

[54] TAPPING HEAD FOR PUNCH PRESS

[75] Inventor: Dennis Daniels, Bellevue, Wash.

[73] Assignee: U.S. Amada, Ltd., Seattle, Wash.

[22] Filed: Sept. 13, 1971

[21] Appl. No.: 179,952

[52] U.S. Cl. 408/130, 408/3, 408/35, 408/126, 408/125, 408/137, 10/139 R

[51] Int. Cl. B23b 47/04, B23b 47/18

[58] Field of Search ... 408/125, 126, 130, 135, 137, 408/129, 124, 3, 35; 10/129 R, 139 R, 105; 29/36

[56] References Cited

UNITED STATES PATENTS

3,162,873	12/1964	Ohme.....	10/139 R X
2,799,872	7/1957	Krahnke	10/105 X

2,724,134	11/1955	Perlotto	10/129 R
1,147,234	7/1915	Gladwin.....	408/137

Primary Examiner—Gil Weidenfeld

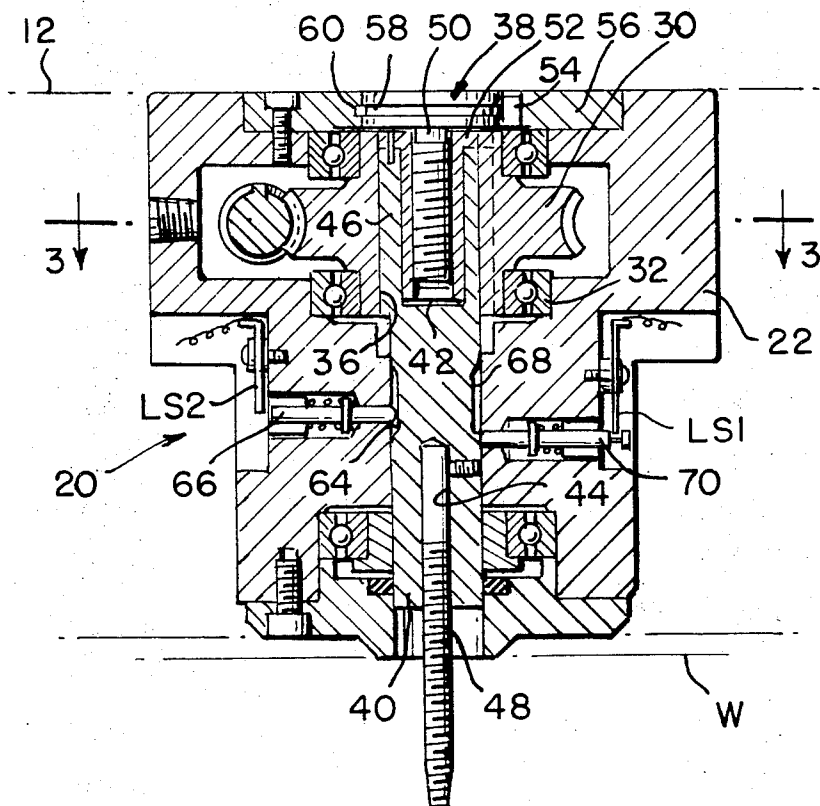
Attorney, Agent, or Firm—Richard W. Seed et al.

[57]

ABSTRACT

A unitized tapping head is incorporated into the turret of a multiple-tool punch press. The tapping head includes a unique replaceable cartridge which houses a tap and a feed lead screw. A self-contained drive unit rotates the cartridge to advance the tap at the same lead as the threads on the feed lead screw. The cartridge is held only by a simple spring clip and thus is easily replaced with the same or a different combination tap and corresponding feed lead screw.

