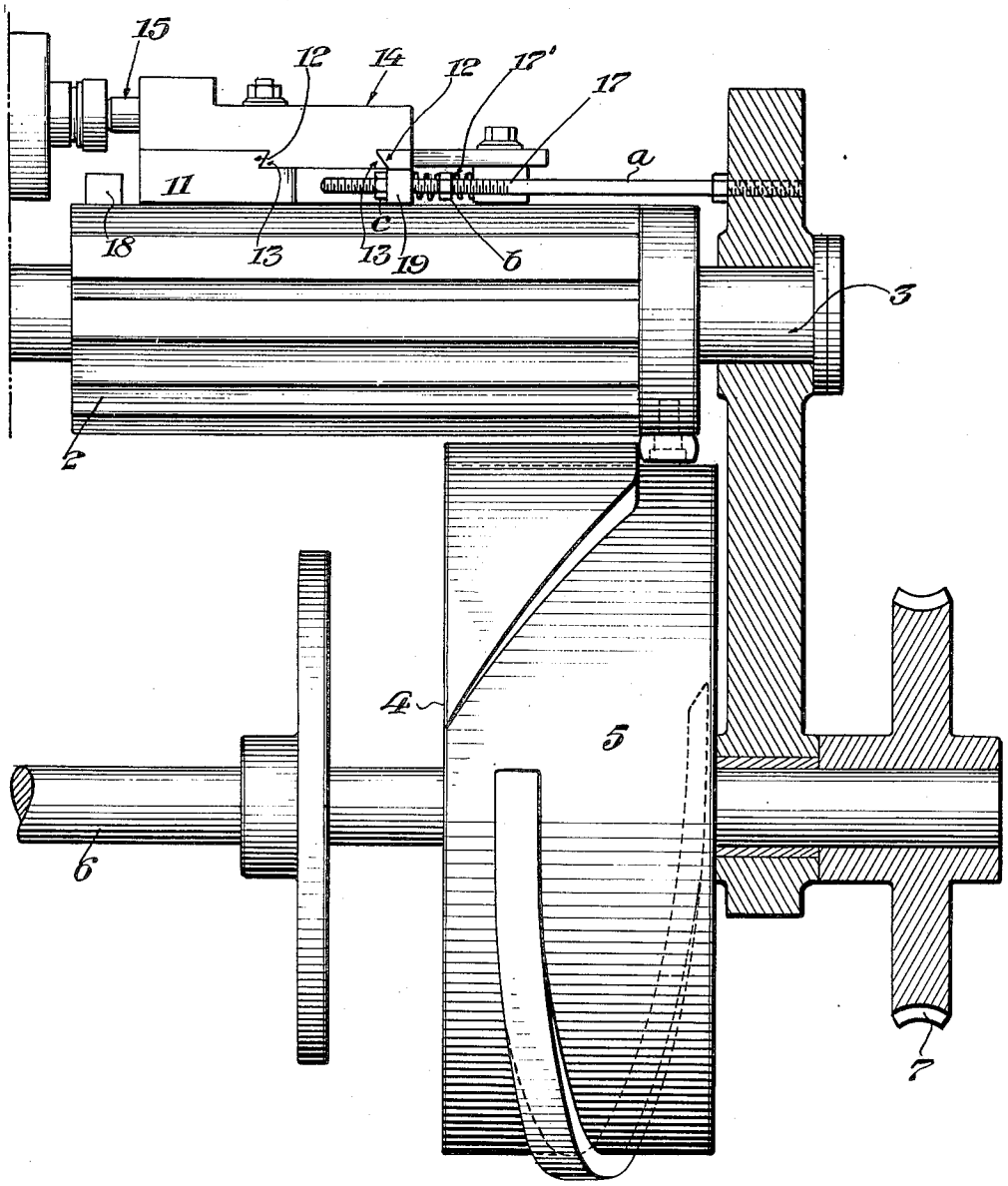
March 3, 1931. O. E. TROBECK 1,794,390

METHOD AND MEANS FOR TURNING AND FINISHING PIECES OF WORK

Filed Nov. 3, 1928 3 Sheets-Sheet 1

Fig. 1.



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March 3, 1931. O. E. TROBECK 1,794,390

METHOD AND MEANS FOR TURNING AND FINISHING PIECES OF WORK

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Fig. 2.

