Oct. 19, 1948. F. J. KRATCHMAN 2,451,497

THREAD MILLER

Filed Sept. 22, 1944

2 Sheets-Sheet 1

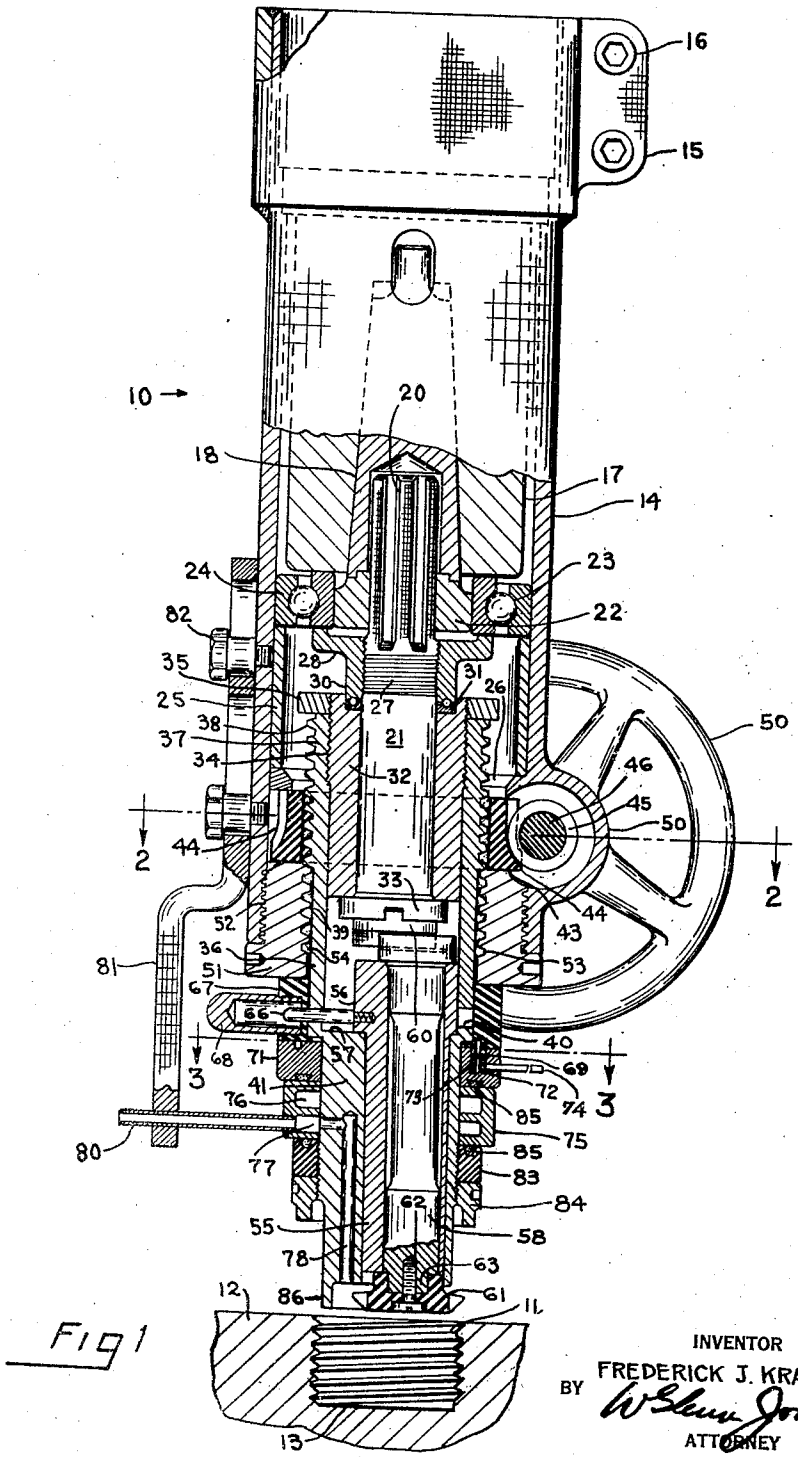



Fig 1

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2 Sheets-Sheet 2

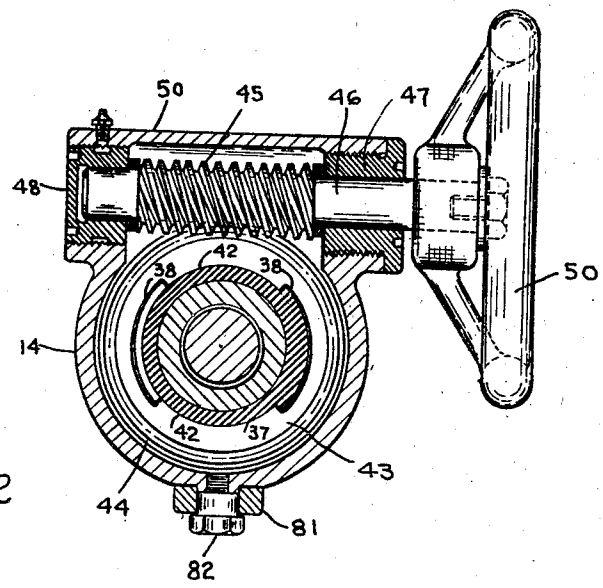



Fig 2

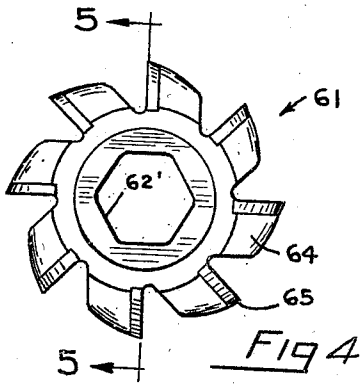



Fig 4

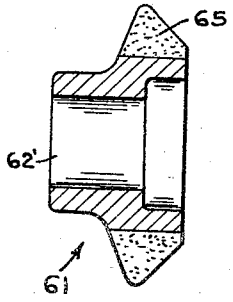



Fig 5

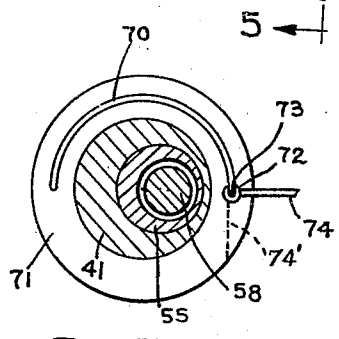



Fig 3

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# UNITED STATES PATENT OFFICE

2,451,497

## THREAD MILLER

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Application September 22, 1944, Serial No. 555,384

8 Claims. (Cl. 90—11.58)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

1

This invention relates to a thread miller and has for an object to provide an improved thread miller intended particularly for milling internal buttress threads for armor bolts.

A further object of this invention is to provide a thread miller particularly useful in quickly providing internal threads in armor plate as compared to the previous practice of making such threads by using a succession of taps. With the previous method it was necessary to undercut the bottom of hole to provide for chip and tap clearance and to use about six successively sized taps in making internal buttress threads in armor plate for a bolt. Such previous method would take about an hour per thread. With the present device the need for the taps and undercutting is eliminated and the thread is provided in a considerably shorter period of time.

A further object of this invention is to provide a thread miller which utilizes a carbide tipped cutter which results in higher production and, in addition, it conserves strategic high tungsten bearing tool steels.

A further object of this invention is to provide a thread miller to produce any combination of thread form, pitch, diameter, and depth desired in internally threaded holes which may be used either with a radial drill press of the type found in many machine shops and may likewise be used with a portable drill head permitting the work to be performed in any convenient place, even when the armor plate may already be in position on a ship or other vehicle.

With the foregoing and other objects in view, the invention consists in the construction, combination and arrangement of parts hereinafter described and illustrated in the drawings in which:

Fig. 1 is a partly sectional and partly elevational view of the thread miller.

