GRINDING ATTACHMENT FOR MACHINE TOOLS

Filed Oct. 26, 1956

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

INVENTOR.

JOSEPH J. NAGLE

BY

ATTORNEY
GRINDING ATTACHMENT FOR MACHINE TOOLS

Filed Oct. 26, 1956

Fig. 2.

Fig. 3.

Fig. 6.

Fig. 7.

INVENTOR.

JOSEPH J. NAGLE

BY

ATTORNEY
This invention relates generally to grinding tools and the like, and is particularly directed to a grinder attachment for machine tools.

As well known, those versed in the art, prior machine-tool grinder attachments have been primarily of the electrically and pneumatically powered types, and are subject to numerous disadvantages, certain of which are inherent in the particular power means. More specifically, electrically powered grinder attachments have been complex in construction, and have required considerable flaring, and consequently, rapid wear of their electrical leads. Similarly, pneumatically powered grinders involve the use of fluid conduits, which are readily subject to wear and often cumber some; and moreover, pneumatic power does not permit close control of tool speed, an important factor in using modern grinding wheels.

It is, therefore, a primary object of the present invention to provide a grinder attachment of the type described, which overcomes the above-mentioned difficulties, is not limited to any particular power source, and is capable of use with a constant-speed drive.

It is a more particular object of the present invention to provide a grinder attachment having the advantageous characteristics mentioned in the preceding paragraph, which is entirely mechanical in operation, and which is capable of achieving extremely high grinding-wheel speeds, in the order of 70,000 revolutions per minute.

It is a further object of the present invention to provide a grinder of the type described which is durable in construction, simple and reliable in use, and which can be manufactured, sold, and maintained at a reasonable cost.

Other objects of the present invention will become apparent upon reading the following specification and referring to the accompanying drawings, which form a material part of this disclosure.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements and details hereinafter described, and of which the scope will be indicated by the appended claims.

In the drawings:

Figure 1 is an elevational view showing a grinder attachment of the present invention, with parts broken away for clarity of understanding;

Figure 2 is a partial side elevation view of the grinder of Figure 1, taken along the line 2--2;

Figure 3 is a transverse sectional view taken substantially along the line 3--3 of Figure 1;

Figure 4 is a transverse sectional view taken substantially along the line 4--4 of Figure 1;

Figure 5 is a transverse sectional view taken substantially along the line 5--5 of Figure 1;

Figure 6 is a transverse sectional view taken substantially along the line 6--6 of Figure 1; and

Figure 7 is a transverse sectional view taken substantially along the line 7--7 of Figure 1.

Referring now more particularly to the drawings, and specifically to Figure 1 thereof, the grinder attachment is there generally designated 10, and a fixed part of a machine tool is designated 11. The particular machine tool forms no part of the present invention, and may be a milling machine, boring machine, or other suitable machine tool. An opening 12 is formed in the fixed machine-tool part 11, for purposes appearing presently.

The grinder 10 includes a spindle or shank 14 which has one end 15 received inward through the opening 12 of the fixed machine-tool part 11 for connection to a constant-speed drive (not shown) of the machine tool. Just outward of or below the fixed machine-tool part 11, the spindle or shank 14 is gradually and concentrically enlarged by a conical portion 16; and, a concentric shaft portion 17 extends outward from the larger end of the conical portion 16, and terminates at its outer end in an enlarged, generally flat mounting head or plate 18, which is disposed concentric with and normal to the axis of the shaft 14. An annular shoulder 19 extends circumferentially about the outer region of the shaft portion 17, on the upper or inner surface of the mounting plate 18, and a peripheral, external groove 20 is formed in the shaft portion 17, adjacent to the shaft portion 16.

