This invention in general relates to a diamond dresser for grinding wheel dressing, and particularly to a continuous radial and straight diamond dresser for grinding wheel dressing.

The grinding wheel is an ancient art, as is the dressing of grinding wheels. However, in the past to put radius and straight, either parallel or tapered, forms on a single wheel there was great expense involved. Several methods were used to obtain this irregularly shaped wheel, such as having two dressers, one to perform the radius dress and the other to perform the straight dress. Also, the operation may be handled by having two different machines, one for the radius machining and one for the straight machining. For some workpieces to be ground, the grinding wheels would be dressed by a diamond rotary wheel dresser which required the dresser wheel to be manufactured for the specific workpiece form. Also, some workpiece forms require the grinding wheel to be manufactured with the specific form of the workpiece.

In the past, all the methods have been expensive, both inherently and in production time. It is the major objective of the present invention to provide a dresser that is universal in application and can dress both a radial and straight form.

Another objective of the present invention is to provide a dresser that will dress both a radial and straight form in continuous motion.

Still another objective is to provide a universal dresser that can dress both a radial and straight form or can be easily adapted for either radial or straight form dressing alone.

Also, the objective of the present invention includes the provision of a dresser construction capable of accomplishing the above objectives with a minimum of material cost and fabricating expense, and at the same time being composed of a simple and ruggedly formed structure which is very reliable in application.

Other objectives and advantages of the invention will be apparent from the following detailed description and claims, taken in connection with the accompanying drawings which form part of the instant specification, and which are to be read in conjunction therewith, and in which like reference numerals are used to indicate like parts in various views.

FIG. 1 is a front perspective view of the dresser unit in its initial position;

FIG. 2 is a cross-sectional view of a workpiece showing a typical form to be ground by a wheel;

FIG. 2a is a partial top view of the diamond dresser and the grinding wheel showing the diamond's path of travel and a typical form to be dressed on a wheel;

FIG. 3 is a side elevational view of the dresser unit as seen in FIG. 1;

FIG. 4 is a partial side elevational view in section of the dresser unit as viewed in FIG. 3;

FIG. 5 is an enlarged partial side view in section of the driven drum and its adjacent parts;

FIG. 6 is a front elevational view of the dresser unit showing it in its initial position;

FIG. 7 is a top view in partial section showing the driven drum and adjacent parts on FIG. 6;

FIG. 8 is a cross-sectional view of the driven drum taken on the line 8-8 in FIG. 6;

FIG. 9 is a partial top view of the diamond dresser and the grinding wheel as seen in FIG. 6;

FIG. 10 is a top view in partial section showing the driven drum and adjacent parts partially through the radial dressing stage;

FIG. 11 is a cross-sectional view of the driven drum taken on the line 8-8 in FIG. 6 when the driven drum has moved to the position shown in FIG. 10;

FIG. 12 is a partial top view of the diamond dresser and the grinding wheel as seen when the driven drum is in the position shown in FIG. 10;

FIG. 13 is a top view in partial section showing the driven drum and adjacent parts when the radial dressing stage is complete;

FIG. 14 is a cross-sectional view of the driven drum taken on the line 8-8 in FIG. 6 when the driven drum has moved to the position shown in FIG. 13;

FIG. 15 is a partial top view of the diamond dresser and the grinding wheel as seen when the driven drum is in the position shown in FIG. 13;

FIG. 16 is a top view in partial section showing the driven drum and adjacent parts when the straight dressing stage is partially complete;

FIG. 17 is a cross-sectional view of the driven drum taken on the line 8-8 in FIG. 6 when the driven drum has moved to the position shown in FIG. 16;

FIG. 18 is a partial top view of the diamond dresser and the grinding wheel as seen when the driven drum is in the position shown in FIG. 16;

FIG. 19 is a top view in partial section showing the driven drum and adjacent parts when the straight dressing is complete;

FIG. 20 is a cross-sectional view of the driven drum taken on the line 8-8 in FIG. 6 when the driven drum has moved to the position shown in FIG. 19;

FIG. 21 is a partial top view of the diamond dresser and the grinding wheel as seen when the driven drum is in the position shown in FIG. 19;

FIG. 22 is a top plan view showing the relationship of the dresser unit with respect to the machine base when manufacturing workpieces shown in FIG. 2;

FIG. 23 is a cross-sectional view of a workpiece showing a typical form with a tapered straight portion;

FIG. 24 is a grinding wheel showing the form required to produce the workpiece shown in FIG. 23;

FIG. 25 is a top plan view showing the relationship of the dresser unit with respect to the machine base when manufacturing workpieces shown in FIG. 23.

