ejecting the abrasive grains during one rotation of the impeller also increases, it looks like the abrasive grains are ejected continuously.

[0009] The abrasive grain jet grinding device further includes a large number of flow-straightening blades that are externally radially extended from the drive shaft of the shaft-side disk and are radially tapered with respect to the shaft-disk and a large number of flow-straightening blades that are radially extended on an inside ring surface of the open disk so as to face the first flow-straightening blades and are radially tapered with respect to the open disk.

[0010] The two types of flow-straightening blades acceleratively move the abrasive grains supplied from the feeder radially outwardly to the periphery of the impeller as the impeller rotates. The abrasive grains are guided into a large number of storage chambers formed by the disks and the abrasive grains stored are then ejected as a continuous cluster.

[0011] The nozzle has a triangular cross-sectional shape with a bottom opening.

[0012] Normally, a glossy portion is formed on the surface of the workpiece by ejecting abrasive grains from the nozzle, while a dull portion is formed surrounding the glossy portion. The use of the nozzle having a triangular cross-sectional shape polishes most efficiently the workpiece surface, resulting in the glossy portion.

Advantageous Effects of Invention

[0013] The abrasive grain jet grinding device thus configured of the present invention includes the blades held densely between the shaft-side disk and the open disk in a manner such that multiple adjacent blades mutually overlap each other with narrow spacing permitted therebetween and a large number of storage chambers of abrasive grains are formed. As a result, the abrasive grains are densely aggregated so that the abrasive grains are ejected through the nozzle as a continuous cluster of the abrasive grains. The abrasive grain jet grinding device thus provides a pronounced advantage of efficiently polishing the workpiece surface as a smooth and glossy surface.

[0014] The two types of flow-straightening blades accelerate the abrasive grains fed from the feeder radially outwardly, thereby efficiently guiding the abrasive grains into the large number of storage chambers formed by the blades and the belt. The continuous cluster of the abrasive grains thus results.

[0015] The nozzle having the triangular cross-sectional shape controls more the occurrence of the dull portion surrounding the glossy portion than a nozzle having a square or a semi-circular cross-sectional shape. The use of the nozzle having the triangular cross-sectional shape polishes the workpiece surface most efficiently.

BRIEF DESCRIPTION OF DRAWINGS

[0016] FIG. 1 generally illustrates an abrasive grain jet grinding device of an embodiment of the present invention.

[0017] FIG. 2 is a cross-sectional view of an impeller.

[0018] FIGS. 3(A) are a front view and a cross-sectional view illustrating the inside of a shaft-side disk, and FIGS. 3(B) are a front view and a cross-sectional view illustrating the inside of an open disk.

[0019] FIG. 4 illustrates the abrasive grain jet grinding device in an operational state.

[0020] FIG. 5 illustrates the shape of a nozzle, and a polished state of a workpiece.

DESCRIPTION OF EMBODIMENTS

[0021] An abrasive grain jet grinding device of a preferred embodiment of the present invention is discussed below. FIG. 1 illustrates an impeller 1 that imparts a centrifugal force to abrasive grains, and an endless belt 2 that is wrapped around the impeller 1 such that the outer circumference surface of the impeller 1 is partly covered with the belt 2. FIG. 1 also illustrates pulleys 3 that causes the belt 2 to rotate in synchronization with the impeller 1. FIG. 1 illustrates four pulleys 3 to drive the impeller 1, but the number of pulleys 3 is not limited to four. FIG. 1 also illustrates a drive shaft 4 configured to rotate the impeller 1. These elements form an abrasive grain ejector. The basic structure of the abrasive grain ejector remains unchanged from the basic structure of the abrasive grain ejector of related art.

