Dec. 16, 1930. W. F. NEWBROUGH 1,784,972

MACHINE FOR FORMING SCREW PROPELLERS

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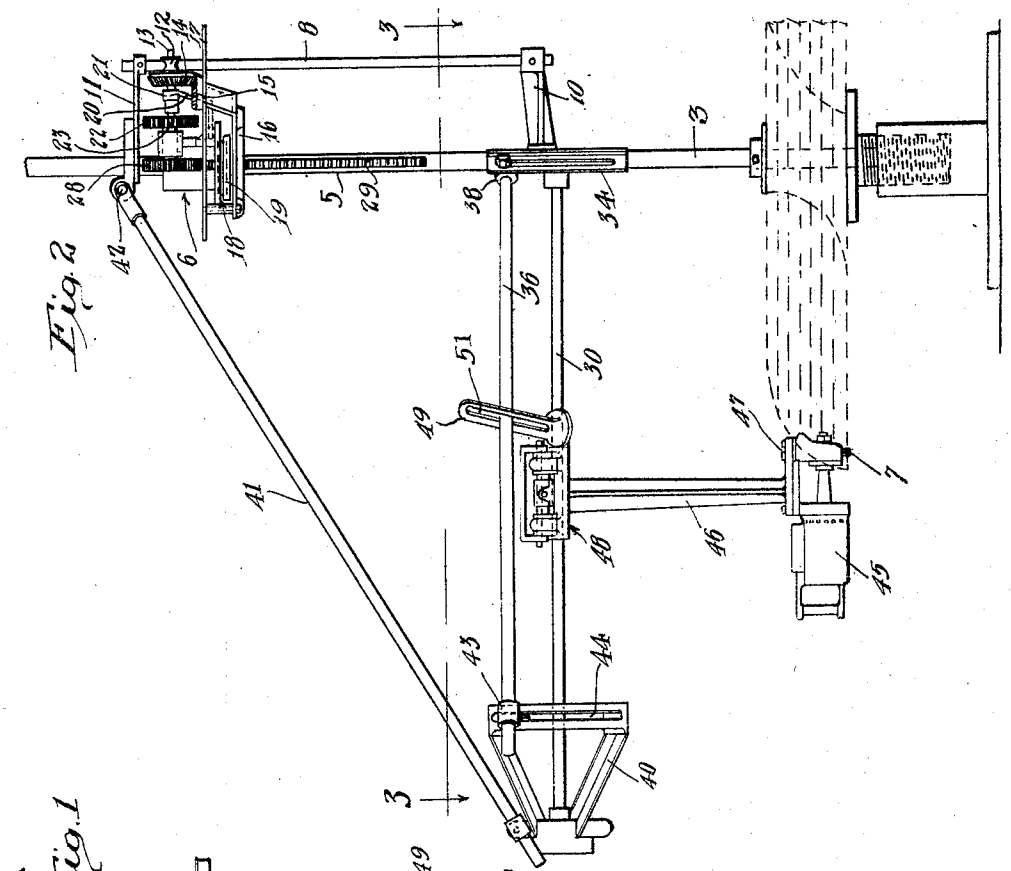