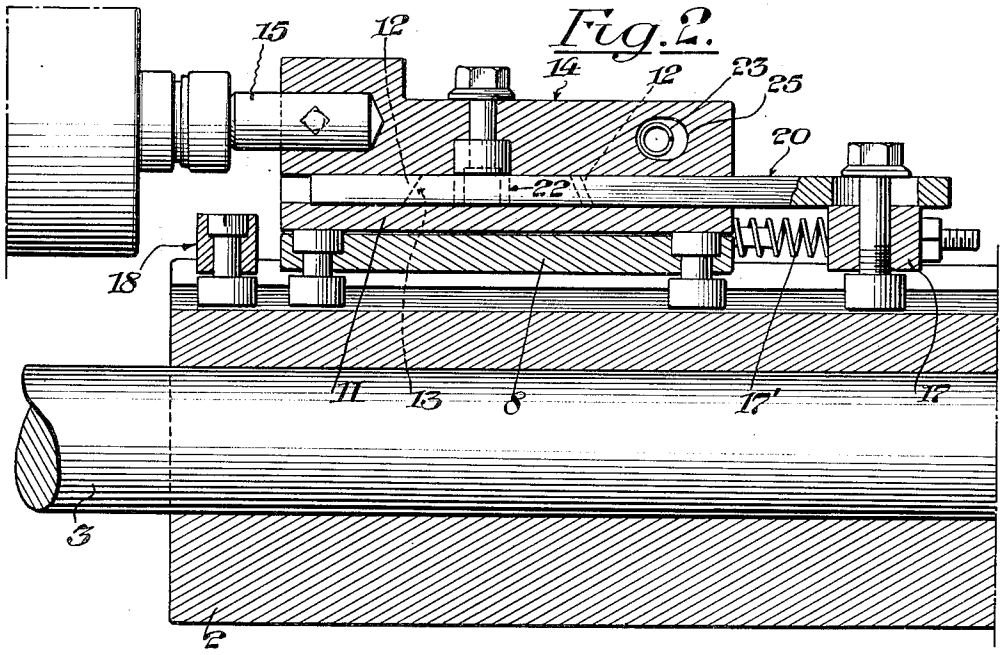
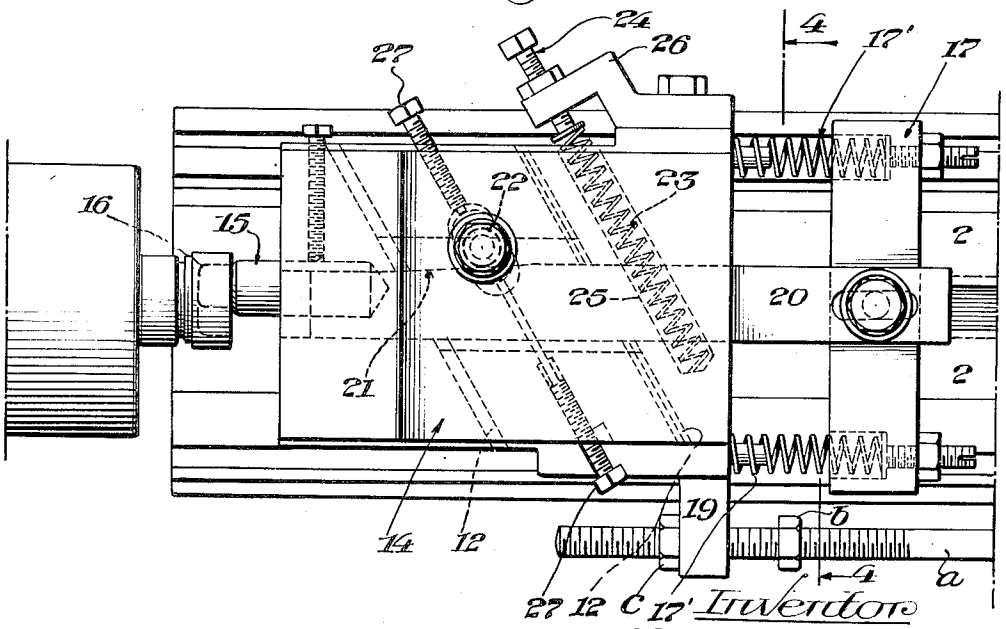


Fig. 3.



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METHOD AND MEANS FOR TURNING AND FINISHING PIECES OF WORK

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Fig. 4.

