May 24, 1949. C. E. MILLER ET AL 2,471,074

MULTIPLE SPINDLE LATHE

Filed May 6, 1943 6 Sheets-Sheet 1

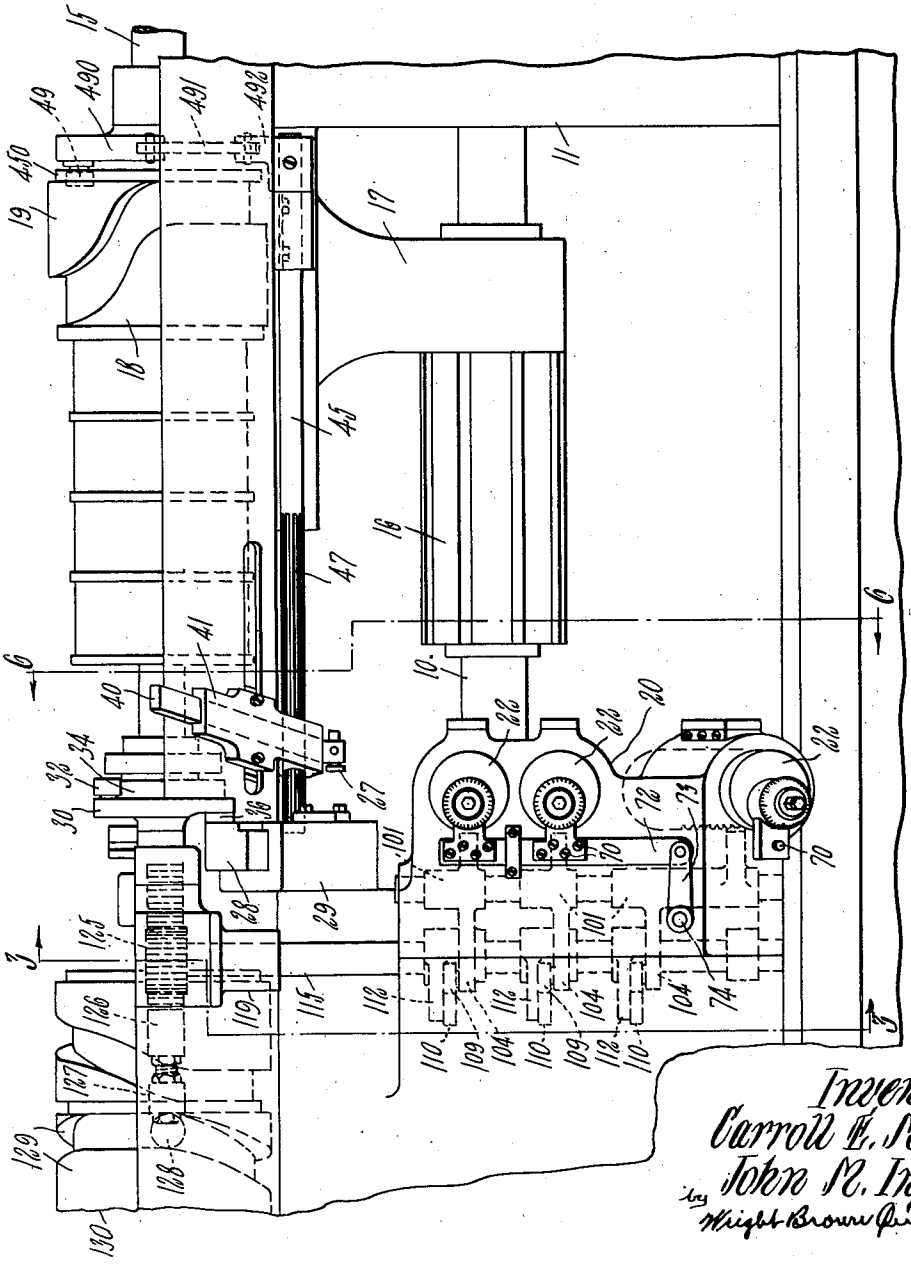


Fig. 1.

