United States Patent [19]

Johnson

[11] **3,717,892**

[45] **Feb. 27, 1973**

[54] **TAPPING ATTACHMENT FOR NUMERICAL CONTROL**

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[73] Assignee: **Tapmatic Corporation**

[22] Filed: **April 9, 1970**

[21] Appl. No.: **26,894**

[52] **U.S. Cl.** .....**10/89 F,** 10/138, 10/141 H, 408/134, 408/140

[51] **Int. Cl.**.....**B23q 1/46,** B23q 5/14

[58] **Field of Search**...10/135, 136, 138, 89 F, 141 H; 74/376, 378, 379; 408/124, 132, 134, 140; 279/16, 18

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Primary Examiner—Charles W. Lanham
Assistant Examiner—E. M. Combs
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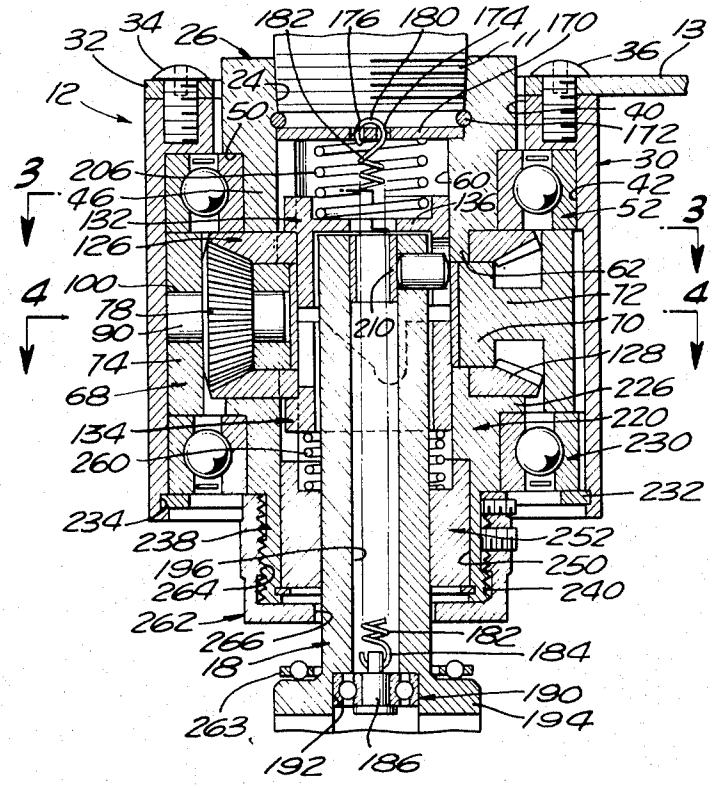
[57] **ABSTRACT**

The invention is a tapping attachment of the type having free axial float. Direct and reverse drive is provided for by way of planetary gears for driving at the same speed in direct and reverse drive. An adjustment is provided for the magnitude of the free axial float. Spring biased clutch driver members are provided for both the direct and reverse drive providing a narrow, neutral position which cooperates with the adjustment of the free axial float. The attachment accommodates itself in a number of ways to numerical or computer control.

5 Claims, 6 Drawing Figures



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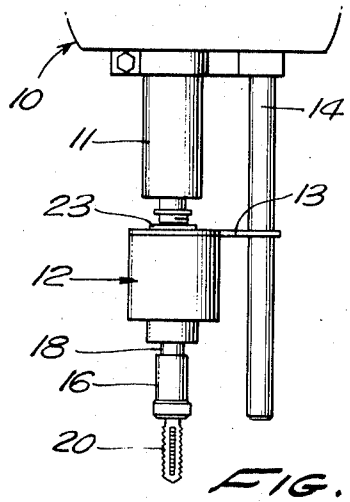

FIG. 1.