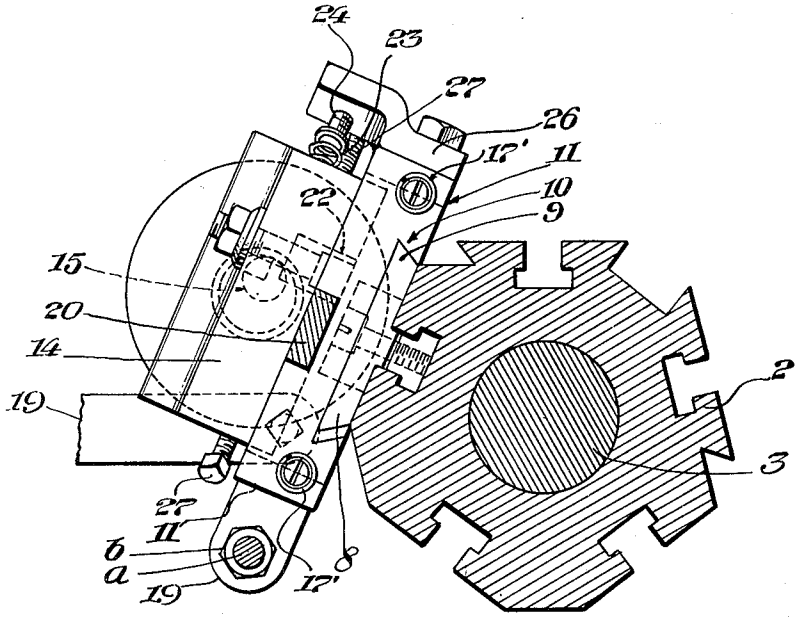


Fig. 5.

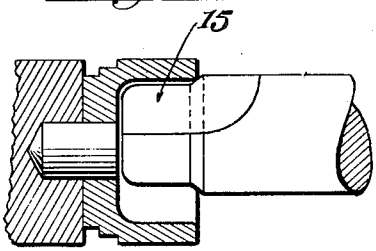
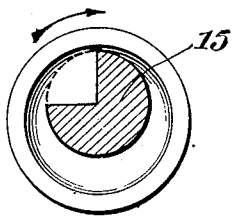


Fig. 6.



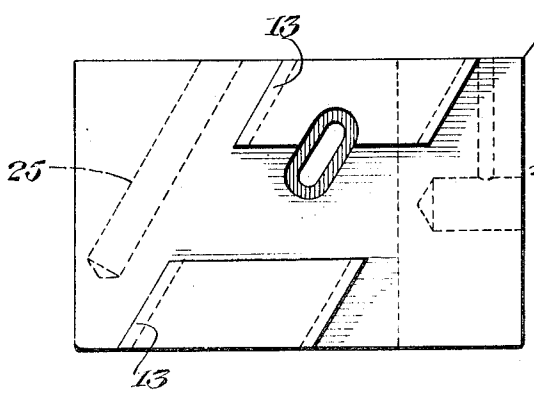


Fig. 7.

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Patented Mar. 3, 1931 1,794,390

UNITED STATES PATENT OFFICE

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METHOD AND MEANS FOR TURNING AND FINISHING PIECES OF WORK

Application filed November 3, 1928, Serial No. 316,996, and in Germany January 4, 1928.

This invention relates to metal working machines, and it more particularly has to do with an improved method and means for turning and finishing pieces of work with a high degree of accuracy, such as pieces made on metal working machines as, for instance, automatic multiple spindle screw machines,—the object of the invention being to provide an improved method and means, simple in construction and operation and highly efficient in use, and by means of which certain disadvantages heretofore present in the turning and finishing of pieces of work are obviated.

Heretofore the tool, being carried by the reciprocating main tool slide of a multiple spindle screw machine and under the control of the lead cam thereof, had necessarily the same amount of movement back and forth as the other tools carried by said slide, resulting in certain disadvantages in the turning and finishing of the piece of work,—so that, prior to the present improvement, a piece of work could only be finished to the same high degree of accuracy as is now obtained by the present improvement by performing a second operation on the piece after it came from the automatic machine or by decreasing the output one-half or more.

By means of the present improvement, the operator can always give the cam that operates the cross-slide a suitable lead, no matter what the length of the lead cam on the cam shaft for the main tool slide may be,—so that the lead of the cross-slide is distributed over the entire length of the feed of the cam shaft lead cam. In other words, should the main tool slide have a fast travel,—namely, a coarse feed,—by means of its lead cam,—say, of one inch,—this turning and finishing tool can, by means of its cam, have a very fine feed,—for instance, of one sixty-fourth to one-sixteenth (1/64″ to 1/16″) of an inch,—thus giving a feed to the finishing tool ten to twenty times finer than the other roughing tools on the main slide.