14 Claims, 8 Drawing Figures



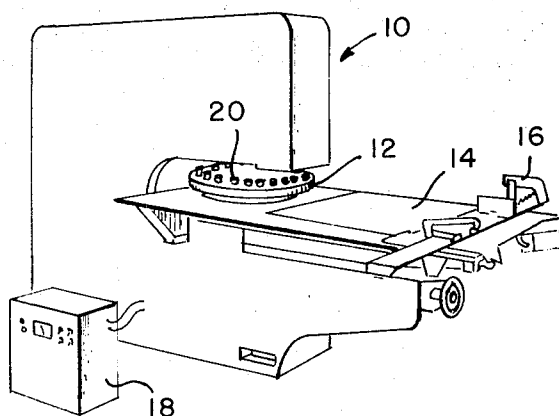


FIG. 1

FIG. 2

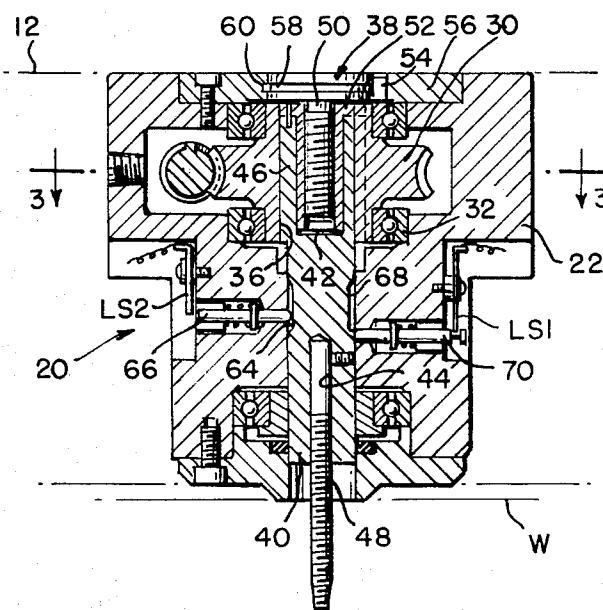
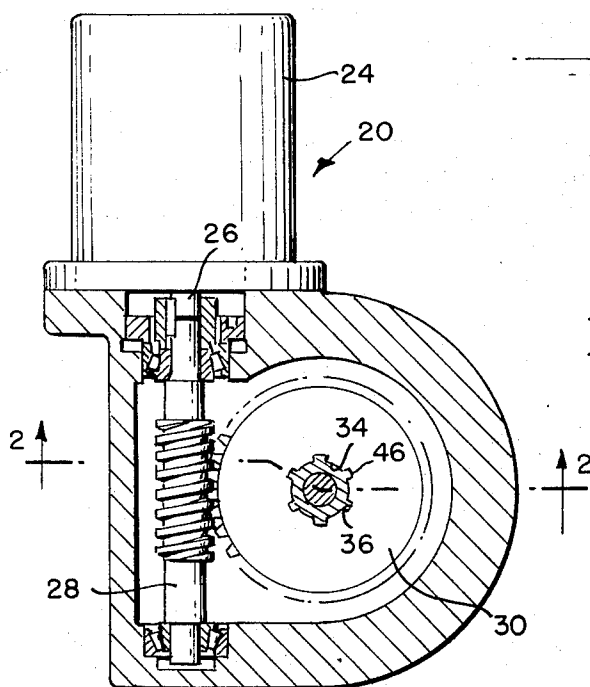


FIG. 3



DENNIS DANIELS
INVENTOR.

BY
Seal Berry, Downey, Rose
ATTORNEYS

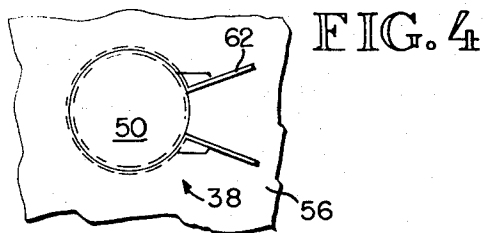
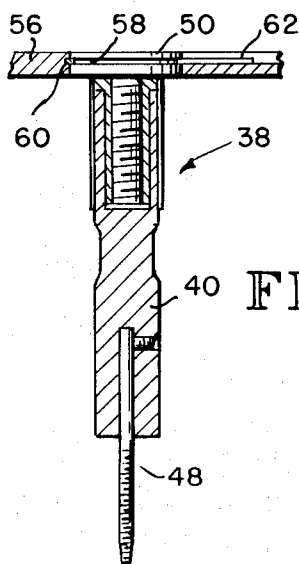


