United States Patent

Knoll

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[54] APPARATUS FOR DRIVING AND FEEDING ELONGATED TOOLS OR THE LIKE

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Oct. 7, 1967 Germany ..... P 26 02 994.0

[52] **U.S. Cl.** **74/22**, 173/149

[51] **Int. Cl.** **F16h 21/00**

[58] **Field of Search** 214/338; 254/31; 74/22; 173/149

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[57] **ABSTRACT**

Apparatus for rotating and feeding elongated material removing tools comprises a pair of carriages which are reciprocable in opposite directions and each of which accommodates a rotary gripper movable into or away from engagement with the peripheral surface of the tool shank. When one of the grippers engages the tool and causes the tool to rotate and to move axially to advance its cutter into or along a workpiece, the gripper of the other carriage is disengaged from the tool and moves in opposite direction. Engagement and disengagement of grippers is controlled automatically and the grippers are rotated in their respective carriages.

17 Claims, 9 Drawing Figures

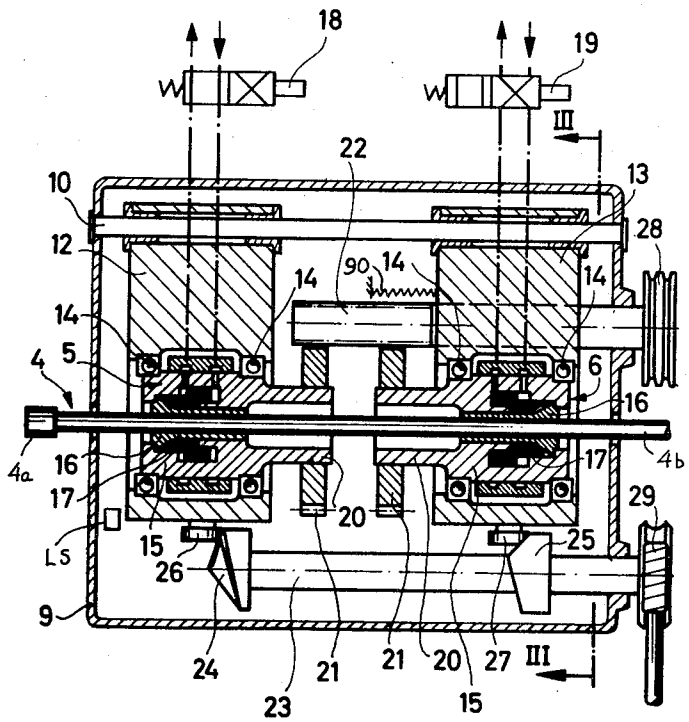


Fig. 1

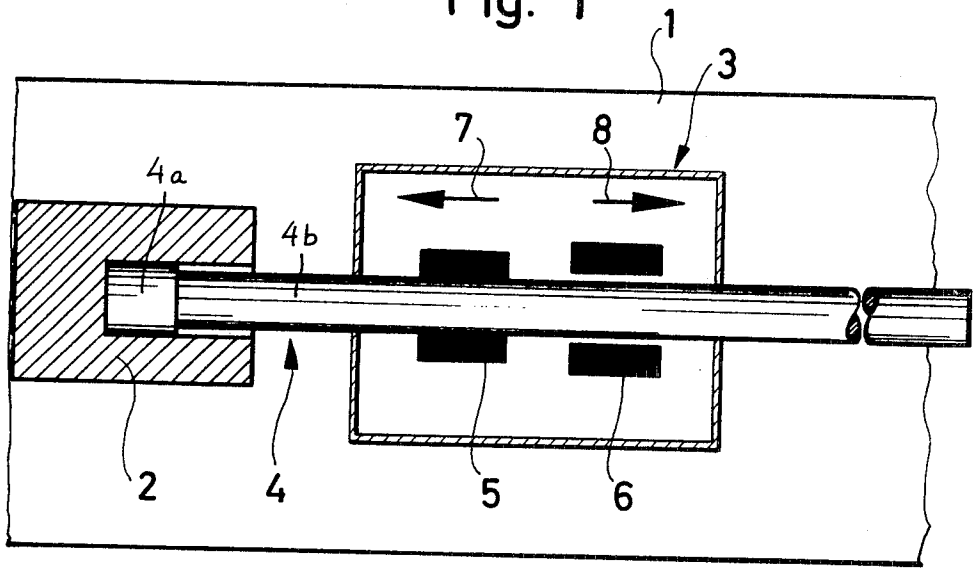
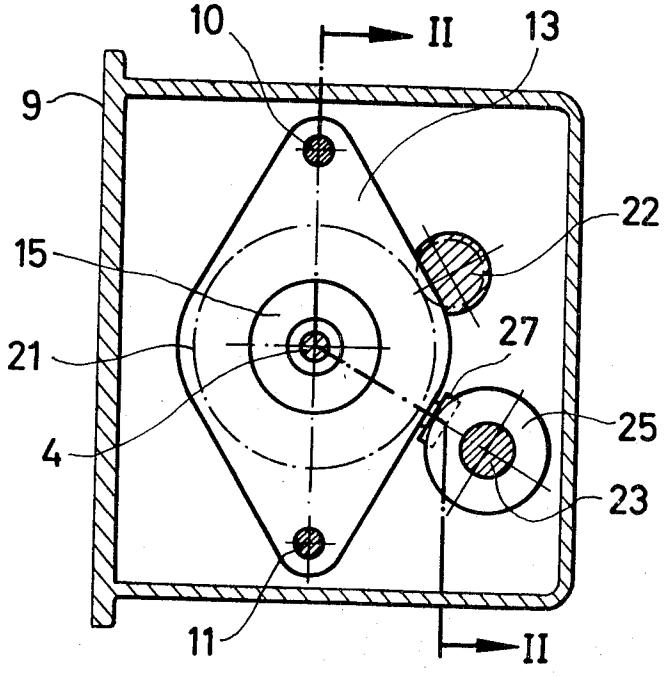


