W. SCHELLENBACH.

RELIEVING MECHANISM.

APPLICATION FILED OCT. 28, 1912.

1,067,141.

Patented July 8, 1913.

4 SHEETS—SHEET 1.

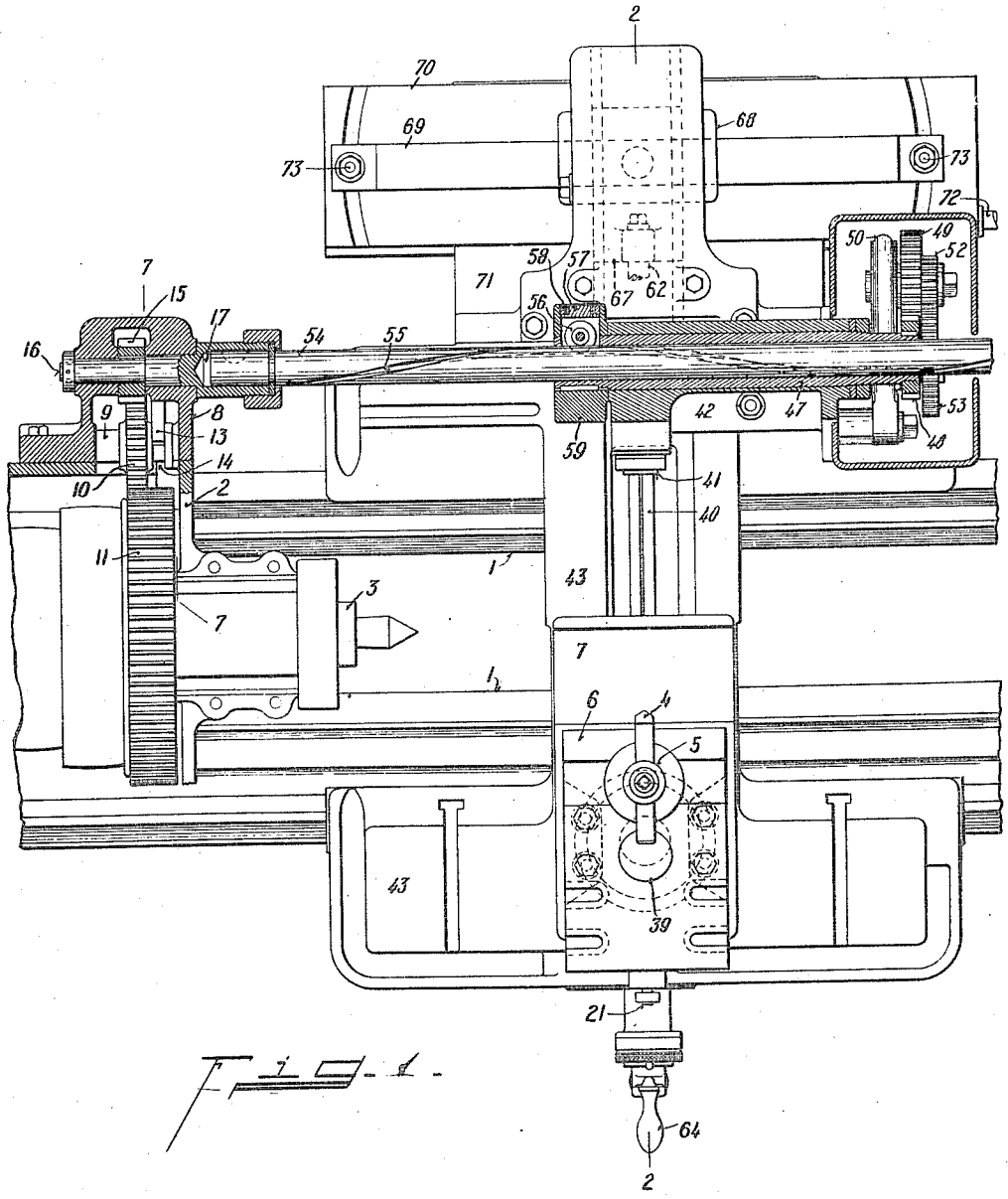


Fig. 1.