Fig. 2 is a sectional view on line 2—2 of Fig. 1.

Fig. 3 is a sectional view on line 3—3 of Fig. 1.

Fig. 4 is an elevational view of the carbide tipped cutter, and

Fig. 5 is a sectional view on line 5—5 of Fig. 4.

There is shown at 10 the thread miller of this invention in the position in which it has just completed milling a thread 11 in a piece of armor plate 12, the thread 11 having been milled in the sides of a previously drilled cylindrical hole, the milling having commenced at the bottom 13 of the drilled hole and having finished at the surface of the plate 12 providing ample space for chip accumulation. The thread miller 10 includes outer housing 14 provided at its upper end with a split ring 15 for securing the same by means of the socket head screws 16 to a drill press.

Cooperating with the drill press spindle 17 is a taper sleeve adapter 18 which is internally splined to cooperate with the external splines 20 of a splined drive shaft 21. The splines 20 of this drive shaft 21 are journalled in the bushing 22 within a bearing 23 whose outer race 24 is supported on the upper edge of a supporting sleeve 25, which supporting sleeve 25 rests in turn on an internal shoulder 26. Threaded on the drive shaft 21 as at 27 is the upper race 28 of a thrust bearing 30 having a lower race 31 supported in a recessed neck formed in the top of a drive shaft sleeve bearing 32 and securing this sleeve bearing against a flange 33 on the lower end of drive shaft 21. Secured on the sleeve bearing 32 by thread 34 and circular nut 35 is an inner housing 36 whose upper portion 37 is provided with an acme interrupted thread 38 which terminates in a cylindrical portion 39.

This cylindrical portion 39 is provided with a radial slot 40 extending 180° thereabout, below which it is joined to an internally eccentric lower portion 41. The interrupted thread 38 of the upper portion 37 of housing 36 is made in two 90° sectors separated by 90° cylindrical portions 42, as will be apparent from Fig. 2. Cooperating with the interrupted thread 38 and interrupted portions 42 is a worm wheel 43 having corresponding internal cylindrical portions and an external thread 44 meshed with a spiral thread 45 on a worm shaft 46.

The worm shaft 46 is journalled in suitable bearings 47 and 48 in a boss 50 formed on the side of the outer housing 14. The worm shaft 46 is rotatable by means of a handwheel 50 for manual operation, although obviously the handwheel 50 could have a power connection substituted therefor. The worm wheel 44 is held in position on top of a lead screw guide nut 51 which is threadably secured as at 52 by an interrupted external thread, engaged in like manner with a co-operating internal interrupted thread in the lower end of outer housing 14, permitting rapid removal of entire inner housing 36. By disengagement of taper sleeve adapter 18 from drill press spindle 17, it is possible to insert appropriate hole producing tools in preparation to thread milling without the necessity of removing the outer housing. This lead screw guide nut 51 is provided with an internal acme thread 53 extending continuously around its inner wall from the top edge to a point 54 somewhat above its bottom edge. When the handwheel 50 is rotated, the worm shaft 46 causes the worm wheel 43 to rotate, thereby causing the inner housing 36 to rotate. As the inner housing 36 rotates its interrupted thread 38 meshes with the internal thread 53 of the guide nut 51 thus causing the inner housing 36 to rotate in a spiral path determined by these cooperating threads.

Extending through the eccentric inner portion 41 of the inner housing 36 is an adjustable eccentric bushing 55. The bushing 55 is provided with

an upper flange 56 resting on a shoulder 57 formed between the concentric upper portion 37 and eccentric lower portion 41 of the inner housing 36. Extending through the bushing 55 is a cutter shaft 58 connected to the drive shaft 21 by means of a coupling shuttle 60 which permits power to be transmitted from the drive shaft 21 to the cutter shaft 58 while the eccentricity of cutter shaft 58 is being varied as well as while it is being maintained. On the lower end of the drive shaft 58 is secured a cutter 61 by means of a stud screw 62. The cutter 61 as shown in Figs. 4 and 5 may be provided with a hexagonal recess 62' cooperating with a similarly shaped end 63 of shaft 58 to secure it more firmly thereto. The cutter 61 may be provided with a plurality of flutes 64 which are tipped with carbide as at 65 as shown.