Furthermore, the construction and operation of this inside finishing or shaving tool is such that the cut pulls or lifts the tool away from the slide. I have observed that when a tool-maker desires to get a smooth cut on his lathe, he reverses his tool and runs his spindle left-hand. This seems a paradox, and I can only explain it by stating that by pulling upwards or away from the bed of the machine, the dovetail of the slide is pulled upward and wedged, so that all play is eliminated; whereas, when the thrust of the tool is downwards, you have whatever play there is in the slide, and a certain amount thereof is always necessary in order to have the slide work freely. Whatever may be the explanation, actual test of this improvement has given excellent satisfaction and a high degree of accuracy in the turning and finishing of the work; whereas, heretofore this has only been possible by two operations or by slowing down the machine, so that the present improvement thus materially saves time and labor.

In the drawings, a piece of work,—such as a ball race or cup, which must be finished with a high degree of accuracy,—is shown being finished. Heretofore the finishing of such a piece was only accomplished by a separate operation after the piece was formed on a multiple spindle screw machine; but, by means of the present improvement, this finishing can be done as a final step on a multiple spindle screw machine, and with a high degree of accuracy,—thus saving a separate finishing step on another machine.

In the drawings accompanying and forming a part of this specification—

Figure 1 illustrates, partly in section, one end of a multiple spindle screw machine having this improved fixture attached thereto;

Fig. 2 is a longitudinal section of the main tool slide of the machine with this fixture applied thereto;

Fig. 3 is a top view of the improvement;

Fig. 4 is a partly cross-sectional view taken on line 4—4, Fig. 3;

Fig. 5 is a detail view of a finishing tool and a sectional view of a ball race or cup;

Fig. 6 is a cross-sectional view of Fig. 5; and

Fig. 7 is a plan view of the top cross-slide.

Similar characters of reference indicate corresponding parts in the several views.

Before explaining in detail the present improvement and mode of operation thereof, I desire to have it understood that the invention is not limited to the details of construction and arrangement of parts which are illustrated in the accompanying drawings, since the invention is capable of other embodiments, and that the phraseology which I employ is for the purpose of description and not of limitation.

In the present instance this improved fixture, in the preferred form thereof, is secured to the main tool slide 2 of the machine,—such, for instance, as a model C, five-spindle "Acme" automatic multiple spindle screw machine. This main tool slide 2 is shifted back and forth on a shaft 3 by means of suitable cams 4, one of which being usually designated as the lead cam, carried by a cam drum 5 mounted on a cam shaft 6, which shaft is rotated by suitable gearing, the worm-wheel 7 only of which it is deemed necessary to show. This main tool slide is provided with the usual number of faces for the reception of the end working tool holders, and in the present instance this improved fixture is secured to one of these faces and for this purpose a plate or supporting member 8 is bolted to one of the faces of the main tool slide 2. This supporting member or plate 8 is provided with a longitudinally-extending dovetail 9 for the reception of a complementary-formed part 10 of an intermediate slide 11 having on its top a diagonal dovetail 12 for the reception of a complementary-formed part 13 of a supplemental or top cross-slide 14, forming the tool holder for carrying the proper tool or cutter, shown as a finishing cutter 15. This top cross-slide is located at an angle suitable for the work to be performed, according to whether it is a finishing, recessing, turning or shoulder undercutting job; and in the present instance the cross-slide 14 is located diagonally and at a suitable angle, being in the present instance shown at an angle of about sixty degrees (60°), to the intermediate slide 11 and main tool slide 2. Bolted to the main tool slide 2 for movement therewith is a cross-bar 17, and between this bar and the intermediate slide 11 are a pair of springs 17′ for pushing the slide 11 forward and holding it in engagement at certain times with a stop 18 bolted to the main tool slide 2, whereby the slide 11 is held during a certain part of the forward movement of the main tool slide 2 in engagement with this stop 18, the forward movement of the slide 11 being limited by a stop C hereinafter described and carried by a fixed part of the machine, this stop C being so set that the tool will, when the slide strikes the stop C, be close to the work to be finished. From the foregoing it will be observed that the fixed stop C limits the forward movement of the slide 11 with the tool slide 2, while the latter can be further shifted by its lead cam.