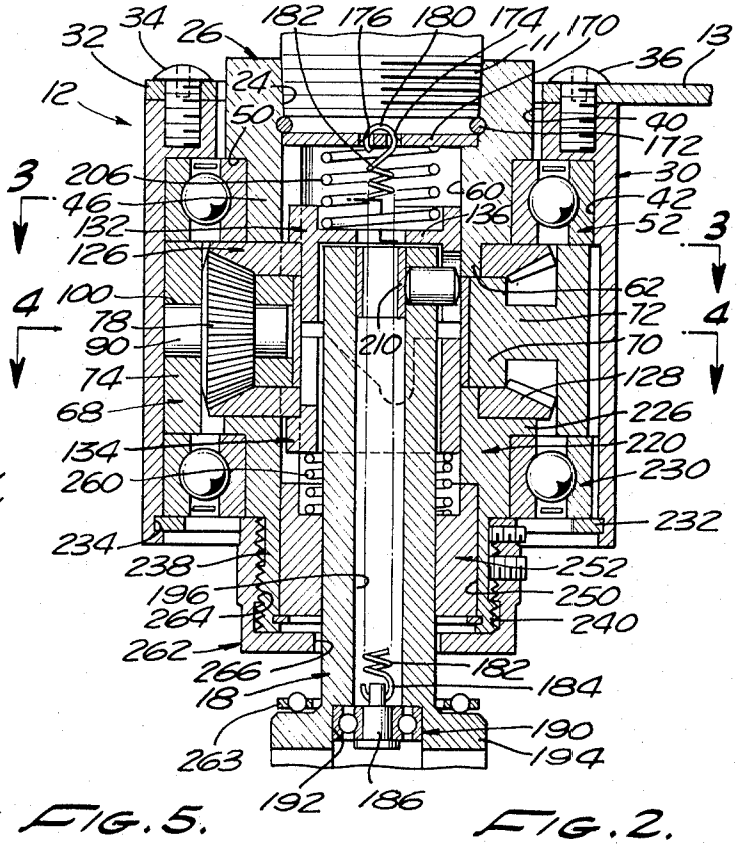

FIG. 2.

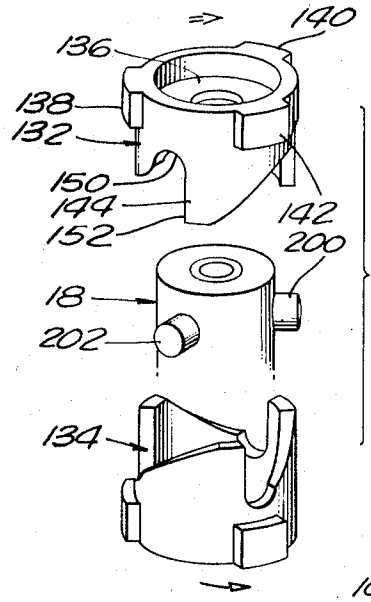

FIG. 5.

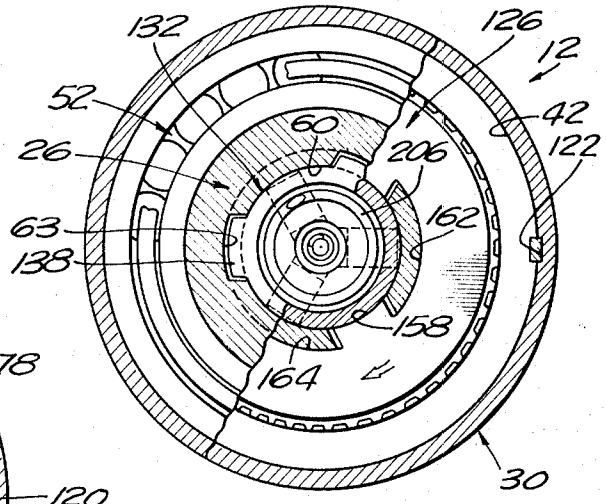

FIG. 3.

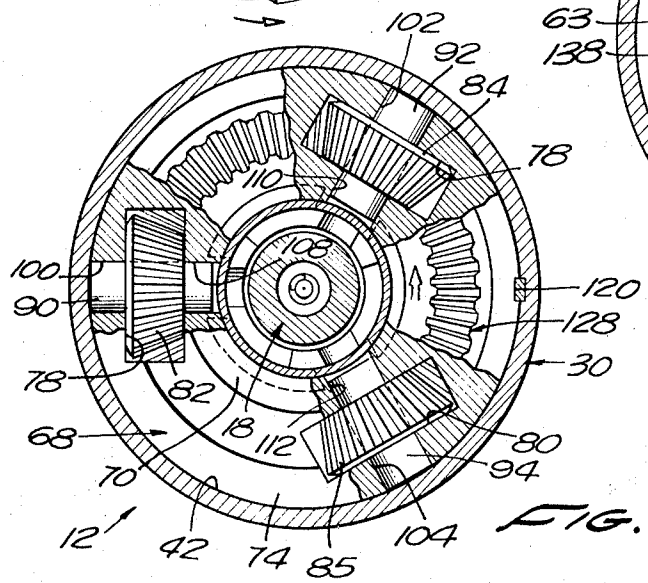

FIG. 4.