Fig. 3



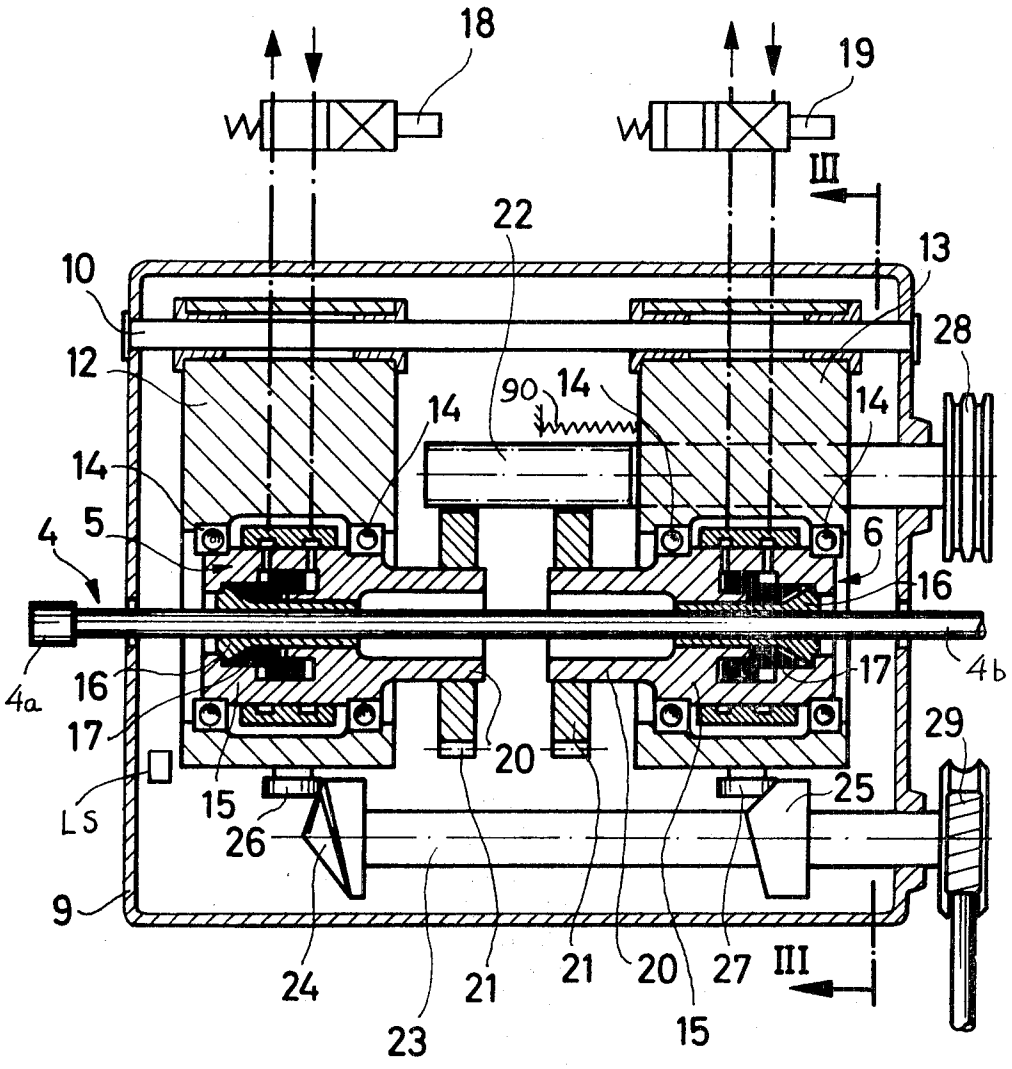
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Fig. 2