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MULTIPLE SPINDLE LATHE

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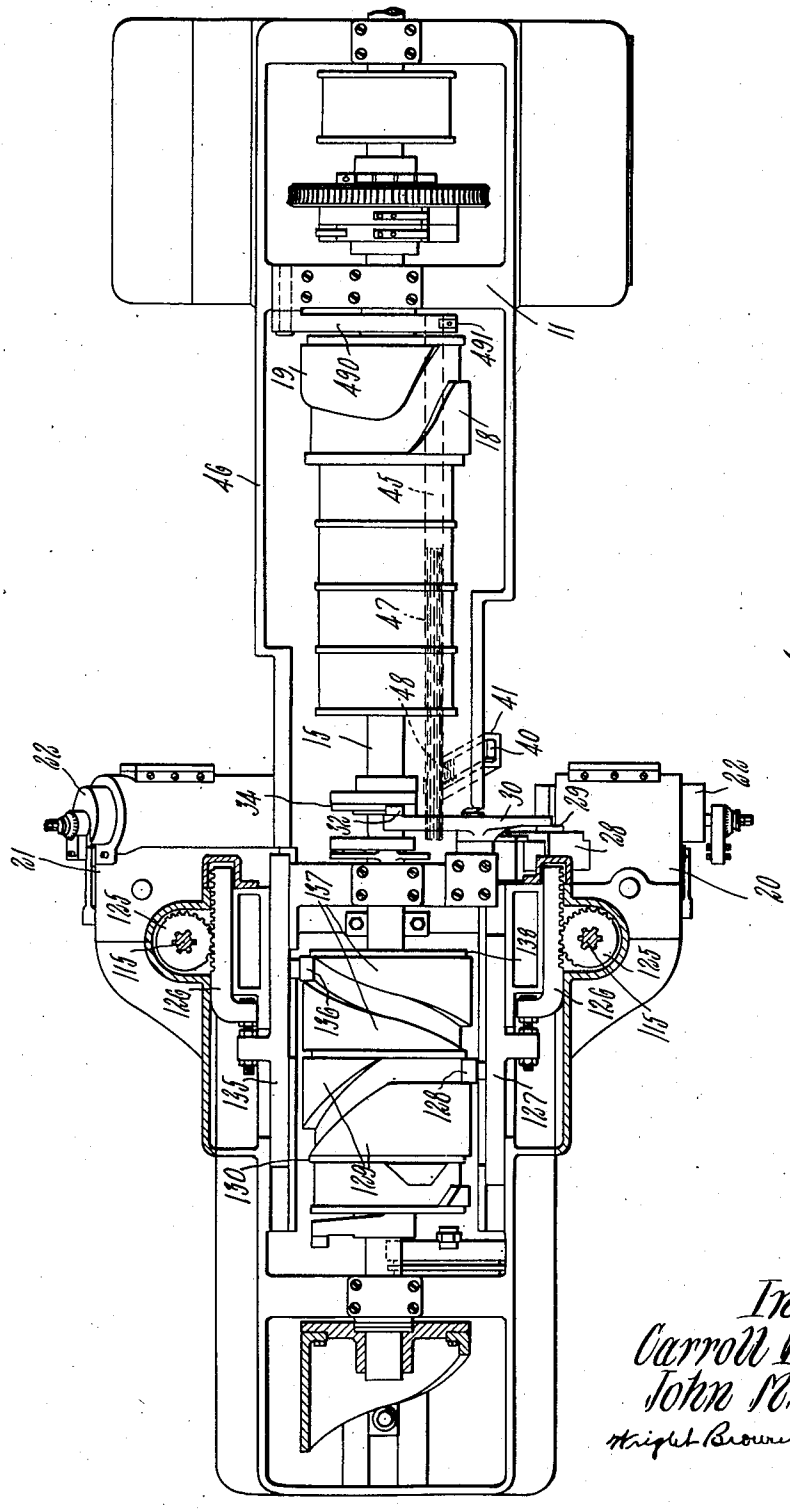


Fig. 2.

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MULTIPLE SPINDLE LATHE

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Fig. 4.

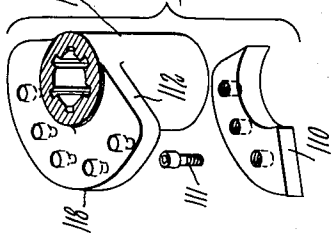


Fig. 5.

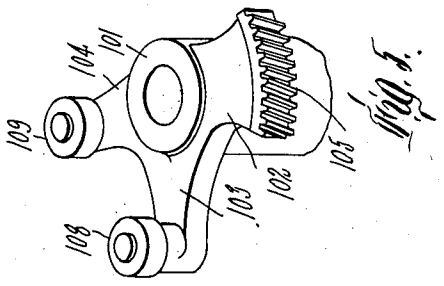
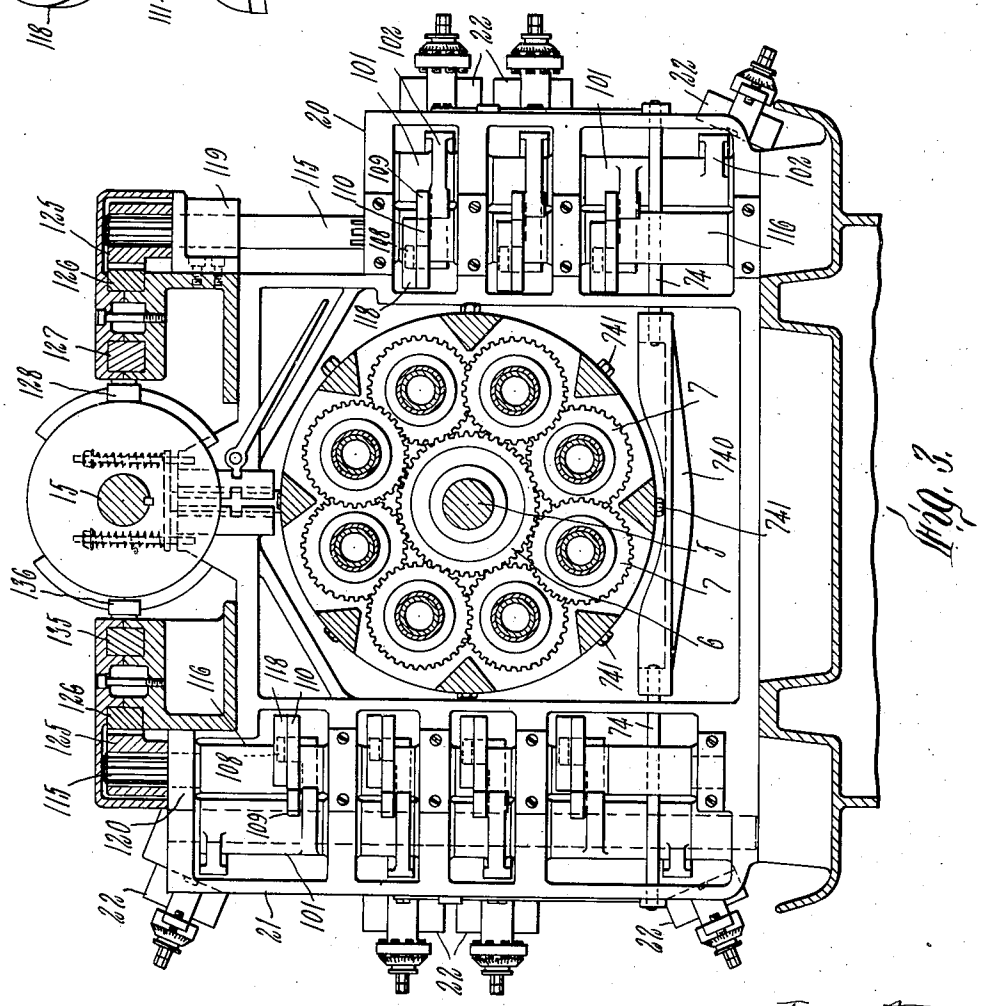


Fig. 3.



