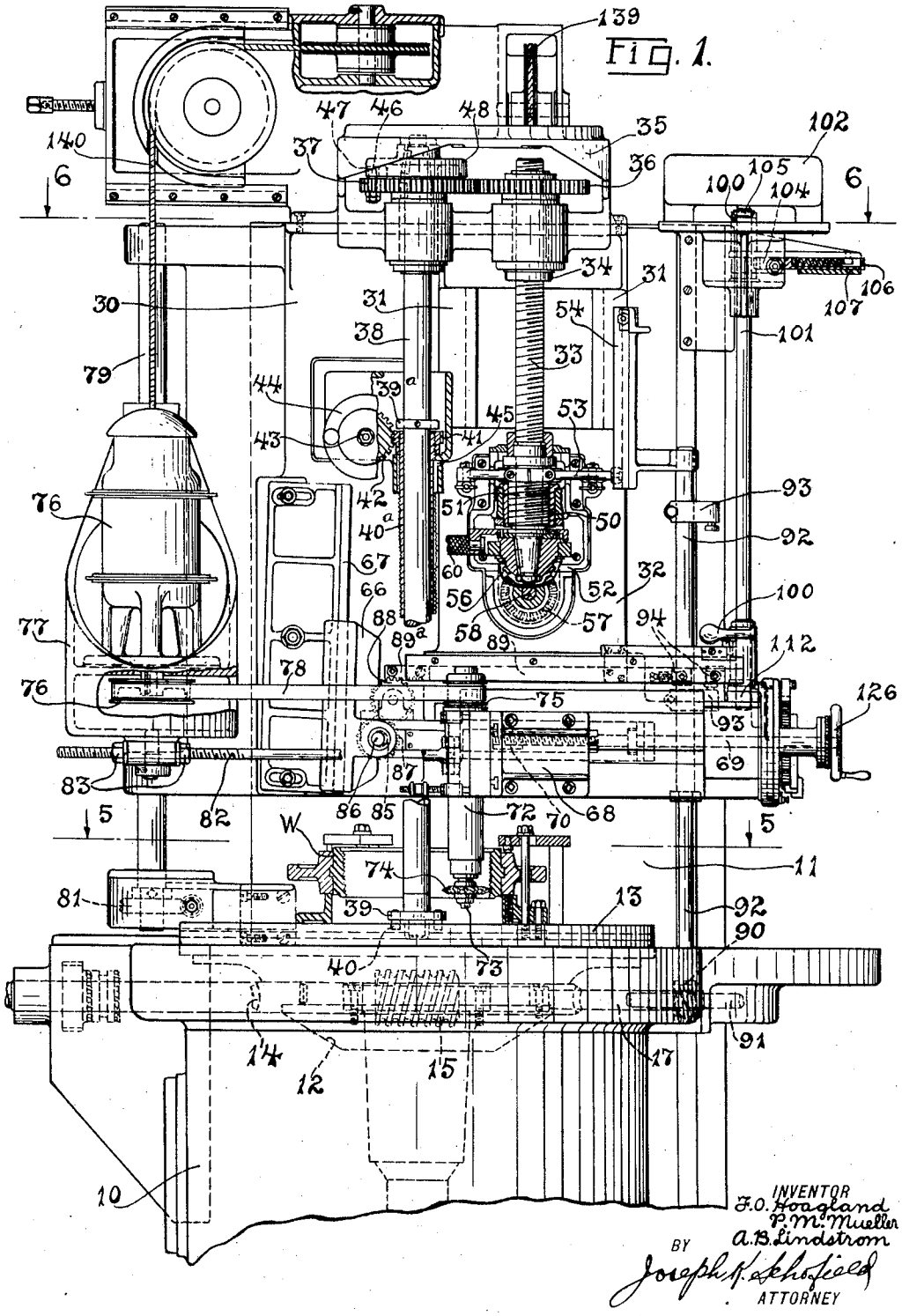
Feb. 12, 1929. 1,701,675

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PRECISION THREAD GRINDING MACHINE

Filed July 1, 1927 6 Sheets-Sheet 1

Fig. 1.



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PRECISION THREAD GRINDING MACHINE

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Fig. 2.

