B. M. W. HANSON.

MACHINE FOR MILLING SPIRALS.

APPLICATION FILED SEPT. 9, 1905.

948,696.

Patented Feb. 8, 1910.

7 SHEETS—SHEET 1.

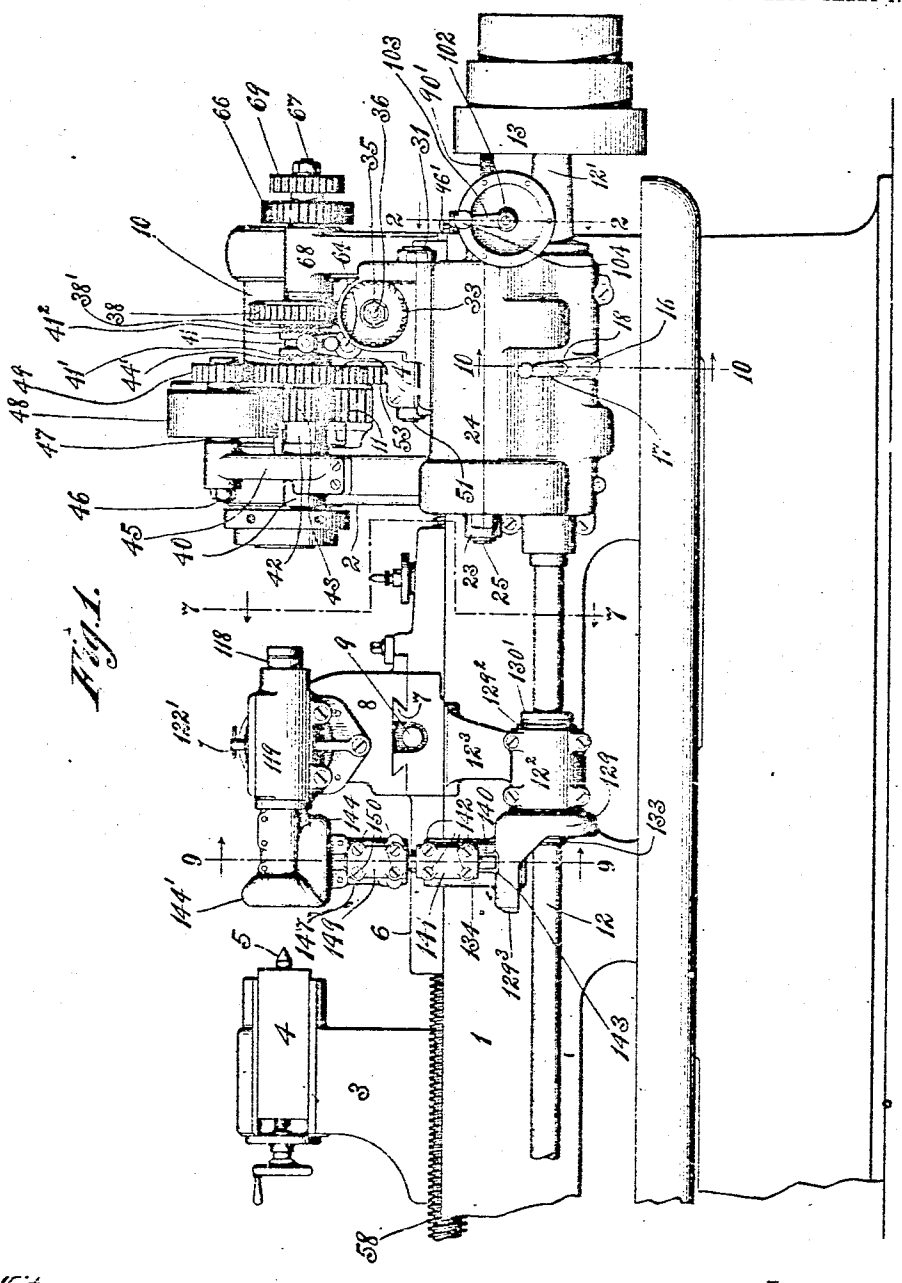

Fig. 1.

Witnesses:

F. E. Anderson

S. L. Grotta.

Inventor:

B. M. W. Hanson,

By his Attorney,

Wm. H. J. Hodgkins

B. M. W. HANSON.

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7 SHEETS—SHEET 2.

Fig. 2.

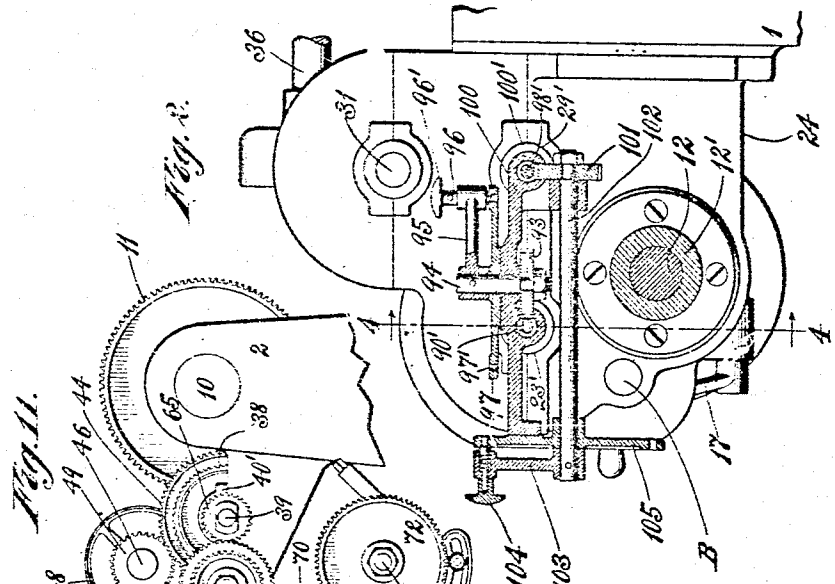
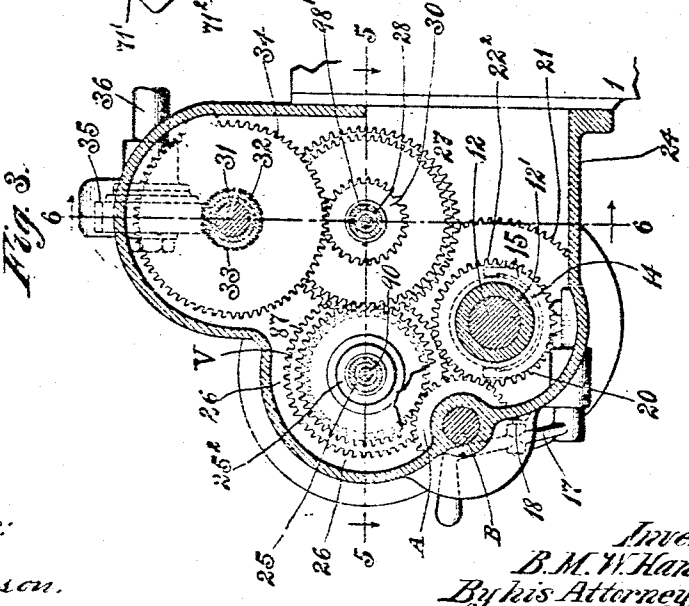