Circumposed about the enlarged projecting portion 17 of the spindle 14 is a bearing 22, preferably a combined thrust and radial bearing of the ball or antifriction type. The inner race of the bearing 22 is circumposed about the shaft portion 17 above the shoulder 19, and its outer race is disposed radially beyond the shoulder 19. A gear-carrying annulus or collar 23 is rotatably circumposed about the outer race of the bearing 22, and has its upper face peripherally recessed at 24. The lower face of the annulus 23 is provided with a peripherally extending, depending rib or skirt 25.

Fidely secured interiory of the annulus 23 beneath the outer race of bearing 22, and having its lower face flush with the lower face of the annulus so as to be spaced above the lower edge of skirt 25, is an internal orbital or ring gear 26. As best seen in Figure 1, the ring gear 26 is secured fast to the annulus 23 by a plurality of threaded fasteners 27, and extends radially inward beneath the outer race of the bearing 22 with its internal teeth disposed adjacent to and spaced radially outward from the spindle shoulder 19. Thus, the annulus 23 and gear 26 may be considered as a single piece defining an internal ring gear.

A locking collar, generally designated 30, is circumposed about the shaft 14 outward of or below the fixed part 11 and inward of the annulus 23. The locking collar 30 includes an inner externally threaded section 31 and an externally circularly disposed about the spindle portion 16 and having an internal shoulder 32 on its lower end rotatably extending about the upper region of the spindle portion 17 just below the groove 20. An external peripherally extending enlargement or shoulder 33 is formed on the lower end of the sleeve 31 and rests on the outer race of the bearing 22. It will be observed that the inner race of the bearing 22 is spaced slightly above the inner race of the bearing 22, and that the sleeve 31 is retained in position about the spindle 14 by a retaining wire or clip 34 releasably held in the groove 20. As the bearing 22 is of a conventional combination thrust and radial type, engagement of the external sleeve shoulder 33 with the outer bearing race frictionally holds the latter stationary and holds the inner race in firm engagement with the spindle shoulder 19 for rotation of the inner race with the spindle. This does not prevent rotation of the gear-carrying annulus 23 relative
to the sleeve 31, as the annulus 23 and gear 26 are rotatable relative to the outer race of the bearing. The locking collar 39 also includes a generally annular housing 35 circumferentially around and in threaded engagement with the sleeve 31 and threaded down on the latter into abutting engagement with the upper surface of the external sleeve shoulder 33. Depending from the periphery of the annulus 35 is a circumferentially extending skirt 36 which is spaced radially outward from the external shoulder 33 and formed on its lower edge with a peripheral ridge 37 entering into the upwardly facing recess 24 of the annulus 23. Thus, a generally annular chamber or space 38 is defined between the external shoulder 33 of the inner sleeve 31 and the peripheral skirt 36 of the annulus 35, which chamber has its lower wall formed by the upper surface of the annulus 23.

A frictional, resilient clutch member 49, which may assume the form of an annular, undulating Phosphor bronze sheet, is seated in the chamber 38 on the upper surface of annulus 23. Superposed on the clutch member 49, also in the chamber 38, is an annular backing member or ring 41, see Figure 5, which is dimensioned so as to be vertically shiftable in the chamber. Projecting radially outward from the backing member 41 through and beyond the skirt 36, are a plurality of shanks or stems 42, each carrying an enlarged head or knob 43. More particularly, the skirt 36 is formed with a plurality of closed-end, through slots 44, see Figure 2, each of which extends obliquely toward and away from the annulus 23 and opens from the chamber 38 to the exterior of the skirt. The stems 42 each extend through and out of a respective slot 44, and are movable longitudinally along their respective slots to effect concentric rotation of the backing member 41 and simultaneous vertical movement of the latter toward and away from the underlying friction clutch member 40.

The locking collar 39 further includes an annular locking member or ring 46 circumferenced in threaded engagement about the sleeve 31 above the housing member 35 and rotatable about the sleeve into and out of clamping engagement with the underside of the fixed machine-tool part 11. Knobs 47 may be provided on the exterior of the locking ring 46 to facilitate manual rotation of the latter into and out of its clamping engagement with the fixed machine-tool part.