Witnesses

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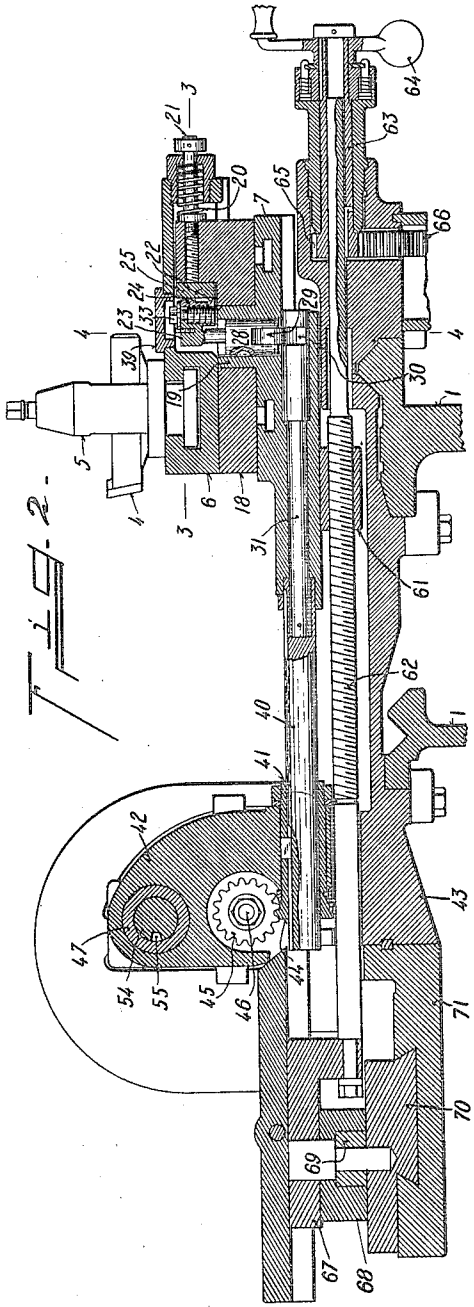


Fig. 2.

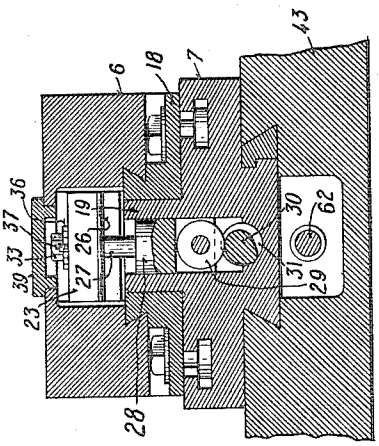


Fig. 4.

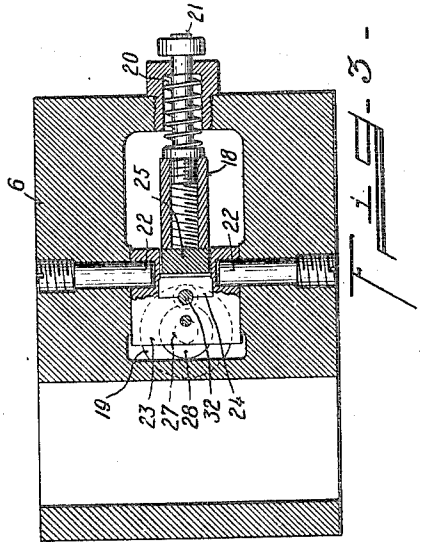


Fig. 3.

Witnesses

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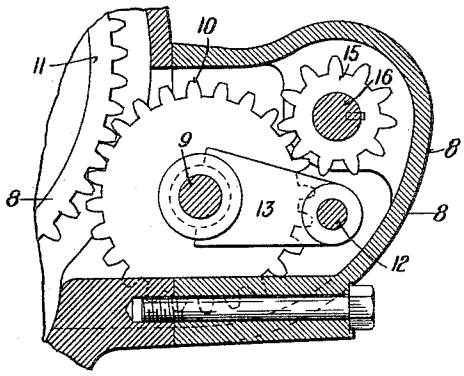


Fig. 7.

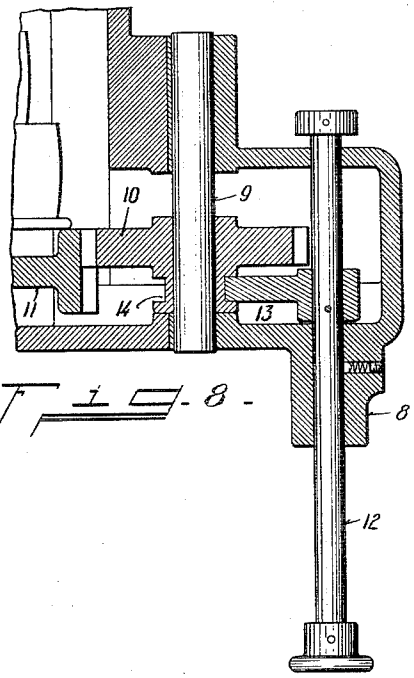


Fig. 8.