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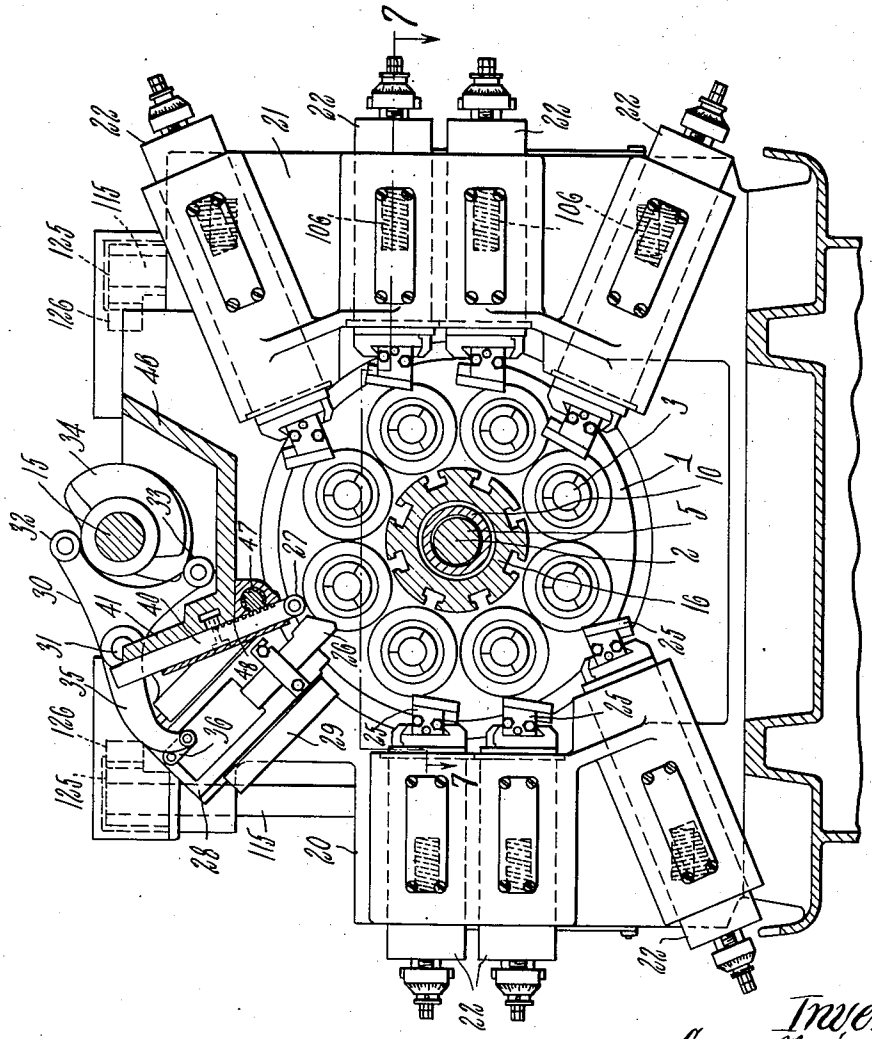


Fig. 6.

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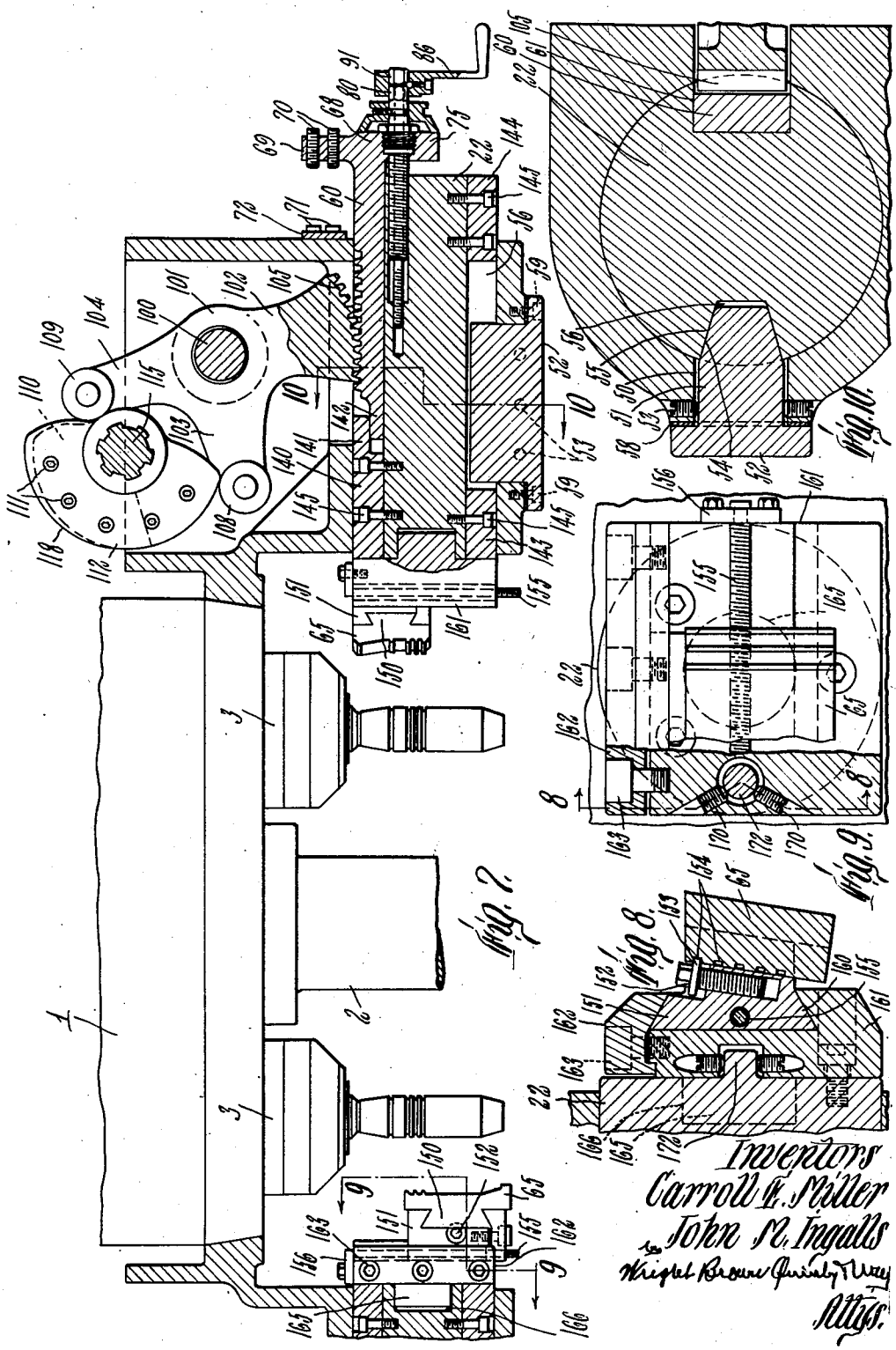