The relative eccentricity of the shaft 58 is controlled by rotating the bushing 55 by means of a radial stop pin 66 secured in the bushing flange 56 and extending through the semi-circular radial slot 40 in the inner housing 36 into a variable eccentric control collar 67. This control collar 67 is provided with a plurality of handles, one of which is shown at 68. Rotating the control collar 67 by means of the handle 68 will, through the stop pin 66, rotate the eccentric bushing 55 and thus shift its center between its utmost limits inasmuch as the slot 40 extends 180°. Depending from the control collar 67 is a stop pin 69 which extends into and has a path of travel along a 180° annular groove 70 in an adjusting and lock collar 71, collar 71 being suitably and adjustably secured as by set screws (not shown) to the top of the lower portion 41 of the inner housing 36.

At the end of the semi-circular annular groove 70 in the collar 71 is a lock 72 consisting of a small cylinder having a radial slot 73 which may be aligned with the semi-circular groove 70 in the position shown in Fig. 3, permitting the stop pin 69 to be moved to the center of lock 72. The radial slot 73 forms the continuation and the end of groove 70, when the handle 74 is projecting out from the collar 71, as illustrated. The slot 73 is radial of the longitudinal axis of the cylindrical lock 72. When in such central position, the lock 72 may be rotated 90° by means of its handle 74 which fits into a recess 74' adapted to receive it in the side of the lock collar 71, thus preventing the stop pin 69 from leaving the same until the radial slot 73 has again been aligned with the semi-circular groove in the lock collar 71. Below the lock collar 71 there is located a coolant distributor 75 having a coolant inflow path 76 and a coolant outlet flow path 77. The coolant outlet flow path 77 is connected to a vertical passageway 78 in the lower portion 41 of inner housing 36 and is also connected to a conduit 80 supported by an adjustable fork 81 mounted by means of studs 82 on the outer housing 14. The coolant inlet path 76 connects to a similar and parallel passageway in the lower portion 41 of the inner housing 36 and in turn is connected to a coolant supply conduit (not shown). Below the coolant distributor 75 there is threaded on the housing 36 a lock nut and stop 83 and below this a regulating nut and stop 84. It will be noted that the lock collar 71 and the lock nut and stop 83 are each provided with countersunk packings 85 bearing against the coolant distributor 75 to prevent leakage therefrom. The extreme lower edge of lower portion 41 of housing 36 is provided with a lip 86 extending 180° thereabout.



In operation, the lock collar 71 is preset by means of its set screws at such a position that rotation of control collar 67 until stop pin 69 engages lock 72 will result in the exact desired degree of eccentricity of cutter shaft 58, and the exact desired depth of thread.

Additional explanation as to the manner in which the thread miller is preset may be thought desirable. If it is desired to change the depth of thread or to compensate for cutter wear, the thread miller is reset in the following manner. The set screws in lock collar 71 are loosened so that the lock collar is free to rotate, and control collar 67 is rotated by means of handles 68 until the desired dimension is secured between the heel of lip 86 and the most remote cutting edge of cutter 61. This dimension is usually measured with a micrometer. When the control collar 67 has been adjusted as above set forth, it is held in place relative to the inner housing 36, and lock collar 71 is rotated relative to control collar 67 until lock 72 engages the stop pin 69. The lock collar 71 is then locked in this position by means of its set screws. In this manner it will be seen that lock 72 in lock collar 71 is so located as to engage and lock stop pin 69 at the exact desired point of eccentricity, and rotation of control collar 67 is permitted as far as the diametrically opposite point of eccentricity for the purpose of withdrawing cutter 61 toward lip 86 for insertion into the hole. Then, after the cutter is rotating, rotation of control collar 67 until stop pin 69 engages lock 72 will result in the cutter 61 achieving the exact depth of cut desired. The thread miller 10 is attached to a radial drill press or any suitable portable drill head by means of the split collar 15 and studs 16 and the press spindle 17 is thus connected to the taper sleeve adaptor 18. The plate 12 and thread miller 10 are placed in relative position so that the inner housing rest lip can enter to the bottom 13 of a previously drilled cylindrical hole 13. Before the milling cutter 61 can be extended to the bottom of the hole, however, it must be withdrawn within the diameter of the lip 86 by releasing the stop pin 69 from the lock 72 and then rotating the handle 68. This will cause the eccentric bushing 55 to rotate 180° and change the eccentricity of the cutter shaft 58 relative to the drive shaft 21. The handwheel 50 is then rotated causing the inner housing 36 to descend until the lip 86 abuts the bottom 13 of the previously drilled hole. The power is then turned on and is transmitted by means of the splines 20, drive shaft 21, coupling shuttle 60 and cutter shaft 58 to the cutter 61.

