Nov. 3, 1942. G. P. REED ET AL 2,300,967

LATHE

Filed June 28, 1939 3 Sheets-Sheet 1

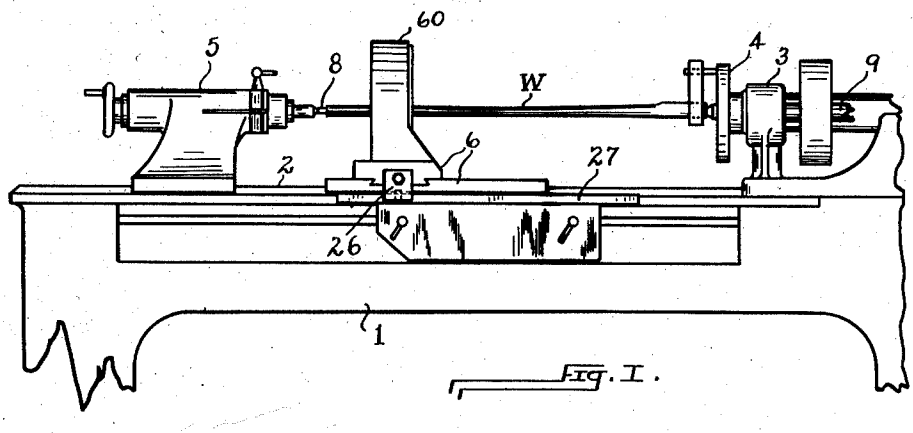

Fig. I.

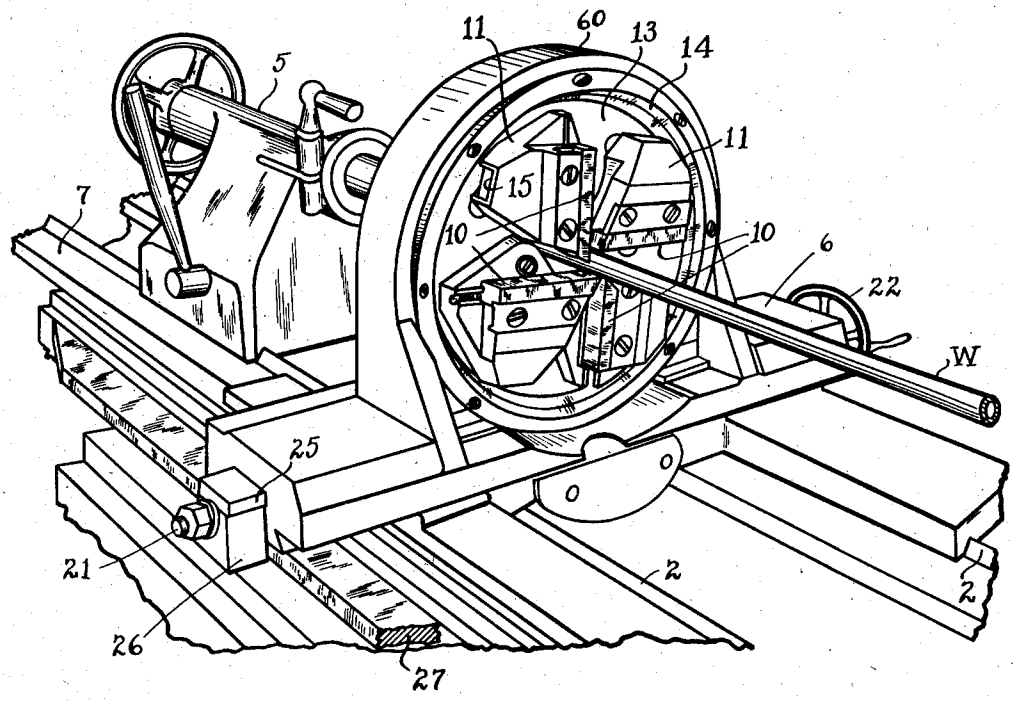

Fig. II.