Fig. 2

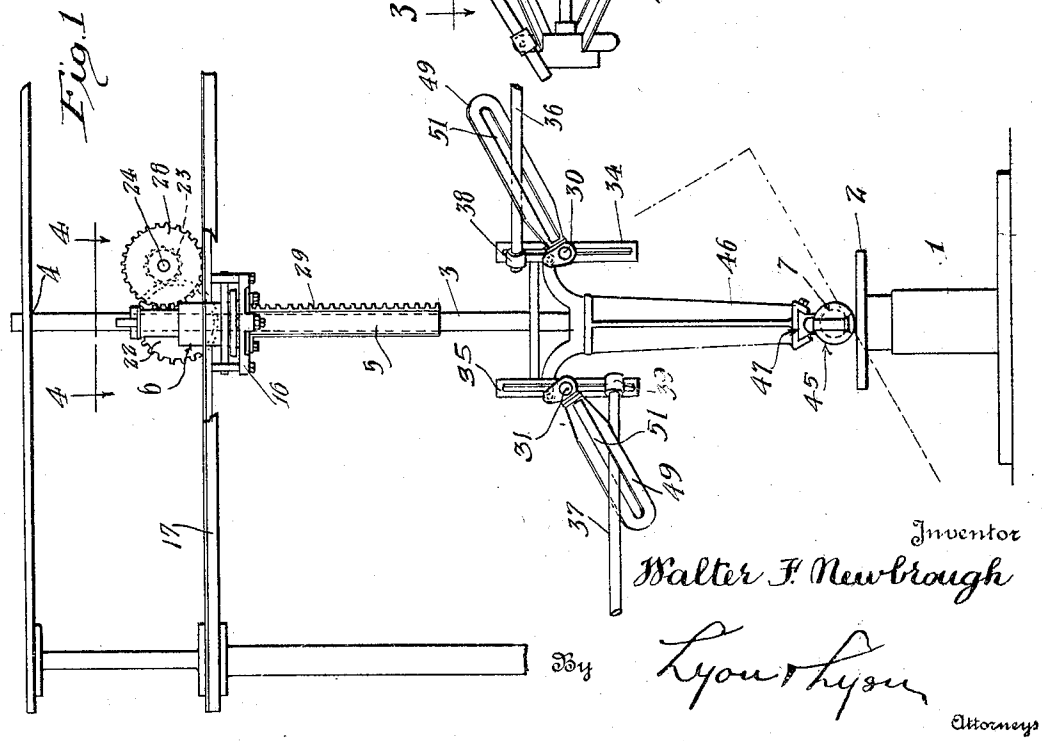


Fig. 1

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Fig. 3

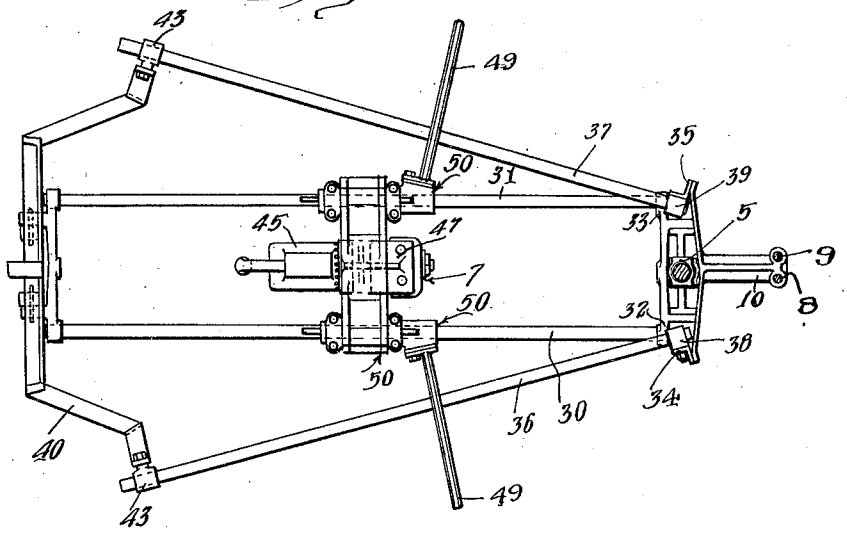


Fig. 4

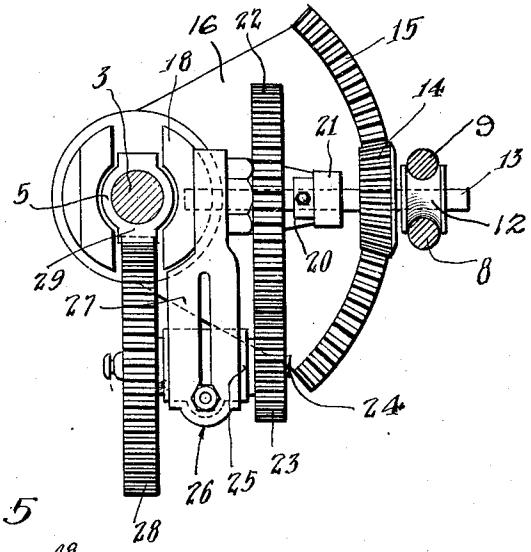
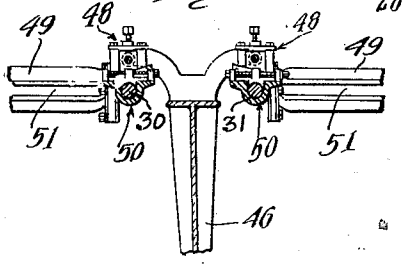