While the invention is susceptible of various modifications and alternative constructions, certain illustrative embodiments have been shown in the drawings and will be described below in considerable detail. It should be understood, however, that there is no intention to limit the invention to the specific forms disclosed, but on the contrary, the intention is to cover all modifications, alternative constructions and equivalents falling within the spirit and scope of the invention as expressed in the appended claims.

**General dresser construction**

Referring generally to the figures, we have a dresser unit 10 shown in FIG. 1. Adjacent to the unit 10, we have a spindle housing 12 and a grinding wheel 14. The dresser unit 10 has a base 16 which is supported by a machine base not shown in the drawings. The base 16 has support brackets 18 which support the major portion of the dresser unit 10 on a tilt shaft 20 which is rotatably secured in the brackets.

The portion of the dresser unit 10 supported by the shaft 20 is secured to it by tilt arm 22. The arm is between the support brackets 18 and encloses shaft 20. Directly secured to the arm 22 is roll housing 24. The
housing has motor 26 with a gear reducer 25 secured to its upper portion and a stationary cam follower holder 27 holding cam follower 28. The motor 26 drives a drum 30 through the gear reducer 25. The drum 30 drives a driven drum 32 by the endless cable 31.

The housing 34 is rotatably connected to the front face of the roll housing 24 by roll housing shaft 19. At the upper end of the housing 34 is the driven drum 32 and between them is located turn disc 36 which has turn disc lug 37 extending from it. Roll housing 24 has a holder arm 21 extending up from its front face with a turn disc stop screw 23 secured by the arm. At the bottom end of the turn housing 34 is located a rotatable holder flange 40 which has a dresser arm 42 secured to it. The arm 42 holds a diamond bar 44 which holds the diamond 43, seen in FIG. 3, which dresses the grinding wheel 14.

Wheel dressing operation

Referring generally to FIGS. 2 and 2a, we have a typical workpiece 59 which could be an outer bearing race, for example. This workpiece has a bore race area 51 and a straight area 52 to be ground in this operation. The present invention discloses a means and apparatus of dressing the grinding wheel 14 to grind this form with one diamond dresser moving continuously along the wheel's circumference, then retracts from the dressing area allowing spindle 12 to move the wheel 14 into grinding position. While the grinding wheel is moving towards its grinding position, the dresser unit 10 is starting to reposition the diamond back to its initial position so it will be ready the next time there a demand that the wheel be dressed.

As seen in FIG. 2a, the diamond starts dressing the wheel at start position A. The diamond bar 44 moves the diamond in an arc forming the circumferential portion of the wheel 14 to radial stop position B and at this position it continues to move the diamond along the straight portion of wheel 14 to finish position C. At this time the diamond is retracted from position C to position C'. The spindle is now free to move the wheel to its grinding position and grind workpiece 50 as required. Also, when the diamond is moved away from position C to C', it can start to move from position C to position B to position A'. The diamond is now in position so that when the wheel 14 is again in position for dressing it can move the diamond will move from retracted position A' to dress position A, and the cycle will repeat itself.

Referring to FIGS. 23 and 24, there is a workpiece 55 and a grinding wheel 15 respectively. The workpiece 55 has the workpiece 50 having a ball race area 51. The straight area 56 is not parallel with the axis of the workpiece, however, but it is actually a conical surface. Therefore, the wheel 15 is similar to wheel 14 from start position A to radial stop position B, but there is a difference from position B to position C because this portion of the wheel must grind the conical area 56. The remainder of this cycle is similar to that explained in the description of the dressing of wheel 14.