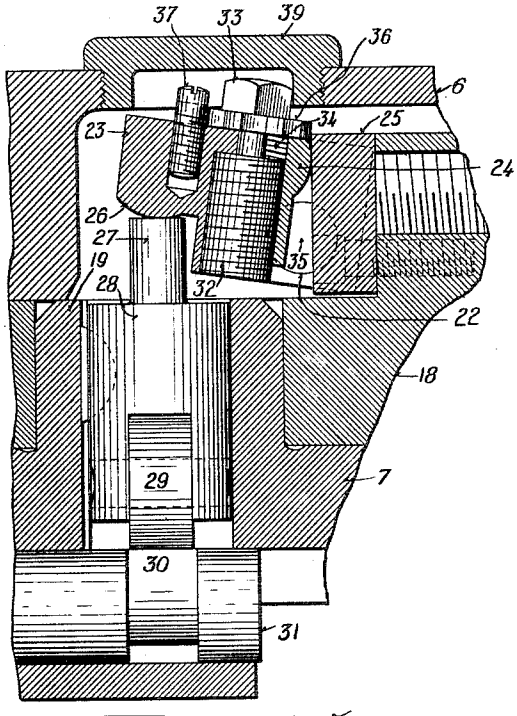


Fig. 5.

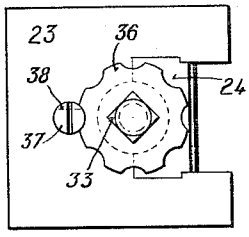


Fig. 6.

Witnesses

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4 SHEETS—SHEET 4.

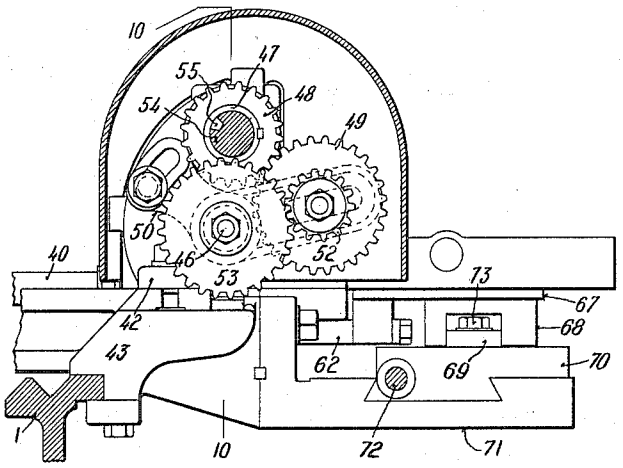


Fig. 9.

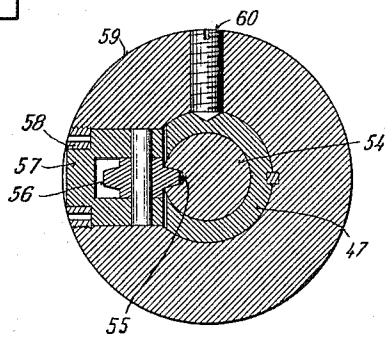


Fig. 11.

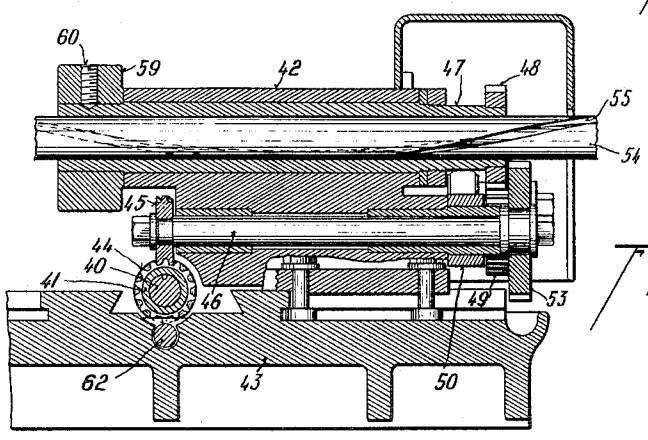


Fig. 10.

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UNITED STATES PATENT OFFICE.

WILLIAM SCHELLENBACH, OF HARTWELL, OHIO.

RELIEVING MECHANISM.

1,067,141. Specification of Letters Patent. Patented July 8, 1913.

Application filed October 28, 1912. Serial No. 728,325.

To all whom it may concern:

Be it known that I, WILLIAM SCHELLENBACH, a citizen of the United States, residing at Hartwell, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Relieving Mechanism, of which the following is a specification.

This invention relates to means for feeding a cutting tool accurately in accordance with a predetermined cycle of movements in which the cycle may be a constant or reversible, and in its more specific aspect it deals with the design and construction of an instrumentality in the nature of an engine lathe attachment operative for performing the operation of "relieving" cutting tools.