Fig. 5



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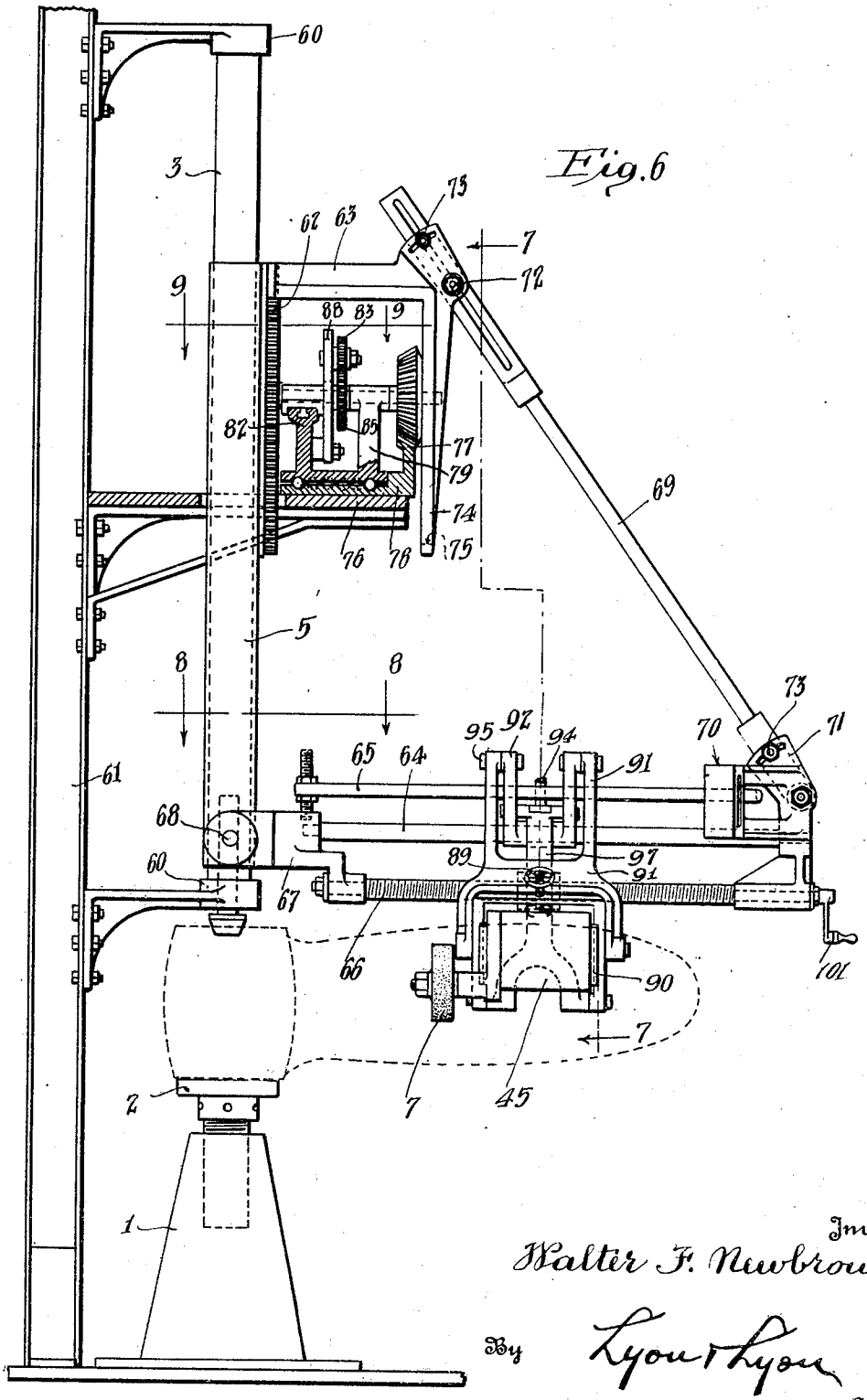
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Fig. 6