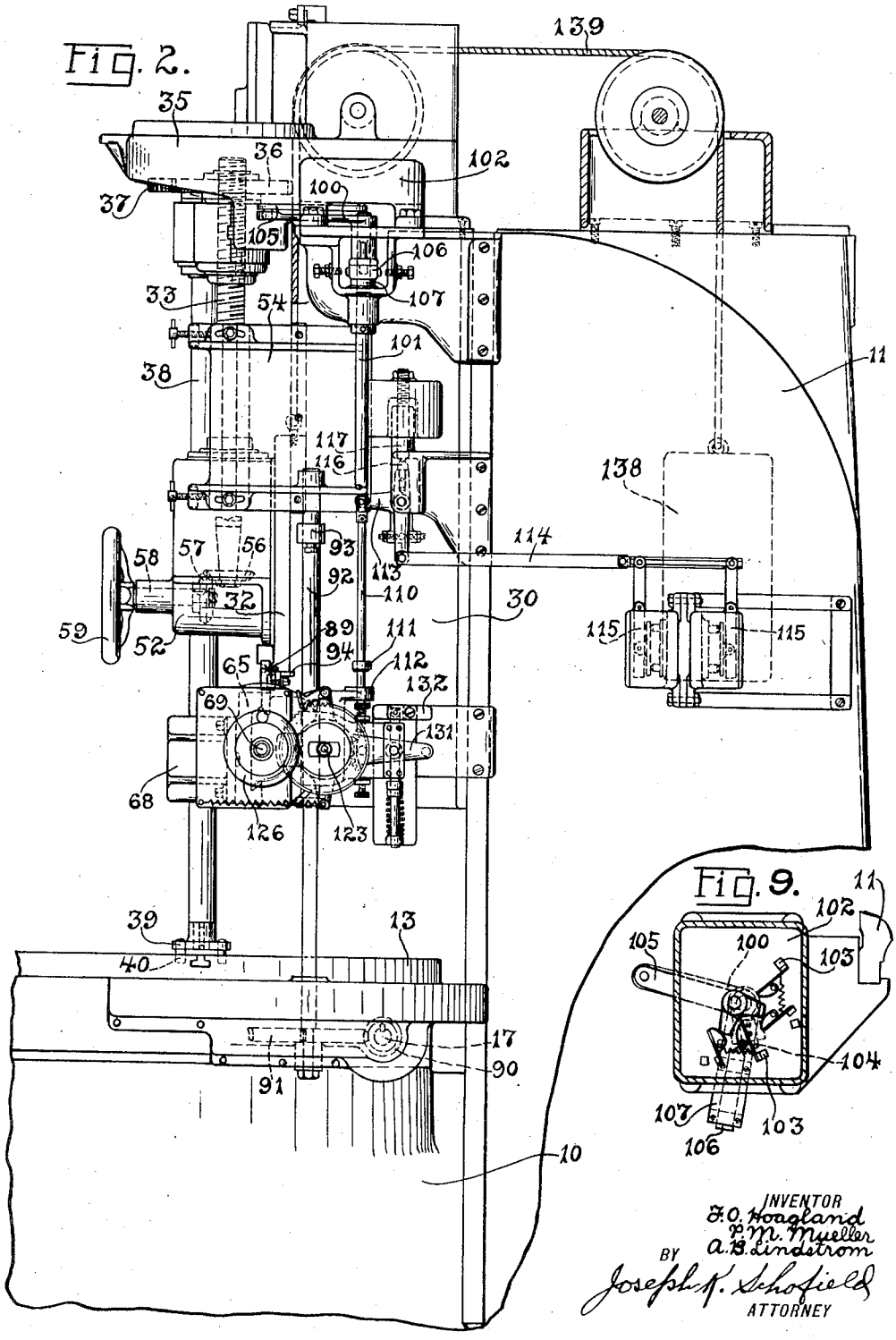


Fig. 9.

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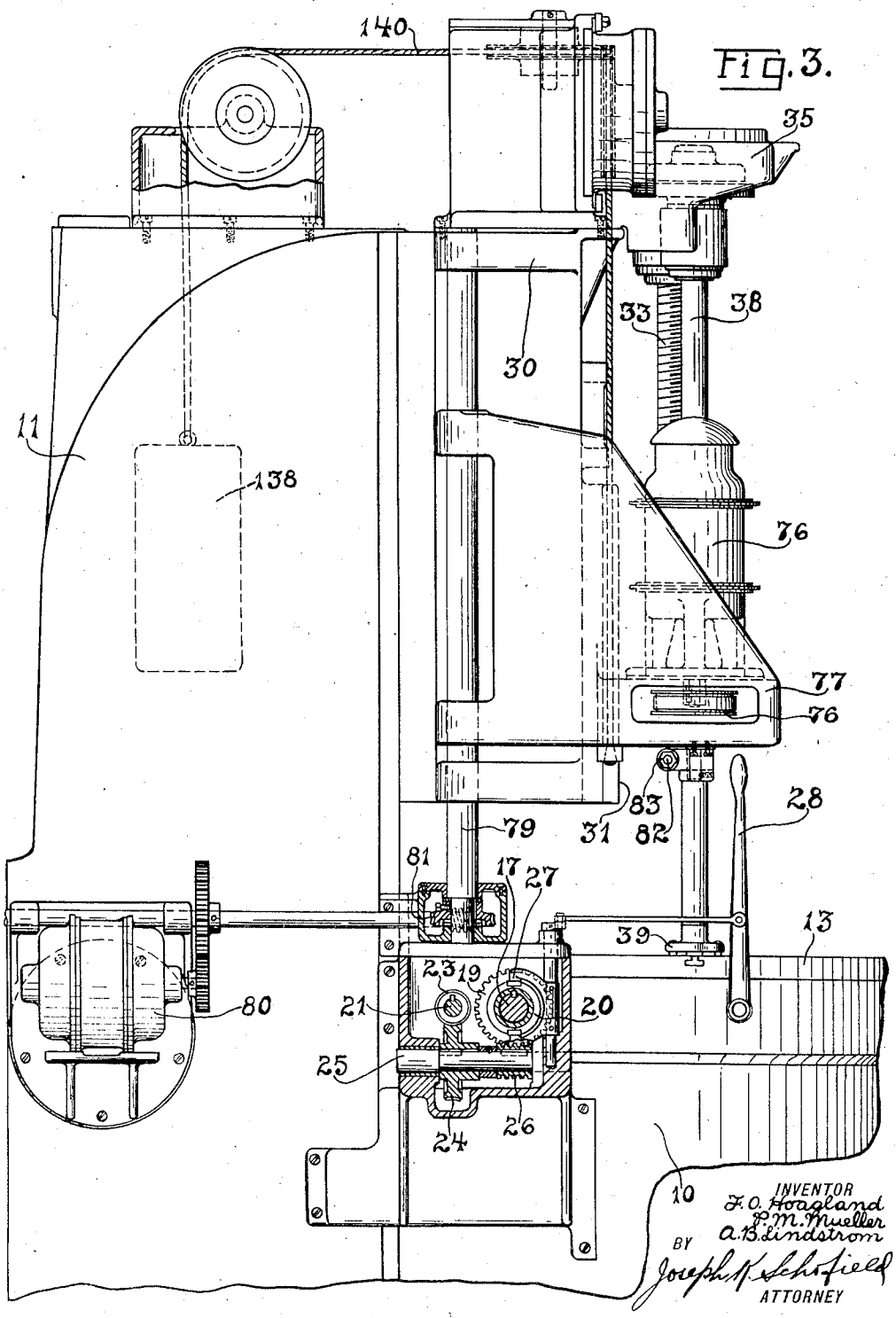
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PRECISION THREAD GRINDING MACHINE

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Fig. 3.



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PRECISION THREAD GRINDING MACHINE

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Fig. 12.