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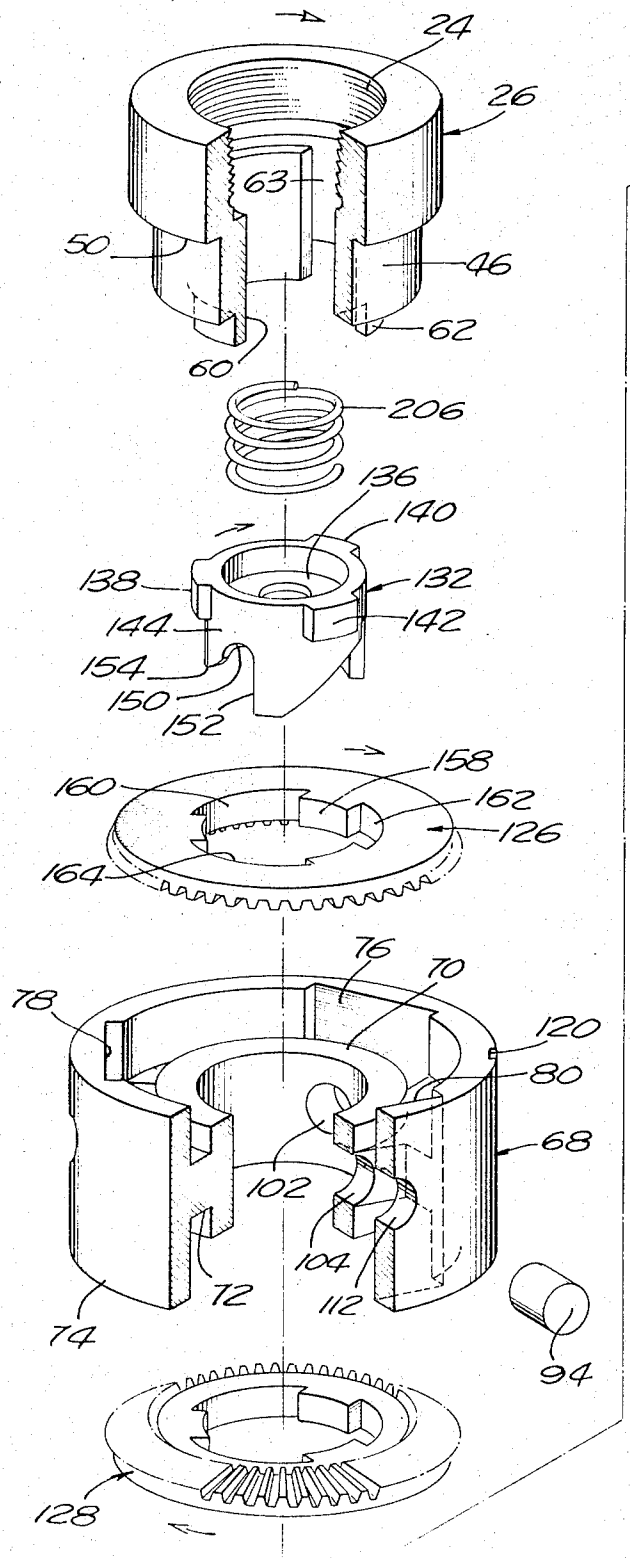