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Fig. 9

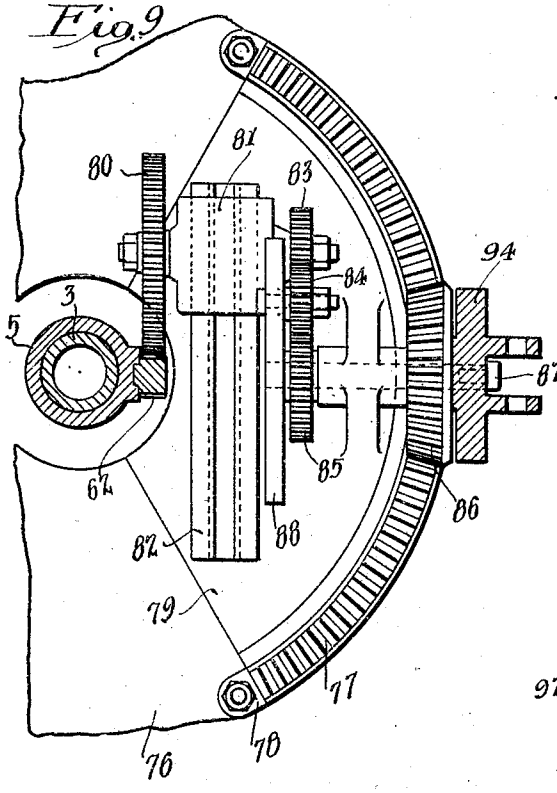
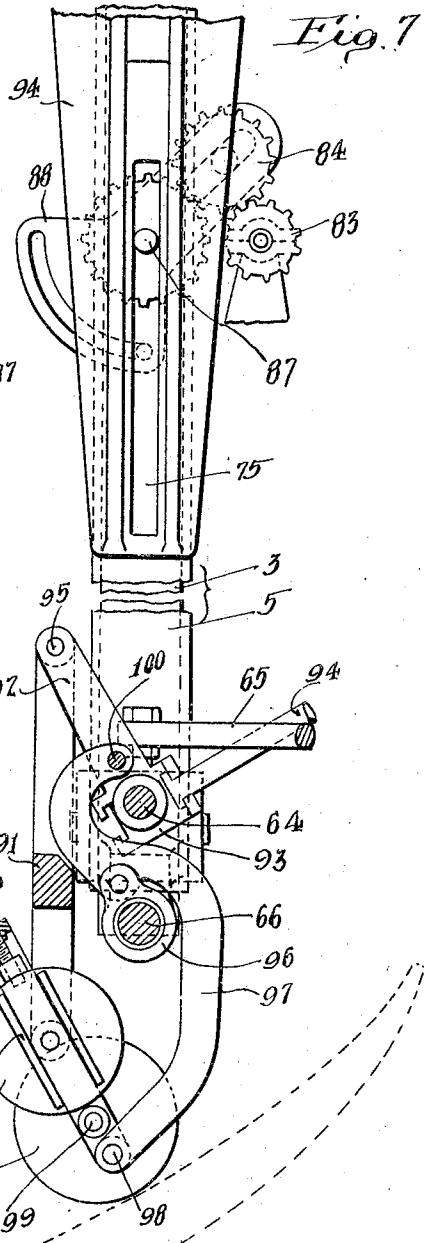


Fig. 7



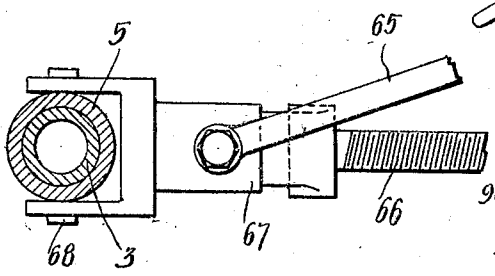


Fig. 8

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UNITED STATES PATENT OFFICE

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MACHINE FOR FORMING SCREW PROPELLERS

Application filed May 28, 1928. Serial No. 281,304.

This invention relates to machines for forming screw propellers, and is more particularly related to a machine for forming patterns for the casting of screw propellers, for forming screw propellers, or for tooling screw propellers to the accurate pitch required after the same have been cast from said patterns.

In forming screw propellers heretofore, it has been the practice to form the patterns for casting the screw propellers by hand and to tool the screw propellers or grind the same by means of tools held and driven in no particular or definite manner so that the truing and tooling or grinding of the screw propellers after they have been cast has also been practically a matter of guesswork, depending upon trial and error to obtain even slight accuracy in the pitch of the propellers. In driving a ship, (or air craft) particularly when traveling through the water with such propellers, vibrations are set up which are traceable directly to the fact that the propellers are not of accurate pitch.

It is, therefore, an object of this invention to provide a machine for forming accurately, patterns for the casting of screw propellers.

Another object of this invention is to provide a machine adapted for use in tooling the cast propellers to accurate pitch.

Another object of this invention is to provide a machine for making screw propellers, which includes means for accurately holding the forming tool in position perpendicularly to each pitch angle of the propeller blade during the forming of said propeller.

Other objects and advantages of this invention, it is believed, will be apparent from the following detailed description of a preferred embodiment thereof, as illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a front elevation of a machine embodying this invention.

Figure 2 is a side elevation thereof.

Figure 3 is a top plan view thereof taken substantially on the line 3—3 of Figure 2.

Figure 4 is a section taken substantially on the line 4—4 of Figure 1.

Figure 5 is an end sectional view illustrating the manner of supporting the working tool hanger on the tracks and swivel connecting means for the chord determining arm embodied in this invention.

Figure 6 is a side elevation partly broken away of a modified form of my invention.

Figure 7 is a front elevation and section taken along the line 7—7 in Figure 6.

Figure 8 is an enlarged horizontal section of one portion of the modified form of my invention taken along the line 8—8 in Figure 6.

Figure 9 is an enlarged horizontal section taken along the line 9—9 in Figure 6.

In the preferred embodiment of this invention, illustrated in the accompanying drawings, 1 indicates a base to which a work support 2 is adjustably secured. Secured to the support 2 at its lower end is a rod 3, the rod 3 being likewise supported at its upper end, as illustrated at 4. Journaled on the rod 3 is a sleeve 5. The sleeve 5 is provided with a bearing 6 through which the sleeve 5 is permitted to move vertically. A shaft 13 is journaled in one side of the bearing 6. This shaft 13 carries a bevel pinion and a spur gear, thereby providing means adapted to raise and lower a forming tool 7, as described hereinafter.

