

Apr. 24, 1923.

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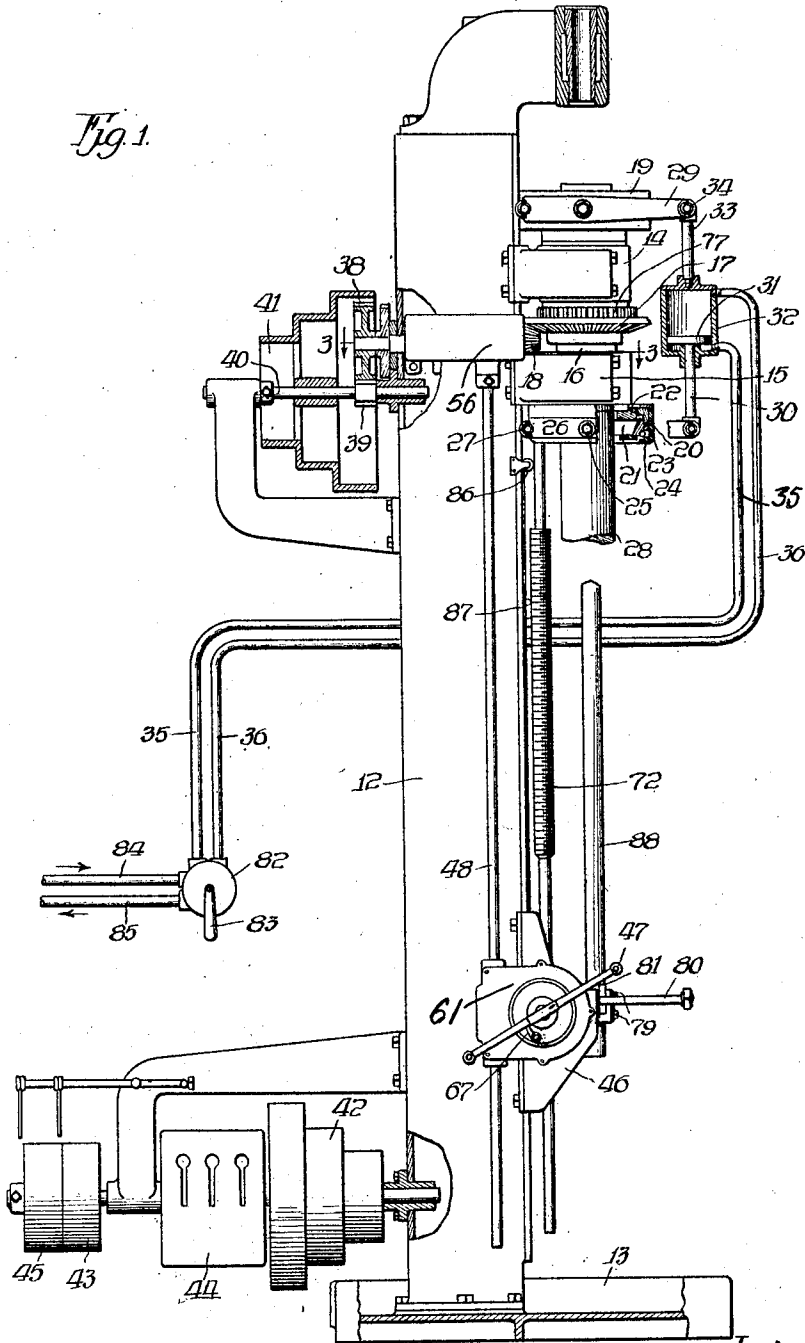
C. STECHER

BORING MACHINE

Filed April 6, 1918

4 Sheets-Sheet 1

Fig. 1.



Witness:

J. D. Quinn

Inventor:

Charles Stecher

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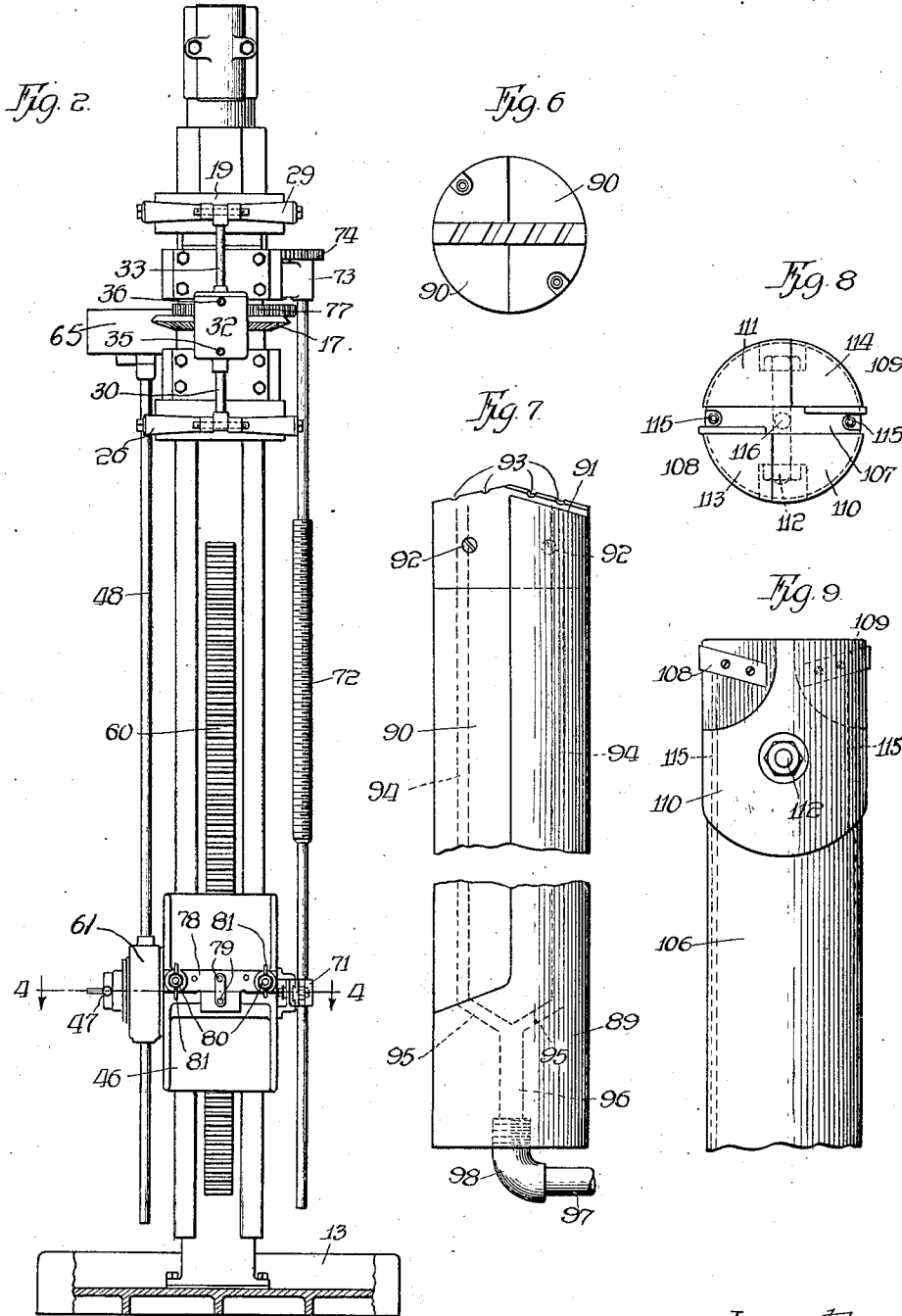
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BORING MACHINE

Filed April 6, 1918

4 Sheets-Sheet 2



Witness:

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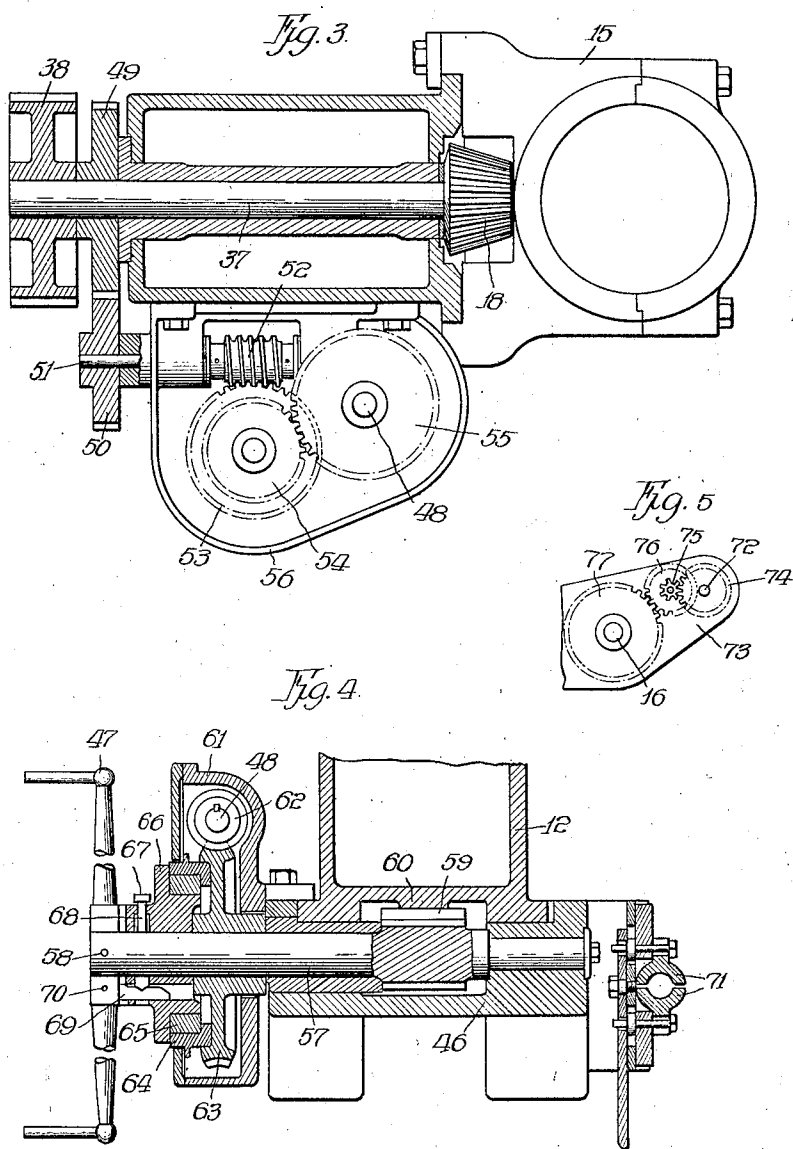
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C. STECHER