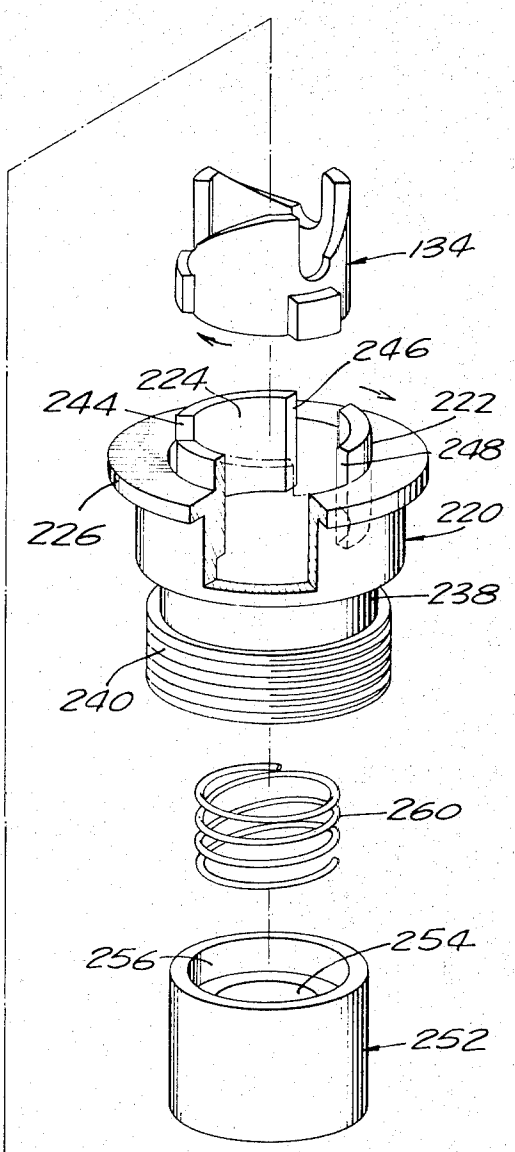

FIG. 6.

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TAPPING ATTACHMENT FOR NUMERICAL CONTROL

SUMMARY OF THE INVENTION

The invention is a tapping attachment of the type having free axial float and providing for both direct and reverse drive. Practical improvements are provided in the device as described in detail herein, particularly adapting it to numerical or computer control.

BACKGROUND OF THE INVENTION

The background of the invention is exemplified in prior patents of this inventor U.S. Pat. Nos. 3,041,893 and 3,397,588, which are hereby incorporated herein by reference. The background patents disclose the characteristics of tapping attachments having free axial float and direct and reverse drive. U.S. Pat. No. 3,397,588 discloses a type of construction wherein for the direct drive there is provided a spring biased clutch driver member which functions to eliminate chattering, when the clutch engages or disengages for direct drive.

The improvements of the herein invention are adapted to realizing the objective that the attachment is capable of doing or accomplishing movements that could be accomplished by a human arm manipulating the attachment. The realization of this end is a broad objective of the invention. A number of improvements are provided in it. The drive is by way of planetary gears in such a way that the driving speed is the same in direct drive as in reverse drive. Spring biased clutch driver members are provided for both direct and reverse drive. An adjustment collar is provided on the attachment which cooperates with the tapping spindle so that the degree or magnitude of axial float can be adjusted. This adjustment in combination with the spring biased clutch driver members makes it possible to have a very narrow neutral zone or area between direct and reverse drive thereby greatly facilitating the adaption of the attachment to numerical or computer control and to the elimination of chattering or knocking both when engaging and disengaging with respect to both direct and reverse drive.

The specific nature of the improvements are described in detail hereinafter in connection with a preferred exemplary form of the invention.

In light of the foregoing, further specific objects of the invention reside in the following:

An object is to provide mechanism whereby the speed of drive in direct drive and reverse drive is the same.

Another object is to provide mechanism to eliminate chattering or knocking both with respect to direct drive and reverse drive clutching and declutching.

Another object is to provide for adjustment of the magnitude or degree of axial float.

Another object is to provide mechanism whereby after tapping, at the limit of travel, the clutch will automatically disengage to allow shifting into reverse gear.

A further object is the realization of a very simple tool of this type, even though it has the improved characteristics set forth with a very few parts subject to wear.

Another object of the invention is the realization of a simplified mechanism in that the upper part of the housing itself becomes the planetary member that is held against rotation by way of a radial arm and this is a very distinctive advantage when the mechanism is controlled by a computer.

Another object of the invention is to realize a mechanism having multiples of identical parts which are easy to fabricate and which can be fabricated by way of powdered metal processes.

A further object of the invention is to realize an attachment of this type in which it is not necessary to provide a spring clutch for reasons which will be made more clear hereinafter.