INVENTORS
George P. Reed, and
Frederick K. Landgraf
by Christy and Wharton
attorneys

Nov. 3, 1942. G. P. REED ET AL 2,300,967

LATHE

Filed June 28, 1939 3 Sheets-Sheet 2

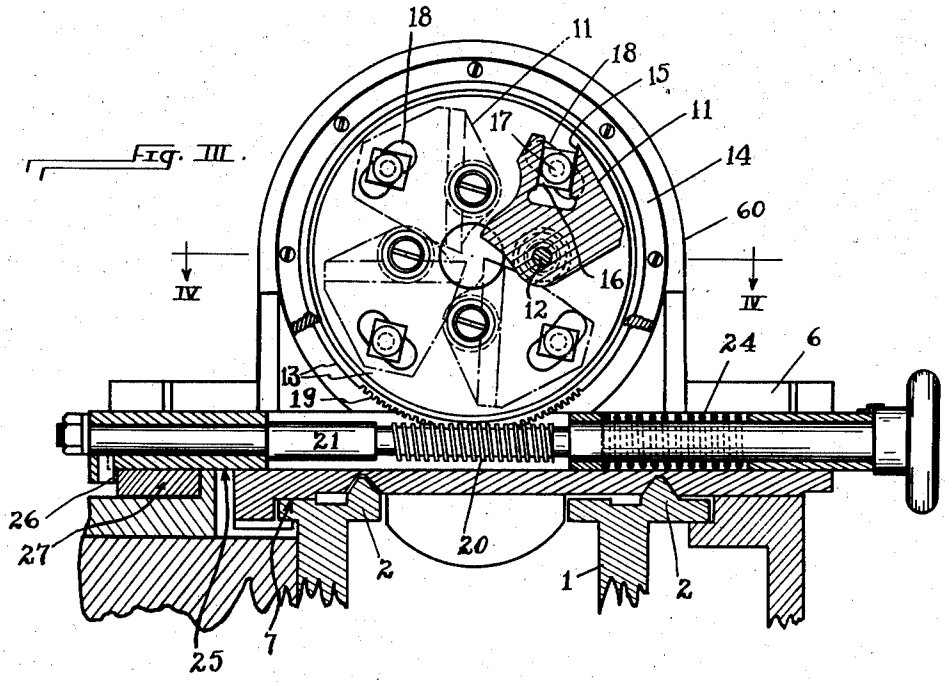

Fig. III.

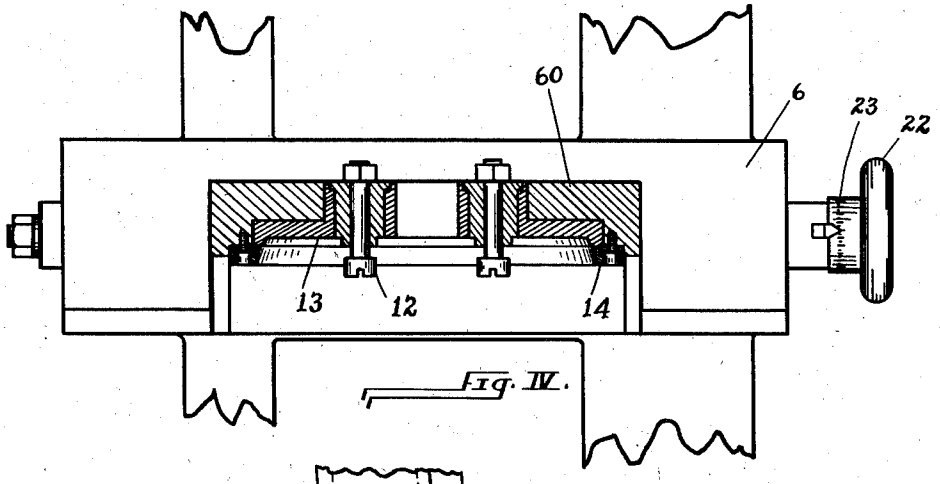

Fig. IV.

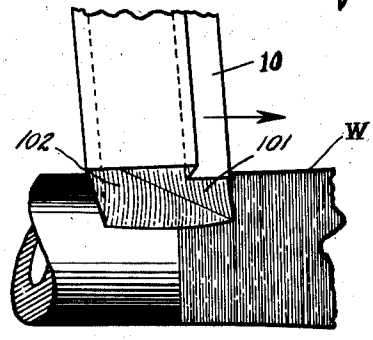

Fig. V.

