Aug. 13, 1957 J. J. NAGLE 2,802,320

GRINDING ATTACHMENT FOR MACHINE TOOLS

Filed Oct. 26, 1956 2 Sheets-Sheet 1

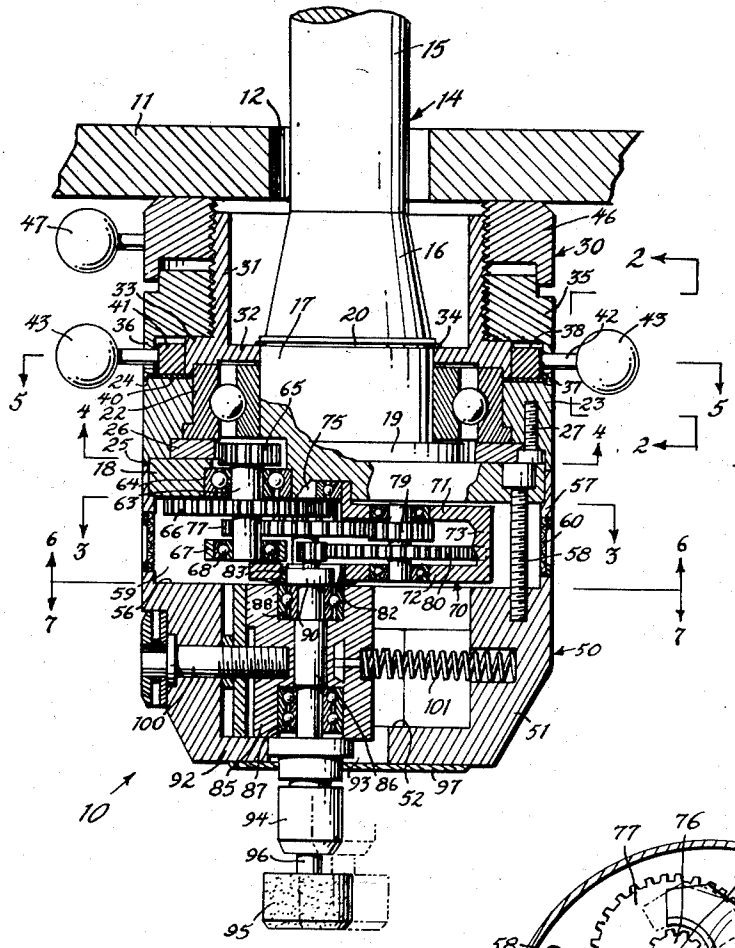

Fig. 1.

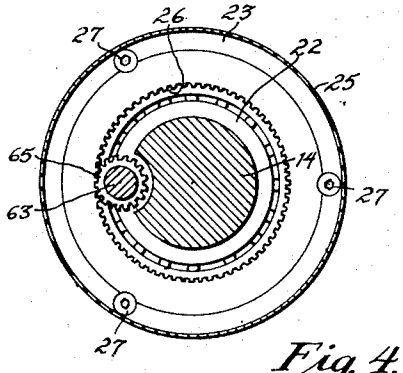

Fig. 4.

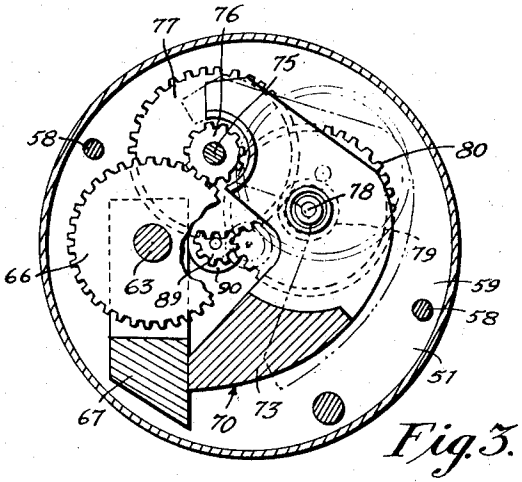

Fig. 3.

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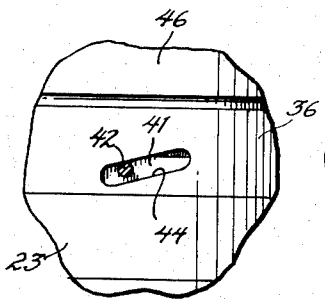


Fig. 2.

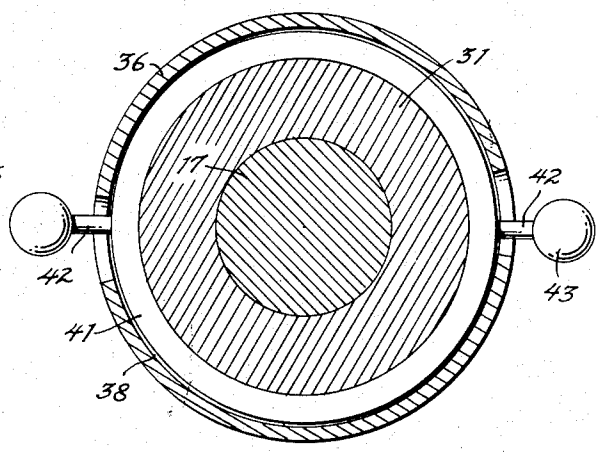


Fig. 5.