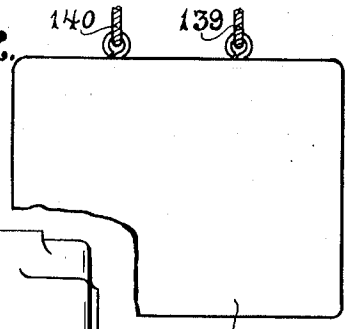
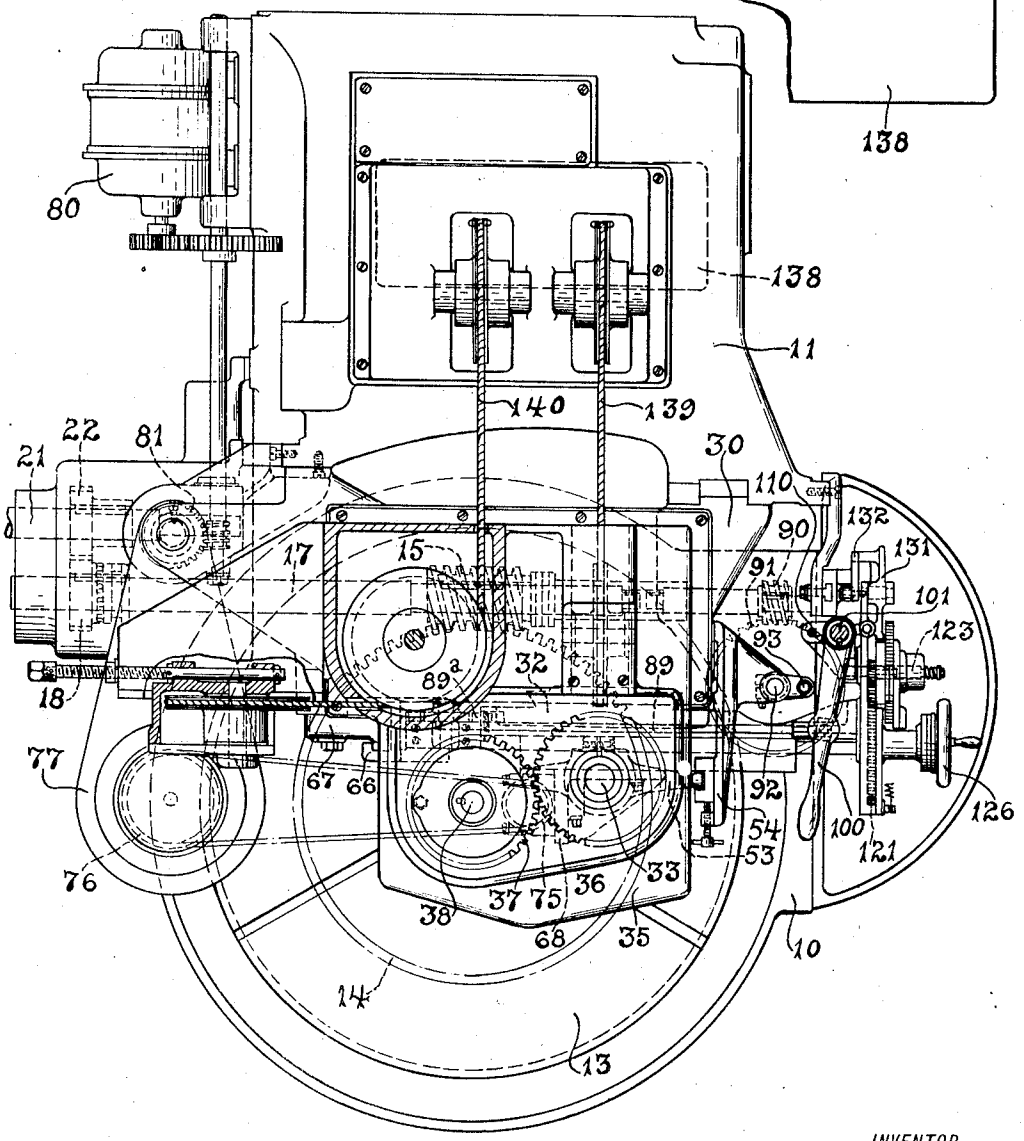


Fig. 4.



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PRECISION THREAD GRINDING MACHINE

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Fig. 5.

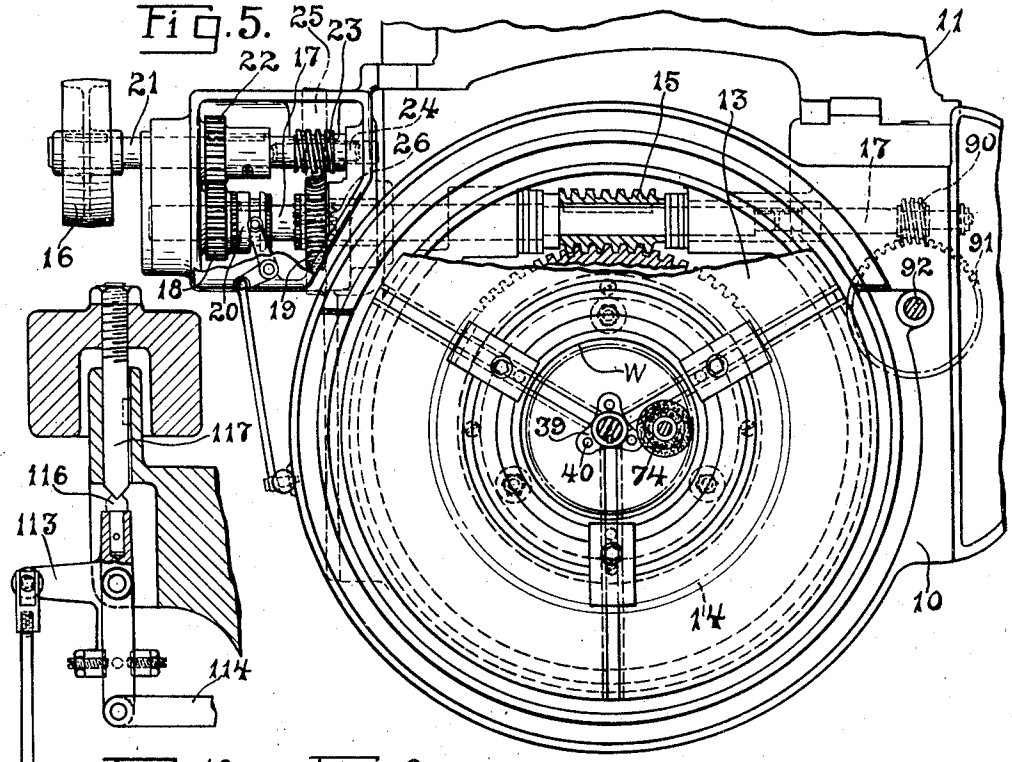
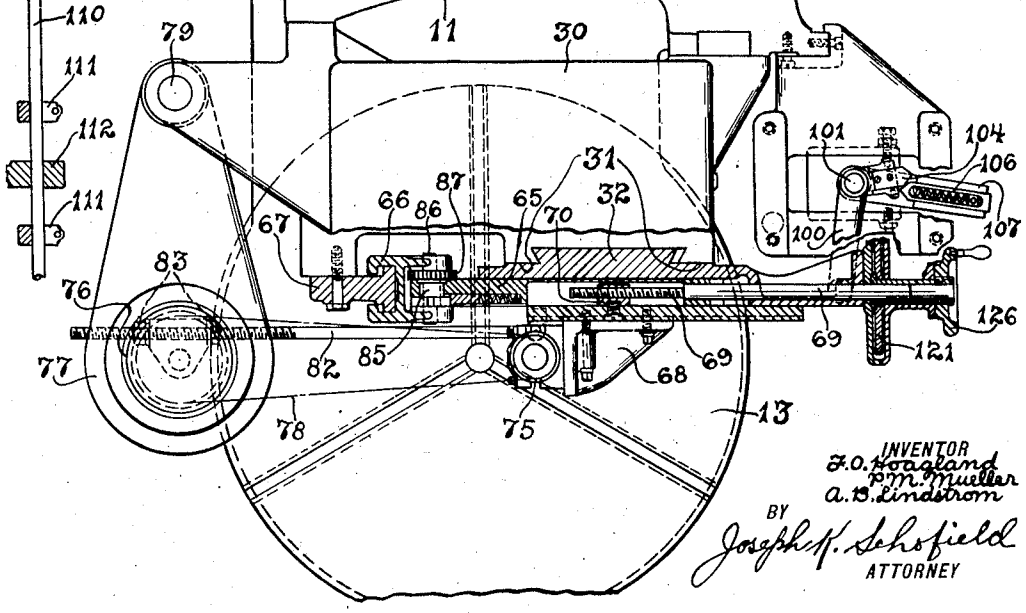


Fig. 10.