One object within the contemplation of this invention is to create a relieving attachment by having a universal capacity whereby spiral or straight fluted cutters either tapering or of uniform diameter and of different sizes and having different numbers of flutes may be relieved accurately and conveniently.

Another object is to devise a relieving attachment that will have the capacity of feeding the cutting tool at right angles to the flute irrespective of the contour thereof and which will enable this to be done without conflict with the other adjustable features of the attachment.

A further object is to render available a relieving attachment readily applicable to an engine lathe that will permit of an adjustment in the length of the stroke of the cutting tool and that will be independently adjustable as to the periodicity and timing of the movements of the cutting tool relative to the movement of the work.

Another object is to devise a means for reciprocating the tool supporting slide on the carriage so that such slide may be set at any predetermined angle to enable the reciprocations to take place in a corresponding direction while maintaining constant the amplitude of reciprocations of the tool irrespective of the position into which the slide may be turned.

Other objects will be in part apparent from the annexed drawings and in part pointed out in the following description in connection therewith.

In order that this invention may be so fully disclosed to those skilled in this art that they may be enabled to embody the same in the various forms and modifications to which it is readily subject, drawings exemplifying a preferred form have been appended as a part of this disclosure, and in such drawings, like characters of reference denote corresponding parts throughout all of the figures, of which:—

Figure 1 is a plan view depicting the bed and head-stock of a conventional lathe to which has been applied a relieving attachment shown partly in section conforming to this invention. Fig. 2 is a section taken along line 2—2 of Fig. 1, showing the means for causing the cutting tool to operate periodically in combination with the means for determining the nature of the cycle of movements of such tool and in combination with the means determining the progressive movement of the tool. Fig. 3 is a horizontal section through line 3—3 of Fig. 2 showing certain relationships of elements of the tool reciprocating means. Fig. 4 is a vertical section through line 4—4 of Fig. 2 showing other details of the tool reciprocating means. Fig. 5 is an enlarged detail of a portion of Fig. 2 showing the position of the parts at the other limit of the stroke of the relieving tool from that shown by Fig. 2. Fig. 6 is a plan of the adjusting nut for determining the length of stroke of the cutting tool. Fig. 7 is a section taken along line 7—7 of Fig. 1 showing the gears whereby motion is derived from the headstock. Fig. 8 is a horizontal section through line 8—8 of Fig. 7 showing the means for enabling the driving gears of the relieving attachment to be shifted into operative or inoperative position. Fig. 9 is an elevation showing the arrangement of change gears whereby the cycle of the relieving tool may be varied to any predetermined extent. Fig. 10 is a section through line 10—10 of Fig. 9 showing further details of the cycle adjusting means for transmitting motion from the splined shaft to the relieving tool. Fig. 11 is a section taken transverse to the head stock driven splined shaft showing the preferred mode of connecting the same with the sleeve telescoping said shaft.

Continuing now by way of a more detailed description, 1 indicates the bed of a lathe on which is supported the head-stock 2 in which is journaled the spindle 3 that carries and revolves the work, which, in this instance will be a cutting tool blank, that is to be finished by a so-called relieving opera-

tion; said relieving being performed by a tool 4 secured by a tool post 5 to the slide 6 of a carriage 7 arranged to be fed along the lathe bed 1 by suitable mechanism in the apron of the carriage.

It will be understood by those skilled in this art that the spindle 3 may be assumed to rotate at a constant speed, and the purpose of this invention is to give the tool 4 a compound movement with respect to the constantly revolving cutting blank such that it will produce the desired contour and relief. To enable this invention to be more readily comprehended a preliminary elemental analysis of the operations to be effected by the cutting tool may be useful. Supposing it is desired to produce a given properly relieved cutting tool. This tool will have a certain length and its diameter from end to end may be constant or may vary uniformly as in a taper or it may vary according to a predetermined curve. This tool may have any given number of flutes extending from end to end along its periphery, and these flutes may extend in a straight line or they may extend in a spiral of any desired character. Each flute or cutting edge must be relieved from end to end so as to provide a proper clearance when the same is used and this clearance may in some cases be greater and in other cases less in extent. It is the relieving operation that provides this clearance. Now it is obviously essential that not only must the tool partake of each of these movements in proper ratio to the work being relieved but to secure the best and most perfect relieving it is important that the tool doing the relieving whenever it advances into the work shall at each point move at right angles to the curve of the flute at that point. Thus it will be seen that the motion of the relieving tool is a composite one of considerable complexity, but by this invention this motion is obtained accurately by means of a comparatively simple mechanism.