The means provided for raising and lowering the tool 7 may be of any suitable or desirable construction, as is well understood in the art, and are herein illustrated as including spaced guide rods 8 and 9 which are secured to the tools rotating means, in a manner which will hereinafter be described, through a bracket 10 secured to the sleeve 5. The rods 8 and 9 are secured at their upper ends to a plate bracket 11, which is secured to the top of the sleeve 5. Supported between the rods 8 and 9 in order to permit the same to reciprocate vertically is a pulley 12 within which a shaft 13 is rotatably mounted. The shaft 13 carries a bevel pinion gear 14 in mesh with a bevel gear rack 15 which is secured to a bracket 16. The bracket 16 is held in position by means of arms 17 which are secured to a stationary support. A split collar 18 holds bearing 6 in contact with bearing 19 sup-

ported by a bracket 16 and on bearing 6 provides an extension 20 for supporting a bearing 21 within which the shaft 13 rotates. To the shaft 13 is secured a gear 22 which meshes with a pinion 23 secured to a shaft 24. The shaft 24 is journaled in a bearing 25 which is adjustably mounted, as indicated at 26, on an arm 27 secured to the bearing 6. The shaft 24 carries a gear 28 which meshes with a rack 29 secured to the sleeve 5. Angular motion of rods 30 and 31 about spindle 3 rotates the bracket 10 and rods 8 and 9, which through contact with pulley 12 cause the bevel pinion 14 carried by the shaft 13 to travel on the arc 15 and to rotate the shaft 13. The rotation of the shaft 13 raises and lowers the sleeve 5 through the rotation of the gears 22, pinion 23 and gear 28.

The gear 28 being held stationary at its axis and rotating in mesh with the rack 29 causes the sleeve 5 to raise and lower on the rod 3. The raising and lowering of the sleeve 5 maintains the tool 7 in position to form the propeller or propellers pattern to the correct pitch. The pitch to which the tool 7 will form the propeller blade is regulated by changing the gears 22 and 28 and the pinion 23. The screw turning machine thus provided at all times maintains the cutting tool in proper position to form the propeller or propeller pattern to the pitch desired as the tool is rotated through an arc about rod 3.

In order to maintain the tool 7 in position perpendicular or at right angles to each pitch angle of the propeller blade during the formof said propeller or propeller pattern, means of the following construction are provided:

A pair of spaced tracks 30 and 31 are secured to arms 32 and 33, respectively. The arms 32 and 33 are preferably formed integral with the sleeve 5. A pair of brackets 34 and 35 are secured to the arms 32 and 33, respectively. Radius rods 36 and 37 are adjustably secured, as indicated at 38 and 39, to the brackets 34 and 35, respectively. The radius rods and tracks are secured at their opposite ends to a bracket 40. The bracket 40 is supported by means of brace rods 41 which are secured at their ends 42 to the plate 11. The radius rods 36 and 37 are adjustably secured by means of collars 43 in guide slots 44 formed in the bracket 40.

The tool 7, which is driven by any suitable form of driving means, as is generally indicated at 45, is secured to a hanger 46, as indicated at 47. The hanger 46 is slidably mounted, as indicated at 48, on the tracks 30 and 31. The radius rods 36 and 37 diverge outwardly at any desired predetermined angle from the tracks 30 and 31. The inner ends of the tracks 30 and 31 and radius rods 36 and 37 are preferably located in the same vertical plane and the tracks and radius rods are horizontally parallel.

Means are provided between the tracks 30 and 31 and radius rods 36 and 37 for maintaining the tool 7 at right angles or perpendicular to each pitch angle of the propeller blade as the tool 7 is moved in and out on the tracks 30 and 31, which means preferably comprise arms 49 which are connected at a swivel connection 50 to the support 48 for the hanger 46. The arms 49 are slotted, as indicated at 51, and the radius rods 36 and 37 extend through the slots 51. At any particular point in its path, as tool 7 is moved longitudinally of the pattern or casting, the arms 49 are constrained to turn about the rods 30 and 31, the angle through which they move being determined by the horizontal and vertical distance between tracks 30 and 31 and radius rods 36 and 37. The angle made by the member 49 to the horizontal plane at any point on the tracks 30 and 31 is the pitch angle of the propeller blade at that same distance from the center of the propeller, and the angular motion of member 49 about the rods or tracks 30 and 31 causes the support 48, arm 46 and tool 7 to move horizontally and vertically, so that the tool will touch the propeller surface at the proper position, that is, it will be tangential to the surface on a radial line. For example, at a point near the center of the propeller or near the spindle 3, the pitch angle is large, while at points further away from the center it becomes gradually smaller. The bracket 40 is adjustably mounted on the brace rods 41 in order to permit the tracks 30 and 31 and radius rods 36 and 37 to be inclined vertically at their outer ends to enable the tool 7 to form the propeller blade to any desired angle other than a square thread as would be formed with the tracks and radius rods in the position indicated in the drawings.