Handle 68 is then rotated while the cutter 61 is operating until the handle 68 has brought the stop pin 69 to the end of the annular groove 70 and into lock 72 whereupon the lock handle 74 is rotated to lock it therein. At this time, the cutter 61 will have moved radially to its limit of eccentricity as it has cut its way into the side of the hole in the plate 12. Then as the cutter 71 continues in rotation, handwheel 50 will be slowly rotated in the opposite direction causing the cutter 61 to be drawn upwardly in a spiral path determined by the cooperating acme threads 38 and 53, thus cutting the internal thread 11 in the plate 12 as it does so. Due to the fact that cutting commences at the bottom of the hole and advances upwardly, the chips merely collect at the bottom without interfering with the operation, a suitable coolant being provided through the coolant distributor 75 and the vertical passageways in the lower portion 41 of inner housing 36.

Other modifications and changes in the number and arrangement of the parts may be made by those skilled in the art without departing from the nature of the invention, within the scope of what is hereinafter claimed.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:

1. A thread miller comprising an outer housing, a power shaft in said housing, a drive shaft splined to said power shaft, an inner housing journalled about said drive shaft, said inner housing including a concentric cylidrical upper portion having an interrupted external thread extending about part of said upper portion, a depending lower portion having an eccentric cylindrical internal shaftway therethrough, a driven shaft, an eccentric bushing in which said driven shaft is journalled, said eccentric bushing being rotatable within said eccentric portion of said inner housing, a coupling shuttle connecting said drive shaft to said driven shaft, a milling cutter mounted on said driven shaft, means connected to said eccentric bushing for rotating the same and thus varying the eccentricity of said milling cutter, means for locking said milling cutter in radially extended position, means for spirally moving said inner housing to cause said milling cutter to mill a thread in a previously drilled hole in a plate, and means for guiding said inner housing in the drilled hole in a plate comprising a depending lip extending partly around its edge.

2. A thread miller comprising an outer housing, a power shaft in said housing, a drive shaft splined to said power shaft, an inner housing journalled about said drive shaft, said inner housing including a concentric cylindrical upper portion having an interrupted external thread extending about part of said upper portion, a depending lower portion having an eccentric cylindrical internal shaftway therethrough, a driven shaft, an eccentric bushing in which said driven shaft is journalled, said eccentric bushing being rotatable within said eccentric portion of said inner housing, a coupling shuttle connecting said drive shaft to said driven shaft, a milling cutter mounted on said driven shaft, means connected to said eccentric bushing for rotating the same and thus varying the eccentricity of said milling cutter, means for locking said milling cutter in radially extended position, means for spirally moving said inner housing to cause said milling cutter to mill a thread in a previously drilled hole in a plate, and means for guiding said inner housing in the drilled hole in a plate.