Turning to Fig. 1, 8 indicates a bracket bolted to the head-stock and containing a shaft 9 on which slides and rotates a gear 10 adapted in one position to be brought into mesh with a gear 11 on the spindle, and in another position to be disconnected from gear 11. The mechanism for shifting these parts may best be understood by turning to Fig. 8 in which 12 is a shift bar adapted to be translated in the bracket 8 and carrying a shifting arm 13 coacting with a groove 14 in the hub of the gear 10. In constant mesh with the gear 10 is a pinion 15 that is keyed to a stub shaft 16 journaled in the bracket 8 and having a socket 17 in its exposed end. When the gears are in mesh this socket revolves at a definite fixed ratio with the spindle of the head-stock and it constitutes the primary source for actuating the tool in its relieving reciprocations through the intermediary means for determining the periodicity of such reciprocation and the means for introducing an accelerating factor into the timing of the periods. It will perhaps be clearer to direct attention first to the means for producing the relieving reciprocations and then consider how such means is controlled by other instrumentalities.

The means imparting relieving reciprocations to the tool is arranged between the slide 6 and the tool carriage 7. This slide 6 is supported directly upon an intervening block 18 that is pivoted to the carriage member 7 by means of the hollow post 19 rising from the latter. The slide 6 is normally urged away from the work by means of a spring 20 (see Fig. 2) carried on the shaft 21 that is screw threaded into the swinging block 18. The sliding tool support 6 is interiorly recessed and has two pins 22 that constitute pivots for the oscillating member 23 shown isolated by Fig. 6 and assembled with its coöperating elements by Fig. 5 and others. This block in turn has a contact member 24 mounted in a slideway therein and which block bears against the stationary hardened wear plate 25 mounted on the revolving member 18. The oscillating member 23 also has an actuating face 26 adapted to be maintained in contact with a stud 27 rising from a member 28 that is keyed within the bore of the hollow post 19 and carries an anti-friction roller 29 at its lower end. This roller 29 bears on a cam 30 formed on the shaft 31 that is journaled in the carriage member 7. Assuming the shaft 31 uniformly to rotate, the member 28 will rise and fall at each revolution thereof and this will cause the block 23 to oscillate about a center determined by the pivot pins 22. Now if the contact piece 24 be positioned to abut the wear-block 25 at one side of the pivot pins, *i. e.* off center, then will the slide 6 be moved toward the work against the resistance of the spring 20, this operation being repeated at each revolution of the shaft 31. Thus the relieving tool will be caused to reciprocate.

The means adjusting the stroke of the relieving reciprocations is of a very simple nature, and it merely consists in a device for shifting the position of the contact piece 24 in the oscillating-member 23. Mounted on the block 23 is a screw 32 terminating in a nut 33 to facilitate its rotation. This screw engages threads 34 on the interior side of the contact piece 24 so that by turning the screw 32 such piece 24 will be shifted up and down to bring its point of contact nearer to or more distant from the center 35 of the pivot pins 22. To enable the parts to maintain their position a star wheel 36 is provided and is locked against rotation by a set screw 37. This set screw has a

notch 38 in one side to permit of adjustment of the parts. A cap 39 may be fitted to the slide 6 to prevent chips from entering the space occupied by the above mentioned parts, and by removing such cap access will be had to the adjusting nut 33. To lengthen the stroke the contact piece 24 will be moved so that its contact point is more remote from the center 35, and to shorten the stroke the contact piece 24 will be moved in the reverse direction.

The means permitting relieving at right angles to the flute line is so devised that it will not disturb or modify the adjustment of the relieving stroke even though the tool should be caused to move at a considerable angle to the transverse line. As has already been stated the slide 6 reciprocates on an intervening block 18 that may be swung about on the carriage member 7 until the direction of movement of the tool is at right angles to the line of the flute at the cutting point. It is to be noted that the bearing face 26 of the block 23 contacts with the rising and falling member 28 at the axis thereof by reason of the curve in the face 26 and as this is the axis about which the intervening block 18 turns it is evident that the relationship of the various elements will be preserved independently at the angle through which the tool has been swung.