A generally hollow, upwardly opening mounting member or body, generally designated 50, is arranged axially along the spindle 14 and fixedly secured on the outer end thereof between the plate 18 and the mounting body 50 thus define a rigid assembly. The mounting body 50 includes a generally cylindrical main portion 51 arranged axially of and in outwardly spaced relation with respect to the spindle plate 18. The main body portion is formed centrally with a generally circular recess 52 which opens upward toward the mounting plate 18. An insert 53, see Figure 7, is fixedly secured in the recess 52 and is centrally cut away to define a pair of parallel spaced, facing walls 54, each of which is provided with an upwardly facing shoulder 55 extending along the respective wall below the upper surface of the main body portion 51. As will appear hereinafter in greater detail, the insert walls 54 and shoulders 55 combine to define a guideway or track extending laterally or transversely across the end of the spindle body 14. An upwardly extending peripheral wall 57 is formed on the upper surface 56 of the main body portion 51 and is secured in abutting engagement with the underside of the spindle end plate 18 by stay members or bolts 58. Thus, the upwardly extending peripheral wall 57 of the mounting member or body 50 serves to maintain the main body portion 51 spaced from the spindle plate 18, so that the mounting body combines with the spindle plate to define an internal chamber 59. A plurality of screened, filter vents 60 may be provided in the upstanding wall 57 communicating between the interior and exterior of the chamber 59.

A shaft 63 extends through the spindle end plate 18, axially thereof in substantial parallelism with the spindle 14, and is journalled in the plate for axial rotation by a bearing 64. Thus, the shaft 63 is rotatable with the plate 18 about the axis of shaft 14, and also rotatable about its own axis. On one end of the shaft 63, the upper end as seen in Figure 1, is carried a planetary spur gear 65 in meshing engagement with the internal ring gear 26, while, a relatively large spur gear 66 is carried by the shaft 63 just below or outward of the mounting plate 18. A generally L-shaped bracket 67, see Figures 3 and 6, is fixedly secured to the under or outer side of the mounting plate 18 and extends beneath or outward of the spur gear 66 to rotatably support the lower or outer end of the shaft 63 in a bearing 68.

An open gear train carrier or housing 70 is arranged interiorly of the chamber 59, and includes an upper wall 71 disposed adjacent to the mounting plate 18, a lower wall 72 in substantially parallel spaced relation with respect to the upper wall and adjacent to the upper surface 56 of the main body portion 51, and a side wall 73 extending between and rigidly connecting together the upper and lower carrier walls. A pivot shaft 75 extends in parallelism with the spindle 14, see Figure 3, laterally or spaced from the axes of the spindle 14 and shaft 63, having its upper end rotatably secured in the mounting plate 18 and extending downward therefrom through both the upper and lower carrier walls 71 and 72 at a location remote from the carrier side wall 73. The pivot shaft 75 serves to mount the carrier 70 for rotation with the spindle 14, and swinging movement relative to the latter about the shaft axis.

A pinion 76 is carried by the pivot shaft 75 for rotation therewith and is in meshing engagement with the spur gear 66. Below the pinion 76, and also carried on the shaft 75 for rotation therewith is a relatively large spur gear 77. An additional shaft 78, having its axis parallel to and spaced from the axes of spindle 14 and shafts 63 and 75, extends between and has its opposite ends rotatably journeed in the upper and lower carrier walls 71 and 72. The shaft 78 is thus swingable with the carrier about the axis of pivot shaft 75. A pinion 79 is carried on the shaft 78, just below the top carrier wall 71 in meshing engagement with the spur gear 77, and a relatively large spur gear 80 is carried on the shaft 78 adjacent to the lower carrier wall 72. The gears 79 and 80 are, therefore, rotatable with the spindle 14 about the axis thereof, rotatable about the axis of shaft 78, and further swingable about the axis of pivot shaft 75. An opening 83 is formed through the lower carrier wall 72 adjacent to the periphery of spur gear 80, and is circumscribed by a bushing 83 fixed in the opening.