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Fig. 4

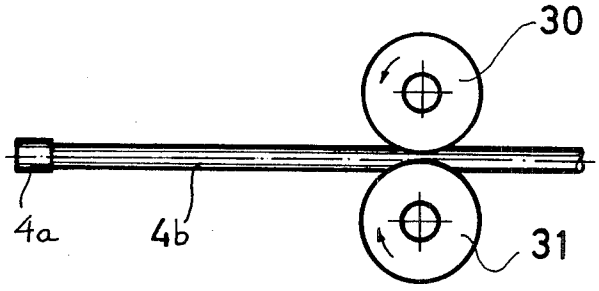


Fig. 5

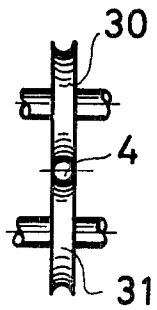


Fig. 6

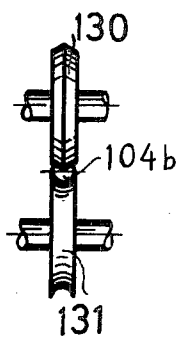


Fig. 7

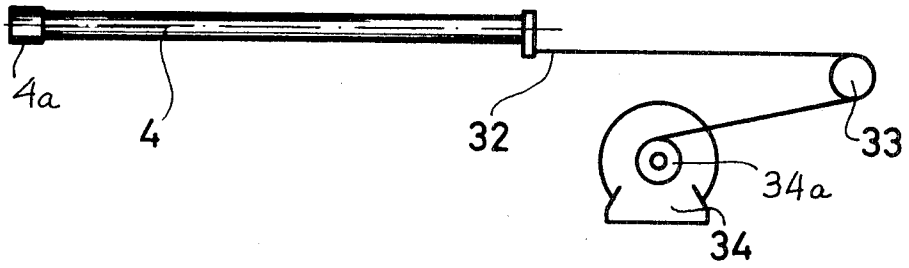
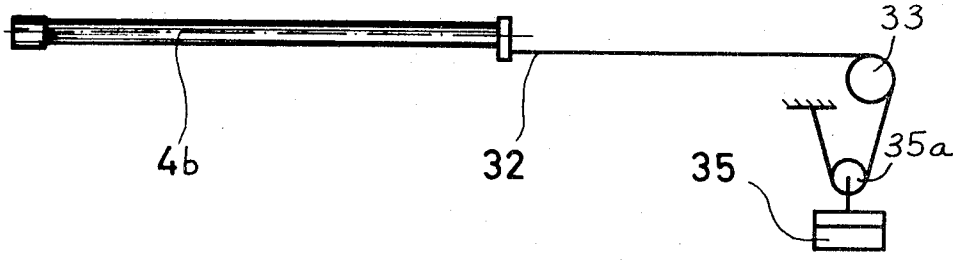