The means determining the periodicity of the relieving reciprocations directly controls the rate of revolution of the shaft 31 having the cam 30. The more frequently this shaft is rotated relative to the work supporting spindle, the more frequent will reciprocations occur of the cutting tool. Thus, should the shaft 31 rotate twice during each revolution of the spindle, then will the relieving tool operate through two complete cycles of periods during each revolution of the work which will correspond to relieving a two fluted blank. Connected to the end of shaft 31 is a splined extension shaft 40 that enters a sleeve 41 that is rotatably secured in a casting 42 bolted or otherwise secured to the base 43 of the carriage. A suitable key in the sleeve 41 enables the splined shaft 40 to be moved longitudinally with respect to such sleeve while caused to rotate therewith. This sleeve 41 carries a worm 44 that meshes with a transversely arranged worm 45 secured to a shaft 46 (see Fig. 10) also journaled in the casting 42 and extending parallel with the guides of the lathe bed. A sleeve 47 is also journaled in the casting 42 and by suitable connections it is driven from the head-stock through the intermediary of the socketed shaft 16 above described. The sleeve 47 is utilized indirectly as a driver for the shaft 46 but to enable any predetermined ratio of movements to be established therebetween so as to secure the desired periodicity of the relieving reciprocations, a change gear system is introduced between the sleeve 47 and the shaft 46 and this will be understood from Figs. 1, 9 and 10. Keyed to the sleeve 47 is a gear 48 that meshes with a gear 49 carried on an arm 50 pivoted concentric to shaft 46 and having a slot so that the gear 49 may be interchanged by another of greater or lesser diameter. Secured to the gear 49 is a pinion 52 that may also be interchangeable and which meshes with a gear 53 keyed to the end of the shaft 46. By this arrangement the shaft 46 may be given any desired ratio of movement relative to the spindle and thus determine the periodicity of the relieving tool.

The means modifying the timing of the periods will now be described. This arrangement enables the operator to relieve a straight flute or a spiral flute. For relieving a straight flute it is apparent that there must be no progressive acceleration or retardation of the frequency of the periods relative to the revolution of the work in the spindle, but should it be desired to relieve a spiral flute, there must be an increment or a decrement in the timing of the periods that will be in correspondence with the angular advance of the spiral flute on the work. Thus, if the spiral is such that for each unit of length along the work it advances a given angle, then will this angle be a function of the increment that is to be imparted to each period of the relieving reciprocations during the time that the tool has been moved by the carriage through a unit of length along the lathe bed. To obtain this increment or acceleration a shaft 54 is secured in the socket 17 in the exposed end of the shaft 16. This shaft has a splined groove 55 and a plotting of this groove will determine the amount of the acceleration or increment. Thus if the groove 55 is straight *i. e.* parallel with the axis of the shaft 54 the increment will be reduced to zero but if the shaft be provided with a spiral spline then will the increment be determined by the steepness of the spiral. The transmission of movements from the shaft 54 to the sleeve 47 moderated to the extent desired by the spline 55 is effected preferably by a roller 56 journaled in a block 57 that is retained in a circular recess by the collar 58 in a member 59 secured to the sleeve 47 as by a set screw 60 and a suitable key. This block 57 is arranged to swivel in its recess so that roller 56 which enters the spline, may assume any angular position corresponding to the twist of the spiral spline. This enables shaft 54 to be interchanged by others having a spiral spline of any desired design and at the same time realize a satisfactory connection between such shaft and the sleeve 47.

The means permitting longitudinal traverse of the tool does not require extensive description as the carriage and the parts

mounted thereon described in the foregoing will be moved along the lathe bed by any desired propelling mechanism extending from the head-stock to an apron of the carriage. Thus such mechanism may be conventional in design. It is to be noted that inasmuch as the shaft 54 telescopes freely within the sleeve 47 by means of the special anti-friction self-adjusting spline and key above described, such movements of the carriage are provided for.

The means determining the normal distance of the tool from the axis of the work will now be described. The mechanism thus far described is adequate for relieving any desired clearance on any desired number of flutes which may extend spirally or otherwise, and for any desired length of work, providing the blank is of constant diameter throughout its length. By the means now to be described however provision is made for doing this work *i. e.* all the foregoing operations, on a blank that varies in diameter in a predetermined manner from one end to the other. Thus, provision is made for relieving a blank that uniformly tapers from end to end. This requires a progressive advance of the relieving tool toward or away from the work as it is moved longitudinally from end to end by the travel of the carriage.