[0022] The present invention is directed to a novel structure of the impeller 1 in the abrasive grain ejector. The impeller 1 is described with reference to FIG. 2 and FIG. 3. In each of FIG. 2 and FIG. 3, the impeller 1 includes two disks having the same diameter, namely, a shaft-side disk 11 and an open disk 12, and a large number of blades 13 held between the shaft-side disk 11 and the open disk 12. The impeller 1 has open slits on the outer circumference surface with one between two adjacent blades. The blades 13 are thin plates

such that the outer circumference surface of each disk is finely segmented, and are inclined obliquely forward in the direction of rotation and densely arranged such that multiple adjacent blades 13 overlap mutually with spacing between the adjacent blades 13 set to be narrow. As a result, a large number of storage chambers 13a are formed by the belt in contact with the outer circumference surface of the impeller 1 and the belt. In this configuration, the number of storage chambers 13a and the number of open slits on the outer circumference surface of the impeller 1 through which the abrasive grains are ejected are much larger than those in the related art impeller. The number of times the abrasive grains are ejected per single rotation is large enough to look like the abrasive grains are continuously ejected.

[0023] A large number of first flow-straightening blades 14 that are radially tapered from a drive shaft 4 toward the external circumference are arranged around the drive shaft 4 on the shaft-side disk 11. The open disk 12 has at the center thereof an opening 12a that receives the abrasive grains fed by a feeder 5. The open disk 12 includes on the ring-shaped internal side thereof a large number of second flow-straightening blades 15 facing the first flow-straightening blades 14 and radially tapered with respect to the donut-shaped internal side. The use of the two types of first flow-straightening blades 14 and second flow-straightening blades 15 radially outwardly moves and accelerates the abrasive grains fed from the feeder 5 as the impeller 1 rotates. The abrasive grains are thus guided to a large number of storage chambers 13a formed by the blades 13 and the stored abrasive grains are then discharged as a continuous cluster of abrasive grains.

[0024] The large number of blades 13 arranged on the periphery of the impeller 1 mutually cooperates with the first and second flow-straightening blades 14 and 15 that move and accelerate the abrasive grains, thereby densely aggregating the abrasive grains and ejecting the abrasive grains as a continuous cluster of the abrasive grains.

[0025] Since a flow of densely clustered abrasive grains ejected from the impeller 1 flies in a slightly scattered fashion, the flow needs to be re-clustered before being impacted on the workpiece. For this reason, a nozzle 6 having a passage narrowed in the direction of movement of the abrasive grains is slightly tilted downward. If the nozzle 6 has a fully closed wall on four sides, the nozzle 6 may be possibly blocked with the abrasive grains. The nozzle 6 is thus opened with the lower side wall thereof partly removed. The polished portion of the workpiece is different depending on the cross-sectional shape of the nozzle 6.

[0026] FIG. 5 illustrates how the polished shape differs depending on the cross-sectional shape of the nozzle when the abrasive grain cluster ejected from the nozzle is impacted on the workpiece as illustrated in FIG. 4. Since the abrasive grain cluster ejected from the nozzle is densely continuous, an impact portion is polished and becomes glossy as a glossy portion (L). The degree of gloss in the surrounding area is slightly decreased. A dull portion (D) thus results. This is because when the abrasive grain cluster impacts on the workpiece, the abrasive grains collide with each other, and some abrasive grains deviate from a target area. The number of deviated abrasive grains is relatively smaller and a portion where the deviated abrasive grains is polished appears as a dull portion. The appearance of dull portion is different depending on the shape and the location of the nozzle.

[0027] The nozzle having a square cross-sectional shape as illustrated in FIG. 5(A) generates a generally rectangular

glossy portion (L). The central glossy portion (L) is surrounded by a dull portion (D) on both sides of the glossy portion (L) and a back side of the glossy portion (L) in the direction of advance of the abrasive grains. If the nozzle has a semi-circular cross-section as illustrated in FIG. 5(B), an oval glossy portion (L) appears, and a dull portion (D) appears behind the glossy portion (L) surrounding a rear circular edge of the glossy portion (L). If the nozzle has a triangular cross-section as illustrated in FIG. 5(C), a glossy portion (L) having a generally triangular shape with a rounded end appears, and a dull portion (D) appears behind the glossy portion (L) along the rear edge thereof.