INVENTORS
George P. Reed, and
Frederick H. Landgraf
by Christy and Wharton
attorneys

Nov. 3, 1942. G. P. REED ET AL 2,300,967

LATHE

Filed June 28, 1939 3 Sheets-Sheet 3

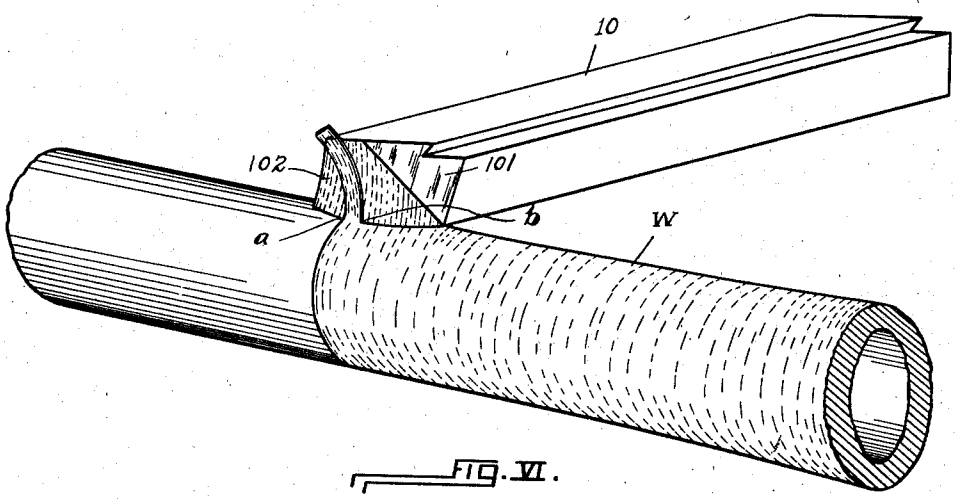

FIG. VI.

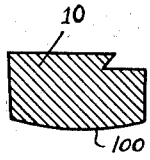

FIG. VII.

INVENTORS
George P. Reed and
Frederick K. Landgraf
BY Christy, Parmelee and Strickland
ATTORNEYS

Patented Nov. 3, 1942 2,300,967

UNITED STATES PATENT OFFICE

2,300,967

LATHE

George P. Reed, Bridgeville, and Frederick K. Landgraf, Crafton, Pa., assignors to Flannery Bolt Company, a corporation of Delaware

Application June 28, 1939, Serial No. 281,580

1 Claim. (Cl. 82—20)

The invention relates to the finishing of spindle-shaped articles in lathes. We have developed it in practical application to the manufacture of gun barrels, and in the taking of a finishing cut upon the rough-cut outer surface of the barrel. Invention is to be found in apparatus. The objects in view are precision of the finishing cut attained with speed and with economy.

In the accompanying drawings Fig. I is a view in side elevation of the finishing lathe of the invention, showing a piece of work in place upon it. Fig. II is a view in perspective and to larger scale, showing a portion of the lathe of Fig. I. Fig. III is a view in cross-section through the tool carriage in place in the lathe. The lathe is here shown to be free of a piece of work. The scale is substantially that of Fig. II. Fig. IV is a view in horizontal section, on the plane indicated at IV—IV, Fig. III. Fig. V is a fragmentary view in elevation and to yet larger scale, showing a cutter in engagement with the work. Fig. VI is a view in perspective, illustrating diagrammatically the operation of the apparatus of the invention. Fig. VII is a view in cross-section of the cutting tool.

Referring first to Figs. I and III, a lathe is here shown that includes a bed, 1, in which is mounted a pair of longitudinally extending, parallel rails, 2, of inverted V-shape in cross-section. At one end the bed carries in a housing 3 a rotatable head-stock 4, and toward the other end it carries a tail-stock 5, adjustable in position relative to the head-stock upon the rails 2. A tool carriage 6 is borne by and travels longitudinally upon the bed. On one side (the right-hand side, Fig. III) the carriage rests upon and makes guiding engagement with one of the rails 2; on the opposite side it rests upon the horizontally disposed surface 7 of the bed. Thus the position of the tool carriage upon the bed is related to a single longitudinally extending member—the rail 2 on the right, of ridged or inverted-V shape.