Dresser units construction and operation

Generally referring to FIGS. 1, 2, 3 and 6, the mechanical movements of the dresser unit groups will be described.

The dresser arm 42 is secured to holder flange 40 and may be adjustably positioned along a diametrical track, not shown in the drawings, across flange 40. The location of the diamond 43 from the center of the turn housing axis, which is the same as the center of the flange 49, will determine the form of the wheel when dressed from position A to position B. If the diamond 43 is behind the turn housing 34 axis, as seen in FIG. 3, the form will be convex having a radius of curvature equal to the distance between the diamond 43 and the turn housing axis 34.

The motor 26 drives the dresser unit 10 in a continuous motion via gear reducer 25 which drives the drum 30 which transmits power to drum 32. The drum 32 rotates the holder flange 49 as the diamond moves from position A to position B. When the diamond reaches position B, the rotary motion of the flange 49 is terminated by turn disc lug 37. An endless cable 31 around the drum 32 continues to rotate. At this position a cam lobe 29, as seen in FIG. 13, contacts cam follower 28 which causes the turn housing to rotate counter-clockwise around the axis of roll housing 24 causing the diamond to move from position C to position C'. When the diamond reaches position C', the flange 29 will start to rotate with the drum 32 causing the diamond to move from position B' to position A'. During this time wheel 14 will move in for grinding, and when again in position for dressing, the motor 26 will again be activated and cause the rod 46 to move the dresser unit into dressing position.

The arrangement of the dresser unit 10 is such that as the diamond moves from position A to position C through position B when dressing the wheel, there is no pause at position B. The pause is not permitted because it would cause a slight groove to form in the wheel which would prevent machining the type of precision workpieces required.

Referring to FIGS. 4 and 5, driven drum 32 is rotatably mounted on turn housing shaft 35 so that it can turn on the shaft, but will not turn the shaft. The shaft 35 runs the length of the turn housing 34 and is secured to holder flange 40 at its lower end. At its upper end, the shaft is secured to a retainer member 47 and near its upper end the shaft is secured to turn disc 36. Therefore, it is shown that turn disc 36, shaft 35, member 47, and the other end is secured to unwind pin 64, secured to turn disc 36. The pin 64 has a hold portion which is received by control slot 66 in driven drum 32. The slot 66 prevents pin 64 from allowing the spring 60 to unwind, as seen in FIG. 7, until the driven drum 32 is rotated in the D direction.

Referring generally to FIGS. 6, 7, 8 and 9, the dresser unit 10 is viewed as it is when at position A. When dressing is to start the motor 26 is started and driven drum 32 will be rotated in the D direction, which will cause the slot 66 to move and the spring 60 will unwind to allow the pin 64 to follow with the end of the slot.

FIGS. 10, 11 and 12 show the driven drum 32, turn disc 36 and coil spring 60, and the diamond 43, and wheel 14, respectively, when the diamond 43 is halfway between positions A and B. The pin 64 is still in position with the control slot 65. The turn disc lug 37 has
not reached turn disc stop screw 23 and is halfway to it at this position.

FIGS. 13 and 14 and 15 show the driven drum 32, turn disc 36 and coil spring 60, and the diamond 43 and wheel 14, respectively, when the diamond 43 has just arrived at position B. In FIG. 13 pin 64 is still in position with the control slot 66 and the turn disc lug 37 has just contacted the turn disc stop screw 23. Therefore, the spring 60 will not be allowed to unwind any further because unwind pin 64 is secured to the turn disc 36 which cannot rotate due to the contact of screw 23 and stop lug 37. As the driven drum 32 continues to be driven by cable 31, pin 64 will remain stationary and the control slot will allow the drum 32 to rotate without restriction by the pin 64.

As seen in FIG. 13, the cam lobe 29 has just made contact with the cam follower 28 and as the drum 32 continues to rotate the turn housing 34 will be rotated counter-clockwise around the axis of roll housing 24 and its roll housing shaft 19, as seen in FIG. 6. The tension spring 68 is secured to the roll housing 24 by one end and to the turn housing 34 by the other end. This urges the turn housing 34 constantly in a clockwise direction as seen in FIG. 6.