Fig. 8

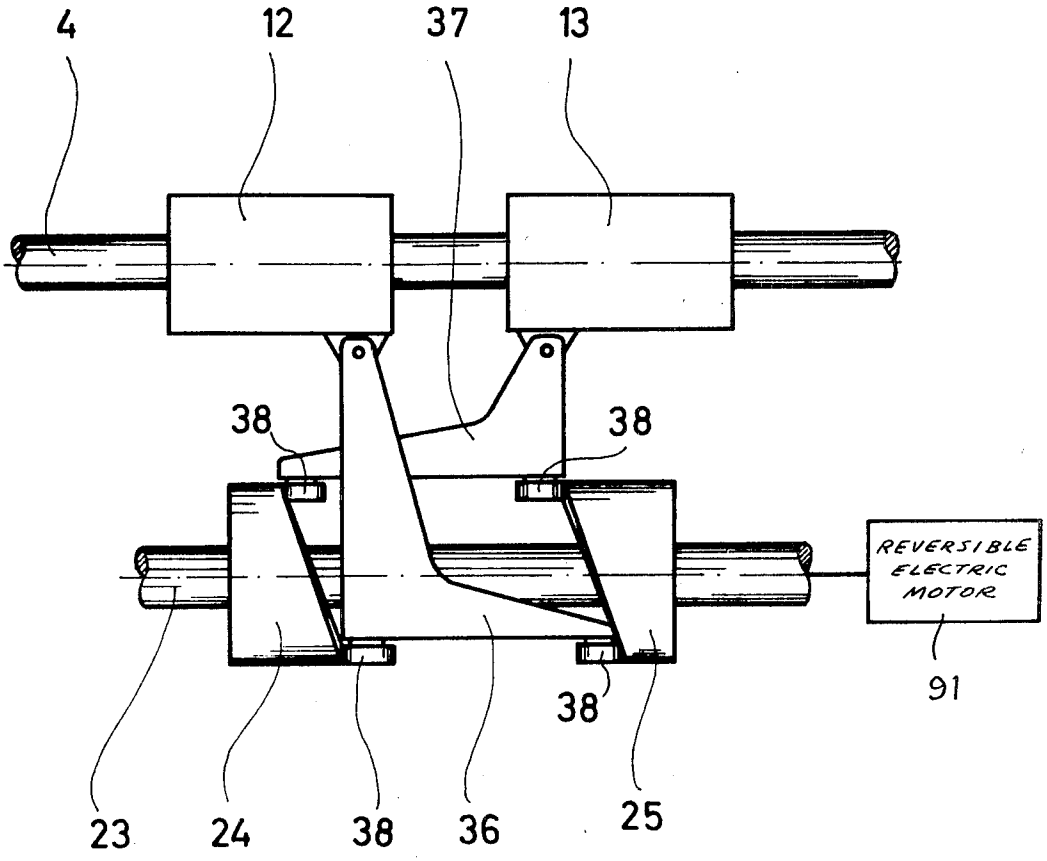


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Fig. 9



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APPARATUS FOR DRIVING AND FEEDING ELONGATED TOOLS OR THE LIKE

BACKGROUND OF THE INVENTION

The present invention relates to apparatus for transmitting motion to elongated bodies, particularly to improvements in apparatus for effecting axial or lengthwise feed movements and for simultaneously effecting rotation of elongated drilling, boring, honing, broaching, thread cutting and/or analogous material removing tools.

In presently known machine tools which are utilized to drill deep bores or holes into metallic or other workpieces, the rear end of an elongated material removing tool is normally clamped in the chuck of a tool spindle which is rotated to thereby rotate the tool with reference to the workpiece. In addition, the carrier for the spindle is moved in axial direction of the tool to thereby feed the cutter or working end of the tool into the workpiece. As a rule, the carrier for the revolving work spindle is mounted in or on a carriage which is reciprocable along rails, columns, tie rods or analogous guide means. The length of the tool shank must suffice to insure penetration of the cutter to a desired depth.

A serious drawback of such machine tools is that the tool receives torque at a point which is remote from the cutter so that the shank of the tool is subjected to substantial twisting and similar stresses. Furthermore, the tool is also subjected to considerable buckling or bending stresses which develop in response to movement of the spindle carrier along its guide means. At the very least, the cutter of the tool is subjected to substantial vibratory stresses which affect the accuracy of the material removing operation. Attempts to reduce or to eliminate such vibratory stresses include the provision of stationary rests which engage the tool shank intermediate the chuck of the tool spindle and the cutter to thus prevent excessive buckling of the shank. The rests must be installed and fixed with a high degree of accuracy and they are unable to prevent excessive twisting of relatively long and slender tool shanks. It was found that the provision of one or more rests is often insufficient to insure accurate removal of material, especially if the shank of the tool is relatively long, for example, when the tool must drill a deep bore into a cylindrical, block-shaped or otherwise configurated workpiece.

SUMMARY OF THE INVENTION

One of the objects of my present invention is to provide an apparatus which can be installed in or on machine tools or like machines for removal of material from metallic or other workpieces and wherein a relatively long and slender tool shank can be guided and moved in such a way that the tool is subjected to minimal twisting, bending, buckling or analogous stresses during penetration of its working end into the material of a workpiece.

Another object of the invention is to provide an apparatus of the just outlined character which can be readily and rapidly installed in or on conventional machine tools.

A further object of the invention is to provide an apparatus which can be installed in or on existing machine tools, which occupies little room, which comprises a relatively small number of simple parts, and which can effect rapid penetration of a rotary tool into or removal or retraction of such tool from a workpiece.

An additional object of the invention is to provide an apparatus which can be used in connection with widely different types of elongated material removing tools and wherein the tools can be interchanged to enable the apparatus to carry out a succession of different operations in rapid sequence.

The invention resides in the provision of an apparatus for feeding elongated bodies lengthwise, particularly for effecting axial movements of elongated material removing tools in machine tools or the like. The apparatus comprises a plurality of transporting units each reciprocable axially of an elongated body between first and second positions and each having gripper means movable into and away from engagement with the elongated body, reciprocating means for reciprocating the units so that one of the units moves from first toward second position while another unit moves from second toward first position, and control means for moving the gripper means into motion transmitting engagement with the elongated body, at least while the corresponding units move from first toward second position so that the body is moved lengthwise in the direction of movement of the units from first toward second positions, either by the one unit, by the other unit or by both units. The apparatus preferably further comprises drive means for rotating the gripper means so that each of the gripper means can rotate the elongated body during motion transmitting engagement therewith, i.e., that the body rotates about its axis while simultaneously moving lengthwise to penetrate into the material of a workpiece.