3. A thread miller comprising an outer housing, a power shaft in said housing, a drive shaft splined to said power shaft, an inner housing journalled about said drive shaft, said inner housing including a concentric cylindrical upper portion having an interrupted external thread extending about part of said upper portion, a depending lower portion having an eccentric cylindrical internal shaftway therethrough, a driven shaft, an eccentric bushing in which said driven shaft is journalled, said eccentric bushing being rotatable within said eccentric portion of said inner housing, a coupling shuttle connecting said drive shaft to said driven shaft, a milling cutter mounted on said driven shaft, means connected to said eccentric bushing for rotating the same and thus varying the eccentricity of said milling cutter, said bushing rotating means comprising a control collar about said inner housing and a stop pin extending from said bushing through a semi-circular radial slot in said inner housing into said control collar, means for locking said milling cutter in radially extended position, means for spirally moving said inner housing to cause said milling cutter to mill a thread in a previously drilled hole in a plate, and means for guiding said inner housing in the drilled hole in a plate.



4. A thread miller comprising an outer housing, a power shaft in said housing, a drive shaft splined to said power shaft, an inner housing journalled about said drive shaft, said inner housing including a concentric cylindrical upper portion having an interrupted external thread extending about part of said upper portion, a depending lower portion having an eccentric cylindrical internal shaftway therethrough, a driven shaft, an eccentric bushing in which said driven shaft is journalled, said eccentric bushing being rotatable within said eccentric portion of said inner housing, a coupling shuttle connecting said drive shaft to said driven shaft, a milling cutter mounted on said driven shaft, means connected to said eccentric bushing for rotating the same and thus varying the eccentricity of said milling cutter, means for locking said milling cutter in radially extended position comprising a locking collar adjacent said control collar, an annular groove in said locking collar, a stop pin extending from said control collar into said locking collar semi-circular annular groove, a stop pin lock at one end of said semi-circular annular groove consisting of a rotatable cylinder having a radial slot adapted to be aligned and misaligned with said semi-circular annular groove and a handle for rotating said cylindrical lock from aligned unlocked position to misaligned locked position, means for spirally moving said inner housing to cause said milling cutter to mill a thread in a previously drilled hole in a plate, and means for guiding said inner housing in the drilled hole in a plate.

5. A thread miller comprising an outer housing, a power shaft in said housing, a drive shaft splined to said power shaft, an inner housing journalled about said drive shaft, said inner housing including a concentric cylindrical upper portion having an interrupted external thread extending about part of said upper portion, a depending lower portion having an eccentric cylindrical internal shaftway therethrough, a driven shaft, an eccentric bushing in which said driven shaft is journalled, said eccentric bushing being rotatable within said eccentric portion of said inner housing, a coupling shuttle connecting said drive shaft to said driven shaft, a milling cutter mounted on said driven shaft, means connected to said eccentric bushing for rotating the same and thus varying the eccentricity of said milling cutter, means for locking said milling cutter in radially extended position, means for spirally moving said inner housing to cause said milling cutter to mill a thread in a previously drilled hole in a plate, said spirally moving means comprising a worm wheel in said outer housing having a two diametered aperture about said interrupted thread portion of said inner housing and a lead thread guide nut secured to said outer housing, said lead thread guide nut being internally threaded corresponding to the threads of the thread portion of said inner housing and means for rotating said worm wheel to rotate said inner housing and thereby cause said inner

housing to move spirally through said lead thread guide nut, said worm wheel rotating means comprising a worm shaft extending through said outer housing and means for controllably rotating said worm shaft, and means for guiding said inner housing in the drilled hole in a plate.