Carried by the cross-bar 17 is a longitudinally-extending cam member or bar 20 having an inclined or cam face 21 in position to engage a roller 22 carried by the top or supplemental slide 14, so that, as the main tool slide 2 moves forward, the cross-bar 17 and longitudinally-extending cam bar 20 are shifted with it and thus operate to shift the top slide 14 diagonally to the direction of movement of the main tool slide 2 and the intermediate slide 11, thus bringing the tool into engagement with the inside faces of the ball race, for instance, thereby to finish or shave it. Thus the diagonally-located dovetail ways of the top slide 14 shift the tool both depthwise or lengthwise of the work, as well as laterally relatively thereto, and this diagonal movement of the tool is at a different or a very slow and fine feed as compared with the feed of the main tool slide, since the feed of the top slide and its tool is controlled by the cam bar 20 and not by the lead cam on the cam drum. The roller 22 is held in engagement with the cam bar 20 by a spring 23 and an adjusting screw 24, the spring being located in an opening 25 of the top slide and held under compression by the adjusting screw bolted to the bottom slide by means of a bracket 26. Suitable adjusting devices or screws 27 are located in the top slide for adjusting the top slide by means of this roller 22 relatively to the cam bar 20, thereby to adjust the position of the top cross-slide and its tool to obtain the right diameter. In other words, if it is desired to adjust the tool cut larger or smaller, the position of the top cross-slide is altered relatively to this roller 22 and cam bar or slide 20.

In the operation of this device, the slide 11—and therewith the top slide 14—moves forward with the main tool slide 2 so long as the springs of the slide 11 hold this slide in engagement with the stop 18 and until a projection or arm 19 of the slide 11 comes into engagement with the fixed stop C,—shown in the form of an adjustable nut carried by a threaded rod *a* secured to the frame or a fixed part of the machine,—whereupon further forward movement of the fixture is arrested. This length of movement is sufficient to bring the tool 15 into its starting position to perform its work on the piece to be finished. The further forward movement of the main tool slide 2, however, carries the usual end working tools (not shown) into engagement with their work, and this continued forward movement of the main tool slide 2 carries the cam bar 20 into position to engage the roller 22 of the top slide 14 and shift the top slide diagonally so as to carry the finishing tool into position to engage the work and thus finish the piece in an accurate and expeditious manner, and by

reason of the diagonal location of the dovetail ways of the top slide, the tool is thus shifted lengthwise or depthwise of the work and also laterally relatively thereto.

Upon the return of the main tool slide, the stop 18 engages the slide 11 and retracts it—of course, simultaneously retracting the cam bar and permitting the spring 23 to carry the top cross-slide away from the work—this return movement of the fixture compressing the springs 17′ and firmly holding the slide 11 against the stop 18.

The rod *a* also carries a check nut *b* which acts as a safety device,—so that, if the springs 17′ should, by reason of weakness, fail to hold the top slide 14 in engagement with the stop 18 and be, for instance, in the position shown in Fig. 2 and thus away from the stop 18, the top slide 14 returning with the main slide, due to the friction between the two, is, when it reaches the stop C, then pushed into engagement with the stop 18 in readiness for the next forward movement of the main slide.

From the foregoing it will be observed that the finishing tool, in the present improvement, does not have imparted thereto a full lengthwise movement corresponding to that of the main tool slide, as has heretofore been necessary, so that considerable wear of the parts is eliminated. In other words, the lengthwise movement of the fixture is short compared with that of the main tool slide and the transverse movement of the tool is comparatively slight, so that the movements of the fixture are small compared with those of the end tools of the main tool slide and the feed of this finishing tool is, therefore, very much less than that of the tools of the main tool slide, in consequence of which a very high degree of accuracy and smooth finish are possible in the finishing of a piece of work. Thus the tools carried by the main tool slide 2 can be crowded as much as desired,—this depending upon the lead of the lead cam on the cam drum,—while this turning, finishing or shaving tool can have a lengthwise and sidewise movement as slow as desired, since the lead of the cam on the cam drum is not imparted to the tool, but movement of which is dependent entirely upon the bar cam which can be arranged to give any desired feed. As the lengthwise and sidewise movement of the tool, so far as its work is concerned, does not commence until the slide 11 reaches the fixed stop C, the feed of the tool can be very slow, with resultant important advantages as compared with finishing tools heretofore used.

The present improvement, which is particularly adapted for automatic multiple spindle screw machines in which a plurality of end working tools are operating simultaneously on a plurality of pieces of work, is applied to one of the tooling surfaces of the main tool slide without interfering with the other tools on that slide and the tool can start cutting at the same time as the end working tools of the main tool slide, with the result that a much finer feed is obtained. For instance, if the main slide is reciprocated by means of a two-inch lead cam, the cam mechanism of the finishing tool is such that the cutting lead of the supplemental tool slide tool is distributed over these two inches of the lead cam, as hereinbefore pointed out, so that the finishing tool can start cutting at the same time as the end working tools, so that the work of the machine is not held up. The result of this improvement is that a feed can be given to the finishing tool ten to twenty times finer than that of the other tools on the main tool slide.