Fig. 1.

Fig. 3.



Witnesses:

H. E. Anderson.

S. L. Grotta.

Inventor:

B. M. W. Hanson,

By his Attorney,

Mary H. Goodwin

B. M. W. HANSON.

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7 SHEETS—SHEET 3.

Fig. 4.

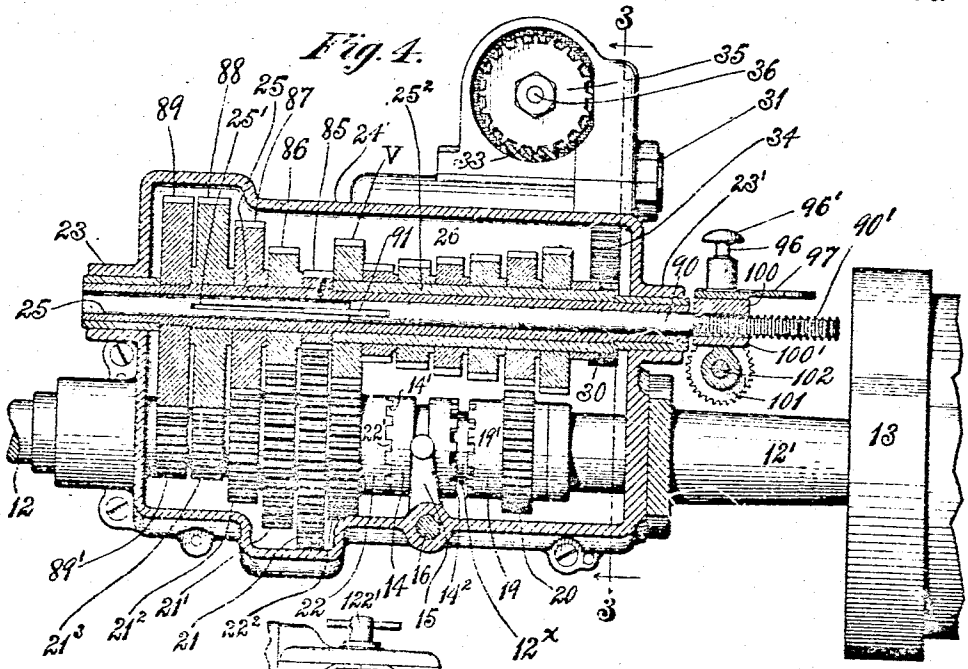


Fig. 9.

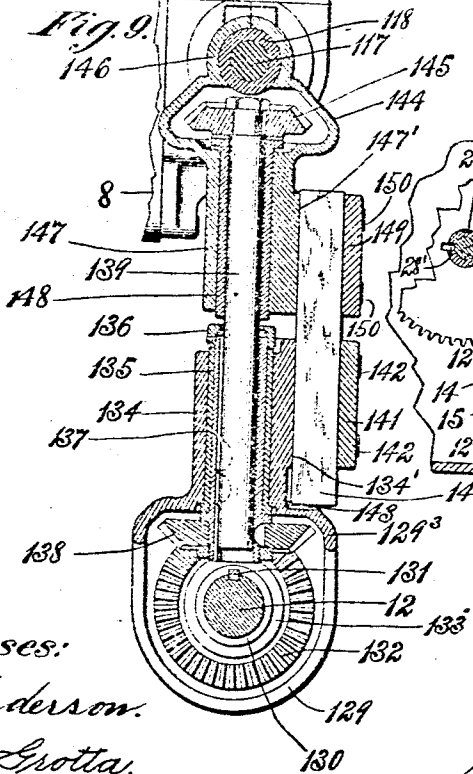
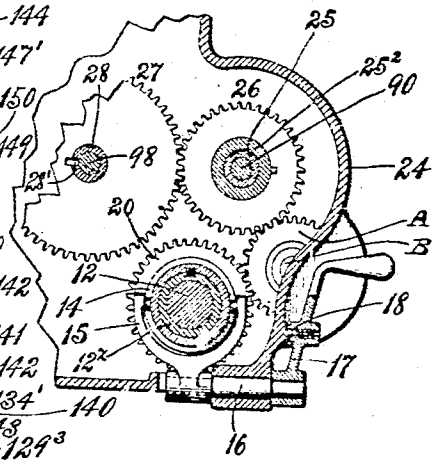


Fig. 10.



Witnesses:

H. E. Anderson.

S. S. Grotta.

Inventor:

B. M. W. Hanson,

By his Attorney,

Wm. F. Dodge

B. M. W. HANSON.

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7 SHEETS—SHEET 4.

Fig. 5.