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PRECISION THREAD GRINDING MACHINE

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Fig. 7.

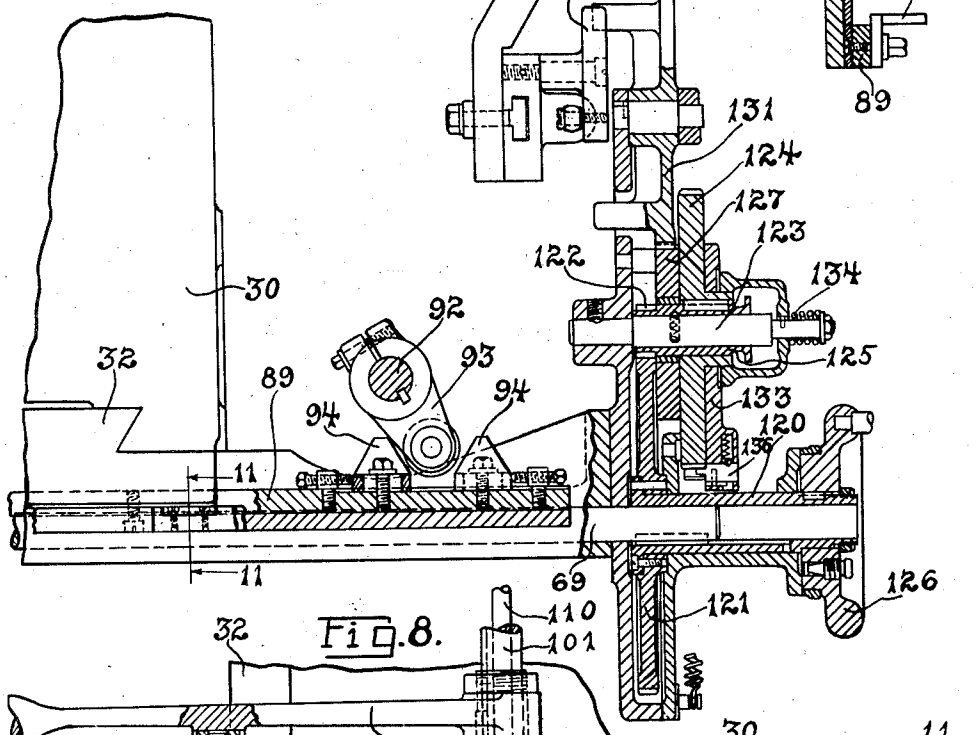
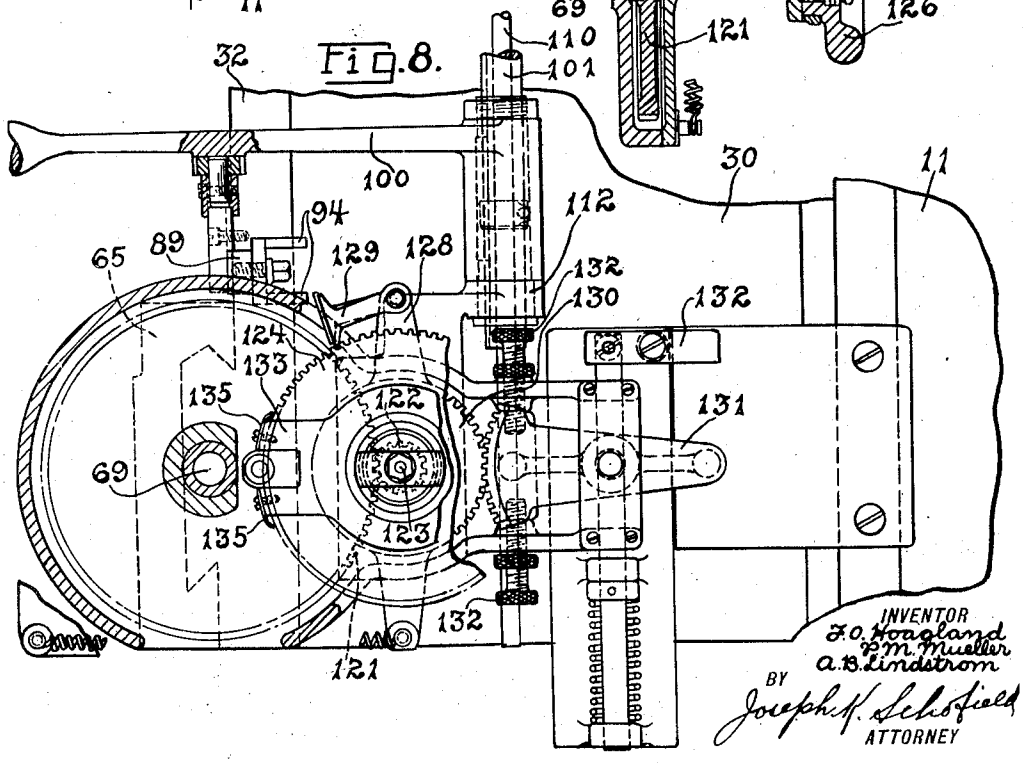


Fig. 11.

Fig. 8.



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UNITED STATES PATENT OFFICE.

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PRECISION THREAD-GRINDING MACHINE.

Application filed July 1, 1927. Serial No. 202,875.

This invention relates to precision machines and particularly to a screw thread generating machine adapted optionally for internal or external and tapered or straight threads.

An object of the present invention is to provide a precision screw thread generating machine for accurately grinding or otherwise forming straight or tapered screw threads within or upon gages and other members.

One feature which enables us to accomplish the above object is that the work is rotated relatively slowly and the generating wheel is advanced during this rotation of the work, the advancing means for the wheel being driven directly from the rotation of the work.

Another object of importance is that a compensating device for the lead of the screw for advancing the wheel saddle is provided so that the effects of inaccuracies in this screw can be eliminated and screw threads of high precision generated.

Another object of the invention is to provide means for slightly advancing the wheel predetermined distances radially during its axial movement along the work so that threads having a slightly tapered form may be generated to a high precision.

Another object of the invention is to provide an automatic control for the machine, preferably electrically operated, and adapted to periodically reverse the direction of rotation of the work table and movement of the saddle carrying the wheel so that the wheel may be repeatedly traversed over the work.