FIG. 5

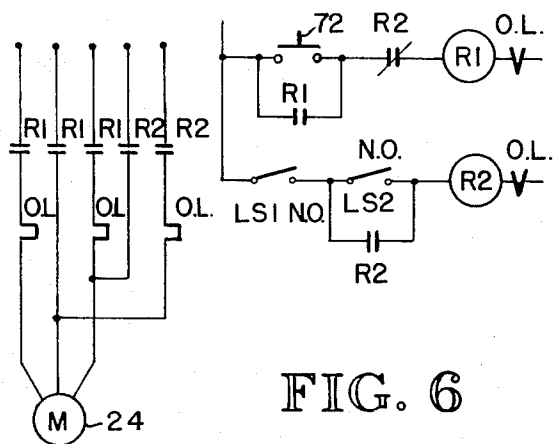


FIG. 6

FIG. 7

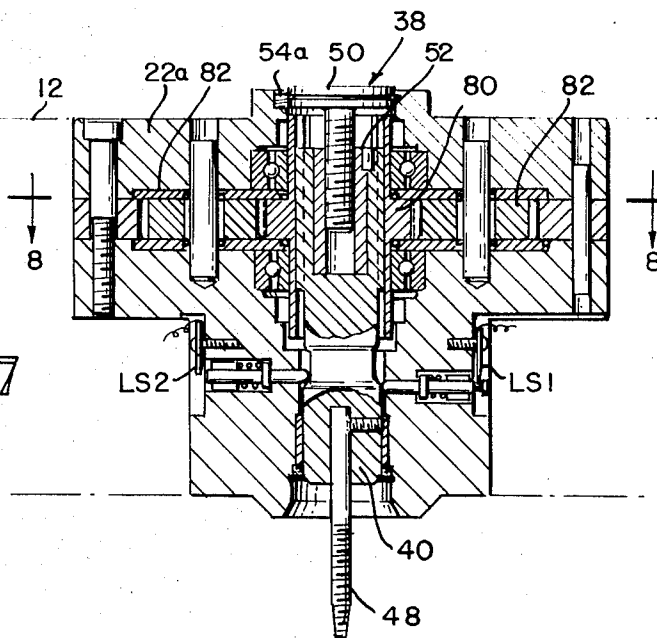
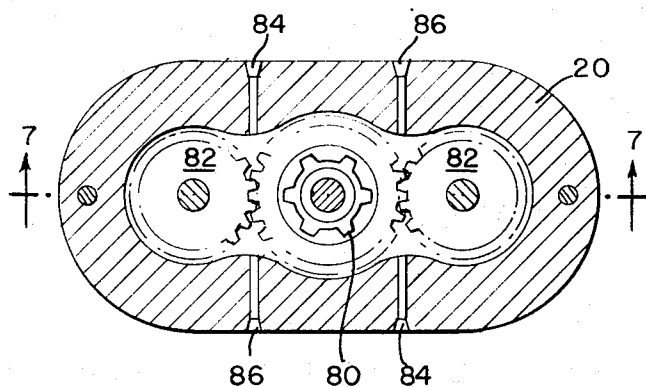


FIG. 8

DENNIS DANIELS
INVENTOR

BY *Seid, Berry, Dora, Cross*
ATTORNEYS

TAPPING HEAD FOR PUNCH PRESS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention pertains to punch presses and more particularly to a unitized tapping head for use in punch presses and a unique replaceable cartridge for housing a tap and a corresponding lead feed screw.

2. Description of the Prior Art

It is a customary practice in the fabrication of metal forms to punch holes in the material and subsequently thread various of these holes by tapping them. Heretofore, the punching operation has been automated to a considerable extent with the position of the workpiece being automatically positioned by a numerical control (N.C.) device. The tapping operation, however, has not been adequately automated and thus has been difficult and time consuming. In the past holes have been tapped by manually positioning the workpiece beneath a separate tapping rig or drill press. Another technique has been to attach a tapping rig or rigs to the frame of the punch press laterally of the punch and using the same numerical control device for positioning the workpiece relative to the punching tool, the workpiece would also be positioned relative to the tapping rigs. This latter technique presented several problems. First, the worktable for supporting the workpiece had to be extended to provide for positioning the workpiece laterally of the punch. Secondly, a separate independent numerical control program had to be utilized with the N.C. device in order to effect positioning of the workpiece relative to the tapping rig rather than the punch. Thirdly, the cost of a separate independent tapping rig had to be added to the basic cost of the punching machine.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a unitized tapping head for use in a punch press.

It is another object to provide a unitized tapping head for use in a multiple-tool turret type punch press.

It is another object of this invention to provide a replaceable cartridge having a self-feeding tap synchronized with a proper feed lead screw.

It is another object of this invention to provide a unitized tapping head in combination with a numerically controlled punch press in which the tap is automatically lowered and raised as a part of the automatic sequencing of the punch press.

It is another object of this invention to provide a compact drive for use in a unitized tapping head.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic perspective illustrating a typical numerically controlled punch press embodying a unitized tapping head.

FIG. 2 is a vertical section of the preferred tapping head embodiment.