The operation of the machine embodying this invention is as follows:

Considering the machine as set for the production of a screw thread of a pitch of, for example, 48 inches and with the radius rods 36 and 37 set at angles of 15° from the tracks 30 and 31, the gears 23 and 28 and gear pinion 22 are fixed by their ratios to carry the tracks 30 and 31 through that pitch in a manner which is well understood in the art of forming screw threads. The vertical spacings of the radius rods 36 and 37 from the respective tracks 30 and 31 is adjusted and the distance of the centers of said radius rods from the centers of said tracks is calculated in the following manner:

The angle between the radius rods and track being 15° and the pitch being 48 inches, the distance of the centers of the tracks would be 15/360 of 48 or 2 inches. The screw to be formed is mounted upon the support 2 either in the form of a rough pattern or

as the casting to be tooled to the exact correct pitch and the tool operating means 45 set in motion to operate the tool 7. The operator then rotates the tracks 30 and 31 on the sleeve 5 around the rod 3 which carries the tool 7 back and forth radially across the pattern or casting.

The tool 7 is moved longitudinally of the pattern or casting by sliding the support 48 longitudinally along the tracks 30 and 31 during which sliding movement of the support 48 the arms 49 operate to determine the pitch angle of the arc upon which the tool 7 is operating, thereby maintaining the tool 7 perpendicular or at right angles to each pitch angle of the pattern or casting on which the tool is operating in any given position of the tool 7 relative to the said pattern or casting. The rotation of the tracks 30 and 31 about rod 3 causes the rods 8 and 9 to operate to shift the vertical position of the tracks 30 and 31 to correspond with the predetermined pitch of the thread being formed.

The form of apparatus shown in Figures 6 to 9 is a modification of my invention which differs in construction but not in mode of operation from the machines previously described herein. The side elevation shown in Figure 6 is partly broken away. In general, the means for supporting the work and moving the forming tool 7 are similar to those previously shown in the drawing. The rod or vertical guide 3 is shown firmly held by means of collars 60, or other suitable means, applied to each end of the guide 3 and connected to a suitable standard, part of a building or the like, 61, so as to maintain the rod 3 in a fixed relation with the work supports 1 and 2.

The sleeve 5 journaled on the guide 3 and movable thereon is provided with a spur gear 62 mounted near the upper end thereof. The sleeve 5, together with bracket 63 and other members connected therewith, may be caused to travel vertically upon the rod or guide 3 by means of suitable gearing which may be set into motion by partial rotation of the sleeve 5 upon the rod 3. For example, the guide rod 64, radius rod 65, and threaded shaft 66, are connected to the sleeve 5 by means of a horizontally pivoted bracket 67, the pivot pins being indicated at 68 (see Fig. 8). These elements are maintained in the required plane by means of a rod or brace 69 adjustably connected to an angular head bracket 70 by a suitable connection 71 formed centrally of the bracket 70 and to the bracket 63 (mounted upon the upper portion of the sleeve 5) by means of a slot and pin connection 72. Arcuate adjustable connections 73 are provided in both connections 71 and 72 so as to allow the brace 69 to assume various angles with the vertical when the bracket head 70 is raised or lowered. The bracket 63 is provided with a downwardly extending extension 74 provided with a slot 75 therein (see Fig. 7).

In suitable relation to the rack 62 mounted upon the sleeve 5 a stationary table or bracket 76 is provided. To this table 76 a section of a bevel gear 77 is attached by suitable means, as, for example, by the fixed support 78. The apex of the gear cone should preferably fall in the center of the vertical guide 3.

A support 79 is provided, said support being adapted to rotate in part about the guide 3, bearings being placed between the support 79 and the fixed support 78, or the table 76. The support 79 carries a gear 80 adapted to engage the rack 62, said gear 80 being mounted upon a shaft journaled in a bearing 81 which is adjustably mounted in a horizontal keyway or bed 82, said bed being rigidly connected with the rotatable support 79. Another gear 83 is also mounted upon the same shaft which carries gear 80 and motion is imparted thereto through an idler gear 84 by means of a driven gear 85, which in turn is actuated by a bevel gear 86 meshing with the quadrant gear 77. Gears 85 and 86 are mounted upon a common shaft 87, the outer end of this shaft extending into the slot 75 provided in the bracket extension 74.