The work W is essentially a rough-cut spindle-shaped article. In this case it is a gun-barrel blank with finished bore and with rough-cut outer surface coaxial with the bore. The work is secured at one end (in this case the breach end) to the head-stock 4, to rotate with the head-stock. At the opposite end a plug 8 is set in the bore of the work, and through this plug the work makes rotatable engagement with the tail-stock 5. The adjustability of the tail-stock upon the bed allows assembly to be made. Means for rotating the head-stock 4, and with it the work W, are fragmentarily indicated in the shaft 9. The work so mounted rotates in unison with the head-stock, and on an axis of rotation coincident with its own axis.

In operation the work has no longitudinal movement. It rotates while the cutters, progressing in straight-line courses, advance longitudinally upon it.

In the carriage 6 the cutting tools 10 are mounted. There is a plurality of them (in this instance, four) spaced circumferentially and forming a cluster. They are held in positions equally spaced from the axis of work rotation, and for each cutter the other members of the cluster form the backing, holding the work, while the cutting operation progresses, to the tool. Each tool 10 is rigidly borne in a block 11. The tool-carrying blocks 11 are pivotally mounted upon pins 12 in an annular plate 13; and the plate 13 is rotatably mounted in the carriage 6. From the bed of carriage 6, an integral part of the casting of which the carriage is formed, rises the standard 60. This standard is provided upon one face with a nicely machined seat for the plate 13; the plate is held to its seat by the keeper ring 14; and the standard is centrally ported, that the work may extend freely through. The mountings of the annular plate 13 in the carriage, and of the carriage upon the bed of the lathe are made with great accuracy, so that the plate is truly centered in the axis of the mounted work. The body of each tool-block 11 is slotted, as indicated at 15 with a parallel-sided slot. The slot extends radially with respect to the centre of turning of the block upon its pin 12, and obliquely with respect to the centre of the tool cluster. The plate 13 is provided with windows 18 and from the standard 60 pins 17 extend through the windows and into the slots 15 in the tool-blocks. Pivoted upon these pins 17 are blocks 16 with opposite parallel sides, that fit nicely between the walls of the slots. It is manifest that, as the plate 13 is rotated upon its seat in standard 60, the movement of blocks 16 along slots 15 effects rotation of the tool-blocks 11 upon their pins 12 and a corresponding adjustment of the circumference to which the cutting edges of the tools 10 coincide. The windows 18 are suitably proportioned to permit such rotation.

Upon the periphery of plate 13 teeth 19 are formed; but it suffices that the lower limb only of the plate be so provided with teeth, for required range of rotation is small. The teeth are worm-gear teeth, and they are engaged by a

worm 20 that is formed upon a spindle 21, which spindle is mounted in the carriage. The spindle extends transversely of the carriage and beneath the plate 13. It is rotatable, to rotate plate 13 and so to adjust the spread of the tools and to bring them to a cutting circumference of desired diameter. A hand-wheel 22 with a micrometer scale 23 are provided for effecting such adjustment.

Not only is the spindle 21 rotatable; it is longitudinally reciprocable also, against tension of a spring 24. The spindle carries a block 25, within which the spindle itself turns, and from the block an arm 26 extends. The machine bed 1 is equipped with a jig or sine-bar 27; and the spring 24 is effective to hold the spindle at the limit of its range of longitudinal reciprocation (the right-hand end, as seen in Fig. III) with its arm 26 in abutment upon the sine-bar 27. As the face of the sine-bar deviates from parallelism with the rail 2, it is manifest that in carriage advance the spindle will be shifted longitudinally in one direction or the other. As the spindle is so shifted, the convolutions of worm 20 will act as a rack in engagement with the teeth 19, turning plate 13 and correspondingly changing the diameter of the circumference of cut of the tool-cluster.

Suitable means (not shown) are provided for causing the carriage 6 to advance, at a rate suitably related to the rate of rotation of the head-stock.