Fig. 2.

Fig. 10.

Fig. 9.

Fig. 8.

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MULTIPLE SPINDLE LATHE

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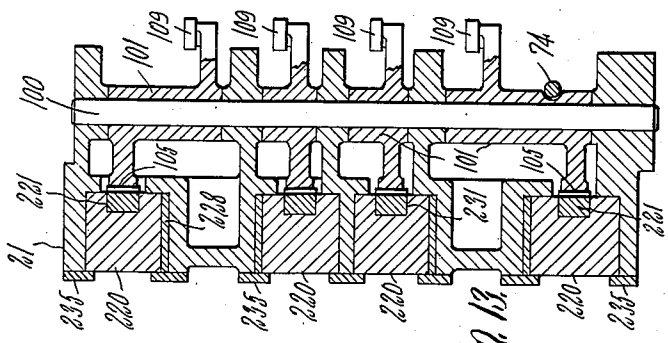


Fig. 13.

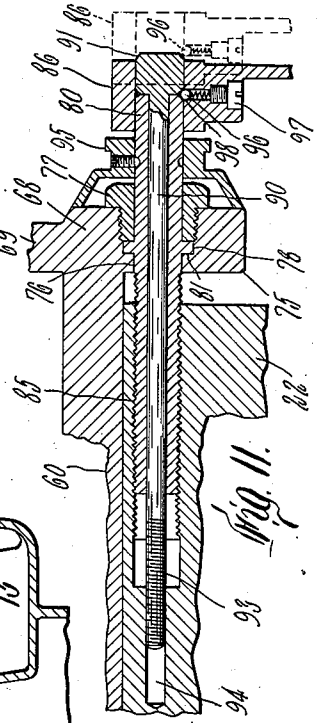


Fig. 11.

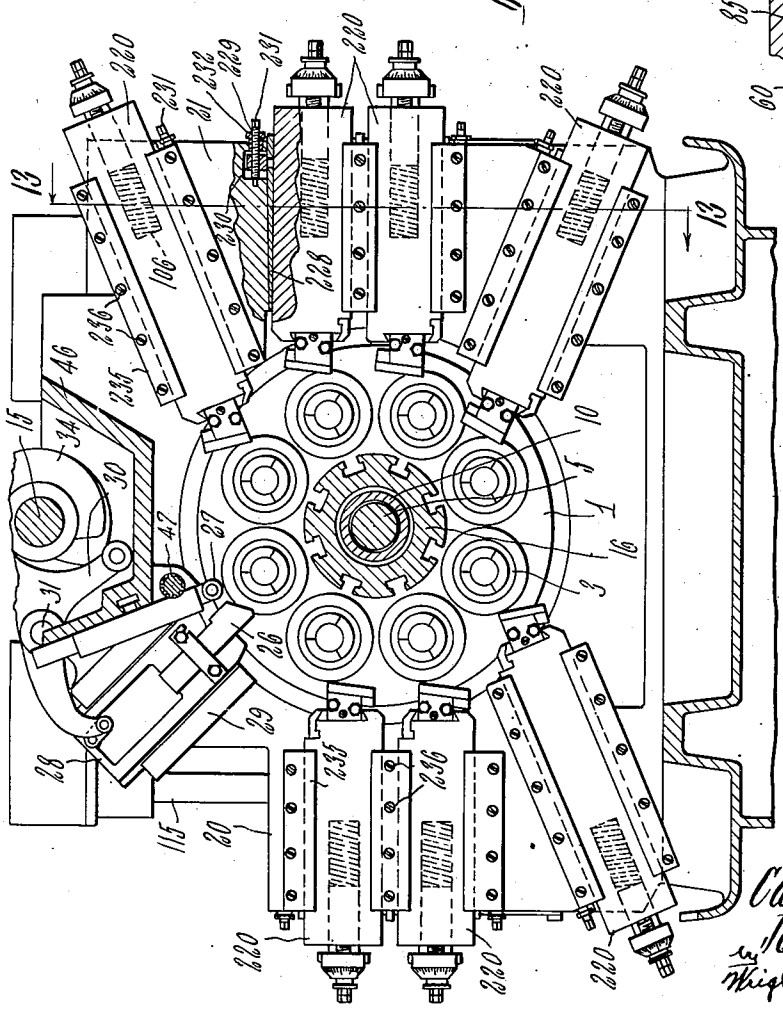


Fig. 12.