The reciprocating means preferably comprises a plurality of reciprocable carriages and the gripper means of each transporting unit is rotatably mounted in one of the carriages. The apparatus further preferably comprises a housing which accommodates tie rods or analogous guide means for the carriages. The drive means for rotating the gripper means may comprise a rotary output shaft which is mounted in the housing in parallelism with the tie rods and with the elongated body and is provided with teeth which drive gears mounted on suitable holders for the gripper means. The gripper means preferably resemble chucks and can be expanded or contracted radially away from or into torque- and axial motion transmitting engagement with an elongated body. The control means may comprise hydraulic valves and pistons which are reciprocable in cylindrical holders for gripper means to thereby effect radial movements of gripper means into or away from the peripheral surface of the shank on an elongated tool or the like.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic plan view of an apparatus which embodies one form of the invention;

FIG. 2 is a longitudinal vertical sectional view of the apparatus, substantially as seen in the direction of arrows from the line II—II of FIG. 3;

FIG. 3 is a transverse vertical sectional view as seen in the direction of arrows from the line III—III of FIG. 2;

FIG. 4 is a side elevational view of a resetting device for the tool which is used in the apparatus of FIGS. 2 and 3;

FIG. 5 is an end elevational view of the resetting device shown in FIG. 4;

FIG. 6 is an end elevational view of a second resetting device;

FIG. 7 is a side elevational view of a third resetting device;

FIG. 8 is a side elevational view of a fourth resetting device; and

FIG. 9 is a schematic side elevational view of a modified apparatus which embodies a further resetting device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The apparatus which is shown in FIGS. 1 to 3 comprises a base or frame 1 which supports a fixedly mounted workpiece 2 and a fixedly mounted tool driving and feeding assembly 3. The tool is shown at 4; this tool may constitute an elongated drill rod or the like having at the forward (left-hand) end of its shank 4*b* a cutter 4*a* which drills a hole into the adjoining end face of the workpiece 2. The purpose of the assembly 3 is to rotate the tool 4 about its own axis and to feed the tool in the direction indicated by arrow 7, i.e., in a direction to cause the cutter 4a to penetrate into the material of the workpiece 2.

The assembly 3 comprises several (for example, two) transporting units 5, 6 which are arranged to operate alternately, i.e., the unit 5 rotates and moves the tool 4 when the unit 6 is disengaged from the tool, and vice versa, preferably with short intervals of overlapping operation. In other words, the unit 6 can cooperate with the unit 5 to rotate and to feed the tool 4 in the direction indicated by arrow 7 when the unit 5 approaches the end of its working (leftward) stroke, and vice versa. In FIG. 1, the unit 5 clamps the tool 4 and causes it to rotate and to move in the direction indicated by arrow 7 while the unit 6 is disengaged from the tool 4 and moves in the direction indicated by arrow 8. When the unit 6 reaches its starting position (namely, its rightmost position), it begins to move in the direction indicated by arrow 7 and simultaneously engages with and rotates the tool 4 so as to impart to the tool a rotary movement about the latter's axis and to simultaneously feed the cutter 4a into the material of the workpiece. The unit 5 reaches the end of its working stroke (namely, its left-hand end position) shortly after the tool 4 is engaged and rotated by the unit 6, and the unit 5 is thereupon disengaged from the tool prior to beginning a return movement toward starting position. The same operation is repeated again and again until the cutter 4a penetrates into the workpiece to a predetermined extent to form therein a bore, to treat the surface surrounding a previously formed bore, to cut threads into such surface, or for another purpose. The units 5 and 6 cooperate to move the tool 4 at a preferably constant rate and preferably without any interruptions.

The construction of the assembly 3 is shown in FIGS. 2 and 3. This assembly comprises a housing or casing 9 which is fixedly mounted on the base 1 and accommodates two guide means here shown as tie rods 10, 11 whose axes are parallel to the axis of the tool 4. The tie rods 10, 11 serve to guide two carriages 12, 13 which are reciprocable thereon in directions indicated by arrows 7 and 8 (FIG. 1). The carriages 12, 13 respectively accommodate the transporting units 5, 6 which are rotatable therein in antifriction bearings 14 in such a way that each of the two units shares all reciprocatory movements of its carriage. The units 5, 6 may but need not be of identical design; in the illustrated embodiment, the unit 6 is a mirror symmetrical replica of the unit 5 with reference to a plane which is normal to the plane of FIG. 2 and extends at right angles to the axis of the tool 4 midway between the carriages 12 and 13.

Each of the transporting units 5, 6 comprises a holder or cylinder 15 which accommodates an axially reciprocable plunger or piston 17 forming part of a control means which serves to move a gripper or chuck 16 into engagement with the peripheral surface of the shank 4a or to permit automatic separation of the gripper 16 from the adjoining portion of the shank. The pistons 17 are preferably operated by hydraulic fluid which is admitted into or evacuated from the chambers of the respective cylinders 15 by control valves 18, 19 shown in the upper part of FIG. 2. In the illustrated embodiment, the valves 18, 19 are operated by solenoids which are controlled by limit switches LS (one shown) located in the path of movement of carriages 12, 13 or of one or more parts which are mounted on or share the movements of such carriages. Each gripper 16 has a conical external surface which can be engaged by a complementary conical internal surface of the corresponding piston 17 to thereby effect radial contraction of the gripper into engagement with the adjoining portion of the shank 4b. The conduits which permit hydraulic fluid to flow between the chambers of the holders 15 and the corresponding control valves 18, 19 are indicated by phantom lines. In FIG. 2, the left-hand piston 17 causes the corresponding gripper 16 to engage the shank 4*b* and to thus rotate the tool 4 and to move it in a direction to the left. The gripper 16 of the transporting unit 6 is disengaged from the shank 4*b* and the carriage 13 is in the process of moving to the right, i.e., back to starting position.