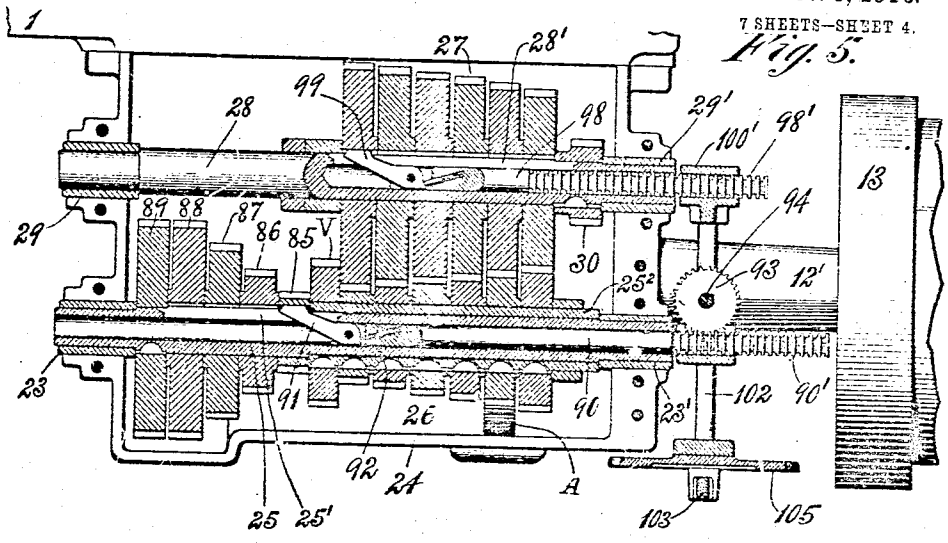


Fig. 6.

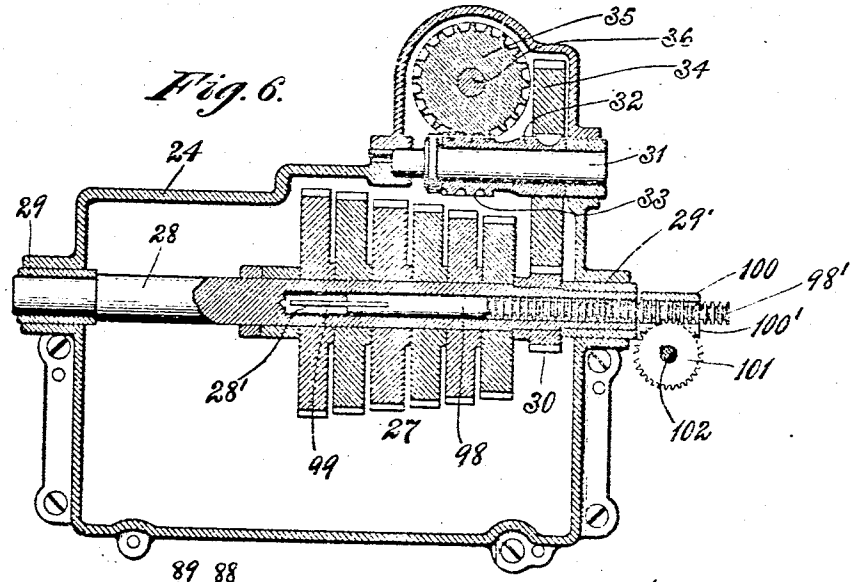
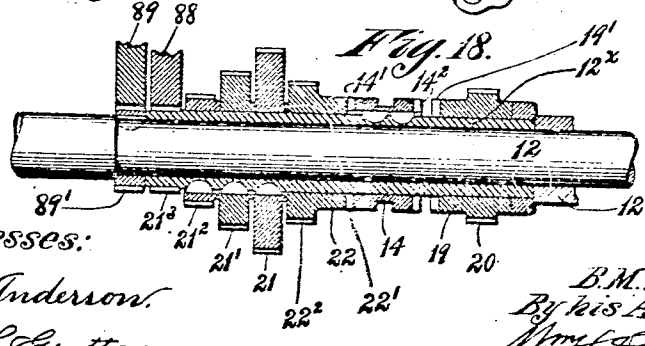


Fig. 18.



Witnesses:

H. E. Anderson.

S. S. Grotta.

Inventor:

B. M. W. Hanson,

By his Attorney,

Wm. H. J. Stadgett

B. M. W. HANSON.

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7 SHEETS—SHEET 5.

Fig. 1".

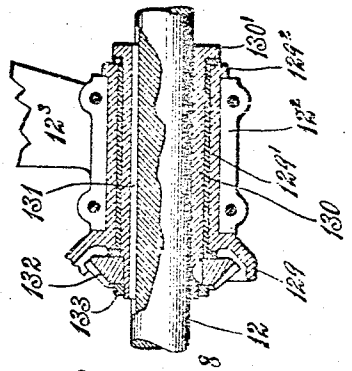

Fig. 1.

Witnesses:

H. E. Anderson.

S. L. Grotta

Inventor:

B. M. W. Hanson,

By his Attorney,

Wm. R. Wright

B. M. W. HANSON.

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7 SHEETS—SHEET 6.