A gun barrel of substantially uniform bore throughout, is commonly of maximum wall thickness at the breach end, and from the breach end the wall thickness diminishes (and, ordinarily, at non-uniform rate) to the muzzle end. In the practice of this invention the rough-cut blank is ordinarily subjected to a single finishing cut. The carriage 6 is retracted to starting position (at the extreme left-hand limit of its range, as seen in Fig. I), and a piece of work W, a rough-cut gun barrel, is secured in place, engaged at its ends by head-stock and tail-stock, and extending through the plate 13, the standard 60, and through the cluster of cutters that has been spread to permit of such placement. The cutters are by the turning of hand-wheel 22 brought to proper spacing; and a sine-bar 27 of proper profile is accurately placed upon and secured to the lathe bed. The lathe is then set in operation. The work is set in rotation, and the carriage advances (from left to right, Fig. I) upon the rotating work. The clustered cutters do not revolve about the axis of the work, but continue in straight-line course, with the qualification, however, that the cluster opens as operation progresses, in response to the shift imparted to spindle 21 by the wedging action of the obliquely set face of the sine-bar upon the arm 26 borne by the advancing carriage. The cutters engage the work, as diagrammatically shown in Figs. V and VI and make a succession of spirally extending cuts, removing the rough surface indicated on the right and leaving the finished surface indicated on the left.

The particular form of the cutting edges of the tools is indicated in Figs. V and VI. Lathe tools for other purposes are, ordinarily, relatively sharply pointed, and do their cutting at the points. At variance with this, the tools of the invention are chisel edged. The bar of steel that forms the tool is convex and substantially cylindrical on the side 100 that in the assembly faces the work (Figs. V, VI, and VII). The cutting edge is formed by shaping the bar at its end to a beveled surface 101 and by grinding the beveled end to a surface 102 that ordinarily is slightly hollowed and ordinarily is not co-extensive with the beveled surface 101. The chisel edge is curved on an arc of long radius. The tool is about an inch wide. When the machine is in operation, only a fraction (about one eighth of an inch) of the curved cutting edge of the tool is in cutting engagement with the work. This is indicated at *a*—*b*, Fig. VI. Manifestly, as the clustered tools spread, the surface that is finished becomes a surface of increasing diameter, and, as the clustered tools move inwardly, the surface finished by the tools becomes a tapered surface of diminishing diameter; and, manifestly, by the particular shaping of the jig, the finished surface may be a tapered surface of non-uniformly increasing diameter, and so the specification for a gun barrel may be satisfied. If the rough-finished gun barrel upon which the finishing cut is made in this machine be a barrel that already has received approximately the desired outer configuration increasing in diameter at a non-uniform rate from nozzle to breach, the bite *a*—*b* of the tool upon the work will in the progress of the finishing operation shift along the extended edge of the tool and, as seen in Figs. V and VI, in direction from left to right.

While the preferred organization is that shown and described, of a stationary lathe bed and an advancing carriage, it is manifest that the relative movement of these two parts is all that is essential, and that the tool-carrier might be stationary, and the lathe bed be reciprocable in relation to it.

The machine, developed for the specific purpose of finishing gun barrels, is manifestly applicable to the finishing of spindle-shaped articles generally, whether they be provided with bores or imperforate.

We claim as our invention:

In a lathe for finishing the outer surface of a gun-barrel blank to a surface of varying taper from the breach end of the barrel to the muzzle, such lathe including a tail-stock, a head-stock adapted to effect rotation of a blank supported against the tail-stock, a carriage equipped with a cluster of pivoted tools whose cutting edges engage the surface of the blank at circumferentially spaced-apart points, means for advancing the carriage longitudinally of the blank between the head-stock and the tail-stock, and means including a jig for turning the tools on their pivots and spreading the cutting edges in unison radially of the axis of the blank as the carriage advances; the invention herein described which consists in the provision in the tool cluster of tools having cutting edges that extend on convex arcs substantially in the direction of the length of the blank whereby in the finishing of the surface of a blank of varying taper, the bite of the tools upon the blank advances along the edge of the tool.

GEORGE P. REED.
FREDERICK K. LANDGRAF.