

AN APPARATUS FOR GRINDING A WORK PIECE

FIELD OF THE INVENTION

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The present invention relates to a novel apparatus for grinding a work piece.

BACKGROUND OF THE INVENTION

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Presently, grinding machines can only grind one end of a work piece, for example, a shaft or a micro-shaft. Therefore, when two ends of a shaft requires grinding, the shaft has to go through the machine a first time (first pass), for grinding at a first end, taken out from the machine, rotated 180°, and then goes through the machine
15 the second time (second pass), for grinding at a second end. This is very cumbersome and time consuming, as manual handling of the shafts requires a greater concentrated effort. This is especially difficult for work pieces with small diameters.

20 Further, in the prior art, work pieces or shafts are first collected in a V-shaped holder, before they are fed to a carrier disc for subsequent grinding. Each individual work piece has to be first manually aligned, before they are placed into the V-shaped holder.

25 Therefore, when two ends of a work piece has to be ground to achieve a desired surface radius, each work piece has to be manually aligned twice. This is an extremely tedious and time-consuming process.

30 In the prior art, shafts are rotated by means of interaction between a rotatable disc located internal to carrier discs, and a timing belt. Slots are not cut onto the carrier disc itself but are provided as a separate feature, and screwed onto the carrier disc. The slots house each shaft therewithin, and to maintain contact of the shaft between the rotatable disc, and the timing belt, so that rotation of the shaft may be
35 induced.

The rotatable disc as explained previously, is located internal to the carrier disc itself and, together with a timing belt, is used to induce rotation on a shaft. In wet type grinding, the friction between the shaft and the timing belt may not be enough to induce rotation onto the shafts, and hence the rotatable disc has been incorporated to ensure that the shafts rotate within the slots. As the diameter of the work piece decreases, the size of the slot must also be reduced. It will be very difficult to fabricate this attachment for small diameter work pieces because of this limitation.

Positioning of the work piece prior to grinding is critical as that will affect the subsequent process of grinding. However, in the prior art, positioning is enacted by an end stop, to prevent over extension of a work piece. This method is not very desirable, as the work piece may still be moved, leading to a very unstable work piece.

It is an object of the present invention to overcome or at least ameliorate one or more of the above problems in the prior art.

Discussion of any one of the prior art mentioned above is not to be taken as an admission of the state of common general knowledge of the skilled addressee.

SUMMARY OF THE INVENTION

According to an aspect of the invention, there is provided an apparatus for grinding a work piece, said apparatus including a hopper for storing and dispensing at least one work piece, each work piece having at least a first end and a second end, a first rotating means rotating at a first predetermined angular velocity, said first rotating means having a plurality of recesses along its periphery, each recess dimensioned to receive one work piece, said first rotating means rotation to transport each work piece to a position for subsequent grinding, a conveyor positioned between said hopper and said first rotating means, to position and transport each work piece to each recess, a second rotating means rotating at a second predetermined velocity, extending across and encapsulating a portion of the

first rotating means, for contacting a surface of each transported work piece so that each work piece is held in position in each recess, each work piece rotating in response to the velocity difference between the first and second predetermined velocity, a first and second rotary abrasive tool, a first rotary abrasive tool to grind a first end of a work piece and a second rotary abrasive tool to grind a second end of a work piece so that both ends are ground.

Preferably, the second rotating means extends to at least the position where the first and second rotary abrasive tools grind the first and second end of the work piece.

In a preferred embodiment, the conveyor further includes ribs along said conveyor, to linearly orientate each work piece for transport to the first rotating means.

In another preferred embodiment, the hopper further includes a vibration means, to vibrate the stored work piece onto the conveyor.

Preferably, the first and second rotating means further includes a velocity control means, to control the rotational speed of the first rotating means and the second rotating means.

In a preferred embodiment, the apparatus further includes an exhaust system to remove residue produced by the grinding of the work piece.

Preferably, the first rotating means is a carrier disc.

Still preferably, the second rotating means is a timing belt.

In a preferred embodiment, the apparatus further includes a selective chute, to orientate asymmetrical work piece onto a conveyor.

Preferably, the conveyor is a linear track, to linearly orientate each work piece transport to the carrier disc.

Preferably, the first and second rotary abrasive tool is a first and second grinding wheel.