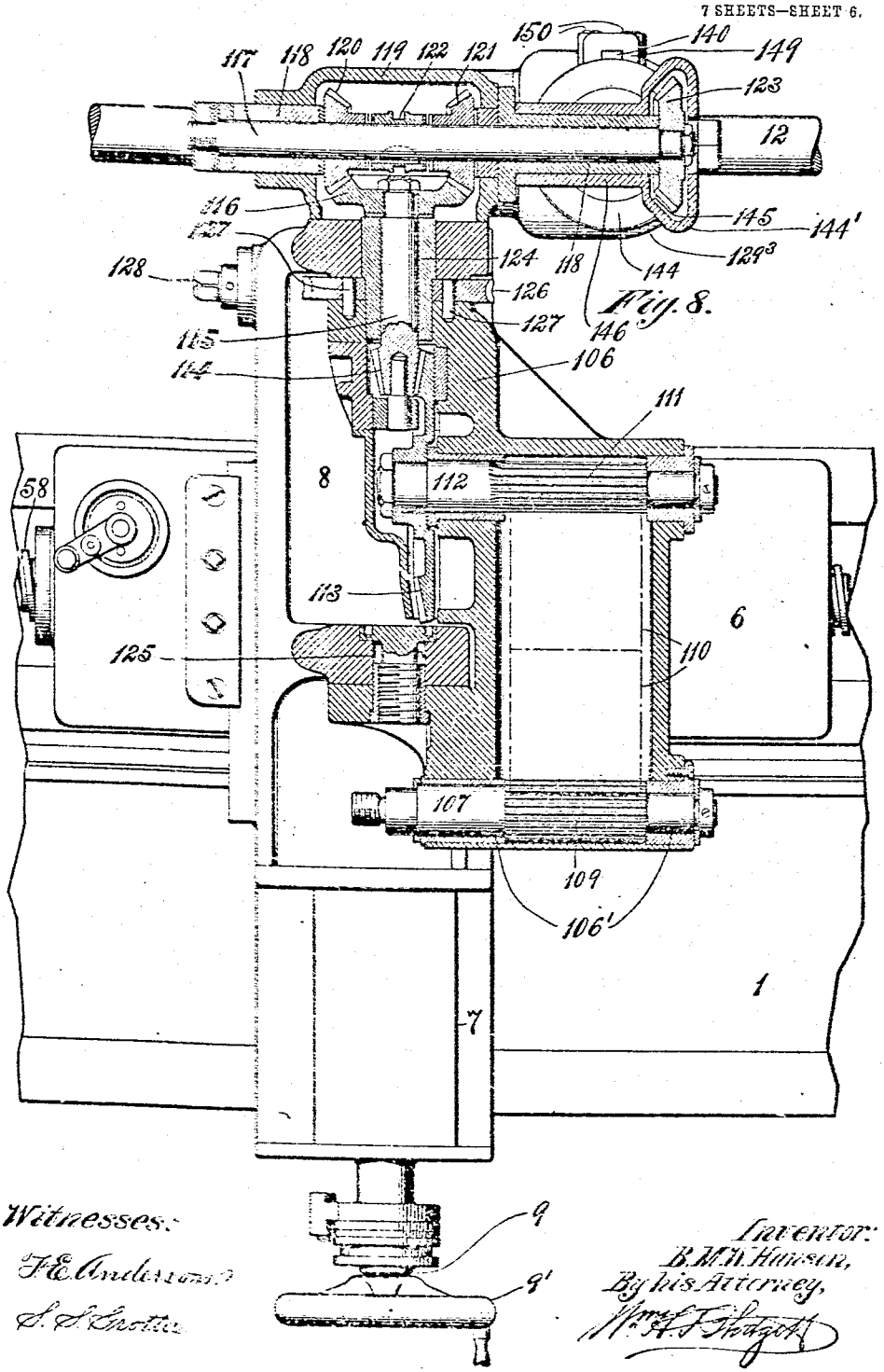

Fig. 8.

Witnesses:

F. E. Anderson

S. S. Grotta

Inventor:

B. M. W. Hanson,

By his Attorney,

Wm. F. Stratford

B. M. W. HANSON.

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7 SHEETS—SHEET 7.

Fig. 13.

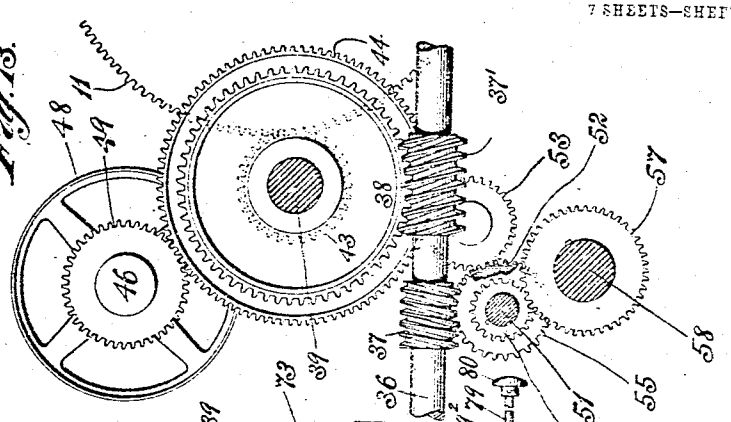


Fig. 16.

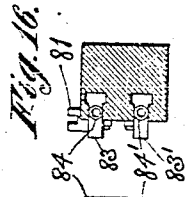


Fig. 15.

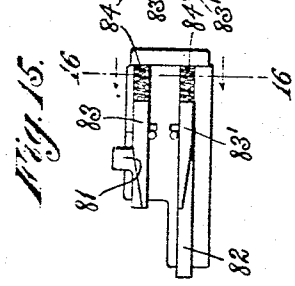


Fig. 14.

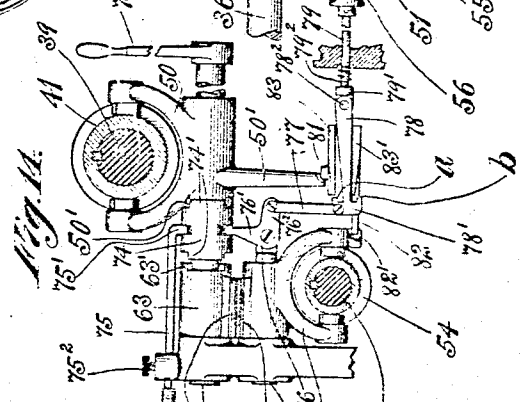
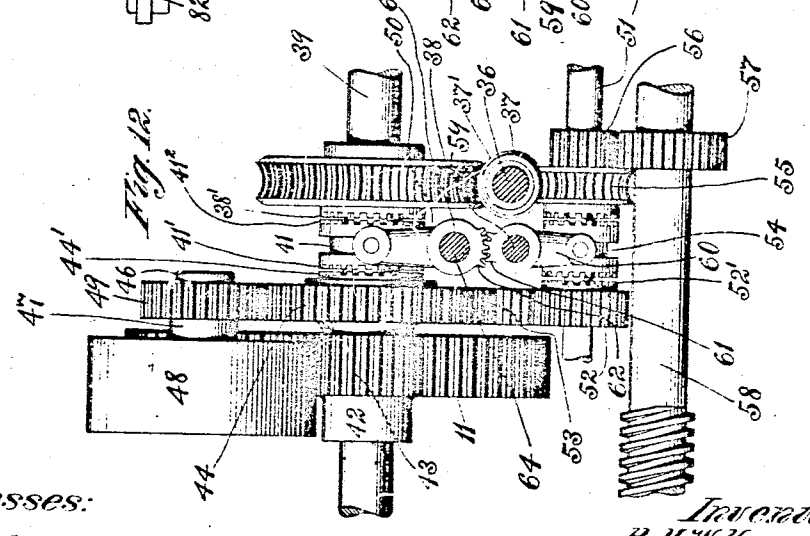


Fig. 12.



Witnesses:

H. Anderson.

L. L. Grotta.

Inventor:

B. M. W. Hanson,

By his Attorneys,

Wm. H. Dodge & Co.

UNITED STATES PATENT OFFICE.

BENGT M. W. HANSON, OF HARTFORD, CONNECTICUT, ASSIGNOR TO PRATT & WHITNEY COMPANY, OF HARTFORD, CONNECTICUT, A CORPORATION OF NEW JERSEY.