Located in the recess 52 of the main mounting body portion 51, and slidably received in the guideway defined by the walls 54 and shoulders 55, is a journal block 85. Thus, the journal block 85 is mounted for lateral shifting movement radially of the axis of spindle 14. A shaft 86 is arranged in the journal block 85 having its axis generally parallel to the axis of spindle 14, and is journeed in the block by bearings 87 and 88 so as to mount the shaft for axial rotation in the block and lateral shifting movement with the latter. The upper end of shaft 86 extends through and beyond the opening 82 of the lower carrier wall 72, and carries a pinion 89 in meshing engagement with the spur gear 80. Also carried on the shaft 86, just below the pinion 89 and interiorly of the carrier opening 82 is an enlarged head 90 which is received loosely and freely rotatably within the bushing 83 of the opening 82.

The bottom or outer wall 92 of the main mounting body portion 51 is open or cut away by a hole or slot 93 to permit extension of the shaft 86 outward beyond the mounting body and to permit lateral movement of
the outward extending shaft portion with the journal block 85. A suitable chuck 94 may be provided on the outer end of the shaft 86 for carrying a grinding wheel 95 on a shank 96. Circumposed about the shaft 86, and mounted on the outer face of the mounting member 50 over the opening 93, is a dust plate 97, which is shiftable laterally with the tool-carrying shaft 86 to close the opening 93 in all positions of lateral shaft movement.

A lead screw 100 extends rotatorily inward through the main portion 51 of mounting member 50, generally radially thereof, and has its inner end in threaded engagement in the journal block 85 to effect lateral shifting movement of the latter upon rotation of the lead screw. Operation of the lead screw 100, a relatively stiff compression spring 101 is preferably mounted in the main mounting member portion 51 for bearing engagement with the journal block 85.

**Operation**

With the inner end 15 of the shank 14 rotatably received in the machine tool, the locking ring 46 of the collar 30 may be rotated on its sleeve 31 to clamping engagement with the fixed machine-tool part 11, as illustrated. This will prevent rotation of the entire collar 30 including the sleeve 31, annular housing 35 and locking ring 46. The knurled nuts 63 are then rotated 65 to shift the annular backing member 41 toward the annulus 23 and squeeze or clamp the resilient friction clutch member 40 between the backing member and annulus.

Assuming the annulus 23 is held against rotation by the frictional engagement therewith of the clutch member 40, rotation of the spindle 14 will cause the shaft 63 to rotate about the spindle axis, and meshing engagement of the gear 65 with the gear 26 will cause a planetary rotation of the gear 65. The gear 66, also on the shaft 63, is, therefore, also rotated in a planetary manner, and the entire gear train consisting of gears 76, 77, 79, and 89, and the gear train carrier 70, are simultaneously rotated about the axis of spindle 14. The planetary motion of gear 66, which is in meshing engagement with the input gear 76 of the gear train, effects rotation of the latter gear about the axis of its shaft 75; and, the gear 77, also carried on the shaft 75, is in meshing engagement with the gear 79 to effect rotation of the latter and its shaft 78. The gear 80, the output gear of the train carried by the carrier 70, is therefore caused to rotate; and as the transmission through the train is always from large gear to small gear, it will be understood that a substantial speed increase is obtained at the output end.

The output gear 80 of the train carried by the carrier 70 is in meshing engagement with the gear 89 of the tool-carrying shaft 86 and, therefore, effects axial rotation of the latter. When the journal block 85 and its carried shaft 86 are located eccentrically with respect to the spindle 14, the tool-carrying shaft will rotate both on its own axis and gyrate about the axis of the spindle.