5 DESCRIPTION OF FIGURES

In order that the invention might be more fully understood, embodiments of the invention will be described by way of example only, with reference to the accompanying drawings, in which:

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Figure 1 shows a side view of a preferred embodiment of the apparatus;

Figure 2 shows a receptacle, to receive the work piece, according to the present invention;

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Figure 3 shows a conveyor, to transport the work piece from the receptacle to a grinding mechanism;

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Figure 4 illustrates the rotation of the timing belt and the carrier disc, resulting in the rotation of the work piece;

The attached drawings are not necessarily drawn to scale.

25 DESCRIPTION OF EMBODIMENTS OF THE INVENTION

Reference will now be made in detail to the preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. The preferred embodiments of the invention are not intended to limit the invention in its broadest aspect to these embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims. Furthermore, in the following detailed description of the embodiments, numerous specific details are set forth in order to provide an understanding of the present embodiments.

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The present invention relates to an apparatus 100 for grinding a first end 11 and a second end 12 of a work piece 10 to a desired end profile. In the following figures, the work piece 10 is shown to be cylindrical.

5 As seen in Figure 1, the apparatus 100 includes a receptacle 20 to receive a plurality of work pieces 10. The receptacle 20 dispenses each work piece 10 onto a conveyor 30 for transport to a rotating means 90, which rotates each work piece to a grinding mechanism 40, for grinding at a first end 11 and a second end 12 of a work piece to a desired end profile.

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Each feature of the invention will be described in turn.

Receptacle

15 Figure 2A shows the receptacle 20, in the form of a hopper 21, having an aperture 22 at one end, to gravitationally dispense each work piece 10 for subsequent grinding. In another embodiment as seen in Figure 2B, the receptacle 20 dispenses each work piece through an aperture at a top end of the receptacle. In this embodiment, the receptacle 20 may further include a motion conveying means, 20 to aid in the dispensation of each work piece 10, from the hopper 21. In an embodiment, the motion conveying means is a vibration means (not shown in the figures), to transmit a vibratory force to the hopper 21, to dispense each work piece 10 from the aperture 22 of the hopper 21.

25 Conveyor

The work piece 10 will be dispensed onto a conveyor 30 as seen in Fig. 3. The conveyor 30 is in the form of a linear track 31, to convey each work piece 10 to the grinding mechanism 40 for grinding each work piece 10, to a desired end profile.

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The linear track 31 is positioned between the hopper 21, and the grinding mechanism 40, so as to transport the dispensed work piece 10 from the hopper 21 to the grinding mechanism 40.

The linear track 31 further includes linear protrusions along the track 31, so that when the work piece 10 is dispensed onto the linear track, they will inevitably be orientated along the linear ribs along the conveyor 30. In this way, each work piece may be properly orientated when transported to the grinding mechanism 40
 5 automatically. However, where the shaft is symmetrical, there is no need for linear abutments along the linear track.

Rotating Means

10 The rotating means 90 is in the form of a first rotating means 50 and a second rotating means 60, each at a different speed of rotation. The first rotating means 50, is in the form of a carrier disc 51. The carrier disc 51 has a plurality of recesses or slots 52, along a periphery of the disc 51 to receive a work piece therewithin. The linear track 31 transports each work piece 10 dispensed from the hopper 21
 15 to each recess or slot 52 of the carrier disc 51. It is to be appreciated that each work piece 10 will be automatically orientated to be received by each slot 52 so that advantageously, a manual alignment of each work piece will not be necessary, thereby saving production time and improving production costs. The carrier disc 51 rotates each work piece to be ground at a first and second grinder, which will be
 20 subsequently described.

The second rotating means 60, is in the form of a timing belt 61, which contacts a surface of each work piece interacting with the belt 61. The differential speed of the carrier disc 51 and the timing belt 61, effects a resulting rotation of the work piece
 25 10 within each slot 52.

Figure 4 illustrates the rotation of the timing belt 61 and the carrier disc 51, each rotating to cause a rotation to the work piece 10.

30 As can be appreciated, the speed of the rotation of each work piece may be varied, by varying the speed of either the timing belt 61, or the carrier disc 51, or both. This may be achieved by having a velocity control means in the form of an inverter built in, or by any other conventional means.

To enable both ends of the work piece 10 to be ground in a single pass, the position of the work piece 10 in relation to the first and second rotating means 90 has to be secure so that the relative position between the work piece and the first and second rotary abrasive tools are fixed. Advantageously, this will enable the abrasive tools to
5 also be in a fixed position, and therefore, the readjustment of the abrasive tools will not be necessary, to achieve a consistent desired end profile.

Therefore, and as seen in Figure 4, the timing belt 61 encapsulates and extends across the carrier disc 51 to a position where the work piece will contact the first
10 and second grinder.