FIG. 3 is a section taken along the line 3—3 of FIG. 2.

FIG. 4 is a plan illustrating a portion of the unique cartridge used in the tapping head.

FIG. 5 is a fragmentary section of the tapping head illustrating the preferred cartridge of the invention.

FIG. 6 is a typical circuit diagram for automatically advancing and retracting the tap.

FIG. 7 is a section of a modified form of tapping head utilizing a hydraulic drive.

FIG. 8 is a section taken along the line 8—8 of FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As best shown in FIG. 1 a numerically controlled punch press 10 is shown illustrated with a multiple-tool rotary turret 12 and a work supporting table 14. The work supporting table is provided with conventional workpiece positioning means 16 which are controlled by a numerical control (N.C.) device 18. As is well known, the N.C. device operates to position the workpiece and the rotary turret according to a prearranged program so that a desired operation takes place on the workpiece and then repositions either the rotary turret or the workpiece or both to perform the next desired operation. Secured in the rotary turret, in the same manner as any of the other tools, is a unitized tapping head 20 embodying the principles of the invention. Although the tapping head is uniquely applicable for a multiple-tool turret type punch press, it is also advantageously employed in a conventional single stationary tool holder type punch press in which the tools are interchangeably employed.

As best shown in FIGS. 2 and 3 the unitized tapping head 20 includes a base 22 which is locked into the turret 12 by any suitable means. The base houses a self-contained conventional pneumatic or electrical motor 24 which may be operated in the forward or reverse directions and has a self-energizing brake which stops the output shaft of the motor prior to initiating motion in the opposite direction. For the purpose of this description an electrical motor will be described; however the principles are equally applicable to a pneumatic motor. The motor 24 is secured to the base by suitable means and is provided with an output shaft 26 that is coupled to worm gear 28. The worm gear 28 meshes with a pinion 30 which may be rotated by the worm gear either in the clockwise or counterclockwise direction. The pinion gear is mounted for rotation in the base in suitable bearings 32 and is provided with an internal axial bore 34. The bore 34 is provided with axial grooves 36 for a purpose to be described.

The tapping head 20 is provided with a unique replaceable tapping cartridge 38. The tapping cartridge includes a core member 40 having an upper axial bore 42, a lower axial bore 44, and a plurality of splines 46 which slidably engage within the grooves 36 of the pinion gear 30. Removably secured in the bore 44 is a conventional tap 48 having a cutting thread of a prescribed lead. As is well known in the art, the tap must be simultaneously rotated and advanced axially into the bore at a prescribed rate so that the proper lead is provided in the thread being cut in the bore.

The desired thread lead is obtained by a feed lead screw 50 having threads at the same lead as the cutting edges of the tap 48. The lead screw is threaded into a bushing 52 that is rigidly secured to the core member 40. The lead screw is fixed against rotation in the base by a cap screw 54 that is seated partially in a notch in the head of the lead screw and partially in a complementary notch in a latch plate 56 that is secured to the base 22. As is readily apparent, rotation of the core member 40 through rotation of the pinion 30 will cause the bushing and thus the core member to thread itself

downwardly on the fixed lead screw 50, thus advancing the tap 48 at the desired lead into the workpiece. W.

It is a particularly advantageous feature of this tapping head that the cartridge 38 is easily removable from the tapping head to be exchanged with either an identical cartridge or one having a feed screw and tap of a different lead configuration. For this purpose the head of the lead screw 50 is provided with a circumferential groove 58 that is aligned with a groove 60 in the latch plate 56 when the cartridge is inserted in the tapping head. A conventional spring clip 62 is shown in FIG. 4 as being expanded to fit partially within the groove 58 and partially within the groove 60 so that the cartridge is held locked within the latch plate 56. The groove 58 is of a smaller internal diameter than the bore in the latch plate so that by pressing the ends of the spring clip together the circular portion of the clip is retracted entirely within the groove 58 and the cartridge can then be removed from the tapping head. Installation of a new cartridge is accomplished in the reverse manner by compressing the spring clip 62 inserting the cartridge and then allowing the spring clip to expand to again engage the groove 60. It is, of course, quite apparent that this substitution can be accomplished quickly and without any special tools.