Turning to Figs. 1 and 2 it should be noted that the carriage member 7 is mounted on the base 43 of the carriage so as to permit of sliding thereon transversely to the lathe bed. As has been stated, the shaft 40 is splined within the sleeve 41 so that such movement may take place without disturbing the functions of the parts described in the foregoing and operating on the cam shaft 31. The position of the carriage member 7 relative to the carriage base 43 is determined by a nut 61 screw threaded to a lead screw 62. This lead screw 62 is splined within a sleeve 63 that may be operated by the hand wheel 64 or automatically by the gears 65 and 66 from the apron mechanism. The other end of the feed screw 62 is rotatably secured to a block 67 that is pivoted to a slide block 68 which in turn travels along a taper bar 69. This taper bar is in turn pivoted to a slide 70 that is carried by an extension 71 from the base of the carriage and it is so arranged that it may be locked to the extension 71 so that it will move as a unit with the carriage, or it may be freed and held stationary with respect to the lathe bed by means of a rod 72 that extends to a suitable bracket adapted to be clamped to the lathe bed in such instance. When the taper bar 69 is set at an angle and retained in position by means of bolts 73 (gear 66 being disconnected from its operating gear) and when the slide 70 is held stationary with respect to the lathe bed, the traverse of the carriage will cause the lead screw 62 to be translated without rotating, thus resulting in a progressive feed of the carriage member transversely to the work thereby causing the relieving tool to operate along a taper. Or should the slide 70 be set to travel as a unit with the carriage (gear 66 being still out) then will there be no sliding of the carriage member 7 on the carriage base 43 and a blank of uniform diameter will be relieved. Or should the gear 66 be brought into operative connection with the apron mechanism so as to be rotated as the carriage is propelled, then will the feed screw 62 be rotated without translating and the carriage member 7 will be caused to slide transversely on the carriage base 43 and again the tool will relieve along a taper. To secure the full range of tapers, this mechanism which is more fully described in my copending application Serial No. 728,321, filed of even date herewith, is preferred, but other taper arrangements may be utilized in the light of this disclosure.

I therefore claim and desire to secure by Letters Patent:—

1. A mechanism of the nature disclosed combining a member, a tool support mounted to reciprocate on said member, a cam shaft journaled in said member, means for rotating said cam shaft, and vertically reciprocating means intervening between said cam shaft and said tool support adapted to be actuated by said cam shaft to reciprocate said tool support.

2. A mechanism of the nature disclosed combining a member, a second member pivoted thereto adapted to be turned into a predetermined position, a tool support slidably mounted on said second member, a shaft journaled in said first member, and means reciprocating through the pivot between said first and second members adapted to be actuated by said shaft to reciprocate said tool support.

3. A mechanism of the nature disclosed combining a member, a second member pivoted thereto adapted to be turned into a predetermined position, a tool support slidably mounted on said second member, a shaft journaled in said first member, means operative through the pivot between said first and second members adapted to be actuated by said shaft to reciprocate said tool support, and an adjusting device operative in connection with said means for determining the length of the stroke of said reciprocations.

4. A mechanism of the nature disclosed combining a member, a second member pivoted thereto adapted to be turned into a predetermined position, a tool support slidably mounted on said second member, a shaft journaled in said first member and

having a cam under said pivot, means operative through the pivot between said first and second members adapted to be actuated by said cam to reciprocate said tool support, a work supporting spindle, and a speed change driving connection between the work supporting spindle and said shaft whereby the latter may be actuated at a predetermined ratio with said spindle.

5. A mechanism of the nature disclosed combining a member, a second member pivoted thereto adapted to be turned into a predetermined position, a tool support slidably mounted on said second member, a shaft journaled in said first member, means operative through the pivot between said first and second members adapted to be actuated by said shaft to reciprocate said tool support, an adjusting device operative in connection with said means for determining the length of the stroke of said reciprocations, a work supporting spindle, and a speed change driving connection between the work supporting spindle and said shaft whereby the latter may be actuated at a predetermined ratio with said spindle.

6. A mechanism of the nature disclosed combining a member, a second member pivoted thereto adapted to be turned into a predetermined position, a tool support slidably mounted on said second member, an oscillating part pivoted to said support and having a portion over the pivot of said member, a shaft journaled in said first member, means operative through the pivot between said first and second members adapted to be actuated by said shaft to operate said oscillating part to reciprocate said tool support, a work supporting spindle, a speed change driving connection between the work supporting spindle and said shaft whereby the latter may be actuated at a predetermined ratio with said spindle, and means operative on said connection for modifying the ratio determined thereby in accordance with the distance of the tool support from said spindle.

7. A mechanism of the nature disclosed combining a member, a second member pivoted thereto adapted to be turned into a predetermined position, a tool support slidably mounted on said second member, a shaft journaled in said first member, means operative through the pivot between said first and second members adapted to be actuated by said shaft to reciprocate said tool support, an adjusting device operative in connection with said means for determining the length of the stroke of said reciprocations, a work supporting spindle, a speed change driving connection between the work supporting spindle and said shaft whereby the latter may be actuated at a predetermined ratio with said spindle, and means operative on said connection for modifying the ratio determined thereby in accordance with the distance of the tool support from said spindle.

8. A mechanism of the nature disclosed combining a member, a second member pivoted thereto adapted to be turned into a predetermined position, a tool support slidably mounted on said second member, a shaft journaled in said first member, means reciprocating through the pivot between said first and second members adapted to be actuated by said shaft to reciprocate said tool support, means for longitudinally moving the tool supporting parts, and an instrumentality for simultaneously moving the tool support transversely in predetermined ratio with its longitudinal movement.