[0028] When a wide flat area of the workpiece is polished in the actual operation, the workpiece is moved up and down and rightward and leftward. If the nozzle having the square cross-sectional shape, the dull portion (D) remains with the workpiece moved backward, and the central area becomes a glossy portion (L) while right and left side areas remain the dull portion (D). If the workpiece is moved forward, the rear dull portion is polished becoming a glossy portion (L), but the right and left side dull portions (D) remain. If the workpiece is moved rightward and leftward, the dull portion becomes a glossy portion (L) but a dull portion (D) remains. If the nozzle having a semi-circular cross-sectional shape, the right and left dull portions (D) are small in area, and the results are alleviated.

[0029] If the nozzle having the triangular cross-sectional shape is used, the dull portion (D) appears behind the back edge of the rounded triangular glossy portion (L). If the workpiece is moved rightward and leftward, only the dull portion (D) remains. For this reason, if the workpiece is moved forward while shifting rightward and leftward, the entire polishing surface is free from any dull portion.

[0030] As discussed above, the polishing results on the surface becomes different depending on the shape of the nozzle. It is found that if the polishing surface is particular wide, a nozzle having a triangular cross-sectional shape most efficiently polishes the workpiece to form the glossy portion. In the present invention, the nozzle having the triangular cross-sectional shape is employed.

[0031] As discussed above, in the abrasive grain jet grinding device constructed as discussed above of the embodiment of the present invention, the large number of blades 13 arranged on the periphery of the impeller 1 cooperates with the first and second flow-straightening blades 14 and 15 that accelerate to feed the abrasive grains into the blades 13. The abrasive grains are thus densely aggregated and ejected in a continuous cluster of abrasive grains. High-quality glossy surface thus results. The use of the nozzle having the triangular cross-sectional shape causes the abrasive grain cluster to be ejected onto the workpiece efficiently. The efficiency of the polishing operation is increased in the surface polishing.

REFERENCE SIGNS LIST

- [0032] 1 Impeller
 - [0033] 2 Belt
 - [0034] 3 Pulleys
 - [0035] 4 Drive shaft
 - [0036] 5 Feeder
 - [0037] 6 Nozzle
 - [0038] 11 Shaft-side disk
 - [0039] 12 Open disk
 - [0040] 12a Opening
 - [0041] 13 Blades
 - [0042] 13a Storage chambers
 - [0043] 14 First flow-straightening blades
 - [0044] 15 Second flow-straightening blades
1. An abrasive grain jet grinding device comprising:
 - a grain jet ejector including an impeller having blades held between a shaft-side disk rotatable by a drive shaft and an open disk having an opening at a center thereof, a circumferential surface having open slits between the blades, and a belt that is entrained between pulleys and the impeller such that part of the circumferential surface is closed so that a plurality of storage chambers for abrasive grains is formed while the impeller is rotated;
 - a feeder that feeds the abrasive grains into the impeller via the opening; and
 - a nozzle that is arranged in a tangential direction of the disks at a point of separation between the belt and the circumferential surface of the impeller to spray the abrasive grains onto a workpiece, wherein the blades held between the shaft-side disk and the open disk are thin plates to finely partition the circumferential surface of the impeller, are inclined obliquely forward in a direction of rotation of the disks, and are arranged densely with spacing between adjacent blades set to be narrow to cause the adjacent blades overlap each other in a manner such that the storage chambers are formed for the abrasive grains.
 2. The abrasive grain jet grinding device according to claim 1, further comprising a first plurality of flow-straightening blades that are externally radially extended from the drive shaft of the shaft-side disk and are radially tapered with respect to the shaft-disks and a second plurality of flow-straightening blades that are radially extended on an inside ring surface of the open disk so as to face the first plurality of flow-straightening blades and are radially tapered with respect to the open disk.
 3. The abrasive grain jet grinding device according to claim 1, wherein the nozzle has a triangular cross-sectional shape with a bottom opening.

* * * * *