A further object is to realize a tool of this type wherein the danger of damage or breakage of the tool when operated under numerical or computer control is eliminated or greatly minimized.

Further objects and additional advantages of the invention will become apparent from the following detailed description and annexed drawings wherein:

FIG. 1 is a view of a preferred form of the tapping attachment mounted on a machine;

FIG. 2 is a cross-sectional view of the tapping attachment of FIG. 1;

FIG. 3 is a sectional view taken along the line 3—3 of FIG. 2;

FIG. 4 is a sectional view taken along the line 4—4 of FIG. 2;

FIG. 5 is a detail exploded view of the spring biased clutch driver members;

FIG. 6 is an exploded view of the major components of the attachment.

Referring now more in detail to the various figures of the drawing numeral 10 designates a machine tool with which the attachment may be used. It has an arbor 11 and the tapping attachment of the invention is designated generally at 12. Numeral 13 designates a radial holding arm which engages a stop rod or column 14 which will hold the body of the attachment against rotation as will be described more in detail hereinafter. Numeral 16 designates the chuck on the tapping spindle 18 and the tap itself is designated at 20.

The tool arbor 11 is threaded as shown in FIG. 2 and it engages a bore 24 in the body 26. Numeral 30 designates a cylindrical housing having a top cover or cap 32 held on by screws 34 and 36 and from which extends the radial arm 13. The housing 30 has a bore 40 and a counter bore 42. The body 26 has a portion 46 of smaller diameter and positioned within the bore 42 between housing 30 and body 26 and engaging square shoulder 50 between the parts of body 26 of different diameter, is a ball-bearing designated generally at 52 and which comprises the usual ball races and interposed balls. The parts of the attachment are shown assembled in FIG. 2 and in the cross sectional views, and the parts are shown individually in the exploded view, FIG. 6.

The body 26 has counter bore 60 (see FIG. 6) and an extending skirt 62. It has axial ways as shown at 63 which engage with and drive the direct drive clutch driver member as will be described. The relationship of the parts may be observed by considering the exploded view FIG. 6 with the assembled view.

Numeral 68 designates a cylindrical cage member within the housing 30 which supports the planetary gears of the gear drive. This cage has a concentric cylindrical part 70 of lesser axial length which provides bearing surfaces as will be described the shafts or ar-

bors of the planetary drive gears. The member **70** is integral with the outer cylindrical part **74** of the cage **78** being contected thereto by the radial web **72**. The outer cylindrical part **74** of the cage has in it on the inside surfaces, equally spaced from each other three axial rectangular ways as designated at **76**, **78** and **80** which provide for spaces to receive the three planetary drive gears as will be described.

The three planetary drive gears are shown best in FIG. **4** as designated at **82**, **84** and **85** positioned as shown between the inner and outer parts **70** and **74** of the cage **68**. These gears have shafts or arbors as designated at **90**, **92** and **94**. The outer ends of these shafts are received in bores formed in the part **74** of the cage **76** as designated at **100**, **102** and **104**. The inner ends of these shafts or arbors are received in radial bores formed in the inner cylindrical member or part **70** of the cage **68** as designated at **108**, **110** and **112**. The cage **68** has an axial groove **120** whereby it can be keyed by way of a key to a corresponding axial groove **122** on the inside of the housing **30** to hold the cage against rotation.

The planetary gears are bevel gears and cooperating with them are two bevel drive gears including the direct drive bevel gear **126** and the reverse drive bevel gear **128**. The opening in these bevel gears are of a configuration to key them to the clutch driver members. Numeral **132** designates the clutch driver member for direct drive and numeral **134** designates the clutch driver member for reverse drive. It will be observed that the clutch driver members are alike but are in inverted positions with respect to each other in the assembly. In the fabrication and production of parts as will be observed, these two parts are identical, except that part **134** does not have web **136** shown in FIG. **6**, as it must slide over spindle **18**, as will be referred to again presently.