MACHINE FOR MILLING SPIRALS.

948,696. Specification of Letters Patent. Patented Feb. 8, 1910.

Application filed September 9, 1905. Serial No. 277,709.

To all whom it may concern:

Be it known that I, BENGT M. W. HANSON, a citizen of Sweden, (having declared my intention of becoming a citizen of the United States,) residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Machines for Milling Spirals, of which the following is a specification.

This invention relates to machines for milling spirals such as screw-threads, worms or spiral work of any kind, and more particularly to that type of said machines covered by Letters Patent of the United States issued to me on February 14, 1905, Number 782,237.

One of the principal objects of this invention is the provision of an improved system of gearing for driving either the lead-screw from the spindle or the spindle from the lead screw, as circumstances may require, in milling threads of different pitches.

A further object of the invention is the provision of improved means for driving the gearing for actuating the milling-cutter or other rotary tool for forming the spiral.

A further object of the invention is the provision of an improved drive for imparting a quick return movement to the lead screw.

Other objects of the invention will be hereinafter set forth.

In the accompanying drawings, Figure 1 is a side elevation of a machine for milling spirals embodying my improvements. Fig. 2 is transverse vertical section on line 2—2 of Fig. 1. Fig. 3 is a transverse vertical section on line 3—3 of Fig. 4. Fig. 4 is a longitudinal vertical section on line 4—4 of Fig. 2, certain elements being represented in elevation. Fig. 5 is a horizontal section on line 5—5 of Fig. 3. Fig. 6 is a longitudinal vertical section on line 6—6 of Fig. 3. Fig. 7 is a transverse section on line 7—7 of Fig. 1. Fig. 8 is a horizontal section on line 8—8 of Fig. 7. Fig. 9 is a longitudinal vertical section on line 9—9 of Fig. 1. Fig. 10 is a transverse vertical section on line 10—10 of Fig. 1. Fig. 11 is a partial end view showing the gearing connecting the spindle and lead-screw; and Figs. 12, 13, 14, 15, 16, 17 and 18 are detail views hereinafter mentioned.

Like numerals designate similar parts throughout the several views.

Referring to the drawings, the numeral 1 designates the frame or bed of the machine, 2 the head-stock, and 3 the tail-stock, the latter carrying the usual adjustable slide 4 and center 5. On the bed is fitted a slide 6 which is provided with a way 7 for the reception of a tool-carriage 8, said tool-carriage being adjusted transversely by the usual screw 9. In the head-stock 2 is mounted a live-spindle 10 carrying a chuck (not shown) of any approved type for clamping the work, and this spindle carries a gear 11 to which power is applied for driving the same directly through a gear train subsequently described, or indirectly from the lead-screw, as will be hereinafter explained.

Designated by the numeral 12 is the driving-shaft of the machine, said shaft carrying at one end a stepped cone-pulley 13, and being mounted in bearings 12′—12² of the frame and cross-slide. Loosely surrounding said driving-shaft is a sleeve 12ˣ, and splined to said sleeve is a clutch 14 having clutch teeth 14′—14² on its respective ends (see Fig. 4), and for shipping said clutch a fork 15 is provided, said fork being attached to a rock-shaft 16 carrying an operating lever 17, having a locking detent 18. Loose on the sleeve 12ˣ at one side of the clutch 14 is a short sleeve 19 having clutch teeth 19′, and carrying a gear 20, and rigid with said sleeve 12ˣ on the opposite side of the clutch 14 are variable-speed gears 21, 21′, 21², 21³, while loose on the sleeve 12ˣ is a hub 22 having a clutch-face 22′ and carrying a gear 22². Above the driving-shaft 12, and journaled in bearings 23—23′ of a gear-box or housing 24, is a tubular shaft 25, slotted for a portion of its length at 25′ for a purpose hereinafter stated, and loose on this tubular shaft is a sleeve 25², said sleeve carrying variable-speed gears designated generally by 26, and one of which is always in mesh with an idler A driven by the gear 20, and mounted on a stub-shaft B, so that when the clutch 14 is in engagement with the teeth 19′ of sleeve 19 the sleeve 25² and the variable-

speed gears 26 keyed to said sleeve will be rotated.

In mesh with the variable-speed gears 26 are the gears of a variable speed cone 27, said gears being loosely mounted on a partitubular shaft 28 slotted at the part of its length where the gears 27 are located at 28′, said shaft 28 being journaled in bearings 29—29′ of the gear-box 24, and carrying keyed thereto a pinion 30.

Loosely mounted on a short stationary shaft 31 in the upper part of the gear-box is a sleeve 32 carrying a spiral-gear 33 and a spur-gear 34, the gear 33 being in mesh with a larger spiral-gear 35 rigid with a transverse shaft 36, carrying a pair of reversely-threaded worms 37—37′ as shown in Fig. 13, and one of which 37′ has a right-hand thread, engages a worm-wheel 38 loose on a shaft 39 journaled in bearings 40—40′ of the head-stock, said worm-wheel having a clutch-face 38′. Splined to the shaft 39 is a clutch 41, having clutch teeth 41′—41², the latter being adapted, when the clutch is thrown to the right from the intermediate position shown in Figs. 1 and 12 to engage the clutch-teeth of said worm-wheel, and thus to cause said worm-wheel to drive the shaft 39. Fixed to the shaft 39 is a hub 42, carrying a pinion 43, and loose on said shaft is a spur-gear 44, the latter having a clutch-face 44′, adapted to be engaged by the clutch when said clutch is shifted to the left. As before stated the spindle 10 is equipped with a gear 11, and the pinion 43 engages said gear and drives the spindle with a slow speed when the clutch is in engagement with worm-wheel 38.

Projecting from a bracket 45 of the head-stock is a stud-shaft 46, and on said stud-shaft is a sleeve 47 carrying a belt-pulley 48 and a pinion 49, said pinion being in mesh with the gear 44 aforesaid, and this gearing being utilized for imparting a quick return movement to the lead screw and tool-carriage actuated thereby as will be hereinafter described. For shifting this clutch any desired means either manual or automatic may be employed, but there is shown for this purpose a fork-and-lever device designated generally by 50.