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UNITED STATES PATENT OFFICE

2,471,074

MULTIPLE SPINDLE LATHE

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Application May 6, 1943, Serial No. 485,804

6 Claims. (Cl. 29—37)

1

This invention relates to lathes, and while in some respects not limited thereto, it has been developed with especial reference to lathes having a plurality of work carrying spindles.

One object of this invention is to improve the construction, mounting and control of tool carriers for tools which operate on work projecting from the several work spindles.

By reason of this invention each tool or set of tools operative at each station may be carried on its or their own tool slide and be moved and controlled independently of each of the others.

Each tool slide is also provided with a micrometer adjustment with respect to its moving means so that high accuracy of control may be insured.

The moving mechanism may also include cam devices which can be readily removed or replaced by others and with minimum wear on the parts which carry these devices.

The tool carriers may be cylindrical, if desired, which makes for easy and accurate machining, suitable means being provided for angular and wear adjustment.

A further object is to improve the stock stop mechanism.

For a more complete understanding of this invention, reference may be had to the accompanying drawings in which

Figure 1 is a fragmentary front elevation of a multiple spindle lathe of the well known "cone" type showing one embodiment of the invention.

Figure 2 is a top plan view of the machine partly shown in Figure 1, this view being partly broken away and in section.

Figure 3 is a detail vertical section on line 3—3 of Figure 1.

Figure 4 is an exploded perspective view of a tool feed cam and a portion of its mounting.

Figure 5 is a perspective view of the cam follower rocker arm.

Figure 6 is a vertical sectional view on line 6—6 of Figure 1.

Figure 7 is a detail sectional view on line 7—7 of Figure 6.

Figure 8 is a detail sectional view on line 8—8 of Figure 9.

Figures 9 and 10 are detail sectional views on lines 9—9 and 10—10, respectively, of Figure 7.

Figure 11 is a detail sectional view through an adjusting mechanism also shown in Figure 7.

Figure 12 is a view similar to Figure 6, but showing a modified construction.

Figure 13 is a vertical sectional view on line 13—13 of Figure 12.

Referring first to the construction shown in

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Figures 1 to 10, inclusive, the machine as shown is of the well known "cone" type. It includes a cylindrical indexing work spindle carrier 1 mounted to index about its central axis 2. This carrier is provided with a plurality of rotary work carrying spindles 3 arranged in circular array about the indexing axis and parallel thereto.

Each of the spindles is rotated, such rotation being produced by rotation of a shaft 5 arranged coaxial with the spindle carrier and in driving relation to the various spindles through a gear 6 fixed to the shaft 5 and meshing with gears 7 carried by the spindles, as is shown best in Figure 3. The shaft 5 extends through a sleeve 10 and projects into an end column 11 of the machine wherein is provided the driving mechanism by which the shaft 5 may be rotated, and which also drives in time therewith an overhead cam shaft 15 arranged parallel to the shaft 5. To the cam shaft 15 are fixed cam carrying drums for effecting various controls of the machine as is well known in the art. As shown, also, the sleeve 10 supports a tool carrying slide 16 secured to a carriage 17 slidably mounted beneath the cam shaft 15 and connected to be moved along the sleeve 10 as by cams 18 and 19 on one of the cam drums carried by the cam shaft 15.

The stock carried by the spindles is arranged to project from one end of each and from the corresponding face of the spindle carrier in a direction toward the column 11, and on opposite sides of these stock extensions are positioned front and back frame members 20 and 21. Through each of these frame members 20 and 21 are arranged cylindrical bores within which are slidably mounted a plurality of cylindrical tool carriers or supports 22. As shown best in Figures 6, as arranged for an eight-spindle machine, three of these tool supports are carried by the front frame member 20, while four of such tool supports are carried by the back frame member 21. In the front frame member 20, two of these supports are arranged substantially parallel to each other and the tools 25 carried thereby are arranged to work on stock extending through the two front spindles in each indexed position of the spindle carrier, while the lower tool support 22 is arranged upwardly and inwardly inclined so that its tool 25 is moved upwardly and inwardly toward the forward lowermost spindle axis.

The two intermediate slides or supports 22 carried by the back frame member 21 position their tools for operation on stock projecting from the two rear intermediate spindles, while the lower support is upwardly and inwardly inclined so

that its tool may operate on work projecting from the lower rear spindle, and the uppermost tool support is mounted in a downwardly and a forwardly inclined position for its tool to operate on stock projecting from the top rear spindle.

The forward top spindle which is at the position where the machine stock is cut off and the stock is then fed forwardly within the spindle to start a new cycle of operations, has positioned to operate on the completed work a cutting-off tool 26, and a projectable and retractible stock stop 27 is arranged to limit the forward feed of the stock for the next cycle of machining operations.

The cutting-off tool 26 is shown as carried by an inwardly and downwardly inclined slide 28 arranged in a corresponding inclined guideway 29 of the front frame member 20, and this slide 28 may be moved to present the cutting-off tool 26 to the stock and then retract it by the rocking of a three-arm rocker 30. This rocker is journaled on a stub shaft 31, and its two rearwardly extending arms have cam follower rolls 32 and 33 thereon which are actuated by cams 34 carried by the cam shaft 15. The forward arm 35 is connected as through a link 36 pivoted thereto at one end and to the slide 28 at the other, so that as the rocker 30 is rocked by the cam 34, the slide 28, and with it the cutting-off tool 26, is moved from and toward the axis of the work projecting from the forward upper spindle, in the proper timed relationship.