FIGS. 10, 17, and 18, show the driven drum 32, turn disc 36 and coil spring 60, and the diamond 43 and wheel 14, respectively, when the diamond 43 is half-way between position B and C. FIG. 17 is the same as FIG. 14, as the turn disc 36 has not rotated since position B. FIG. 16 shows that the pin 64 has remained stationary and the driven drum 32 has continued to rotate because of the control slot 66. Motor reverse dog 70 is just contacting motor reverse switch 72. The cam lobe 29 continues to rotate with the drum 32 and acting on follower 28 to rotate the turn housing 34, thus moving the drum 32 and follower 28 to position 20 as seen in FIG. 6.

FIGS. 19, 20, and 21 show the driven drum 32, turn disc 36 and coil spring 60, and the diamond 43 and wheel 14, respectively, when the diamond 43 has reached position C. FIG. 20 is the same as FIGS. 14 and 17 as the turn disc 36 has not rotated since position B. FIG. 19 shows that the dog 70 has just tripped the switch 72 and the motor 26 will be reversed. At this moment, the means which tilt the dresser unit about the tilt shaft 20 is actuated removing the diamond from the dressing area. As soon as the dressing unit is out of the way, the grinding wheel 14 can be fed into grinding position.

The motor will be reversed and the driven drum will be rotated in direction E. When the driven drum arrives at position B', the control slot will act on the unwind pin 64 causing the turn disc 36, the shaft 35, and its attached elements to be rotated in the E direction. Also, when the dresser unit 10 arrives at position B' the turn housing stop 38 and the roll housing stop 33 will be engaged, locating the turn housing 34 in proper vertical position. When the dresser unit arrives at the position A', the motor stop dog 74, see FIG. 7, will have tripped the switch 72 to shut the motor 26 off. All diamonds and the cam follower 28 will be tripped to move the dresser 10 to the dressing position and start the motor 26 to repeat the dressing cycle.

In FIG. 22 is shown the axial layout of the roll housing axis 19' with respect to a line 11 which is parallel to the axis of grinding wheel 14. They are at right angles to each other. This is the arrangement which will be used when dressing a wheel 14 as shown in FIG. 2. A.

In FIG. 23 is shown the axial layout of the roll housing axis 19' with respect to a line 11 which is parallel to the axis of grinding wheel 14. They form an acute angle F with respect to each other. This is the arrangement when a wheel 15, as shown in FIG. 2, is dressed. The difference between a right angle and the angle F will equal the angle of the taper from position B to C in FIG. 24.

While the embodiment of the present invention herein disclosed constitutes a preferred form, it is to be understood that other forms might be adapted and still be within the spirit of the disclosed invention.

I claim:

1. A dresser unit for a machine tool grinding wheel, said unit comprising,
(a) a base having support brackets, a tilt shaft, a tilt arm, a roll housing,
(b) the support brackets supporting the tilt shaft across the said base,
(c) the tilt arm being integral with the roll housing and supported by the tilt shaft so that it may rotate with respect to the base,
(d) a roll housing shaft, a turn housing, a driven drum, a turn disc, a dressing tool,
(e) the roll housing shaft is supported by the roll housing and is secured to the turn housing,
(f) the driven drum and the turn disc are attached to one end of the turn housing,
(g) the dressing tool is positioned at the other end of the turn housing and is connected to the turn disc and rotatable with it,
(h) a driver drum, an endless cable, a power source, a cam lobe, a cam follower,
(i) said driver drum connected to the power source and driven by it,
(j) the endless cable transmits power from the driver drum to the driven drum rotating with them,
(k) the cam lobe is integral with the driven drum,
(l) the cam follower is connected to and supported by the said roll housing,
(m) the turn disc has means permitting only partial rotation with the driven drum, and
(n) the cam lobe contacts the cam follower when the turn disc's rotating is stopped and rotates the turn housing about the roll housing shaft's axis.