When it is desired to vary the degree of gyration of the grinding tool 95, it is only necessary to rotate the lead screw 100 and shift the journal block 85 toward or away from the axis of spindle 14. As the tool-carrying shaft 86 is thus shifted laterally along a straight line, the hub 90 of the shaft, which is received loosely in the gear train carrier bushing 83, serves to swing the gear train carrier about the axis of pivot shaft 75. During this swivelling motion of the gear train carrier 70, the output gear 80 of the train remains in meshing engagement with the input gear 89 of the tool-carrying shaft, and the input gear 76 of the gear train remains in meshing engagement with the gear 66 of the planetary shaft 65. Hence, the tool-carrying shaft 86 is effectively driven in all positions of its lateral adjustment.

While frictional engagement of the clutch member 40 was described hereinbefore as being accomplished before rotation of the spindle 14, which may be desired in actual use, the clutch may also be engaged after rotation of the spindle is initiated. In either case, inadvertent or accidental release of the clutch member 40 from its frictional engagement with the annulus 23 is effectively prevented by the spindle rotation. Thus, upon rotation of the spindle 14, the planetary gear 65 tends to cause rotation of the ring gear 26, which is fixed to the annulus 23. However, incipient rotation of the annulus 23 will tend to cause rotation of the backing member 41, through its frictional engagement with the clutch member 40, which in turn tends to increase clamping engagement of the backing member against the clutch member for the reason of the inclination of slots 44. Of course, the spindle is driven in a known direction of rotation which tends to rotate the backing member in a certain direction; and, the slots are inclined relative to the direction of backing-member rotation, so as to cause its increased clamping engagement. Hence, incipient rotation of the gear 26 serves to increase the holding action of the clutch member 40 against gear rotation.

However, when the cutting tool 95 meets with a relatively high resistance to cutting, say at the initiation of cutting, a high reaction torque will be transmitted from the tool-carrying shaft 86, through the train of gears in the gear carrier 70, to the planetary shaft 65. In order that the drive spindle 14 may operate at substantially constant speed, a sufficiently high reaction torque transmitted from the planetary shaft 65, through the planetary gear 65 to the ring gear 26, will cause the latter to rotate against the frictionally holding action of the clutch member 40. As the reaction torque decreases, the clutch member 40 again restrains the annulus 23 and its internal ring gear 26 from rotation, all without affecting the spindle 14 and its drive means.

From the foregoing, it is seen that the present invention provides a grinder attachment for machine tools which fully accomplishes its intended objects, and is well adapted to meet practical conditions of manufacture and use.

Although the present invention has been described in some detail by way of illustrative and example for purposes of clarity of understanding, it is understood that certain changes and modifications may be made within the spirit of the invention and scope of the appended claims.

What is claimed is:

1. A grinding attachment for a machine tool, said attachment comprising a spindle adapted to be rotatably carried by the machine tool with one spindle end projecting outward beyond a fixed part of said machine tool, a locking collar rotatably circumposed about a projecting portion of said spindle and adapted to be releasably locked relative to said fixed machine-tool part, an internal ring gear rotatably surrounding said spindle outward of said collar, clutch means operatively connecting said ring gear and collar to prevent rotation of the former relative to the latter at less than a predetermined torque, a planetary gear rotatably carried by said spindle eccentrically thereof in meshing engagement with said ring gear, a gear train carrier mounted on the projecting end of said spindle for pivotal movement about an axis parallel to and spaced from the axis of said planetary gear, a speed-increasing gear train mounted in said carrier for pivotal movement therewith and having its input end in driven connection with said planetary gear in all positions of carrier movement, a mounting body disposed outward of the projecting end of said spindle beyond said carrier and gear train and fixed to said spindle for rotation therewith, a tool-carrying shaft mounted in said mounting body for axial rotation and lateral shifting movement relative to said mounting body and spindle and connected in driven relation with respect to the output of said gear train, and means connecting said tool-carrying shaft to said gear train carrier to pivot the latter upon lateral shifting movement of said tool-carrying shaft, to thereby maintain said
A grinding attachment according to claim 1, said clutch means comprising a friction member resiliently maintained in frictional connection with said ring gear.