In bearings of the frame in which the shifter 50 is mounted is journaled a shaft 51, and on said shaft is loosely mounted a pinion 52 having clutch-teeth 52′, said pinion being in mesh with an idler 53 in engagement with the gear 44 on the shaft 39. Splined to the shaft 51 is a clutch 54 having clutch-teeth at each end, and adjacent to the right-hand clutch-teeth and also loose on the shaft, is a worm-wheel 55, driven by the left-hand worm-wheel 37 aforesaid. Adjacent to said worm-wheel is a pinion 56 keyed to the shaft 51, and said pinion is in mesh with a gear 57 rigid with the lead-screw 58.

Designated by 59 is a stud upon which is sleeved a clutch-shifting lever 60, provided at its upper end with a gear segment 61, the latter engaging a like segment 62 on a sleeve 63 loosely mounted on a rock-shaft 64.

On the shaft 39, and exterior to the bearing 40′ is keyed a pinion 65 in mesh with a gear 66 rigid with a shaft 67, said shaft being journaled in a bearing 68. This shaft 67 is reduced at its end, and has keyed on said reduced end a gear 69 of any desired diameter, and said gear meshes with a gear 70 which and a gear 71 rigid therewith, are loosely mounted on a stud 71′ fitted for sliding adjustment in the usual swinging change-gear lever 71². On the end of the lead-screw 58, about which as an axis said lever may be adjusted, is keyed a gear 72, driven by the gear 71 aforesaid. To the shaft 64 is secured an operating lever 73, and upon said shaft is loosely mounted the fork 50 for actuating the clutch 41, as above described.

Keyed to the shaft 64 between the hub of the yoke 50 and the sleeve 63 is a sliding clutch 74, having teeth 74′ at its respective ends, said teeth 74′ engaging clutch-teeth 63′ on the inner end of sleeve 63 when the clutch is shifted to the left, and said teeth 74′ engaging complemental teeth 50′ on the hub of fork 50 when the clutch is shifted to the right, as shown in Fig. 14. To operate the clutch 74 a rod 75 is mounted in a bearing of the frame, said rod having a hook 75′ at its inner end for engaging a groove in the clutch, and being secured after it has been shifted in either direction by a set-screw 75². To the inner end of shaft 59 is pivoted an angle lever 76 one arm 76′ of which is fitted at its end in a groove of the clutch 74, while its other arm 76² is articulated to a link 77 pivoted to the T-head 78′ of a lever 78, the latter being pivoted at 78² to the head 79′ of a sliding rod 79. This rod passes through the machine-frame, and is equipped at its outer end with a knob 80. A spring 79² surrounding the rod and bearing at one end against the head 79′ thereof, and at its other extremity against the frame, serves normally to keep the rod in the position illustrated in Fig. 14.

Normally the clutches 41 and 54 are held in neutral position by latches 81 and 82 respectively, and the latch 81 engages an arm 50′ depending from the hub of the fork 50 while the latch 82 engages an arm 82′ of fork 60. Each latch is rigid with a plunger 83, 83′ respectively, thrown outward by springs 84, 84′, as illustrated in Fig. 15.

Loose on the shaft 25 are gears 85, 86, 87 and 88 of varying diameters, and keyed to said shaft adjacent to the bearing 23 is a gear 89, in mesh with a pinion 89′ rigid with the driving shaft 12.

For connecting any of the loose gears 85, 86, 87 and 88 to the shaft 25 suitable clutch-mechanism is necessary and while not limited in choice, there is shown for accomplishing this result a rod 90 having a rack-thread 90′ at one end, and carrying at its opposite extremity a pivoted dog 91, the engaging face of which travels in the slot 25′, and is normally thrown upward to lock the desired gear to the shaft by a spring-actuated plunger 92. In mesh with the teeth 90′ is a gear 93 mounted on a shaft 94, said shaft being manipulated by a crank-handle 95 pinned thereto, and carrying a spring-actuated detent 96, having a finger grasp 96′. Mounted on the frame is a plate 97 having a series of holes 97′ with any of which the plunger may be engaged. In the bore of the shaft 28 a rod 98 is mounted, said rod having rack-teeth 98′, and carrying a dog 99 adapted to engage and lock to the shaft any gear of the variable speed set 27. This rod is movable in a bearing 100′ of a frame-plate 100, and is actuated by a pinion 101 carried by a transverse shaft 102, provided with a crank-handle 103, said handle having a spring-actuated plunger or detent 104, adapted to be received in perforations of a disk 105 rigid with the frame-plate 100, as shown in Fig. 2.

On the cross slide 8, which is adjustable transversely of carriage 6 by the screw 9 carrying a hand-wheel 9′ is mounted an angularly-adjustable cutter-frame 106, in journal-bearings 106′ of which is mounted a spindle 107 to which the milling cutter 108 is secured. For driving this spindle any desired gearing may be employed, and there is shown for this purpose a pinion 109 in mesh with gearing 110 (see dotted lines Fig. 8) actuated by a pinion 111 on a shaft 112 also journaled in the cutter-frame, said shaft having rigid therewith a bevel-gear 113. In mesh with the gear 113 is a bevel-pinion 114 rigid with a shaft 115 carrying at its end opposite said pinion a bevel-gear 116.

Designated by 117 is a shaft at right-angles to the shaft 115, and this shaft is journaled in bearings 118 of a hood or covering 119 constituting part of the cutter-frame, and carries within said hood a pair of loose opposing bevel-gears 120—121, each in mesh with the gear 116. A sliding-clutch 122 is splined to the shaft intermediate the gears 120—121, and may be shifted by any desired means, for instance, a knob 122′ to lock either of said gears to said shaft. On the end of shaft 117 is a bevel-gear 123, rigid with said shaft, and driven by means hereinafter described. To permit of angular adjustment of the cutter-frame it is sleeved on trunnions 124—125, and the desired adjustment is effected by a worm-wheel 126, secured to the frame by pins 127, and actuated by a worm shaft 128, the worm-teeth serving as means for locking the frame against movement after it has been adjusted.