The grinding of the work piece is performed by a first rotary abrasive tool 70, and a second rotary abrasive tool 80, positioned adjacent to a first end 11 and a second end 12, of the work piece, respectively.

15 As seen in Fig 5, the abrasive tools are grinding wheels 71 and 81. Different surface profiles can be achieved at each end of the work piece by varying the position of the carrier disc 51 and the first and second grinding wheel 71, 81. The movement and resultant position of the first and second grinding wheel are
20 independent of each other and therefore, as can be appreciated, each work piece can have differing surface profiles, if so desired.

In the present invention, the carrier disc 51 may be moved vertically along the y-axis, and forwards and backwards along the x-axis. The first and second grinding
25 wheels 71, 81, may be moved along all 3 axes so as to meet a desired surface profile of the work piece. In the embodiment, the first axis can move along all 3 axes, and the second grinding wheel can move only in the z-axis.

When the grinding wheels 71, 81 are brought into contact with the first and second
30 end of the work piece 10, the rotating work piece frictionally contacts the abrasive surface of the grinding wheels, so that the surface is ground. The grinding continues until such time a desired end profile is achieved, which is determined by the position between the grinding wheel and the end of the work piece. For grinding of small work pieces, for example micro shafts, the length of each work piece is
35 very short, and therefore, the grinding wheels will come into contact with each other

if both ends of the shaft are ground simultaneously. Therefore, in the present invention, grinding is first performed at a first end, and then performed at a second end, without the need to manually remove and align each work piece for grinding to be performed at a second end.

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Alternatives

If so desired, the apparatus may be coupled to a feedback control loop, which performs a first cut, and automatically readjusts itself to result in a desired end
10 profile or depth of cut of the work piece.

The apparatus may also be further fitted with an exhaust system to remove the residue produced during the grinding process, to maintain a level of cleanliness and hygiene in the work area.

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The length of the work pieces, suitable in the present invention, is in direct relation to the width of the timing belt 61, and carrier disc 51, as both ends of the work piece will have to be extending from the timing belt and carrier disc 51 so that they may come into contact with the grinding wheels.

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The embodiments have been advanced by way of example only, and modifications are possible within the scope of the invention as defined by the appended claims.

CLAIMS

1. An apparatus for grinding a work piece, said apparatus including
a hopper for storing and dispensing at least one work piece, each
5 work piece having at least a first end and a second end;
a first rotating means rotating at a first predetermined angular
velocity, said first rotating means having a plurality of recesses along its
periphery, each recess dimensioned to receive one work piece, said rotating
means rotating to transport each work piece to a position for subsequent
10 grinding;
a conveyor positioned between said hopper and said first rotating
means, to position and transport each work piece to each recess;
a second rotating means rotating at a second predetermined
velocity, extending across and encapsulating a portion of the first rotating
15 means, for contacting a surface of each transported work piece so that each
work piece is held in position in each recess, each work piece rotating in
response to the velocity difference between the first and second
predetermined velocity;
a first and second rotary abrasive tool, a first rotary abrasive tool to
20 grind a first end of a work piece and a second rotary abrasive tool to grind a
second end of a work piece so that both ends are ground.
2. An apparatus for grinding a work piece according to claim 1, wherein the
second rotating means extends to at least the position where the first and second
25 rotary abrasive tools grind the first and second end of the work piece.
3. An apparatus according to any one of claims 1 or 2, wherein said conveyor
further includes ribs along said conveyor, to linearly orientate each work piece for
transport to the first rotating means.
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4. An apparatus according to any one of the preceding claims, wherein the
hopper further includes a vibration means, to vibrate the stored work piece onto the
conveyor.

5. An apparatus according to any one of the preceding claims, wherein the first and second rotating means further includes a velocity control means, to control the rotational speed of the first rotating means and the second rotating means.
- 5 6. An apparatus according to any one of the preceding claims, wherein the apparatus further includes an exhaust system to remove residue produced by the grinding of the work piece.
7. An apparatus, according to any one of the preceding claims wherein the first
10 rotating means is a carrier disc.
8. An apparatus, according to any one of the preceding claims, wherein the second rotating means is a timing belt.
- 15 9. An apparatus, according to any one of the preceding claims, wherein the apparatus further includes a selective chute, to orientate asymmetrical work piece onto a conveyor.
- 10 10. An apparatus according to any one of the preceding claims, wherein the conveyor is a linear track, to linearly orientate each work piece transport to the carrier disc.
11. An apparatus according to any one of the preceding claims, wherein the first and second rotary abrasive tool is a first and second grinding wheel.