The drive means for rotating the transporting units 5, 6 about the axis of the tool 4 comprises an input shaft 22 which is provided with a pulley 28 for one or more V-belts not shown, and is formed with teeth meshing with two gears 21 each mounted on the extension 20 of one of the holders 15. These holders rotate in the bearings 14 and drive the corresponding pistons 17 and the grippers 16 (when the pistons 17 cause the associated grippers to engage the shank 4*b*). The gears 21 are preferably installed in the central portion of the housing 9.

The reciprocating means of the assembly 3 comprises the aforementioned carriages 12, 13 and a camshaft 23 which is rotated by a worm drive 29 and carries two cams 24, 25 cooperating with roller followers 26, 27 respectively mounted on the carriages 12 and 13. Springs 90 (one shown) or analogous biasing means are provided to permanently urge the followers 26, 27 against the faces of the adjoining cams on the shaft 23. The configuration of faces on the cams 24, 25 is such that the carriage 12 moves in a direction to the left when the valve 18 admits pressure fluid into the left-hand holder 15 of FIG. 2 in such a way that the piston 17 of the transporting unit 5 causes the corresponding gripper 16 to engage the shank 4*b* and to move the tool 4 in a direction to the left, and that the valve 19 then permits fluid to escape from the left-hand chamber of the holder 15 in the transporting unit 6 so that the gripper 16 of the unit 6 is disengaged from the shank 4*b*. The aforementioned limit switches LS regulate the operation of control valves 18, 19 and the operation of these valves is synchronized with the operation of the worm drive 29 in a manner as described hereinabove, i.e., that the tool 4 is normally rotated and moved axially by a single gripper 16 but that the two grippers 16 engage the shank 4*b* at the same time shortly before one of the carriages 12, 13 reaches the end of its working (leftward) stroke. The prime mover or prime movers which rotate the shafts 22 and 23 are not shown in FIGS. 2 and 3.

THE OPERATION

In FIG. 2, the transporting unit 5 is moved by the carriage 12 which travels in a direction to the left in that it follower 26 engages with a portion of the face on the cam 24 which causes the follower 26 to move away from the cam 25. The gripper 16 of the transporting unit 5 is in torque-transmitting engagement with the shank 4*b* and, therefore, the entire tool 4 is moved to the left and causes its cutter 4*a* to penetrate into the workpiece. The gripper 16 of the transporting unit 5 is rotated by the output shaft 22 through the intermediary of the left-hand gear 21, extension 20 of the holder 15 and the corresponding control piston 17. The gripper 16 of the transporting unit 6 is disengaged from the shank 4*b* and the follower 27 engages a portion of the face on the cam 25 which allows the carriage 13 to move in a direction to the right so that the gripper 16 of the unit 6 advances counter to the direction of movement of the tool 4.

When the transporting unit 6 reaches the right-hand end of its stroke (starting position), one of the limit switches LS is actuated by the carriage 13 and causes the control valve 19 to bring about engagement between the gripper 16 of the unit 6 and the shank 4*b* of the tool 4. This preferably takes place shortly before the transporting unit 5 reaches the left-hand end of its stroke so that the shank 4*b* is then rotated by both grippers. At the same time, the gripper 16 of the unit 6 begins to move in a direction to the left, as viewed in FIG. 2, and to feed the tool 4 in the same direction. The gripper 16 of the unit 5 is disengaged from the shank 4*b* at the time when or shortly before the carriage 12 reaches its left-hand end position, and one of the limit switches LS is then engaged by the carriage 12 to actuate the control valve 18 in a manner to effect return movement of the carriage 12 and unit 5 to starting position. During such return movement of the carriage 12, the shank 4*b* is rotated and fed axially by the gripper 16 of the unit 6. When the unit 5 reaches its starting position, the control valve 18 causes the gripper 16 of the unit 5 to engage with the shank 4*b* and to rotate and feed the tool together with the unit 6. Such simultaneous engagement between the grippers 16 of

both units and the shank 4*b* is terminated when the unit **6** reaches the left-hand end of its stroke. The same operation is then repeated again and again until the cutter 4a reaches a predetermined distance from the housing **9**.

The apparatus of the present invention is further provided with resetting means for retracting or returning the tool **4** to starting position, either in such a way that the cutter 4*a* can treat the workpiece **2** during return movement or that the cutter 4*a* is simply withdrawn from the bore or hole of the workpiece without removing any material during retraction. It is normally desirable to effect rapid return movement of the tool **4** to starting position, especially when the cutter 4*a* removes material only when it moves in the direction indicated by arrow **7**.