In the bearing 12^2 of the arm 12^3 depending from carriage 6, is mounted the hub 129′ of a gear-case 129, said hub being flanged at its inner end at 129^2. In this hub is journaled a sleeve 130 flanged at 130′, and is splined at 131 to the driving-shaft, said sleeve being reduced at its end opposite the flange 130′ to receive a bevel-gear 132 held in place by a nut 133. Rising from a lateral extension 129^3 of the gear-case 129 is a tubular extension 134, and in said extension is mounted a bearing 135 closed at its upper end by a dust cap 136. In the bearing a sleeve 137 is journaled, and to said sleeve is keyed a bevel-gear 138, said bevel-gear being in mesh with the gear 132 aforesaid, as illustrated in Fig. 9, and said sleeve is keyed to a vertical shaft 139 passing through the bearing. On its other side the extension 134 has a plane-surface 134′, and resting against said plane-surface is a bar 140, held in place by a grooved cap 141 secured to said plane surface by screws 142. Beneath the plane-surface the lower part of the extension and the top of the gear-case are cut away at 143 to permit of the extreme downward movement of the bar. The sleeve 137 and the shaft 139 constitute together an extensible shaft. Designated by 144 is another gear-case, which protects a bevel-gear 145 on the upper end of the shaft 139, said bevel-gear engaging a companion gear 123 on the shaft 117 for actuating the gearing for driving the milling cutter. This gear-case is extended at 144′ to surround the gear 123, and is suspended by a bearing 146 from the sleeve-bearing 118, around which it has a rocking movement.

Depending from the gear-case 144 is a sectional hub 147, in a bore of which is mounted a sleeve-bearing 148 through which the shaft 139 passes, and on its front side this hub has a plane-surface 147′ against which the upper part of the bar 140 bears when secured in place by a grooved cap 149, and screws 150. A sectional housing for the shaft 139 is thus provided,—the hanger 147 constituting one part of said housing, and the tubular extension 134 the other part thereof.

When the cross-slide 8 is moved in or out on the way of the carriage 6 by its screw 9, binding of the gearing would be liable to occur unless provision were made to prevent it, and by clamping the binder-rod 140 tight at one point and by permitting it to slide freely in one of the caps, for instance 141, at another point it will be seen that the necessary rocking movement of the parts for driving said shaft 117 is provided for, and there will be no cramping of the gears 123,

132, 138 and 145 when the cross slide is adjusted to locate the cutter with relation to the work, and free running of said gears and the shafts by which they are carried is thus insured.

In the operation of the improved machine power is applied by belting to the pulley 13 and driving-shaft 12, and the clutches 41 and 54 being in neutral position such gearing as is driven will idly revolve. If it is desirable to drive the lead-screw 58 from the spindle 10, the rod 75 is actuated to throw clutch 74 into engagement with the hub of fork 50. During this movement of the clutch 74 the bell-crank 76 is rocked, and through link 77 throws the pivoted lever 78 to the position shown in Fig. 14, thereby locating the upper laterally-projecting lug or stud *a* of the T-head 78′ in line with the plunger 83. By now grasping the knob 80 and pulling the rod 79 and lever 78 inward the lug *a* will engage said plunger 83 and force it backward against the spring 84, thus removing the latch 81 from the path of the arm 50′ of the fork 50, and permitting the shaft 64, now connected to the hub of the fork 50 by the clutch 74, to be rocked by the lever 73, and thus to shift the clutch 41 into engagement with the large worm-wheel 38 of shaft 39. In this position of the parts the latch 82 will engage the lug 82′ of clutch-yoke 60 and will lock the clutch 54 of shaft 51 in a neutral position. When coupled as just described and the clutch 14 is in its engaging position, shown in Figs. 4 and 18, power will be transmitted from the driving-shaft 12, through the pinion 89′ keyed thereto, to the gear 89 rigid with the tubular shaft 25, and said shaft will be rotated, and the gears 85, 86, 87 and 88, which are loose thereon, will remain idle. When, however, one of said gears is connected to its shaft by the clutch-dog 91 (for instance, the gear 85 as shown in Fig. 5) said gear will, of course, rotate with the shaft 25, and in the instance given by intermeshing with the gear 21 (Fig. 4 and 18) will rotate the sleeve 12^x, and the gears 21, 21′, 21^2, 21^3 rigid with said sleeve, and as the clutch 14, in the instance given, is in engagement with the hub of the gear 22^2 said gear will also be driven by the sleeve, and in turn will drive the end gear V rigid with the sleeve 25^2 loose on the shaft 25. This sleeve 25^2 has rigid therewith the series of gears 26 of different diameters, and said gears 26 drive the series 27 of variable-speed gears loose on the shaft 28, and any of which may be coupled to said shaft by the clutch-dog 99 in the manner above described, and when thus connected will rotate said shaft and the pinion 30 keyed thereto. This pinion 30 drives the gear 34 keyed to the sleeve 32, loose on the stationary shaft 31 and carrying the spiral-worm 33, which engages the worm-wheel 35 rigid with the shaft 36 (Fig. 6), thereby rotating said shaft and through the worm 37′ thereon driving the worm-wheel 38 on shaft 29 said shaft carrying the fixed pinion 43 in mesh with the gear 11 of the spindle 10. Rotation of the chuck-spindle having thus taken place power is transmitted from said spindle through the change-gearing described and illustrated in Fig. 11 to the lead-screw 58, and it will traverse the carriage 6 and the cutter-frame at the speed selected for the work in hand.

To drive the spindle from the lead-screw the screw 75^2 (Fig. 14) is released, the knob on the rod 75 is grasped and the clutch 74 is shifted to engage the hub 63, carrying the segment 62, thereby locking said hub to the shaft 64, and said screw is again tightened to hold the rod in place. When the clutch is shifted to the left in the manner just described the angle-lever 76 is rocked to swing the lug *b* of the T-head of lever 78 into line with the end of plunger 83′, and to carry the lug *a* of said T-head away from the plunger 83, which is then immediately advanced by its spring 84 to cause the latch 81 to engage the arm 50′ of fork 50 and lock said fork and the clutch 41 which it actuates against movement. Now by actuating the pull-rod 79 the lug *b* of the T-head 78′ of lever 78 will engage the end of plunger 83′, force it inward and withdraw the latch 82 from contact with the lug 82′ of fork 60, the hub of said fork carrying segment 61 in mesh with the segment 62 of hub 63 as aforesaid. Now by turning the shaft 64 by means of the lever 73 the yoke 60 will be actuated to throw the clutch 54 splined to shaft 36 into mesh with the clutch-hub of the worm-wheel 55. This couples the worm-wheel 55 to the shaft 51, and as said worm-wheel is driven by the left-hand worm 37 of the shaft 36, said worm will now actuate the shaft 51 which will through the gears 56 and 57 rotate the lead-screw 58, and said lead-screw will through the change-gear train illustrated in Fig. 11 rotate the gear 11 and chuck-spindle 10. Should it be necessary at any time to impart movement in a reverse direction to the lead-screw and the various gear-trains, this may be accomplished by shifting the clutch 14 into engagement with the clutch-hub 19 of gear 20, when the various sets of gearing will be actuated by the idler A in mesh with one of the gears of the set 26 on sleeve 25^2. When necessary to impart a quick return movement to the carriage and when the lead-screw is driven from the spindle, said quick return is obtained by throwing the clutch 41 into engagement with the gear 44, driven by pulley 48 and gear 49, thereby imparting a reverse rotation and higher speed to the shaft 39, said reverse