BORING MACHINE

Filed April 6, 1918

4 Sheets-Sheet 3



Witness:

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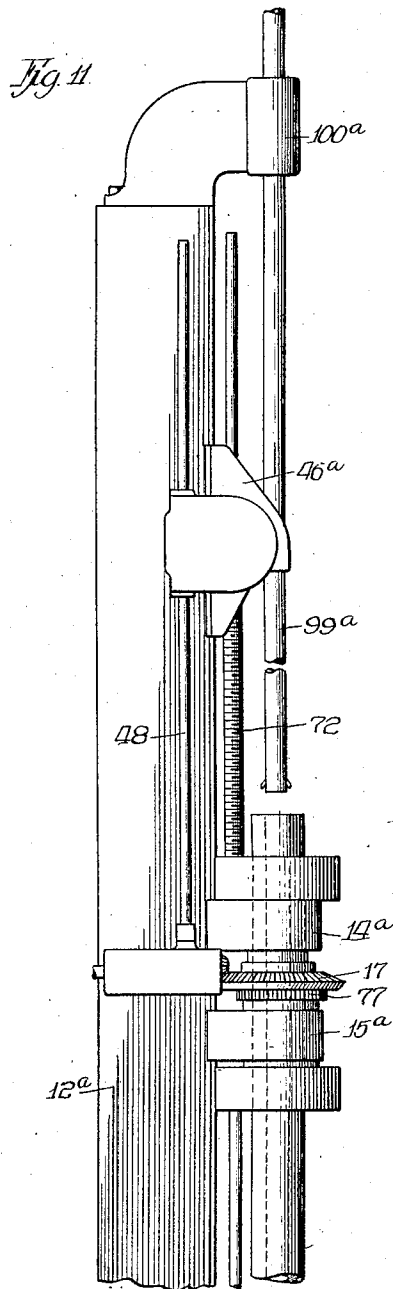
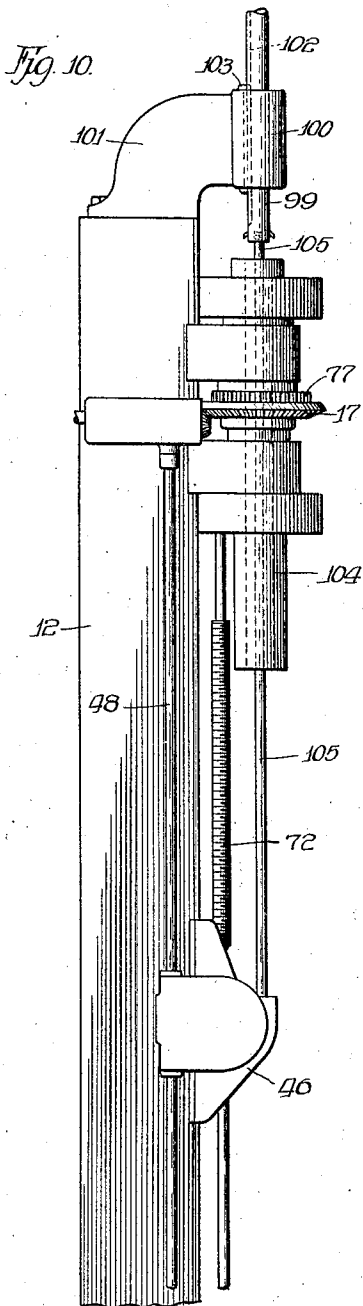
Apr. 24, 1923.