The clutch driver member **132** is like the clutch driver member **85** of U.S. Pat. No. 3,397,588. It is cylindrical having an intermediate transverse web **136** as may be seen in FIG. **2**. It has three angularly spaced lugs **138**, **140** and **142**. It has an extending skirt **144** and formed in the skirt are three equally angularly spaced pin receiving openings or cutouts, one of which may be seen at **150**. (See FIG. **6**) Adjacent to one side of this cutout is an axial tapered surface **152** and on the opposite side of the cutout is a tapered surface leading to the next opening or cutout as designated at **154**. Inasmuch as the clutch driver member for reverse drive is identical with the clutch driver member **132** it need not be described in detail. Clutch drive member **132** engages with and is driven by body **26** as may be observed from FIG. **6**.

The opening in direct drive gear **126** is in the form of a bore **158** and there are equally spaced cutouts of larger radius or diameter designated at **160**, **162** and **164** configurated to accommodate or receive the lugs **138**, **140** and **142** on the clutch driver member **132**. Inasmuch as the bevel gear **128** for reverse drive is identical to the gear **126** it need not be described in detail. It should be observed that in the fabrication and production of the attachment these two gears being alike, reduces the total number of different parts.

FIG. **2** shows the assembled relationship of the planetary gears, the direct drive gear **126** and the direct drive clutch driver member **132**.

Positioned at the end of the bore **24** in the body **26** is a disc **170** and in between this disc and the end of the arbor **11** is a snap ring **172**. The disc **170** has two spaced openings **174** and **176** and hooked through these openings is a hook **180** on the end of a suspension spring **182** which has hook **184** at its opposite end which hooks into the end of support member **186** that extends through a ball bearing **190** in a counter bore **192** in the cylindrical end part **194** of the spindle **18**, the spindle **18** having axial bore **196** through which spring **182** extends.

At the upper end of the spindle **18** are three angularly spaced radial bores in which are received radial drive pins, two of which are shown at **200** and **202** in FIG. **5**. These pins are adapted to cooperate with the cutouts previously described in the direct drive clutch driver member **132** and the reverse clutch driver member **134**. It is to be observed that there is a coil spring **206** positioned in the bore **60** of the body **26** between the disc **170** and the direct clutch driver member **132** whereby this member is allowed to move against this bias in the manner described in detail in the prior U.S. Pat. No. 3,397,588. Within the upper end of the drive spindle **18** there is provided bushing **210** against which the inner ends of the drive pins like **200** abut.

Referring to FIG. **6** numeral **220** designates the lower support body. In the assembled attachment the reverse clutch driver member **134** engages in the opening of the reverse drive bevel gear **128** in the same manner that the direct drive clutch driver member **132** engages in the direct clutch drive gear **126**. The body **220** has another cylindrical part **222**; a bore **224** and extending flange **226** which in the assembled position shown in FIG. **2** is over ball bearing **230** which is interposed between the body **220** and the housing **30**. The ball bearing **230** is positioned by a snap ring **232** received in annular groove **234** in the housing **30**. (See FIG. **2**) The body **220** has cylindrical part **238** of smaller diameter and extending threaded cylindrical part **240** as shown. The upper cylindrical part **222** of the body **220** has three equally spaced axial grooves **244**, **246** and **248** adapted to receive the radial lugs on the reverse drive clutch member **134**. The body **220** has a bore **250** (see FIG. **2**) and received in this bore is a cylindrical member or bushing **252** having a bore **254** and an upper counter bore **256**. Retained in the counter bore **256** is coil spring **260** which corresponds to the spring **206**, this being a biasing spring which biases the reverse drive clutch driver member **134** permitting it to move axially in the same way and for the same purpose as the upper clutch driver member **132** moves.

Numeral **262** designates an adjustment collar which has internally threaded bore **264**, the collar being threaded on to the threaded part **240** of the body **220**. This collar is in the form of a cap having an end part which has a bore **266** through which the spindle **18** extends. In operation the spindle **18** can float as described in the previous patents, being suspended by the spring **182**. The amount of this float is adjustable by adjusting the position of collar **262** on the body **220**, that is by way of adjusting the position of the end of the collar relative to the chuck **194** on the end of the spindle, so that the axial float may be adjusted from any maximum amount to a minimum of 1/16inch for example, depending on the size of the drive pins. Collar **262** can en-

gage thrust bearing **263** limiting the degree of freedom of float while in direct drive.

In the light of the foregoing description and the disclosures contained in the prior patents those skilled in the art will readily understand the operation of the attachment and will fully understand and appreciate the manner in which the objective set forth in the foregoing are realized and how the attachment adapts itself to numerical or computer control. It adapts itself to all of the movements and/or manipulations that could be made with the human arm.