A still further object of the invention is to provide feeding mechanism for advancing the wheel slightly toward the work at each movement of the saddle in one direction, and also to provide mechanism for disengaging the wheel from the work upon movement of the wheel saddle in the opposite direction.

Another object of importance is that a control shaft is provided rotated from the table and having dogs thereon adapted to move the slide on which the wheel is mounted in one or the other direction, movement of this slide being adapted to control the reversal of movement of the saddle and rotation of the table.

With these and other objects in view, our invention consists in the features of construction and operation set forth in the following specification and illustrated in the accompanying drawings.

In the accompanying drawings annexed hereto and forming a part of this specification, we have shown our invention embodied in a special form of grinding machine for screw thread gages of large size, but it will be understood that the invention can be otherwise embodied and that the drawings are not to be construed as defining or limiting the scope of the invention, the claims appended to this specification being relied upon for that purpose.

In the drawings:

Figure 1 is a front elevation, partly in section, showing a complete machine built according to the present invention.

Fig. 2 is a side elevation of a complete machine taken from the right-hand side of the machine as seen in Fig. 1.

Fig. 3 is a side elevation of a complete machine taken from the left-hand side of the machine as seen in Fig. 1.

Fig. 4 is a plan view of the complete machine, parts being shown in section.

Fig. 5 is a horizontal, sectional view taken upon the line 5—5 of Fig. 1.

Fig. 6 is a similar view taken substantially upon the line 6—6 of Fig. 1, parts being sectioned to more clearly show their construction.

Fig. 7 is an enlarged horizontal sectional view of the feed mechanism for the wheel.

Fig. 8 is a side elevation of the feed mechanism shown in Fig. 7.

Fig. 9 is a detail view of the switch controlling the table rotation.

Fig. 10 is a detail view of the control mechanism for stopping the machine.

Fig. 11 is a detail cross sectional view of the slide actuating rod and dog, and

Fig. 12 is a front elevation of the counterweight for the saddle and auxiliary slide.

In the above mentioned drawings we have shown but one embodiment of the invention which is now deemed preferable, but it is to be understood that changes and modifications may be made within the scope of the appended claims without departing from the spirit of the invention.

Briefly, and in its broadest aspect, our invention comprises the following principal parts: First, a base having a rotatable work

supporting table mounted thereon; second, means to rotate the table preferably by an electric motor and at a plurality of relatively slow speeds; third, a column forming a part of the base; fourth, a saddle slidable vertically on the column above the table; fifth, screw threaded means for raising and lowering the saddle; sixth, rotating means for the said screw threaded means detachably connected directly to the center of the work supporting table and driven thereby; seventh, lead compensating means for said screw threaded means for raising and lowering the saddle; eighth, a transversely movable slide on the saddle; ninth, an adjustable bar for guiding said transverse slide; tenth, a wheel supporting sleeve and head on the transversely movable slide; eleventh, means to adjust the position of said sleeve and head relative to the slide and to feed the wheel toward the work during rotation of the table; twelfth, a motor movable with the saddle for rotating the wheel; thirteenth, controlling means for reversing the table rotation and movement of the vertically movable saddle between predetermined positions of the saddle, these means being operable with transverse movements of the wheel carrying slide; and fourteenth, a control rod having dogs thereon and rotated by the table for controlling the transverse movement of the wheel carrying slide.

Referring more in detail to the figures of the drawings, we provide a base 10 preferably formed with an integral column 11 extending upwardly therefrom. On suitable circular and horizontal ways 12 on the base 10 is mounted a rotatable table 13 which may be driven by any conventional or well-known means. As shown clearly in Fig. 1, the work W, which in the present instance is an internal screw threaded gage, is mounted on and clamped fixedly to the upper horizontal surface of the work supporting table 13. It will be understood that the table 13 may be rotated at a number of different relatively slow speeds during operation depending upon the different types of work W being ground or otherwise operated on. In the present instance the work table 13 is rotated by means of a worm wheel 14 directly mounted on the table and connected to a worm 15. The worm 15 may, as shown in Fig. 5, be rotated through any suitable gearing from a pulley 16 which may be driven from an electric motor at two different speeds. The worm 15 is keyed to an elongated shaft 17 rotatably mounted in the base 10 on which are rotatable a spur gear 18 and a worm gear 19. A clutch 20 splined to the shaft 17 is disposed between these gears 18 and 19. Adjacent shaft 17 is a short shaft 21 on the outer end of which is mounted the driving pulley 16. Shaft 21 has keyed thereto a spur gear 22 meshing directly with gear 18 and also a worm 23 meshing with a worm wheel 24 keyed to an intermediate shaft 25. On this shaft 25 is a worm 26 meshing with the worm wheel 19. It will be seen from the above construction that by moving the clutch 20 from one extreme position to the other the table may be rotated at either of two different speeds. To move the clutch 20 a yoke 27 is provided which may be actuated by a hand lever 28 through appropriate connections.

Upon the column 11, which in the present instance is formed integrally with the base 10, is fixed a member 30 extending forwardly over the table 13 and provided with vertical ways 31 on its outer surface. On these ways 31 is mounted a large saddle 32 for vertical movement directly over the table 13. In order to raise and lower this saddle 32 in timed relation to the rotation of the work table 13, a screw 33 is provided which is secured to the saddle 32 in a manner presently to be more fully described. This screw 33 engages a rotatable nut 34 held against axial movement within a suitable bearing provided in a member 35 secured to the upper portion of the column 11. On this nut 34 is a spur gear 36 meshing with a similar spur gear 37 on the upper end of a vertical shaft 38. This vertical shaft is supported within a bearing formed in the member 35 and is coaxial with the axis of rotation of the work supporting table 13. At its lower end the shaft 38 is provided with a member 39 having spaced recesses 40 therein adapted to be engaged by a plurality of spaced pins in the work table 13. These pins and recesses are so disposed that the member 39 will always assume the same position rotatively of the table. It will be be seen from this construction that the raising and lowering of the saddle 32 is obtained directly from the rotative movement of the table and therefore the movement of the saddle is necessarily in exact timed relation thereto. The connections for raising and lowering the saddle 32 are restricted to the fewest possible number of parts so that any possibility of error is reduced to a minimum.

The vertical driving shaft 38 for the lead screw 33 is adapted to be raised out of engagement with the table 13 so that access to the work W may be had for measuring or testing and for mounting and removing the work W. A collar 39^a is therefore pinned to this shaft 38 and a threaded sleeve 40^a surrounds the shaft. The threaded sleeve 40^a slides within an opening on the member 30 secured to the column 11. Movement of this sleeve 40^a will therefore raise or lower the shaft 38. In order to move the sleeve 40^a a spiral gear 41 is rotatably mounted thereon in mesh with a corresponding spiral gear 42 on a short forwardly extending shaft 43. Rotation of this shaft 43 by means of a hand wheel 44 will raise or lower the threaded sleeve 40^a and also the driving shaft 38 by engagement of the sleeve 40^a with the collar 39^a. A key 45 secured within the member

30 and splined to the threaded sleeve 40ª prevents rotation of the sleeve during its up and down movement.