The stock stop 27 is adjustably secured to the lower and inner end of a slide bar 40, mounted for axial motion in a guide member 41 which is arranged in a downward and inward inclination toward the front face of the spindle carrier, so that when the slide 40 is in its lowermost position, the stock stop 27 is positioned in substantially axial alinement with the top forward spindle. When it is so positioned and after the machine stock has been cut off by the cutting-off tool 26, which has been retracted, the stock or work is fed forward through the spindle in the well known manner until it strikes the stock stop. The stock stop is then retracted, its motion laterally away from the end of the stock being accompanied by an axial motion away therefrom so that it easily frees itself from the stock end, having a component of releasing motion longitudinally of the stock as well as laterally away therefrom. The stock stop is given this motion by the rocking of a shaft 45, mounted beneath the upper frame member 46, which supports through suitable bearings the overhead cam shaft 15. This rock shaft 45 is provided with a long gear portion 47, the teeth of which mesh in rack teeth 48 in the slide 40 as shown in Figure 6, these rack teeth being arranged diagonally with respect to the slide 40, as is shown best in Figure 2.

The rock shaft 45 is actuated by a cam 450 carried by the cam shaft 15 and controlling a follower 49 on an arm 490 connected through a link 491 with a rock arm 492 secured to the rock shaft 45.

Front and back tool slide mounting and control

As shown best in Figures 1, 2, 9 and 10, the tool carriers 22 are formed cylindrical, and are mounted for axial motion in correspondingly shaped ways in the side frames 20 and 21. Means are provided by which wear between the carriers and their ways may be taken up, and this is shown best in Figures 7 and 10. Referring to these figures, the frame member, opposite to each of the ways, is provided with a slot 50, arranged longitudinally of the adjacent tool supports, and extending substantially radially with reference thereto. Within each of these slots 50 there is positioned a key 51 having an enlarged head 52. The key 51 is of slightly less width than that of the slot 50, and means such as adjusting screws 53 threaded through openings in the frame members, may be engaged at their inner ends with the side walls of the key 51. The inner portion of each key 51 is provided with tapering side walls 54 which engage matingly tapered faces 55 of a key slot 56 in the corresponding tool supports 22, the slot 56 being sufficiently deep so as to provide for adjustment of the keys toward the axis of the tool support as wear may take place. By this means each tool support may be adjusted laterally to maintain the close sliding engagement desired between it and the inner portion of its way and with the sides 54 of the key 51. Slight angular adjustment of each of these supports is provided for by the lateral adjustment of the keys by means of adjustment of the screws 53. Shims of the necessary thickness, as at 58, may be inserted between the head 52 and the outer face of the frame member to limit the inward adjustment of the key 51, and these may be replaced with thinner shims from time to time as may be required, as the key 51 is adjusted inwardly. This inward adjustment may be made by means of screws 59 passing through the head 52 and threaded into the frame member.

The axial motion of each of these tool supports is produced by imparting such motion to a rack bar 60 which may be set into a slot 61 in the tool support, as shown best in Figure 10. This rack bar 60, as shown, is axially adjustable with respect to its tool support through a micrometer adjustment which makes it possible to adjust the position of the tool 65 carried thereby from and toward the axis of the work piece with great accuracy. This adjustment is illustrated best in Figures 7 and 11. The rack bar 60 is provided with a T-shaped head 68 at its outer end. One branch 69 of that T head may be provided with adjustable stop screws 70 which may contact with selected stops 71 on a movable stop selector slide 72 to provide adjustable positive stops limiting the extent of inward cutting of the tool 65 in accordance with the individual spindle which is presenting work in position to be machined at any particular time. Each of the slides 72 is mounted for substantially vertical movement, its position being controlled by the angular position of an arm 73 (see Figure 1) secured to a rock shaft 74. The two alined rock shafts 74, as shown in Figure 3, are connected together by an eccentric cross connection 740 against which bear individually adjustable screws 741 carried by the spindle carrier, and presented in sequence into operative relation to the member 740, thus determining the angular position of this member, and the presentation of the proper positive stops for each index position of the carrier. Suitable means for indexing the carrier will, of course, be provided but as this per se forms no part of the present invention, it will not be described.

The other arm 75 of the T head has a bore 76 therethrough, having a threaded outer portion within which is engaged an externally threaded headed sleeve 77. This sleeve retains in position, axially with respect to the bar 60, an outwardly extending flange 78 on a sleeve 80 which is journaled through the portion 75. The sleeve 80 is held against axial motion by the flange 78, which rides