The tap holding spindle has the characteristic of free axial float which is limited as described in the foregoing, the axial float being like that described in the previous patents. The tap follows its own lead. No lead pressure is applied. The machine moves the machine spindle behind the lead of the tap until the desired depth is reached. The direct drive bevel gear **126** is driven from the body **26** by reason of its engagement therewith as described in the foregoing. Body **26** drives the direct drive clutch driver member **132** by reason of its engagement therewith as described. In operation, it will be understood that the attachment as it starts tapping, moves forwardly relative to the housing **30**. The adjustment collar **262** can be adjusted to a spacing as between it and the chuck **194** so that when the tool reaches the limit of its travel, that is, as determined by the setting of collar **262**, the drive pins such as the pins **220** will feed out of the clutch driver member **132** and this may represent movement of only one-eighth inch, for example, at which time the drive pins are then in a neutral position between the direct drive clutch drive member **132** and the reverse drive clutch driver member **134**. The direct drive clutch driver member disengages without knocking or chattering as described in U.S. Pat. No. 3,397,588 and the reverse drive clutch driver member engages with the pins similarly without chattering or knocking because it too is cushioned by a biasing spring this being the spring **260**. The neutral position of the spindle in between direct and reverse drive is very sensitive, the neutral position being very narrow. The neutral position or zone can be as narrow as half the diameter of the radial driving pins. This very significantly adapts the attachment and accommodates it to numerical or computer control in that the amount of relative axial movement of the spindle to change between direct and reverse is reduced to a minimum. It feeds in and out at the same rate and drives at the same speed in direct and reverse drive. The collar **262** can serve the same purpose as a spring clutch which is not required in this attachment. A spring clutch is not desirable in a computer or numerical control application because this might result in holes being tapped at **3** or **4** threads and others at **5** or **6** for example, depending at what torque load the clutch started slipping. Also in an attachment with a spring clutch used in a computer or numerical control application if the tool should stall and stop rotating, and the tool is still being driven forward, the computer not knowing that the tool is not rotating or that the clutch is slipping, since the tool is still being driven forward something has to break unless other protection is built into the assembly. With the herein attachment the computer is programmed to cause the tool to tap into the hole, the specified amount. The adjustable collar **262** is adjusted with respect to the chuck on spindle so that when the tap has reached the specified depth movement of the spindle of the machine is stopped without stopping the rotation. The tap is still turning in the work and it pulls the spindle down, the small amount necessary to bring the drive pins into neutral position after which the engagement can then be made in the manner described for reverse operation.

The foregoing disclosure is representative of a preferred form of the invention and is to be interpreted in an illustrative rather than a limiting sense, the invention to be accorded the full scope of the claims appended hereto.

I claim:

1. In a tapping attachment having a body member adapted to be rotated about an axis thereof, a tapping spindle mounted for rotation about said axis and for free axial movement along said axis relative to said body member, and positive drive clutch means for drivingly connecting said body member to said tapping spindle, the improvement comprising;

said clutch means being defined by relatively axially movable elements on said body member and tapping spindle, respectively, said elements being in mutually driving engagement throughout a range of relative axial movement and being relatively axially movable in one direction to disengage said clutch means;

biasing means normally biasing said elements to move into clutch engaging relation; and

adjustable limiting means on said attachment for predetermining the extent of axial movement of said elements in a clutch engaging direction for presetting the magnitude of relative axial movement from full clutch engagement to disengagement thereof.

2. An attachment as in claim **1** wherein the said adjustable means comprises a member threadedly adjustable relative to the body member and positionable to be engaged by the tapping spindle to limit the extent of axial movement thereof.

3. An attachment as in claim **1** wherein said clutch element on said body is movable thereon and adapted to engage the element on said spindle for direct drive, and a biasing spring acting against the direct drive clutch member on said body to allow clutching and declutching without chattering.

4. A tapping attachment as in claim **3** including reverse driving means whereby the tapping spindle is driven at the same speed in direct drive as in reverse drive.

5. A tapping attachment as in claim **4** wherein the drive to the spindle comprises a planetary gear transmission including planetary gears and a direct drive gear and a reverse drive gear of the same size.

* * * * *