It is to be understood that by describing in detail herein any particular form, structure or arrangement, it is not intended to limit the invention beyond the terms of the several claims or the requirements of the prior art.

Having thus explained the nature of my said invention and described a way of constructing and using the same, although without attempting to set forth all of the forms in which it may be made or all of the modes of its use, I claim:

1. In a metal working machine having a main tool slide and means for reciprocating it, a supplemental tool slide carried thereby on the longitudinal face thereof, and means for shifting said supplemental tool slide on the main slide in a diagonal direction with a reduced or different feed as compared with the feed of the main tool slide.

2. In a metal working machine having a main tool slide and means for reciprocating it, a supplemental tool slide carried thereby and occupying only a single tooling position and means for shifting said supplemental tool slide on the main slide endwise and laterally with a reduced or different feed as compared with the feed of the main tool slide.

3. In a multiple spindle screw machine having a main tool slide adapted to carry a plurality of tools operative simultaneously, and means for reciprocating it, a supplemental tool slide carried thereby and means for shifting said supplemental tool slide on the main slide obliquely at a reduced or different feed as compared with the feed of the main tool slide, and comprising resilient means and a reciprocating cam.

4. In a multiple spindle screw machine having a main tool slide adapted to carry a plurality of tools operative simultaneously, and means for reciprocating it with a fast movement during the idle movement of the tools carried thereby, a supplemental tool slide carried thereby and movable therewith with the same feed during a predetermined time, and means for shifting said supplemen-

tal slide on the main slide diagonally at a different or materially reduced feed as compared with the feed of the main tool slide.

5. In a metal working machine having a main tool slide and means for reciprocating it with a fast movement during the idle movement of the tools carried thereby, a supplemental tool slide carried thereby on the longitudinal face thereof and movable therewith with the same feed during a predetermined time, means for shifting said supplemental slide obliquely at a different or materially reduced feed as compared with the feed of the main tool slide, and comprising resilient means for shifting the slide endwise and cam-operated means for shifting it laterally simultaneously.

6. In a metal working machine, the combination of a reciprocating main tool slide, an intermediate slide mounted on a longitudinal face of said main slide and shiftable in the same direction as the main tool slide, a top tool-carrying slide shiftable with the intermediate slide and also independently thereof in an oblique direction, and means for shifting said slides.

7. In a metal working machine, the combination of a reciprocating main tool slide, an intermediate slide mounted on a longitudinal face of said main slide and shiftable in the same direction as the main tool slide, a top tool-carrying slide shiftable with the intermediate slide and also independently thereof in transverse directions with a feed different from that of the main tool slide, and means for shifting said slides.

8. In a metal working machine, the combination of a reciprocating main tool slide, an intermediate slide mounted on a longitudinal face of said main slide and shiftable in the same direction as the main tool slide, a top tool-carrying slide shiftable with the intermediate slide and also independently thereof in transverse directions at a feed less or different from that of the main tool slide, a rotary lead cam for reciprocating the main tool slide, resilient means for shifting the intermediate slide, and a reciprocating cam and obliquely-located ways for shifting the top tool slide.

9. The combination with a reciprocating main tool slide adapted to carry a plurality of tools operative simultaneously on a plurality of pieces of work, of a resiliently-shifted slide carried by said main tool slide, means for limiting the movement of said second slide, a tool-carrying slide carried by said second slide and shiftable in an oblique path, and means shiftable with the main tool slide for shifting said tool-carrying slide.

10. The combination with a reciprocating main tool slide adapted to carry a plurality of tools operative simultaneously on a plurality of pieces of work, of a resiliently-shifted slide carried by said main tool slide, means for limiting the movement of said second slide, a tool-carrying slide carried by said second slide and shiftable in an oblique path, means shiftable with the main tool slide for shifting said tool-carrying slide, and means carried by the main tool slide for retracting said slides.

11. The combination with a reciprocating main tool slide adapted to carry a plurality of tools operative simultaneously on a plurality of pieces of work, of a resiliently-shifted slide carried by said main tool slide, means for limiting the movement of said second slide, a tool-carrying slide carried by said second slide and shiftable in an oblique path, and means shiftable with the main tool slide for shifting said tool-carrying slide, said last means comprising a reciprocating cam member and a roller, one carried by the main tool slide and the other by the tool-carrying slide.