between an annular shoulder 81 of the bore 76 and the inner end of the sleeve 77. This sleeve 80 is externally threaded at its inner end and engages an internally threaded bore 85 of the tool support 22. The outer end of this sleeve 80 is squared or otherwise formed to be engaged and turned by a wrench 86, by the turning of which the sleeve may be threaded more or less into the tool support 22 thus to adjust the tool support inwardly or outwardly with respect to the rack bar 60. When the adjustment has been effected the parts may be locked in adjusted position. For this purpose, a rod 90 having a head 91 at its outer end contoured to mate the outer end of the sleeve 80, so that the wrench 86 may engage either, has its inner end 93 threaded to the same pitch as the threaded portion 85 and engages in a threaded socket 94 of smaller diameter coaxial with the bore 85. Secured to the sleeve 80 is an indicator dial member 95 which cooperates with a suitable mark on the adjacent face of the head 68 to indicate the adjusted position of the sleeve 80. The wrench 86 is shown as provided with a spring pressed ball detent 96 backed up by a threaded plug 97, its socket 98 being narrowed at its inner end to prevent the ball 96 from escaping therefrom, but allowing it to project inwardly of the surface of the wrench socket. The outer end of the sleeve 80 and the inner edge of the head 91 are shown as cut away and the outer edge of the head 91 is similarly cut away, so that the ball 96 may act as a latch tending to retain the wrench in either the full or dotted line axial positions shown. In the full line axial position the wrench engages both the head 91 and the outer end of the sleeve 80, so that when the wrench is turned both the sleeve and the rod 90 are turned together, while when the wrench is moved to its dotted line position, it engages only the head 91. When in full line position turning of this wrench will serve to adjust the rack bar 60 axially with reference to the tool holder 22. When the adjustment has been completed, the wrench may be then moved to its dotted line position and turned slightly so as to turn the head 91 and tighten the threaded connections between the rod 90 and its socket and the sleeve 80 and its socket, the threaded connection between the rod 90 and its socket acting in the way of a lock nut to tighten the sleeve 80 against accidental turning. Release of the parts by a preliminary releasing motion of the wrench while it engages only the head 91 is then necessary when further adjustment is to be effected. The wrench may be entirely removed for normal operation of the machine, it being only used when adjustment or locking of the relation between the actuating rack bar 60 and the tool support 22 is desired. The inner end portion of the slot 61 which receives the rack bar 60 is preferably closed off by a filler block 140 having a rearwardly extending lip 141 engaging outwardly of an inner lip 142 on the inner end of the rack bar 60, these sleeves being slidably related one to the other. Similarly the outer ends of the keyway 55 are closed off by filler blocks 143 and 144, all these filler blocks being secured as by screws 145. These filler blocks serve to close off the tool slides with respect to their supporting frames and prevent the entry of foreign matter between them.

The axial motion of each of the tool slides to control the presentation and retraction of the tools carried thereby with reference to the work, is independently adjustable for each tool support in accordance with this invention. Each of the

frame members 20 and 21 carries an upright pivot shaft 100 and rockable thereon are a series of rockers 101, there being one such rocker for each of the tool supports. Each of these rockers, as shown best in Figures 1, 3, 5 and 7, is provided with three angularly spaced arms 102, 103, and 104. The arm 102 is provided with a rack segment 105 which meshes with the teeth of one of the rack bars 60, and in order that such meshing may be smooth, the teeth of the segment and rack bar are arranged diagonally with respect to their directions of motion as is shown in Figure 5 and by dotted lines at 106 in Figure 6. The arms 103 and 104 of each of the rockers 101 have journaled thereon cam follower rollers 108 and 109, these rollers being arranged at different elevations, the roller 108 being higher than the roller 109. The roller 109 is the one which is acted upon in order to rock the rocker 101 in a direction to move the tool support toward the work, and this roller is controlled by a detachable cam member 110 which is arranged to be secured, as by screws 111, to the under face of a cam extension 112 secured to a rock shaft 115. These rock shafts 115 are shown as splined to receive the extensions 112, which, as shown best in Figure 4, are provided with hub portions 116 through which suitable fastening means may be passed to secure these extensions in the desired axial relation to their respective rock shafts.

It will be noted that the front rock shaft 115 is provided with but three extensions 112, while the rear rock shaft 115 is provided with four such extensions, the upper one being employed in connection with the top back tool support, the front top spindle having the stock stop and the cut-off tool associated therewith, as previously described.

It will be understood that the inward motion of each tool toward its work should be carefully controlled, as this determines the cutting action of the tool, and that, depending upon the particular cut desired, the desirable cam contour for imparting its active motion may differ as between various tools. For this reason the inward motion of the tool is controlled by the detachable cam element 110, which can be formed in each case in accordance with the particular tool control desired, and may be removed and another substituted therefor in case of a different tooling operation. The particular control of the return motion of the tool is not so important, however, so that a single relatively permanent cam for all tools may be sufficient. For this reason the rock shaft extension 112 may have an edge cam surface 118 which bears upon the cam follower roll 108 and produces the retracting motion of the corresponding tool support.

Likewise, as the special contoured cams 110 are replaceable, it is desirable that as much as possible of the wear between the securing means for this cam and the cam extension, which is relatively permanent, shall be localized in the replaceable cams and securing means. For this reason the threaded connections for the securing screws 111 are formed in the cams 110, while the extensions 112 are provided with unthreaded sockets to receive the shanks of the securing screws 111. The screws 111 and the replaceable cam elements 110 thus take the wear and relieve the substantially permanent extensions 112 from this duty.

Since each of the tool supports is moved toward its work by its own specially contoured cam 110, control of the active motions of the tool supports

is independent of each other, even though all are actuated by the rocking of one or the other of the rock shafts 115. As shown best in Figure 3, the rock shafts 115 are journaled in suitable top bearings 119 and 120 and in lower and intermediate bearings as may be desired, and at their upper splined ends, they are provided with gear segments 125 with which are engaged front and rear rack bars 126 shown in Figure 2. The front rack bar 126 is adjustably secured to a cam slide 127 having a cam follower 128 controlled by cams 129 on a cam drum 130 carried by the upper cam shaft 15, while the rear rack bar 126 is adjustably secured to a similar slide 135 having a cam follower 136 controlled by cams 137 on a cam drum 138, also carried by the cam shaft 15.