One retracting or resetting device for the tool **4** is shown in FIG. **4**. This device is operative when both grippers **16** are disengaged from the shank 4*b* and comprises two advancing rollers **30, 31** which can engage the peripheral surface of the shank 4*b* and can be driven in opposite directions as indicated by arrows to thereby effect rapid return movement of the shank 4*b* to starting position. As shown in FIG. **5**, the rollers **30, 31** may be provided with circumferential grooves bounded by concave surfaces to properly engage and entrain the peripheral surface of a cylindrical shank 4*b*. FIG. **6** shows two modified advancing rollers **130, 131** which can engage a shank **104***b* having a partly convex and partly concave peripheral surface. The exact configuration of profiles on the advancing rollers **30, 31, 130, 131** or analogous rollers depends on the cross-sectional configuration of the shank. The means for rotating the rollers **30, 31** or **130, 131** may comprise a motor and a suitable transmission or the like, not shown. Such motor may be started automatically when the cutter 4*a* penetrates into the workpiece to a predetermined depth, or by hand.

FIG. **7** illustrates a modified retracting or resetting device which comprises a flexible element here shown as a cable or cord **32** connected to the trailing end of the tool **4** and to a pulley 34*a* on the output shaft of a reversible polarity electric gear motor **34**. The cable **32** is trained over a guide roll **33** and can rapidly retract the cutter 4*a* from the workpiece when the motor **34** is started in a direction to convolute the cable on the pulley 34*a*. The motor **34** may be utilized to drive the shafts **22, 23** of FIG. **2**; in such apparatus, the motor **34** drives the shafts **22, 23** when it rotates in one direction and it drives the pulley 34*a* when it rotates in the other direction.

FIG. **8** illustrates a simplified retracting or resetting device which comprises a cable or cord **32**, a guide roll **33** for the cable, and a weight **35** which is suspended on the shaft of a roll 35*a* bearing against the cable **32**. One end of the cable **32** is affixed to the shank 4*b* and the other end of the cable is fixedly secured to a stationary support. If desired, the weight **35** can be attached directly to the right-hand end of the cable **32**. The weight **35** insures automatic return movement of the tool **4** to starting position in immediate response to simultaneous disengagement of both grippers **16** from the shank 4*b*.

Referring finally to FIG. **9**, there is shown a portion of a further apparatus wherein the resetting or retracting device for the tool **4** is mounted directly on the carriages **12, 13** and cooperates with or forms part of the reciprocating means for the carriages **12, 13** and the transporting units (not shown). The camshaft **23** is driven by a reversible electric motor **91**, preferably in such a way that the motor **91** drives the shaft **23** at a lesser speed while rotating in a first direction to effect penetration of the cutter into the workpiece and that the motor drives the shaft **23** at a greater speed while it rotates in the opposite direction to effect rapid retraction of the tool **4** to starting position. The resetting device comprises two levers **36, 37** which are respectively pivoted to the carriages **12, 13** and carry pairs of roller followers **38**. The roller followers **38** of each lever engage the faces of both cams **24, 25**. It will be readily understood that one of the carriages **12, 13** moves to the left when the other carriage moves to the right, and vice versa and that, by the simple expedient of reversing the direction of rotation of the shaft **23** and by moving the grippers **16** of the transporting units **5, 6** in the carriages **12, 13** into alternating engagement with the tool shank, the apparatus of FIG. **9** is capable of rapidly retracting the tool **4** to starting position. It is clear, however, that the mechanical resetting devices of FIGS. **4** to **9** can be replaced by pneumatic, hydraulic or other types of resetting devices without departing from the spirit of the present invention.

An important advantage of my apparatus is that an elongated tool can be fed axially in a very simple material- and space-saving manner. Thus, the length of the base **1** (FIG. **1**) need not substantially exceed the length of the housing **9** and may be substantially less than the length of the tool shank 4*b* or **104***b*. In other words, the length of the base is not dependent on the length of the tool. Furthermore, and since the housing **9** can be placed into close or immediate proximity of the workpiece, torsional stresses to which the shank 4*b* or **104***b* is subjected, particularly at the moment when the cutter begins to penetrate into the material of the workpiece, are reduced to a minimum so that the tool is not caused to vibrate and/or to perform other stray movements which could affect the accuracy of the material removing operation. The apparatus can be used to perform a variety of operations, such as drilling of deep holes, tapping of prefabricated bores or holes, honing, broaching and/or others. Moreover, the apparatus can be readily installed in or on existing machine tools so that such machine tools can be used to perform a series of operations, either simultaneously or in a predetermined sequence. For example, the apparatus can be used in or on a machine tool which is employed to produce and/or to treat cylinders of hydraulic or pneumatic aggregates or analogous workpieces. The output of the apparatus is much higher than the output of presently known apparatus which are utilized for similar purposes and the accuracy of machining is also superior to the accuracy which can be achieved by resorting to presently known structures.

The apparatus of FIG. **9** is particularly suited for honing of workpieces, i.e., for carrying out an operation during which the revolving cutter of a tool moves axially back and forth with reference to a workpiece. If the apparatus of FIG. **9** is used for honing, the motor **91** for the camshaft **23** can be arranged to rotate at the same speed in a clockwise or in a counterclockwise direction.