rotation and higher speed being transmitted to the lead-screw through pinion 65, gear 66 and change-gears 69, 70, 71 and 72, see Fig. 11. When the spindle is driven from the lead-screw, a quick return of the carriage is obtained by throwing the clutch 54 into engagement with the gear 52, said gear being driven in a reverse direction and at a higher speed than the worm-wheel 55, by the pulley 48 through gears 49, 44, and 53. This increased speed and reverse rotation are transmitted to the lead-screw through shaft 51, the pinion 56 keyed thereto and gear 57 rigid with the lead-screw.

With the variable-speed sets of gearing described provision is made for twenty-four changes in speed of the lead-screw and spindle, but these sets may be variously changed to afford a greater or less number of speeds without departure from the invention.

As the carriage slides along the bed in either direction the hub of the bevel-gear 132 moves with it along the driving-shaft 12, and the gearing for actuating the cutter spindle is driven in the direction desired, when the clutch 122 is in engagement with either of the oppositely-rotating bevel-gears 120 or 121, but when said clutch is shifted to the neutral position shown in Fig. 8 the cutter will remain idle.

As above stated binding of the gears for driving the cutter-actuating gearing is prevented by the construction fully described and illustrated in Figs. 1, 9 and 17 when the cross-slide is adjusted by its screw 9. It will thus be seen that either the spindle or the lead-screw may be driven one from the other and in either forward or reverse direction by the mechanism described and that a quick-return movement may be imparted to the carriage and cutter-mechanism when desired.

Changes may be made in various details of the mechanism shown and described without departure from the invention, and likewise, various locking or stop devices may be substituted for those illustrated in Fig. 14 without departure therefrom.

Having thus described my invention, what I claim is:

1. The combination of a slide, a spindle supported by said slide, a rotary shaft, a second shaft operatively connected with said first mentioned shaft and with said spindle for transferring the effect of the former to the latter, a sectional housing one section of which is mounted to swing about the axis of said first mentioned shaft and the other section of which moves with said slide, and a slidable connection between the sections of the housing to prevent relative lateral motion of said sections, said second shaft being extensible and journaled in said housing.

2. The combination of a cross slide, a tool-spindle supported by said cross slide, a rotary shaft supported by fixed bearings, a sectional housing one section of which is supported by said rotary shaft for swinging movement and the other section of which is connected with said slide, a slidable connection between the sections of said housing, an extensible shaft journaled in said housing, and geared to said rotary shaft and also to said tool-spindle.

3. The combination of a slide, a spindle supported by said slide, a rotary shaft, a sectional housing supported for swinging movement, an extensible shaft journaled in said housing and operatively connected with said rotary shaft and with said spindle, and means connecting the sections of said housing for relative movement longitudinally of said shaft and for preventing relative lateral movement of said sections.

4. The combination of a rotary shaft, a sectional housing supported for swinging movement by said shaft, an extensible shaft journaled in said housing, gears for transferring the effect of said rotary shaft to said extensible shaft, one of which is inclosed by the said housing, a cross-slide, a tool-spindle supported by said cross slide, means including gears one of which is inclosed by said housing, for transferring the effect of said extensible shaft to said tool-spindle, a slidable connection between the sections of the housing to prevent relative lateral motion thereof said housing being connected with said cross slide for swinging movement.

5. The combination of a slide, a sectional, swinging housing operatively connected with the slide the movement of the slide serving to swing said housing, a slidable connection between the sections of the housing to prevent relative lateral motion thereof, a rotary shaft journaled in said housing the latter turning about a relatively fixed axis, and a device on said slide operatively connected with said rotary shaft to be driven thereby.

6. The combination of a slide, a sectional swinging housing operatively connected with the slide the movement of the slide serving to swing said housing and the latter being movable about a fixed axis, a rotary shaft journaled in said housing, a device on the slide operatively connected with said rotary shaft to be driven thereby, and means connecting the sections of said housing for relative movement longitudinally of said shaft and for preventing relative lateral motion of said sections.

7. The combination of a sectional housing mounted for swinging movement, a rotary shaft journaled in said housing, and means connecting the sections of said housing for relative movement longitudinally of said

shaft and for also preventing relative lateral movement of said sections.

8. The combination of a driving shaft, a carriage having a part in which said driving shaft is journaled, a sleeve mounted in a bearing of said part, and having a tubular extension, a gear having a hub journaled in said sleeve, and splined to the driving shaft, a bar fitted for sliding movement to said tubular extension, a cross-slide on the carriage, a cutter-frame on the cross-slide, a tool-spindle journaled in said cutter-frame, gearing including a vertical, extensible shaft, for actuating the tool-spindle, and driven from the gear on said driving shaft, a hanger suspended from a shaft of said gearing, and means for clamping said bar to said hanger.

9. The combination of a carriage, a cross-slide thereon, a cutter frame on the cross-slide, a tool-spindle journaled in said cutter-frame, gearing carried by the cutter-frame for driving said tool-spindle, a bearing in which a shaft of said gearing is journaled, a combined gear-case and hanger suspended from said bearing, a rod clamped to the hanger, a horizontal shaft, a gear-case having a vertical extension, a guiding clamp for the rod secured to said vertical extension, an extensible shaft journaled in the vertical extension and hanger, gearing connecting said vertical shaft with the driving shaft, and gearing for connecting said shaft with the tool-spindle operating gearing.

In testimony whereof I affix my signature in presence of two witnesses.

BENGT M. W. HANSON.

Witnesses:

F. E. ANDERSON,

FRANCES E. BLODGETT.