Tool mountings

The tools 65 are carried by the tool slides or supports 22 by means which permits adjustment of the tool lengthwise, crosswise, and angularly. To this end the tool 65 is provided with a dovetail projection 150 at its base which engages in a mating dovetail slot of a tool carrier 151, and as shown best in Figure 8, this carrier 151 may have threaded therein an adjusting screw 152 provided with a shoulder 153 which may be engaged in any one of a series of cross slots 154 of the tool 65. By turning of the screw 152 the tool may be moved axially. As illustrated in Figure 8, this direction of motion may be inclined to the perpendicular to the tool slide axis. The tool carrier 151 is in turn mounted for motion transverse to the length of the tool, being provided with a dovetail portion 160 guided for traverse in a block 161. This block is provided with one detachable side wall 162, removal of which will permit removal and placement of the tool carrier in position, this portion 162 being then secured in proper bearing relation to the carrier by means of the screws 163. The carrier 151 may be adjusted laterally by means of the adjusting screw 155 threaded therethrough and journaled at one end in a plate 156 secured to one end of the block 161. The block 161, as best shown in Figure 7, is provided with a cylindrical boss 165 projecting from its rear face and which is journaled in a socket 166 in the inner end of the tool support and coaxial therewith, and this block is adjustable angularly about the axis of the boss 165, by the adjustment of a pair of screws 170 angularly arranged in the block 161 and engaging against a small cylindrical boss 172 projecting eccentrically from the inner end of the tool support 22.

Tool slide modification

In Figure 12 is shown a modification in which instead of employing cylindrical tool carriers, carriers of rectangular cross section have been substituted, such carriers being shown at 220. Each of these is provided with a rack bar 221 corresponding to the rack bar 69 shown best in Figures 7 and 10 for the cylindrical supports, and each of these is actuated by rockers which may be the rockers 191 shown in Figure 5. Each of the rack bars 221 may be adjustable with reference to its support, as by the mechanism previously described in connection with Figures 7 and 10, and for the purpose of taking up wear between the rectangular supports 220 and the corresponding ways in the frame members, tapered shims 223 may be employed, these being adjustable lengthwise. For this purpose each is provided with a lug 230 (see Figure 12) internally threaded for the reception of an adjusting screw 229 journaled in the machine frame member, and having a squared outer end 231 for the reception of a wrench by which it may be turned. A lock nut 232 may be employed to lock the adjusting screw in adjusted position. The tool supports 220 may be secured in their ways, which are open at one side, by cover strips 235 secured to the frame member as by screws 236 and overlapping the supports 220.

From the foregoing description of certain embodiments of this invention it should be evident to those skilled in the art that various other changes and modifications might be made without departing from the spirit or scope of this invention.

We claim:

1. In combination, a guide member, a tool slide movably carried by said guide member, a tool slide connecting member carried by said guide member, and means for adjustably securing said connecting member and slide together, comprising an externally threaded sleeve having threaded connection with said slide and provided against axial motion in said connecting member, and a headed rod extending through said sleeve and having its inner end threaded into said slide with threads of the same pitch as said sleeve, and means for selectively turning said sleeve and rod simultaneously to adjust said tool slide relative to said connecting member, or to turn said rod only to lock or release said threaded sleeve with respect to said slide.

2. In a multiple spindle lathe, an indexing carrier, a plurality of rotary work spindles journaled in said carrier in circular array about the indexing axis, and arranged to receive stock projecting from one face of said carrier, a frame member extending transverse to said indexing axis adjacent to the projecting portions of said stock and provided with tubular ways extending theretoward, cylindrical slides movable axially in said ways and having carriers for tools at their ends adjacent to said projecting portions, wedge means for taking up wear between said slides and ways, and means for moving said slides.

3. In a multiple spindle lathe, an indexing carrier, a plurality of rotary work spindles journaled in said carrier in circular array about the indexing axis and arranged to receive stock projecting from one face of said carrier, a frame member extending transverse to said indexing axis adjacent to the projecting portions of said stock and provided with tubular ways extending theretoward, cylindrical slides movable axially in said ways and having carriers for tools at their ends adjacent to said projecting portions, wedges and cooperating slots in said ways and slides preventing rotation of said slides and adjustable to take up wear between said slides and ways, and means for moving said slides.

4. In combination, a frame having a cylindrical bore, a cylindrical slide axially movable within said bore, said frame having a slot lengthwise of and intersecting said bore, said slide having a tapered slot opposite to the slot of said frame, a key of less width than said frame slot seated in said frame slot and provided with a tapered portion fitting the tapered slot of said slide, means for adjusting said key laterally of said frame slot to thereby adjust the angular position of said slide, and means for securing said key to said frame.

5. In combination, a frame member having a cylindrical bore, a cylindrical slide mounted for

axial motion in said bore, said slide having a longitudinal slot provided with inwardly converging side faces, said frame member having a slot registering with said slide slot, a key mounted in said frame slot said key being narrower than said frame slot and having an inner portion of tapering thickness engaging in said slide slot, means for adjusting said key transversely of said frame slot, and means for adjusting said key toward and from the axis of said slide.

6. A multiple spindle lathe comprising an indexing work spindle carrier, a plurality of work spindles mounted in said carrier in circular array about the indexing axis thereof, a frame member extending transverse to the indexing axis of said carrier at one side of work pieces projecting from one end of each of certain of said work spindles, a plurality of tool supports carried by said frame member and movable toward and from such work pieces, a single cam shaft mounted in said frame, the axis of said cam shaft being at right angles to said indexing axis, certain of said tool supports being mounted to slide transverse to the cam shaft axis and others of said tool supports being disposed at an acute angle to the cam shaft axis, cams on said cam shaft individual to the respective tool supports, rockers pivotally mounted in the frame member having a portion thereof engageable and operable with the cam shaft, and a gear sector on each rocker, all of said gear sectors being arranged transversely to the cam shaft, each of said tool supports having rack teeth engageable with the respective gear sectors for actuation thereby.

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