9. A mechanism of the nature disclosed combining a member, a second member pivoted thereto adapted to be turned into a predetermined position, a tool support slidably mounted on said second member, a shaft journaled in said first member, means operative through the pivot between said first and second members adapted to be actuated by said shaft to reciprocate said tool support, and an adjusting device operative in connection with said means for determining the length of the stroke of said reciprocations, and means for longitudinally moving the tool supporting parts, and an instrumentality for simultaneously moving the tool support transversely in predetermined ratio with its longitudinal movement.

10. A mechanism of the nature disclosed combining a member, a tool support mounted to reciprocate on said member, a cam shaft journaled in said member, means for rotating said cam shaft, a plunger and a vibrator intervening between said shaft and said tool support adapted to be actuated by said cam shaft to reciprocate said tool support, a speed change driving connection between the work supporting spindle and said shaft whereby the latter may be actuated at a predetermined ratio with said spindle, means for longitudinally moving the tool supporting parts, and an instrumentality for simultaneously moving the tool support transversely in predetermined ratio with its longitudinal movement.

11. A mechanism of the nature disclosed combining a member, a second member pivoted thereto adapted to be turned into a predetermined position, a tool support slidably mounted on said second member, a vibrator pivoted to said support and bearing against said second member, a shaft journaled in said first member, a plunger operative through the pivot between said first and second members adapted to be actuated by said shaft to operate said vibrator to reciprocate said tool support, a work supporting spindle, a speed change driving connection between the work supporting spindle and said shaft whereby the latter

may be actuated at a predetermined ratio with said spindle, and means for longitudinally moving the tool supporting parts, and an instrumentality for simultaneously moving the tool support transversely in predetermined ratio with its longitudinal movement.

12. A mechanism of the nature disclosed combining a member, a second member pivoted thereto adapted to be turned into a predetermined position, a tool support slidably mounted on said second member, a shaft journaled in said first member, means operative through the pivot between said first and second members adapted to be actuated by said shaft to reciprocate said tool support, an adjusting device operative in connection with said means for determining the length of the stroke of said reciprocations, a work supporting spindle, a speed change driving connection between the work supporting spindle and said shaft whereby the latter may be actuated at a predetermined ratio with said spindle, and means for longitudinally moving the tool supporting parts, and an instrumentality for simultaneously moving the tool support transversely in predetermined ratio with its longitudinal movement.

13. A mechanism of the nature disclosed combining a member, a tool support mounted to reciprocate on said member, a vibrator pivoted between said support and member, a cam shaft journaled in said member, means for rotating said cam shaft, a plunger intervening between said shaft and said tool support adapted to be actuated by said cam shaft to operate said vibrator to reciprocate said tool support, a speed change driving connection between the work supporting spindle and said shaft whereby the latter may be actuated at a predetermined ratio with said spindle, means operative on said connection for modifying the ratio determined thereby in accordance with the distance of the tool support from said spindle, and means for longitudinally moving the tool supporting parts, and an instrumentality for simultaneously moving the tool support transversely in predetermined ratio with its longitudinal movement.

14. A mechanism of the nature disclosed combining a member, a second member pivoted thereto adapted to be turned into a predetermined position, a tool support slidably mounted on said second member, a cam shaft journaled in said first member, reciprocating means operative through the pivot between said first and second members adapted to be actuated by said shaft to reciprocate said tool support, a work supporting spindle, a speed change driving connection between the work supporting spindle and said shaft whereby the latter may be actuated at a predetermined ratio with said spindle, means operative on said connection for modifying the ratio determined thereby in accordance with the distance of the tool support from said spindle, means for longitudinally moving the tool supporting parts, and an instrumentality for simultaneously moving the tool support transversely in predetermined ratio with its longitudinal movement.

15. A mechanism of the nature disclosed combining a member, a second member pivoted thereto adapted to be turned into a predetermined position, a tool support slidably mounted on said second member, a shaft journaled in said first member, means operative through the pivot between said first and second members adapted to be actuated by said shaft to reciprocate said tool support, an adjusting device operative in connection with said means for determining the length of the stroke of said reciprocations, a work supporting spindle, a speed change driving connection between the work supporting spindle and said shaft whereby the latter may be actuated at a predetermined ratio with said spindle, means operative on said connection for modifying the ratio determined thereby in accordance with the distance of the tool support from said spindle, means for longitudinally moving the tool supporting parts, and an instrumentality for simultaneously moving the tool support transversely in predetermined ratio with its longitudinal movement.

In testimony whereof, I have hereunto set my hand.

WILLIAM SCHELLENBACH.

Witnesses:
OLIVER B. KAISER,
CLARENCE B. FOSTER.