It is further clear that the apparatus of my invention may comprise three or more transporting units which alternate to effect feed movements of an elongated body or which are arranged in pairs or in groups of three or more whereby the units of each group cooperate to move the shank lengthwise while the units of the other group or groups move back to starting positions.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended

1. Apparatus for feeding elongated bodies, particularly for effecting axial movements of elongated material removing tools in machine tools, comprising a plurality of transporting units each reciprocable lengthwise of an elongated body and each having gripper means movable into and away from motion transmitting engagement with the body; reciprocating means for reciprocating said units so that one of said units moves from a first toward a second position while another of said units moves from a second toward a first position, said reciprocating means comprising a plurality of reciprocable carriages, one for each of said transporting units, rotary cam means, and follower means provided on said carriages and cooperating with said cam means to effect reciprocatory movements of the respective carriages, the gripper means of each of said units being rotatably mounted in the respective carriages; control means for moving said gripper means into

motion transmitting engagement with the elongated body, at least while the corresponding units move from said first toward said second positions thereof; and drive means for rotating said gripper means so that each of said gripper means rotates the elongated body during said motion transmitting engagement therewith.

2. Apparatus as defined in claim 1, wherein each of said units is arranged to return to first position before the other unit reaches said second position thereof and wherein said units thereupon move simultaneously toward their second positions until the one unit reaches such second position.

3. Apparatus as defined in claim 1, further comprising a housing and guide means mounted in said housing, said carriages being reciprocably supported by said guide means.

4. Apparatus as defined in claim 3, wherein said drive means comprises a rotary output shaft mounted in said housing in parallelism with said guide means and with the elongated body.

5. Apparatus as defined in claim 1, wherein each of said gripper means is contractible and expansible radially into and away from motion transmitting engagement with the elongated body and wherein each of said units further comprises a holder mounted in the respective carriage and accommodating the corresponding gripper means, said control means comprising a plurality of piston means each movable in one of said holders to thereby effect expansion or contraction of the respective gripper means, and means for regulating the movements of said piston means.

6. Apparatus as defined in claim 5, wherein each of said holders is rotatable in the respective carriage and wherein said gripper means are rotated by said drive means through the intermediary of said pistons and said holders.

7. Apparatus as defined in claim 1, wherein said units are of identical construction.

8. Apparatus as defined in claim 7, wherein said units are arranged mirror symmetrically relative to each other.

9. Apparatus as defined in claim 4, wherein each of said units further comprises a holder for the respective gripper means, each of said holders being rotatable in the respective carriage and said drive means further comprising means for rotating said gripper means for rotating said gripper means by way of said holders in response to rotation of said output shaft.

10. Apparatus as defined in claim 9, wherein each of said holders has an extension projecting from the respective carriage and wherein the means for rotating said holders comprises gears provided on said extensions.

11. Apparatus as defined in claim 10, wherein said gears are located in a central portion of said housing.

12. Apparatus as defined in claim 1, wherein said control means comprises actuating means for effecting movements of said gripper means into and from engagement with the elongated body in predetermined positions of said carriages.

13. Apparatus as defined in claim 12, wherein said actuating means comprises limit switches.

14. Apparatus for feeding elongated bodies, particularly for effecting axial movements of elongated material removing tools in machine tools, comprising a plurality of transporting units each reciprocable lengthwise of an elongated body and each having gripper means movable into and away from motion transmitting engagement with the body; reciprocating means for reciprocating said units so that one of said units moves from a first toward a second position while another of said units moves from a second toward a first position; control means for moving said gripper means into motion transmitting engagement with the elongated body, at least while the corresponding units move from said first toward said second positions thereof; and resetting means for returning the elongated body to a starting position, said resetting means comprising a flexible element which is connected to the elongated body.

15. Apparatus as defined in claim 14, wherein said resetting means is arranged to return the elongated body by way of said reciprocating means and said control means.

16. Apparatus as defined in claim 15, wherein said reciprocating means comprises a carriage for each of said units and means for reciprocating said carriages, including a rotary camshaft, cam means provided on said cam shaft and follower means cooperating with said cam means, said resetting means comprising motion transmitting levers connected with said carriages and supporting follower means.

17. Apparatus for feeding elongated bodies, particularly for effecting axial movements of elongated material removing tools in machine tools, comprising a plurality of transporting units each reciprocable lengthwise of an elongated body and each having gripper means movable into and away from motion transmitting engagement with the body; reciprocating means for reciprocating said units so that one of said units moves from a first to a second position while another of said units moves from a second toward a first position; control means for moving said gripper means into motion transmitting engagement with the elongated body, at least while the corresponding units move from said first toward said second positions thereof; and resetting means for returning the elongated body to a starting position, said resetting means comprising driven advancing rollers arranged to engage the peripheral surface of the elongated body and to thus advance the body in a direction corresponding to the direction of movement of said units from said second toward said first positions thereof.

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