By describing an arc with the head bracket 70 and other connecting elements about the vertical guide 3, the gear 86 will be caused to travel upon the gear segment or quadrant 77 (the shaft 87 being impelled by the bracket 74 which is connected with the sleeve 5 by means of the member 63), thereby causing the gear 80 to move the sleeve 5 in a vertical plane. This vertical motion is also imparted to the elements connected to said sleeve, namely, the guide rod 64, radius rod 65, shaft 66 and cutting tool 7.

The idler gear 84 is journaled in a pivoted carrier 80 so that the same gear may be used on the other side of the longitudinal axis of shaft 87, particularly when the bearing block 81, together with gears 80 and 83, is moved along the keyway or bed 82 so as to cause the gear 80 to engage the other side of the spur gear 62 from that shown engaged in Figure 9.

The forming tool 7 is driven by means of suitable gearing (not shown) by a motor 45 which is provided with means for adjusting the position of the motor with respect to the work upon which the forming tool operates. Such adjusting means may comprise a threaded shaft and hand wheel 89, the end of the threaded shaft being journaled into the motor housing so as to cause the motor to move along guides 90 in a plane at right angles to the surface of the work upon which the tool 7 operates. The motor 45 and forming tool 7 are supported by means of a yoke 91 suspended from a lever arm 92. The lever arm 92 is journaled upon the guide 64 through a collar 93. Extending from the collar 93 an arm 94 is provided, the axis of

the arm 94 being at right angles to the axis of the lever arm 92. The upper surface of the arm 94, however, should lie in a plane passing through the center of the guide rod 64 and the arm 94 passes beneath the radius rod 65 and during the operation of the apparatus the upper portion of the arm 94 moved slidably in contact with the lower portion of the radius rod 65. The elements 94, 93 and 92 constitute a link, the yoke 91 depending from a pivoted connection 95 at the outer end of the lever 92.

A threaded collar 96 is mounted upon the threaded shaft 66, the threaded collar 96 being pivotally connected to a yoke 97, the upper end of said yoke being pivotally connected to the two arms or levers 92. The lower end of the yoke 97 is pivotally connected to an extension of the motor and forming tool support so that the distance between the pivot 98 and the axis 99 of the forming tool is substantially equal to the distance between the center of the guide rod 64 and the pivot pin 100 by means of which the upper end of the yoke 97 is connected to the arms 92. A motion of the threaded shaft 66 imparted thereto by means of a handle 101 causes the entire mechanism comprising motor 45, forming tool 7, yokes 97 and 91 and arm 94 to travel radially away from or toward the vertical guide 3. In view of the fact that the radius rod 65 makes an angle with the guide 64, the forming tool 7 will make a greater angle with the vertical as the mechanism is moved towards the vertical guide 3 and a smaller angle with the vertical as the mechanism is moved away from the rod 3.

The operation of this modified form of apparatus will be evident to those skilled in the art in view of the description of the operation given regarding the apparatus shown in Figures 1 to 5 inclusive. Having fully described my invention, it is to be understood that I do not wish to be limited to the details of construction herein set forth as my invention is susceptible to various modifications without departing from the scope of my invention as defined in the appended claims.

I claim:—

1. In a device of the class described, the combination of a work support, a thread turning machine, a working tool, a track, means operably connecting the thread turning machine with said track, means for supporting said tool from said track, a radius arm adjustably mounted at an angle to said track, and means operably connecting said tool with said radius arm to maintain said tool in position substantially perpendicular to each pitch angle of the thread segment being formed.

2. In a device of the class described, the combination of a work support, a working tool, a screw turning machine operably connected with said tool, means for moving said tool over the work to form a thread segment, and means operably connected with said tool for maintaining the same in position substantially perpendicular to each pitch angle of the thread segment being formed.

3. In a device of the class described, the combination of a vertical rod, a sleeve on said rod, means for moving said sleeve on said rod when said sleeve is angularly displaced thereon, a cutting tool support attached to said sleeve comprising a threaded shaft and a guide rod extending radially from said sleeve and parallel to each other, a raidus rod extending from said sleeve and at a predetermined angle with said shaft and guide rod, a collar threadedly mounted on said shaft, a yoke pivotally connected to said collar, a lever slidably mounted on said guide and adapted to cooperate with said radius rod, said lever being pivotally connected with said yoke, a cutting tool pivotally carried by the yoke, and means operated by said lever for pivoting said cutting tool.

4. In a device of the character described, the combination of a vertical rod, a sleeve and rack gear on said rod, means for moving said sleeve on said rod, when said sleeve is angularly displaced thereon, said means including a rack gear carried by the sleeve, a fixed horizontally disposed gear segment, a horizontally movable gear train adapted to maintain said rack and segment in operative contact, a cutting tool support attached to said sleeve, comprising a threaded shaft and a guide rod extending radially from said sleeve and parallel to each other, a radius rod extending from said sleeve, means for positioning said radius rod at a predetermined angle with said shaft and guide rod, a lever slidably mounted on said guide rod and adapted to cooperate with said radius rod, and a cutting tool suspended from said lever.