6. A thread miller comprising an outer housing, a power shaft in said housing, a drive shaft splined to said power shaft, an inner housing journalled about said drive shaft, said inner housing including a concentric cylindrical upper portion having an interrupted external thread extending about part of said upper portion, a depending lower portion having an eccentric cylindrical internal shaftway therethrough, a driven shaft, an eccentric bushing in which said driven shaft is journalled, said eccentric bushing being rotatable within said eccentric portion of said inner housing, a coupling shuttle connecting said drive shaft to said driven shaft, a milling cutter mounted on said driven shaft, means connected to said eccentric bushing for rotating the same and thus varying the eccentricity of said milling cutter, means for locking said milling cutter in radially extended position, means for spirally moving said inner housing to cause said milling cutter to mill a thread in a previously drilled hole in a plate, means for guiding said inner housing in the drilled hole in a plate comprising a depending lip extending partly around its edge, and cutter coolant supply means including coolant inlet and outlet passageways extending through the eccentric portion of said inner housing to within said depending lip, and a coolant collar having coolant paths connected to said housing passageways and to conduit coolant supply means.

7. A thread miller comprising an outer housing, a power shaft in said housing, a drive shaft splined to said power shaft, an inner housing journalled about said drive shaft, said inner housing including a concentric cylindrical upper portion having an interrupted external thread extending about part of said upper portion, a depending lower portion having an eccentric cylindrical internal shaftway therethrough, a driven shaft, an eccentric bushing in which said driven shaft is journalled, said eccentric bushing being rotatable within said eccentric portion of said inner housing, a coupling shuttle connecting said drive shaft to said driven shaft, a milling cutter mounted on said driven shaft, means connected to said eccentric bushing for rotating the same thus varying the eccentricity of said milling cutter, means for locking said milling cutter in radially extended position, means for spirally moving said inner housing to cause said milling cutter to mill a thread in a previously drilled hole in a plate, and means for guiding said inner housing in the drilled hole in a plate comprising a depending lip extending partly around its edge, said milling cutter being adapted to be retracted to within the external diameter of said depending lip at one limit of eccentricity and to a milling position with a portion of said cutter beyond the diameter of said lip at the other limit of eccentricity.

8. A thread miller comprising an outer housing, a power shaft in said housing, a drive shaft splined to said power shaft, an inner housing journalled about said drive shaft, said inner housing including a concentric cylindrical upper portion having an interrupted external thread extending about



part of said upper portion, a depending lower portion having an eccentric cylindrical internal shaftway therethrough, a driven shaft, an eccentric bushing in which said driven shaft is journalled, said eccentric bushing being rotatable within said eccentric portion of said inner housing, a coupling shuttle connecting said drive shaft to said driven shaft, a milling cutter mounted on said driven shaft, means connected to said eccentric bushing for rotating the same and thus varying the eccentricity of said milling cutter, said bushing rotating means comprising a control collar about said inner housing and a stop pin extending from said bushing through a semi-circular radial slot in said inner housing into said control collar, means for locking said milling cutter in radially extended position comprising a locking collar adjacent said control collar, an annular groove in said locking collar, a stop pin extending from said control collar into said locking collar semi-circular annular groove, and a stop pin lock at one end of said semi-circular annular groove consisting of a rotatable cylinder having a radial slot adapted to be aligned and misaligned with said semi-circular annular groove and a handle for rotating said cylindrical lock from aligned unlocked position to misaligned locked position, means for spirally moving said inner housing to cause said milling cutter to mill a thread in a previously drilled hole in a plate, said spirally moving means comprising a worm wheel in said outer housing having a two diametered aperture about said interrupted thread portion of said inner housing and a lead thread guide nut secured to said outer housing, said lead thread guide nut being internally threaded corresponding to the threads of the thread portion of said inner housing and means for rotating said worm wheel to rotate said inner housing and thereby cause said inner housing to move spirally through said lead thread guide nut, said worm wheel rotating means comprising a worm shaft extending through said outer housing and means for controllably rotating said worm shaft, means for guiding said inner housing in the drilled hole in a plate comprising a depending lip extending partly around its edge and cutter coolant supply means including coolant inlet and outlet passageways extending through the eccentric portion of said inner housing to within said depending lip, and a coolant collar having coolant paths connected to said housing passageways and to conduit coolant supply means, said milling cutter being adapted to be retracted to within the external diameter of said depending lip at one limit of eccentricity and to a milling position with a portion of said cutter beyond the diameter of said lip at the other limit of eccentricity.

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