12. The combination with a reciprocating main tool slide adapted to carry a plurality of tools operative simultaneously on a plurality of pieces of work, of a resiliently-shifted slide carried by said main tool slide, means for limiting the movement of said second slide, a tool-carrying slide carried by said second slide and shiftable in an oblique path, means shiftable with the main tool slide for shifting said tool-carrying slide, said last means comprising a reciprocating cam member and a roller, one carried by the main tool slide and the other by the tool-carrying slide, and means for holding the roller and cam in engagement.

13. The combination with a reciprocating main tool slide, of a resiliently-shifted slide carried by said main tool slide, means for limiting the movement of said second slide, a tool-carrying slide carried by said second slide and shiftable in an oblique path, means shiftable with the main tool slide for shifting said tool-carrying slide, said last means comprising a reciprocating cam member and a roller, one carried by the main tool slide and the other by the tool-carrying slide, means for holding the roller and cam in engagement and comprising a spring carried by the tool-carrying slide, and means carried by the main tool slide for compressing said spring.

14. The combination with a reciprocating main tool slide, of a resiliently-shifted slide carried by said main tool slide, means for limiting the movement of said second slide, a tool-carrying slide carried by said second slide and shiftable in an oblique path, means shiftable with the main tool slide for shifting said tool-carrying slide, said last means comprising a reciprocating cam member and a roller, one carried by the main tool slide and the other by the tool-carrying slide, and means for adjusting the roller.

15. In a metal working machine having a

main tool slide and means for reciprocating it, the combination of a plate fixed thereto and provided with a longitudinally-extending dovetail, an intermediate slide mounted thereon for reciprocating movement with the main tool slide, means carried by the main tool slide for reciprocating said intermediate slide, means for limiting the forward movement of said intermediate slide, means carried by the main tool slide for retracting said intermediate slide, a top tool-carrying slide shiftable in an oblique path relatively to the intermediate slide, means carried by the main tool slide for shifting the top slide in transverse paths with a feed different from that of the main tool slide and comprising a cam member and a roller, one carried by the top slide and the other by the main slide, means for holding said roller in co-operation with the cam member, and means for adjusting the roller relatively to the cam slide.

16. In a metal working machine having a main tool slide and means for reciprocating it, the combination of a plate fixed thereto and provided with a longitudinally-extending dovetail, an intermediate slide mounted thereon for reciprocating movement with the main tool slide, a resilient means carried by the main tool slide for reciprocating said intermediate slide, means for limiting the forward movement of said intermediate slide, means carried by the main tool slide for retracting said intermediate slide, a top tool-carrying slide shiftable in an oblique path relatively to the intermediate slide, and means carried by the main tool slide for shifting the top slide in transverse paths with a feed different from that of the main tool slide.

17. In a metal working machine having a main tool slide and means for reciprocating it, the combination of a plate fixed thereto and provided with a longitudinally-extending dovetail, an intermediate slide mounted thereon for reciprocating movement with the main tool slide, resilient means carried by the main tool slide for reciprocating said intermediate slide, means for limiting the forward movement of said intermediate slide, means carried by the main tool slide for retracting said intermediate slide, a top tool-carrying slide shiftable in an oblique path relatively to the intermediate slide, means carried by the main tool slide for shifting the top slide in transverse paths with a feed different from that of the main tool slide and comprising a cam member and a roller, one carried by the top slide and the other by the main slide, means for holding said roller in co-operation with the cam member, and means for adjusting the position of the top slide relatively to its cam member.

18. The combination with a main tool slide of a metal working machine adapted to carry tools operative simultaneously on a plurality of pieces of work and having a predetermined length and feed of movement and means for reciprocating it, of a tool fixture carried thereby having a length and feed of movement less than or different from that of the main tool slide, and means for shifting said fixture at an angle one part to the other.

19. The combination with a main tool slide of a metal working machine adapted to carry tools operative simultaneously on a plurality of pieces of work and having a predetermined length and feed of movement and means for reciprocating it, of a tool fixture carried thereby having a length and feed of movement less than or different from that of the main tool slide and comprising a plurality of superimposed slides supported for longitudinal movement with the main tool slide and one supported for movement relatively to the main slide at a suitable angle for the work to be performed, means for shifting said slides with the main tool slide, means for limiting the shifting movement of the slides, and means operated by the main tool slide for shifting one of said slides at an angle to the other.

20. The method of finishing a piece of work which consists in providing a fixture carried by a main tool slide having a predetermined feed and length of movement, in which the said fixture has both a movement and a feed less than or different from that of the main tool slide in an oblique path and in which the tool is pulled or lifted away from the slide.