5. In a device of the character described, the combination of a vertical rod, a sleeve and rack gear on said rod, means for moving said sleeve on said rod when said sleeve is angularly displaced thereon, said means including a rack gear carried by the sleeve, a fixed horizontally disposed gear segment, a horizontally movable gear train adapted to maintain said rack and segment in operative contact, a cutting tool support attached to said sleeve, comprising a threaded shaft and a guide rod extending radially from said sleeve and parallel to each other, a radius rod extending from said sleeve, means for positioning said radius rod at a predetermined angle with said shaft and guide rod, a lever slidably mounted on said guide rod and adapted to cooperate with said radius rod, a cutting tool suspended from said lever, and means operated by rotation of said shaft for moving said lever and cutting tool suspended

therefrom longitudinally upon said rod and shaft.

6. In a device of the class described, the combination of a vertical rod, a sleeve slidably mounted on said rod, a cutting tool supporting and guiding means attached to said sleeve and extending radially therefrom, a cutting tool pivotally suspended from said supporting and guiding means, means for moving said cutting tool along said supporting and guiding means, and means for raising and lowering said sleeve and cutting tool, supporting and guiding means when said sleeve is partially rotated about said rod, so as to move the cutting tool over work during said partial rotation to form a thread segment therein.

7. In a device of the class described, the combination of a vertical rod, a sleeve slidably mounted on said rod, a cutting tool supporting and guiding means attached to said sleeve and extending radially therefrom, a cutting tool pivotally suspended from said supporting and guiding means, means for moving said cutting tool along said supporting and guiding means, means for raising and lowering said sleeve, supporting and guiding means and cutting tool when said sleeve is partially rotated about said rod, to move the cutting tool over work during said partial rotation to form a thread segment therein, and means for pivoting said cutting tool to maintain the same substantially perpendicular to pitch angle of the segment being cut.

8. In a device of the class described, the combination of a vertical rod, a sleeve slidably mounted on said rod, a cutting tool supporting and guiding means attached to said sleeve and extending radially therefrom, a linkage suspension movable along said cutting tool supporting and guiding means and including a cutting tool pivotally carried by said linkage means for moving said cutting tool and linkage along said supporting and guiding means, means for raising and lowering said sleeve, supporting and guiding means and cutting tool when said sleeve is partially rotated about said rod to move the cutting tool over work during said partial rotation, to form a thread segment therein.

9. In a device of the class described, the combination of a vertical rod, a sleeve slidably mounted on said rod, a cutting tool supporting and guiding means attached to said sleeve and extending radially therefrom, a linkage suspension movable along said cutting tool supporting and guiding means and including a cutting tool pivotally carried by said linkage means, for moving said cutting tool and linkage along said supporting and guiding means, means for raising and lowering said sleeve, supporting and guiding means and cutting tool when said sleeve is partially rotated about said rod to move the cutting tool over work during said partial rotation, to form a thread segment therein, and means actuated by movement of said linkage suspension along said supporting and guiding means for pivoting the cutting tool to maintain the same substantially perpendicular to pitch angle of thread segment being cut.

10. In a device of the class described, the combination of a vertical rod, a sleeve on said rod, means for moving said sleeve on said rod when said sleeve is angularly displaced thereon, a cutting tool supporting and guiding means attached to the said sleeve, said supporting means comprising a threaded shaft and a guide rod extending radially from said sleeve and parallel to each other, a radius rod extending from said sleeve at an angle with said shaft and guide rod, a collar threadedly mounted on said shaft, a yoke pivotally connected to said collar, a lever slidably mounted on said guide and adapted to cooperate with said radius rod, said lever being pivotally connected with said yoke, a cutting tool pivotally carried by the yoke, means operated by said lever for pivoting said cutting tool, and means for rotating said threaded shaft for moving said collar, yoke and lever longitudinally along said shaft and guide rod.

11. In a device of the class described, the combination of a vertical rod, a sleeve and rack gear on said rod, means for moving said sleeve vertically upon said rod when said sleeve is partially rotated thereon, a cutting tool support attached to said sleeve, comprising a threaded shaft and a guide rod extending radially from said sleeve and parallel to each other, a radius rod extending from said sleeve and angularly positioned with respect to said shaft and guide rod, a lever slidably mounted on said guide rod and adapted to cooperate with said radius rod, a cutting tool suspended from said lever, and means actuated by rotation of said threaded shaft for moving said lever and cutting tool longitudinally along said guide rod.

Signed at Los Angeles, California, this 17th day of May, 1928.

WALTER F. NEWBROUGH.