At the upper end of the shaft 38 is a driving connection to the gear 37 permitting upward movement of the shaft 38 while the gear remains in mesh with its driven gear 36. On the upper face of the gear 37 is a wedge shaped stud 46. This stud 46 is adapted to fit within a correspondingly shaped radially extending recess 47 in a disk 48 keyed to the shaft 38. The disk 48 may be separated, therefore, from the stud 46 and returned to precisely the same position when the shaft 38 is again lowered.

In order to compensate for slight inaccuracies in the lead of the screw 33 upon which depends the precision of the work being ground, a lead compensating device is provided on the lower end of the screw. This device comprises a threaded member 50 rotatable between fixed collars on the screw 33 and engaging a nut 51 fixed to a head 52 on the saddle 32. An arm 53 secured to this threaded member 50 engages a slot in an elongated member 54 secured slightly obliquely to the column 11 in a manner permitting limited adjustment. During the raising and lowering of the saddle 32 the member 50 will be rotated slightly due to the obliquity of the slot in the elongated member 54, thus adding to or subtracting from the raising and lowering effect of the screw 33 due to the relative rotation between the threaded member 50 and its nut 51.

To manually raise and lower the saddle 32 and its attached parts a bevel gear 56 is keyed to the lower end of the screw 33. This gear 56 meshes with a corresponding bevel gear 57 on a short shaft 58 extending forwardly. A hand wheel 59 on the forward end of this shaft 58 permits the rotation of the screw 33 to raise or lower the saddle 32. Normally and during operation, the screw 33 is locked against rotative movement by means of a lever 60.

On the lower part of the saddle 32 is a transversely movable slide 65 suitably mounted for movement within suitable horizontally extending guideways provided in the saddle 32. One end of this slide 65 is provided with a pivotally mounted member 66 having guideways adapted to engage corresponding ways extending vertically on a member 67 adjustably bolted to the member 31. By mounting this member so that its ways extend slightly obliquely in a vertical plane, movement vertically of the saddle 32 will cause the slide 65 to move horizontally slight amounts dependent upon the obliquity of the member 67 bolted to the member 31. On this slide 65 is a head 68 movable within ways provided in the slide 65. The head 68 is adjustable horizontally on the slide 65 by means of a screw 69 rotatably mounted in the slide 65 and engaging a nut 70 provided in the head 68. Feeding means for rotating the screw 69 to adjust the head for different sizes of work W and to advance it slightly at each movement of the saddle 32 for successive operations on the work W are mounted on the outer end of the shaft on which the screw 69 is formed.

On the head 68 is mounted a sleeve 72 disposed vertically and within which is the wheel spindle 73. In the present embodiment a grinding wheel 74 is mounted on the lower end of this spindle 73 and a driving pulley 75 is secured at its upper end.

To rotate the wheel spindle 73 and wheel 74 a motor 76 is provided on a swinging frame 77 movable with the saddle 32 and drivingly connected to the spindle pulley by a suitable belt 78. As shown in Fig. 1, the frame 77 supporting the motor 76 may be movable upon a guide in the form of a vertical shaft 79. This shaft 79 passes through suitable openings formed in the member 30. To facilitate the movement of the member 30 and the member 77 on the shaft 79, this shaft may be slowly rotated as by a small motor 80 secured to the base 10 and connected to the shaft 79 by means of suitable gearing 81. To maintain the belt 78 under constant tension a tie rod 82 is provided extending between the head 68 and the member 77. Threads on this rod and nuts 83 engaging opposite sides of the member 77 enable the belt to be adjusted and maintained at the proper tension.

To slightly move the slide horizontally so that the wheel may be moved into and out of engagement with the work W at the upper and lower limits of its movement, the following mechanism is provided. The pivotal connection between the slide 65 and member 66 engaging the obliquely adjustable member 67 is made in the form of an eccentric 85. A short shaft 86, as shown in Fig. 6, has its central portion formed into this eccentric portion 85, which eccentric portion engages a suitable bearing in the slide 65. On opposite sides of this eccentric are journals engaging bearings in the pivotal member 66. It will be seen from this construction that a movement of a half revolution of the eccentric 85 will move the slide 65 horizontally in one direction or the other. To rotate this eccentric half revolutions in opposite directions the shaft 86 carrying the eccentric portion also carries a spur gear 87 on one end engaging another gear 88 on the slide 65. This latter gear 88 is in mesh with rack teeth on the end of a rod 89 longitudinally movable on the slide 65. Means to move this rod 89 a short distance in one direction at one end of the movement of the saddle 32 and in the opposite direction at the end of the movement of the saddle in the opposite direction is provided at the outer end of the rod 89.

This mechanism for actuating the slide 65 and also for reversing the rotation of the table 13 and vertical movement of the saddle 32 will now be described.

The shaft 17 carrying the table rotating worm 15 carries a small worm 90 at its outer end in mesh with a worm wheel 91 on the lower end of the vertical shaft 92. On this shaft 92 are disposed arms 93 adapted to be adjustably positioned at any points along the vertical shaft 92. These arms 93 carry tappets at their outer or free ends. During rotation of the table 13 the vertical shaft 92 will be very slowly rotated, the direction of rotation of the vertical shaft being reversed with the reversal of rotation of the table. Adapted to be engaged by the tappets on the arms 93 are small dogs 94 on the rod 89 carried in the slide 65. With the table 13 and vertical shaft 92 rotating in one direction, one of the dogs 94 will be struck by a tappet on the shaft 92 at each limit of movement of the saddle 32. Movement of the dog 94 and slide 89 by one of the tappets will force the eccentric 85 in a direction to move the wheel 74 in a direction to engage the work W and by engagement with the opposite tappet will move the wheel 74 in a direction to disengage the wheel from the work. By altering the vertical position of the arms 93 on the vertical shaft 92, this movement of the rod 89 to engage and disengage the wheel 74 with the work W may take place at any points in the vertical movement of the saddle 32. Also by rotating the eccentric 85 manually a half revolution the movement of the head 68 to engage the work W may take place in either direction. For this purpose the rack teeth on the rod 89 are adapted to be disengaged from the pinion 88 by swinging the member 89a away from the pinion.