21. The combination with a main tool slide of a metal working machine adapted to carry tools operative simultaneously on a plurality of pieces of work and having a predetermined length and feed of movement and means for reciprocating it, of a tool fixture carried thereby having a length and feed of movement less than or different from that of the main tool slide and comprising a plurality of superimposed slides supported for longitudinal movement with the main tool slide and one supported for angular movement relatively to the main slide, means for shifting said slides with the main tool slide, means for limiting the shifting movement of the slides, and means for shifting the angularly-movable slide.

22. The combination with a main tool slide of a metal working machine adapted to carry simultaneously-operative end tools and having a predetermined length and feed of movement and means for reciprocating it, of a finishing tool fixture carried thereby on a longitudinal face thereof and having a length and feed of movement in an oblique path less than that of the main tool slide, and means for shifting said finishing tool and comprising resilient and cam-operated means.

23. The combination with a main tool slide of a metal working machine adapted to carry

simultaneously-operative end tools and having a predetermined length and feed of movement and means for reciprocating it, of a finishing tool fixture carried thereby on a longitudinal face thereof and having a length and feed of movement in an oblique path less than that of the main tool slide, and means for shifting said finishing tool and comprising resilient and cam-operated means, one for imparting lengthwise movement to the finishing tool and the other for imparting transverse movement thereto.

24. The combination with a main tool slide of a metal working machine adapted to carry simultaneously-operative end tools and having a predetermined length and feed of movement and means for reciprocating it, of a finishing tool fixture carried thereby having a length and feed of movement in an oblique path less than that of the main tool slide and comprising a plurality of superimposed slides located on a longitudinal face of and supported for longitudinal movement with the main tool slide and one supported for transverse movement relatively to the main slide at an angle of approximately sixty degrees (60°), means for shifting said slides with the main tool slide, means for limiting the shifting movement of the slides, and means operated by the main tool slide for transversely shifting one of said slides and comprising resilient means and cam-operated means.

25. The combination with a main tool slide of a metal working machine adapted to carry end tools and having a predetermined length and feed of movement and means for reciprocating it, of a finishing tool fixture carried thereby having a length and feed of movement in an oblique path less than that of the main tool slide and comprising a plurality of superimposed slides supported for longitudinal movement with the main tool slide and one supported for transverse movement relatively to the main slide at an angle of approximately sixty degrees (60°), means for shifting said slides with the main tool slide, means for limiting the shifting movement of the slides, and means operated by the main tool slide for transversely shifting one of said slides and comprising resilient means and cam-operated means, the former carried by the main tool slide and co-operating with the bottom of said slides and the latter comprising a cam member carried by the main tool slide and co-operating with a roller carried by the transversely-shiftable slide.

26. In a metal working machine having a main tool slide carrying a plurality of end working tools adapted for simultaneous operation and means for reciprocating it and including a lead cam having a predetermined lead, a supplemental tool-carrying slide carried thereby, and means for shifting said supplemental tool slide at an angle to the main slide with a reduced or different feed as compared with the feed of the main tool slide and so constructed that the cutting lead of the supplemental tool slide tool is distributed over the lead of the cam of the main tool slide so that the supplemental slide tool can start work at the same time as the end working tools and have a much finer feed.

27. In a metal working machine having a main tool slide carrying a plurality of end working tools adapted for simultaneous operation and means for reciprocating it and including a lead cam having a predetermined lead, a supplemental tool-carrying slide carried thereby, and means for shifting said supplemental tool slide at an angle to the main slide with a reduced or different feed as compared with the feed of the main tool slide and so constructed that the cutting lead of the supplemental tool slide tool is distributed over the lead of the cam of the main tool slide so that the supplemental slide tool can start work at the same time as the end working tools and have a much finer feed and whereby also the supplemental slide tool is pulled or lifted away from the slide.

28. In a multiple spindle screw machine having a main tool slide adapted to carry end working tools and means for reciprocating it, a supplemental tool slide carried thereby and carrying a finishing tool operative on the interior of a piece of work, and means for shifting said supplemental tool slide at an angle to the main tool slide without interfering with the operation of the tools carried by the main tool slide and constructed to impart to the tool carried by the supplemental tool slide a feed materially finer than that of the main tool slide.

29. In a multiple spindle screw machine having a main tool slide adapted to carry a plurality of simultaneously-operative end working tools and means for reciprocating it, a supplemental tool slide carried by said main slide, and means for shifting said supplemental slide at an angle to the main slide with a reduced or different feed as compared with the feed of the main tool slide and without interference with the operations of the end working tools of the main slide.

Signed at Berlin, Germany, this 23rd day of October, 1928.

OLOF ENOCH TROBECK.