2. A dresser unit for a machine tool grinding wheel as set forth in claim 1 having,
(a) a coil spring, a stationary pin, an unwind pin, a control slot,
(b) the stationary pin is secured to the said turn housing and attached to one end of the coil spring,
(c) the unwind pin is secured to the turn disc with one end extending into the control slot and the other end is attached to one end of the coil spring, and
(d) the control slot is integral with the driven drum and prevents the unwind pin from rotating the said turn disc until the driven drum is rotating.

3. A dresser unit for a machine tool grinding wheel as set forth in claim 2 having,
(a) a turn housing stop, a turn disc lug,
(b) the turn housing stop is connected to and supported by the roll housing,
(c) the turn disc lug is integral with the turn disc and rotates with it, and
(d) the turn disc makes a partial rotation with the driven drum until the turn disc lug contacts the turn disc stop screw which prevents its further rotation.

4. A dresser unit for a machine tool grinding wheel as set forth in claim 3 having,
(a) motor reverse dog, a motor reverse switch, a tilt means,
(b) the motor reverse dog is connected to and supported by the said driven drum,
(c) the motor reverse switch is connected to and supported by the turn housing, and
(d) the motor reverse dog will activate the said switch which will reverse the power source causing the rotation of the driven drum to be reversed and the tilt means will be actuated to cause the roll housing to be rotated with respect to the base.
5. A dresser unit for a machine tool grinding wheel as set forth in claim 4 having,
(a) a motor stop dog which is connected to and supported by the driven drum and will stop the said drum's reverse rotation by stopping the power source when it contacts the motor reverse switch.
6. A dresser unit for a machine tool grinding wheel, said unit comprising;
(a) a base supporting said dresser,
(b) a roll housing,
(c) a roll housing shaft, a turn housing, a driven drum, a turn disc, a dressing tool,
(d) the roll housing shaft is supported by the roll housing and is secured to the turn housing,
(e) the driven drum and the turn disc are attached to one end of the turn housing,
(f) the dressing tool is positioned at the other end of the turn housing and is connected to the turn disc and rotatable with it,
(g) a driver drum, a power source, a cam lobe, a cam follower,
(h) said driver drum connected to the power source and driven by it,
(i) the cam lobe is integral with the driven drum,
(j) the cam follower is connected to and supported by the said roll housing,
(k) the turn disc has means permitting only partial rotation with the driven drum, and
(l) the cam lobe contacting the cam follower and rotating the turn housing about the roll housing shaft's axis before the turn disc's rotation is stopped causing simultaneous motion about both turn disc's axis and the roll housing shaft axis.
7. A dresser unit for a machine tool grinding wheel as set forth in claim 6 having;
(a) a coil spring, a stationary pin, an unwind pin, a control slot,
(b) the stationary pin is secured to the said turn housing and attached to one end of the coil spring,
(c) the unwind pin is secured to the turn disc with one end extending into the control slot and the other end is attached to one end of the coil spring, and
(d) the control slot is integral with the driven drum and prevents the unwind pin from rotating the said turn disc until the driven drum is rotating.
8. A dresser unit for a machine tool grinding wheel as set forth in claim 7 having;
(a) a turn housing stop, a turn disc lug,
(b) the turn housing stop is connected to and supported by the roll housing,
(c) the turn disc lug is integral with the turn disc and rotates with it, and
(d) the turn disc makes a partial rotation with the driven drum until the turn disc lug contacts the turn disc stop screw which prevents its further rotation.
9. A dresser unit for a machine tool grinding wheel as set forth in claim 8 having;
(a) a motor reverse dog, a motor reverse switch, a tilt means,
(b) the motor reverse dog is connected to and supported by the said driven drum,
(c) the motor reverse switch is connected to and supported by the turn housing, and
(d) the motor reverse dog will actuate the said switch which will reverse the power source causing the rotation of the driven drum to be reversed and the tilt means will be actuated to cause the roll housing to be rotated with respect to the base.
10. A dresser unit for a machine tool grinding wheel as set forth in claim 9 having;
(a) a motor stop dog which is connected to and supported by the driven drum and will stop the said drum's reverse rotation by stopping the power source when it contacts the motor reverse switch.

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