Also movable with the rod 89 on the transverse slide 65 is a lever 100 keyed to a vertical control shaft 101 at its lower end so that with each movement of the horizontal rod 89 to disengage or engage the wheel 74 relative to the work W this vertical control shaft will also be oscillated. At the upper end of the vertical control shaft 101 is a switch box 102 having contacts 103, some of which are closed in either oscillated position of the shaft. A plan view of these contacts 103 is shown in Fig. 9 in one of their operative positions. With one set of contacts closed, a motor (not shown) will be driven in a direction to rotate the table 13 in one direction and when the opposite set of contacts is closed the motor and table 13 will be rotated in opposite directions. This reversal of rotation of the table 13 will therefore take place simultaneously with engagement and disengagement of the wheel 74 and work W at the limits of vertical movement of the saddle 32. In order to enable the movable member 105 of the switch 101 to effect its movement to close the contacts, the vertical control shaft 101 is provided with a short arm 104 having a V-form projection at its outer end. This end of the arm 104 is adapted to contact with a spring detent 106 on an actuating bell crank 107 for actuating the switch member 105. Movement of the rod 89 by engagement of the tappet arm 93 with the dog 94 will move the control shaft 101 to a mid position whereby the spring detent 106 will engage the opposite face of the V end of the arm 104 so that movement of the detent forward by its spring will complete oscillating movement of the electric switch arm 105.

In order to stop movements of the saddle 32 and table 13 after a single traverse of the saddle 32, as when a milling cutter is used in the head 68, a second vertical shaft 110 is provided adjacent the vertical control shaft 101 and having collars 111 pinned in fixed position thereon. Movement of the saddle 32 to an upper or lower limiting position will cause a projection 112 on the saddle 32 to engage one or the other of these collars 111, thus forcing longitudinal movement of this shaft 110. By means of a bell crank 113 and reach arm 114, this shaft 110 is connected to electric switches 115 in the circuits for the table rotating motor normally permanently closed and which, by movement of the reach arm 114, will be moved to a neutral position, thus stopping further movement of the saddle 32 and also stopping the rotation of the table 13. As shown in Fig. 10 the bell crank 113 operating the switches 115 is provided with a notched projection 116 adapted to be engaged by the pointed end of a suitable guide and weighted rod 117. As soon as the bell crank 113 is oscillated slightly the weighted rod 117 forces the bell crank 113 to its extreme oscillated position to move one of the switches 115 to its open position.

In order to feed the cutting wheel 74 toward the work W with each movement of the saddle 32 in one direction, means are provided to very slightly rotate the threaded shaft 69 when the saddle 32 reaches its upper limit of movement. The mechanism for effecting this movement is shown clearly in Figs. 7 and 8. The outer end of the threaded shaft 69 has keyed to it a sleeve 120 to which is secured a large gear 121 In mesh with this large gear is a pinion 122 preferably mounted on a sleeve 125 slidable upon a short shaft 123 adjacent the feed screw 69. A ratchet wheel 124 is splined to this sleeve 125 so that rotative movement of this ratchet wheel 124 will effect rotative movements of the pinion 122 and the gear 121, thus rotating the feed screw 69 a slight amount. In order to disengage the pinion 122 from the gear 121, the outer end of the sleeve is extended so that it may be manually moved to a position disengaging the pinion from the gear, thus enabling the feed screw 69 to be directly rotated by hand. For

that purpose a hand wheel 126 is provided on the sleeve 120.

In order to slowly and step by step rotate the ratchet wheel 124 a member 127 carrying an arm 128 having a pawl 129 at its upper end is rotatably mounted upon the sleeve 125. This member 127 has gear teeth 130 along one side adapted to engage teeth on an oscillating member 131 pivotally mounted adjacent the short shaft 123 carrying the ratchet wheel 124. Oscillatory movements therefore of this pivotally mounted member 131 will oscillate the arm 128 carrying the pawl 129. To limit the oscillatory movements of the pivotal member 131, adjustable screws 132 may be provided adapted to engage a projection on the pivotal member 131. With each vertical movement of the saddle 32, an outer projection on the pivotal member 131 comes in contact with a projection 132 outstanding from the member 31, so that with each vertical movement of the saddle 32 the pivotal member will be oscillated to slightly advance the position of the wheel 74 by rotating the threaded shaft 69.

In order to discontinue feeding movements of the wheel when a predetermined position of the ratchet wheel 124 has been reached, an arm 133 having a small projection 136 engaging the teeth of the ratchet wheel 124 is provided forced toward the ratchet wheel by a suitable spring 134 surrounding the shaft. With each movement of the ratchet wheel 124 this arm 133 will also be moved. This arm carries members 135 extending over the teeth in the ratchet wheel 124 so that as soon as this arm 133 has been advanced to a position directly below the pawl 129, the pawl will ride over one of the members 135 and thus prevent further movement of the ratchet wheel 124 and thus stop further movement of the wheel 74 toward the work W.

To counterbalance the weights of the saddle 32 and its attached parts and the weight of the auxiliary slide 77 a single counterweight 138 is employed. This is movable within the column 11 and is connected to the saddle by a cable 139 passing over suitable idler pulleys. The counterweight 138 is connected to the slide 77 by a second cable 140 also passing over suitable idlers. By this arrangement of counterweight the slide 77 is moved simultaneously with the saddle 32.

What we claim is:

1. A screw thread generating machine comprising in combination, a base, a work supporting table thereon, means to rotate said table, a saddle movable on said base toward and from said table, a transversely movable slide on said saddle, a wheel spindle having a cutting wheel thereon rotatably mounted in said slide, a screw driven from said table rotation to move the saddle in one direction in timed relation to the table rotation, means to move said slide laterally during movement of the saddle, and driving means for the wheel spindle.

2. A screw thread generating machine comprising in combination, a base, a work supporting table thereon, means to rotate said table, a saddle movable on said base toward and from said table, a transversely movable slide on said saddle, a wheel spindle having a cutting wheel thereon rotatably mounted in said slide, means detachably attached to the center of the table to move the saddle in one direction in timed relation to the rotation of the table, means to move said slide laterally during movement of the saddle, and driving means for the wheel spindle.

3. A screw thread generating machine comprising in combination, a base, a work supporting table thereon, means to rotate said table, a saddle movable on said base toward and from said table, a transversely movable slide on said saddle, a wheel spindle having a cutting wheel thereon rotatably mounted in said slide, a driving shaft detachably attached at the center of said table, a screw attached to said saddle driving connections between said shaft and said screw whereby rotation of said table will move said saddle in timed relation to the table rotation, and manually operable means to disengage said shaft from said table.

4. A screw thread generating machine comprising in combination, a base, a work supporting table thereon, means to rotate said table, a saddle movable on said base toward and from said table, a transversely movable slide on said saddle, a wheel spindle having a cutting wheel thereon rotatably mounted in said slide, a shaft connected to the center of said table, a screw attached to said saddle, a nut rotatably mounted on said base and engaging said screw whereby rotation of said nut will raise and lower said saddle, and driving connections between said shaft and nut, said connections comprising a single tooth clutch.