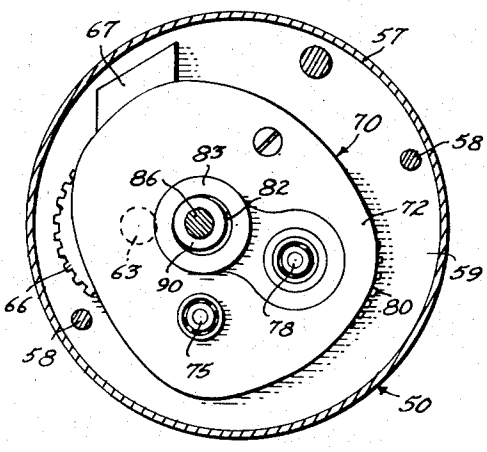


Fig. 6.

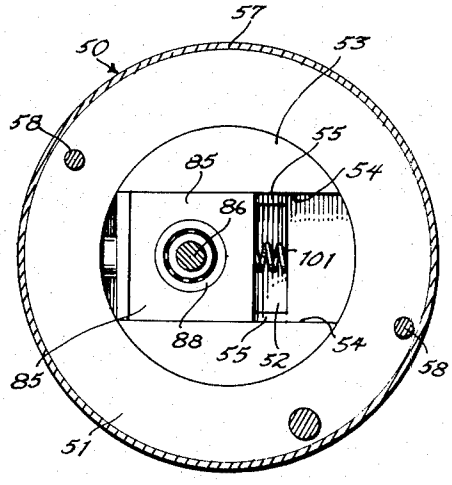


Fig. 7.

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United States Patent Office 2,802,320 Patented Aug. 13, 1957



2,802,320

# GRINDING ATTACHMENT FOR MACHINE TOOLS

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Application October 26, 1956, Serial No. 618,573

7 Claims. (Cl. 51—241)

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

As is well known to those versed in the art, prior machine-tool grinder attachments have been primarily of the electrically and pneumatically powered types, and have been subject to numerous disadvantages, certain of which are inherent in the particular power means. More specifically, electrically powered grinder attachments have been necessarily complex in construction, and have required considerable flexing, 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 cumbersome; and moreover, pneumatic power does not permit close control of tool speed, an important factor in using modern grinding wheels. In addition to the above-mentioned disadvantages, prior grinding tools have been incapable of satisfactory use with constant-speed drives.

It is, therefore, a primary object of the present invention to provide a grinder attachment of the type described, which overcomes the above-mentioned difficulty, 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 of parts, which will be exemplified in the construction 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 elevational 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.

Fixedly secured interiorly 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 sleeve 31 spacedly circumposed 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 internal shoulder 32 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 **30** also includes a generally annular housing **35** circumposed about 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 sleeve shoulder **33** and is 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 **40**, 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 **40**, 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 **30** further includes an annular locking member or ring **46** circumposed 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 of the spindle **14** and fixedly secured on the outer end thereof to the end plate **18**. The spindle **14** and 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 axis of the spindle **14**. An upstanding 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 upstanding 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**, eccentrically thereof in substantial parallelism with the spindle **14**, and is journaled 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 Figures 3 and 6, laterally 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 journaled in the upper and lower carrier walls **71** and **72**. The shaft **78** is thus swingable with the carrier **70** about the axis of pivot shaft **75**. A pinion **79** is carried on the shaft **78**, just beneath 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 **82** 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 journaled 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 or hub **90**. The hub **90** is received loosely and freely rotatably within the bushing **83** of the opening **82**.

The bottom or outer wall **92** of the main mounting member 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 rotatably 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. Opposite 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** into 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 knobs **43** are then rotated 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** to be 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 **80**, 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 shaft. 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 swinging motion of the gear train carrier **70**, the output gear **80** of the train remains in meshing engagement with the 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 **63**. 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 spindle rotation. That is, 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, by 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, incipent 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 **63**. In order that the drive spindle **14** may operate at substantially constant speed, a sufficiently high reaction torque transmitted from the planetary shaft **63**, through the planetary gear **65** to the ring gear **26**, will cause the latter to rotate against the frictional 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 illustration 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

tool-carrying shaft in said driven relation in all positions of its lateral shifting movement.

2. 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 shitfing 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 lateral shaft 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 for rotation therewith and swinging movement about the axis of said pinion while in driven connection therewith, a tool-carrying shaft rotatably mounted in said assembly for axial rotation and lateral shifting movement relative thereto, said tool-carrying shaft being in driven connection with the high-speed end of said gear train, and means constraining said gear train to swinging movement upon lateral shifting of said tool-carrying shaft, to thereby maintain the driven connection of said tool-carrying shaft with said gear train upon lateral shifting movement of said tool-carrying shaft.



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 relsilient means from said clamping engagement with said ring gear.

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