3. A grinding attachment according to claim 1, said connecting means comprising a hub on said tool-carrying shaft loosely and rotatably received in said gear-train carrier to effect pivotal movement of the latter upon lateral shifting of said tool-carrying shaft.

4. A grinding attachment for a machine tool, said attachment comprising a spindle adapted to be rotatably carried by said machine tool with one spindle end projecting outward beyond a fixed part of said machine tool, a locking collar rotatably circumposed about a projecting portion of said spindle adjacent to said fixed machine-tool part and adapted to be releasably locked relative to the latter, an internal ring gear rotatably surrounding the spindle outward of said collar, friction clutch means interposed between and in operative connection with said collar and ring gear to prevent rotation of the latter relative to the former at less than a predetermined torque, a planetary gear rotatably carried by said spindle eccentrically thereof in meshing engagement with said ring gear, a gear-train carrier mounted on the projecting end of said spindle for pivotal movement about an axis parallel to and spaced from the axis of said planetary gear, a speed-increasing gear train mounted in said carrier for pivotal movement therewith and having its input end in driven connection with said planetary gear in all positions of carrier movement, a mounting body disposed outward of the projecting end of said spindle beyond said carrier and gear train and fixed to said spindle for rotation therewith, a tool-carrying shaft mounted in said mounting body for axial rotation and lateral shifting movement relative to said mounting body and spindle and connected in driven relation with respect to the output of said gear train, and a hub on said tool-carrying shaft concentric therewith and loosely rotatably received in said gear-train carrier to effect pivotal movement of the latter upon lateral shifting movement of said tool-carrying shaft, to thereby maintain the tool-carrying shaft in said driven relation in all positions of its lateral shifting movement.

5. A rotary-tool drive comprising a normally fixed releasable locking member, a clutch gear mounted for rotation relative to said locking member, holding means releasably maintaining said clutch gear against rotation relative to said locking member at less than a predetermined torque, a rotary driven assembly, a planetary gear in meshing engagement with said clutch gear and carried by said driven assembly for orbital rotation with the latter, a pinion rotatably mounted in said assembly in driven connection with said planetary gear, a speed-increasing gear train having its low-speed end in driven connection with said pinion and mounted in said assembly.

6. A grinding attachment for a machine tool, said attachment comprising a spindle adapted to be rotatably carried by said machine tool, a locking collar surrounding said spindle and adapted to be releasably clamped to the fixed part of said machine tool, an internal ring gear circumposed about said spindle, bearing means mounting said ring gear for axial rotation about said spindle, clutch means operatively connecting said collar and ring gear to prevent rotation of the latter relative to the former at less than a predetermined torque, a planetary gear rotatably carried by said spindle eccentrically thereof in meshing engagement with said ring gear, a speed-increasing gear train pivotally mounted on said spindle for rotation therewith and swingable relative thereto and having its input gear in driven connection with said planetary gear at all positions of said swinging movement, a tool carrier journaled on said spindle and mounted for lateral shifting relative to said spindle and for rotation therewith and rotation relative thereto, and gear means carried by said tool carrier for driven connection with the output gear of said gear train, said swinging gear-train movement serving to maintain said gear means in said driven connection upon lateral shifting of said tool carrier.

7. A grinding attachment according to claim 6, said clutch means comprising a backing member carried by said locking collar for movement relative to the latter obliquely toward and away from said ring gear and resilient means interposed between and in frictional engagement with said backing member and ring gear, whereby incipient movement of said ring gear in one direction tends to move said backing member toward said ring gear and clamp said frictional means tightly against said ring gear to prevent movement of the latter, movement of said backing member away from said ring gear serving to release said resilient means from said clamping engagement with said ring gear.

References Cited in the file of this patent

UNITED STATES PATENTS

2,546,490 Baldwin 35 Mar. 27, 1951
2,715,806 Hancock 35 Aug. 23, 1955
2,718,820 Fasell 35 Sept. 27, 1955