It is another unique feature of this tapping head that it automatically senses its position relative to the depth of the tap into the bore of the workpiece so that reversal of the drive motor and retraction of the feed screw may take place automatically and thus become a part of the program of the numerical control device. For this purpose the core member is provided with a cam slot 64 in which a spring biased switch arm 66 is engaged. Movement of the core member axially causes the switch arm 66 to ride out of the cam slot and engage a switch contact LS2. Similarly a cam slot 68 is engaged by a switch arm 70 which engages a contact LS1 when the switch arm 70 is within the cam slot 68. Contacts LS1 and LS2 are incorporated into the circuit shown in FIG. 6. As is best shown in FIGS. 2 and 6 when the tap is retracted, the contact LS2 is opened with switch arm 66 seated in cam slot 64. At the same time contact LS1 is also opened with the switch arm 70 riding out of the cam slot 68. Closing of switch 72 either manually or from a signal from the N.C. device 18 as part of a predetermined program energizes relay R1 through normally closed contact R2. Relay contacts R1 are closed to lock-in the circuit through relay R1. Closing contacts R1 in the motor circuit will initiate forward operation of the motor so that the pinion 30 is rotated in the direction necessary to advance the tap 48. At the moment the core member 40 is advanced the switch arm 70 enters the cam slot 68 thus closing contact LS1. Since LS2 remains open, however, no change occurs in the circuit. When the core member has advanced to the desired distance such that the tap has threaded the hole in the workpiece, the switch arm 66 will ride out of the cam slot 64 closing contact LS2 thus completing the circuit to relay R2. Contacts R2 are closed to lock-in the relay R2 and to open the contacts to the relay R1 while simultaneously closing the contacts R2 to the reverse motor circuit. As is understood in motors of this type, the motor will first brake itself to a stop and will then begin operation in the reverse direction threading the core member 40 upwardly out of the workpiece. When the core member reaches its uppermost position as shown in FIG. 2,

contact LS1 will again be opened thus opening the circuit to relay R2. All of the contacts in the motor circuit will then be opened and the motor will brake itself to a stop ready for the next signal to begin operation. If part of a prearranged program, opening LS1 will signal to the N.C. device to sequence to the next operation in the program.

The modification shown in FIGS. 7 and 8 employs a cartridge 38 basically identical to that shown in the preferred embodiments. Base 22a is modified slightly so that the cartridge 38 is directly coupled to the base member by a set screw 54a which seats in complementary notches in the head of the lead feed screw 50 and the base member 22a. In the modification a pinion 80, also connected to the body member by a spline and groove connection as in the preferred embodiment, is drivingly engaged by a pair of hydraulically driven gears 82. Obviously a single gear could suffice, but the double gear arrangement advantageously increases the torque to the pinion. The gears 82 are journaled in the base member 20 and are simultaneously driven by fluid entering ports 84 for rotation of the pinion in one direction or fluid entering ports 86 and exiting ports 84 for rotation in the opposite direction. Operation of the modification is basically the same as that of the preferred embodiment. The numerical control device will send a signal to the fluid source to direct fluid into either the ports 84 or 86 and upon receipt of the various signals from switches LS1 and LS2 the motor will be brought to a stop and then reversed.

While preferred forms of the invention have been illustrated and described, it should be understood that variations and further modifications will be apparent to one skilled in the art without departing from the principles of the invention. Accordingly, the invention is to be limited only by a literal interpretation of the claims appended hereto.

I claim

1. In a machine having a tapping head and means for supporting a workpiece opposite said tapping head; said tapping head comprising means for removably holding a tap for rotational and axial movement; and drive means for simultaneously rotating and advancing said tap into a workpiece positioned on said workpiece supporting means; said tapping head including a hollow base secured to said tool holding means; said means for removably holding the tap for rotational and axial movement including a cartridge releasably retained in said base and removable as a unit in a direction away from said workpiece supporting means; said cartridge including a core member having an outer end, said tap being secured in said outer end of said core member, a feed lead screw having a longitudinal axis concentric with the longitudinal axis of said tap, said tap and said lead screw having threads of substantially identical lead; and said drive means including force transmitting means secured in said base for advancing the core member relative to the lead screw and allowing said cartridge to be slid axially out of said base as a unit away from said workpiece for replacement of said feed lead screw and said tap.

2. The apparatus of claim 1 said tool holding means including a multiple tool turret having an upper plate provided with circumferentially spaced tool holding opening, said tapping head secured within one of said openings, and means for positioning the turret to place a desired opening over a desired location on a work-

piece in the same manner as any other tool on the turret.

3. The apparatus of claim 2, said drive means including means for automatically stopping the movement of the core member when the tap is full-out and full-in.