5. A screw thread generating machine comprising in combination, a base, a work supporting table thereon, means to rotate said table, a saddle movable on said base toward and from said table, a transversely movable slide on said saddle, a wheel spindle having a cutting wheel thereon rotatably mounted in said slide, a shaft connected to the center of said table, a screw attached to said saddle, a nut rotatably mounted on said base and engaging said screw whereby rotation of said nut will raise and lower said saddle, driving connections between said shaft and nut, said connections comprising a single tooth clutch, and means to manually disengage said clutch and detach said shaft from said table.

6. A screw thread generating machine comprising in combination, a base, a work supporting table thereon, means to rotate said table, a saddle movable on said base toward

and from said table, a transversely movable slide on said saddle, a wheel spindle having a cutting wheel thereon rotatably mounted in said slide, a screw mounted in said saddle and normally maintained against rotation, a rotatable nut mounted in the base engaging said screw and adapted to be rotated by said table, means to move said slide laterally during movement of the saddle, and driving means on the slide for the wheel spindle.

7. A screw thread generating machine comprising in combination, a base, a work supporting table thereon, means to rotate said table, a saddle movable on said base toward and from said table, a wheel spindle having an abrasive wheel thereon adjustably mounted on said saddle, a shaft connected to the center of said table, driving connections between said shaft and a rotatably mounted nut, a screw attached to said saddle and engaging said nut whereby rotation of said nut will move said saddle, and lead compensating means between said screw and saddle.

8. A screw thread generating machine comprising in combination, a base, a work supporting table thereon, means to rotate said table, a saddle movable on said base toward and from said table, a wheel spindle having an abrasive wheel thereon adjustably mounted on said saddle, a shaft connected to the center of said table, driving connections between said shaft and a rotatably mounted nut, a screw attached to said saddle and engaging said nut whereby rotation of said nut will move said saddle, a threaded member secured to said screw and engaging a correspondingly threaded member secured to said saddle, and means to slightly rotate said screw in its threaded member during movement of said saddle whereby the lead of said screw may be compensated.

9. A screw thread generating machine comprising in combination, a base, a work supporting table thereon, means to rotate said table, a saddle movable on said base toward and from said table, a wheel spindle having an abrasive wheel thereon adjustably mounted on said saddle, a shaft connected to the center of said table, driving connections between said shaft and a rotatably mounted nut, a screw attached to said saddle and engaging said nut whereby rotation of said nut will move said saddle, a threaded member secured to said screw and engaging a correspondingly threaded member secured to said saddle, and means to rotate said screw in its threaded member adjustable predetermined amounts during movement of said saddle whereby the lead of screw may be compensated.

10. A screw thread generating machine comprising in combination, a base, a work supporting table thereon, means to rotate said table, a saddle movable on said base toward and from said table, a wheel spindle having a cutting wheel thereon adjustably mounted on said saddle, a shaft connected to the center of said table, driving connections between said shaft and a rotatably mounted nut in said base, a screw attached to said saddle and engaging said nut whereby rotation of said nut will move said saddle, and means to manually rotate said screw to adjust the position of said saddle.

11. A screw thread generating machine comprising in combination, a base, a work supporting table thereon, means to rotate said table, a saddle movable on said base toward and from said table, a transversely movable slide on said saddle, a wheel spindle having a cutting wheel thereon rotatably mounted in said slide, means driven from said table to move the saddle in one direction in timed relation to the rotation of the table, means to move said slide laterally during movement of the saddle, an auxiliary slide movable parallel to said saddle, and driving means on the auxiliary slide for the wheel spindle.

12. A screw thread generating machine comprising in combination, a base, a work supporting table thereon, means to rotate said table, a saddle, movable on said base toward and from said table, a transversely movable slide on said saddle, a wheel spindle having a cutting wheel thereon rotatably mounted in said slide, means to rotate said table and move said saddle in timed relation to each other, an auxiliary slide, means to move said slide with said saddle, a motor on said auxiliary slide, and driving connections between said motor and said spindle.

13. A screw thread generating machine comprising in combination, a base, a work supporting table thereon, means to rotate said table, a saddle movable on said base toward and from said table, a transversely movable slide on said saddle, a wheel spindle having a cutting wheel thereon rotatably mounted in said slide, means to rotate said table and move said saddle in timed relation to each other, an auxiliary slide, means to move said slide with said saddle, a vertical shaft forming a pivotal support for said auxiliary slide whereby it may oscillate on said shaft, a motor on said auxiliary slide, driving connections between said motor and spindle, and means to maintain said auxiliary slide in oscillated position during operation of the machine.

14. A screw thread generating machine comprising in combination, a base, a work supporting table thereon, means to rotate said table, a saddle movable on said base toward and from said table, a transversely movable slide on said saddle, a wheel spindle having a cutting wheel thereon rotatably mounted in said slide, means to rotate said table and move said saddle in timed relation to each other, an auxiliary slide, means to

move said slide with said saddle, a vertical shaft forming a pivotal support for said auxiliary slide whereby it may oscillate on said shaft, means to rotate said shaft to facilitate sliding movement of said auxiliary slide thereon, a motor on said auxiliary slide, driving connections between said motor and spindle, and tensioning means for said driving connections extending between said slide and auxiliary slide.

15. A screw thread generating machine comprising in combination, a base, a work supporting table thereon, means to rotate said table, a saddle movable on said base toward and from said table, a wheel spindle having an abrasive wheel thereon adjustably mounted on said saddle, means to move said saddle in timed relation to the table rotation, a motor supporting slide movable with said saddle, a motor thereon, a vertical shaft pivotally supporting said slide, means to slowly rotate said shaft to facilitate movement of said slide thereon, and driving connections between said motor and spindle.

16. A screw thread generating machine comprising in combination, a base, a work supporting table thereon, means to rotate said table, a saddle movable on said base toward and from said table, a transversely movable slide on said saddle, a wheel spindle having a cutting wheel thereon rotatably mounted in said slide, a screw driven from said table rotation to move the saddle in one direction in timed relation to the table rotation, a transversely movable slide on said saddle, a control shaft adapted to be rotated in timed relation to the table, dogs on said control shaft adapted to move said slide in opposite directions, and means operated by movement of said slide to reverse the movement of said saddle and the rotation of said table.

17. A machine tool comprising in combination, a base, a column thereon, a saddle supported thereon for vertical movement, an auxiliary slide adjacent said saddle and supported for vertical movement, a single counterweight, and independent cables connecting said counterweight respectively to said saddle and said auxiliary slide.

18. A machine tool comprising in combination, a base, a column thereon, a saddle supported thereon for vertical movement, an auxiliary slide adjacent said saddle and supported for vertical movement independently of said saddle, a single counterweight, and independent cables connecting said counterweight respectively to said saddle and said auxiliary slide.

In testimony whereof, we hereto affix our signatures.

FRANK O. HOAGLAND.
PAUL M. MUELLER.
A. B. LINDSTROM.