4. The apparatus of claim 1, said drive means including a motor having a worm gear, a pinion gear driven from said worm gear, and means for operatively connecting said pinion gear to said tap for rotating the tap while allowing relative axial movement.

5. A tapping head for a machine having a workpiece supporting means, comprising means for removably holding a tap for rotational and axial movement, and drive means for simultaneously rotating and advancing said tap for moving said tap into a workpiece positioned on said workpiece supporting means, said drive means including a motor having a worm gear, a pinion gear driven from said worm gear, and means for operatively connecting said pinion gear to said tap for rotating the tap while allowing relative axial movement, said means for operatively connecting said pinion gear with said tap including a core member having a spline and groove connection for allowing axial movement of the core while being rotated by said pinion gear, a feed lead screw secured against rotation in said tapping head, a bushing secured to said core member and threadably engaging said lead screw whereby rotation of the pinion screws the bushing and thus the core member axially, said tap being secured within said core member and extending downwardly therefrom for cutting a thread in said workpiece when the tap is rotated and advanced.

6. A tapping head for a machine having a workpiece supporting means, comprising a means for removably holding a tap for rotational and axial movement, and drive means for simultaneously rotating and advancing said tap for moving said tap into a workpiece positioned on said workpiece supporting means, said drive means including an hydraulic motor having a fluid inlet and outlet and at least one pair of fluid driven gears between said inlet and outlet, one of said gears operatively interconnected with the tap for rotating the tap and moving the tap axially.

7. The apparatus of claim 6, said means for operatively connecting said gear with said tap including a core member having a spline and groove interconnection with said gear for allowing axial movement of said core member as it is rotated, a feed lead screw secured against rotation in said tapping head, a bushing secured to said core member and threadably engaging said feed lead screw whereby rotation of the gear screws the core member axially, said tap being secured within said core member and extending downwardly therefrom for cutting a thread in said workpiece at the same lead as the feed lead screw when the tap is rotated and advanced.

8. The apparatus of claim 3, said punching machine having a numerical control device for positioning the turret and workpiece and actuating the tapping head according to a prearranged program, said control device automatically actuating the drive means for tapping the workpiece so that the workpiece is tapped with the same program and at the same position beneath the

turret as any other tool on the turret.

9. A tapping head for use in a machine suitable for tapping holes in a workpiece supported on a workpiece supporting means comprising a hollow base, a cartridge means for removably mounting said cartridge in said base, drive means for rotating said cartridge, said cartridge including a tap, a feed lead screw, means interconnecting said tap and feed lead screw wherein rotation of said cartridge simultaneously rotates and axially moves said tap at the same rate as the lead of said feed lead screw whereby a change of tap size is effected by replacing the entire cartridge with a cartridge having the new tap size and a new feed lead screw corresponding to the new tap size so that the tap and the lead rate are always properly correlated, said cartridge being removable from said base and said drive means within said base in a direction away from said workpiece supporting means for ease of replacement of said tap and feed lead screw.

10. The tapping head of claim 9, said cartridge further including a core member having a spline and groove connection with said drive means, the tap secured in one end of said core member, an axial bore in the other end of said core member, a bushing in said axial bore and secured to said core member, said feed lead screw threadably engaging said bushing, means for securing said feed lead screw against rotation in said base whereby rotation of said core member axially advances the bushing and thus the core member along said feed lead screw at the desired lead.

11. The tapping head of claim 7, said means for removably mounting said cartridge in said base including a latch plate secured to the base and having a central bore, a groove around the periphery of said bore, said feed lead screw having a head provided with a circumferential groove, and a spring clip compressible entirely within said groove in said head for permitting withdrawal of said cartridge from said base and expandable to partially seat in said groove in said head and said groove in central bore of said latch plate for releasably locking said cartridge in said base.

12. The apparatus of claim 1, said drive means including means for automatically stopping movement of the core member when the tap is full-out and full-in.

13. The tapping head of claim 9, said means for removably mounting said cartridge in said base including a latch plate secured to the base and having a central bore, and means releasably securing said cartridge to said latch plate, said cartridge being removable from said base through said central bore of said latch plate.

14. The tapping head of claim 13, a groove around the periphery of said central bore of said latch plate, said feed lead screw having a head provided with a circumferential groove, and a spring clip compressible entirely within said groove in said head for permitting withdrawal of said cartridge from said base and expandable to partially seat in said groove in said head and said groove in said central bore of said latch plate for releasably locking said cartridge in said base.

* * * * *