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C. STECHER
BORING MACHINE

Filed April 6, 1918

4 Sheets-Sheet 4



Witness:

F. D. Johnson

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UNITED STATES PATENT OFFICE.

CHARLES STECHER, OF CHICAGO, ILLINOIS.

BORING MACHINE.

Application filed April 6, 1918. Serial No. 227,118.

To all whom it may concern:

Be it known that I, CHARLES STECHER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Boring Machines, of which the following is a specification.

My invention relates to an improved form of boring machine, which may be used for either boring, drilling, or reaming deep holes in solid stock, and my invention consists particularly in arranging the mechanism involved, so that the chips formed by the boring, drilling, or reaming operation are removed from the stock being worked as fast as they are formed, so that there is never any clogging or binding of the chips between the stock and the tool; as a result of which, the speed of working the stock is much greater than is the case where the tool has to be removed from the stock frequently to clear away the chips formed in working the stock.

My machine is of the vertical type, and while I am aware that vertical boring machines have heretofore been used in the art, as far as I am aware, I am the first to construct a machine of this type in which a solid bar of stock is supported in vertical position above the tool employed to work the stock, the stock being rotated and the tool being held against rotation by suitable devices and fed upwardly into the stock. By this construction the desirable result is secured, that the rotation of the stock tends to maintain the boring tool, or drill in central position in the stock, and the chips that are formed naturally tend to clear themselves by the action of gravity from the cutting edge of the tool, which effect may be increased by the use of lubricant in the form of oil fed under pressure to the cutting edges of the tool.

The novel construction by which I secure the desirable results referred to, and other features characterizing my invention, will best be understood by reference to the accompanying drawings showing a preferred embodiment of my invention in which

Fig. 1 shows the complete machine in side elevation, certain of the parts being shown in section to indicate more clearly the construction.

Fig. 2 is a front elevation of the complete machine,

Fig. 3 is a sectional view, on an enlarged

scale, of the parts shown in Fig. 1, taken along the line of 3—3,

Fig. 4 is a sectional view of the parts shown in Figs. 1 and 2, on an enlarged scale, this view being taken along the line 4—4 in Fig. 2,

Fig. 5 shows in plan view the gearing employed to drive the screw used in thread cutting operations,

Fig. 6 is an end view of a form of cutter that may be employed in connection with the machine,

Fig. 7 is a side elevation of the tool shown in Fig. 6,

Fig. 8 shows in a view similar to Fig. 6, a modified construction of tool,

Fig. 9 shows in a view similar to Fig. 7, the tool shown in Fig. 8.

Fig. 10 shows in a view similar to Fig. 1, the machine arranged for reaming a tubular bar, and

Fig. 11 shows in a view similar to Fig. 10, a different arrangement of the parts of the machine by which the tool carriage is located above the stock supporting and driving devices, instead of below them, as shown in Figs. 1, 2 and 10.

Similar numerals refer to similar parts throughout the several views.

As shown in Figs. 1 to 4 inclusive, the machine consists of the vertical column, 12, supported upon a base 13, to the upper end of which bearing 14 and 15 are secured to support a hollow spindle 16. The spindle 16 has rigidly secured thereto, between bearings 14 and 15, a bevel gear 17,—meshing with a bevel pinion 18, employed to drive the gear 17 and thus to drive the spindle 16.

The upper and lower ends of the spindle 16 are provided with chucks 19 and 20 respectively, which chucks are of similar construction and oppositely disposed, as a result of which it is necessary to describe but one of the chucks, for example, chuck 20. This chuck consists of a plurality of clamping jaws, 21, slidably mounted, radially in the lower end of a head 22, carried by the spindle 16, so that their outer ends engage a bevel ring 23, loosely mounted in sleeve 24. The sleeve 24 is held against rotation by pivot screws 25 connecting said sleeve to a forked lever 26, the forked ends of which in turn are pivotally secured to an extension of the bearing 15 at 27.

The fit between the bevel ring 23 and

sleeve 24 is such that the ring rotates freely within the sleeve and is retained in the sleeve by inwardly extending flanges at the top and bottom of said sleeve as indicated. As a result of the construction described, when the lever 26 is raised, the bevel ring 23 is lifted, thus releasing the clamping jaws 21 and permitting the bar of stock 28 to be inserted between the said jaws, after which the lever 26 is moved downward, thus moving the bevel ring 23 downward and forcing the clamping jaws inwardly to engage and securely hold the bar 28.

The chuck 19 is provided with an operating lever 29, similar to the lever 26, and since the chucks 19 and 20 are oppositely disposed, the same result is secured for the chuck 19 as described for chuck 20, by moving the lever 29 in an opposite direction to that above referred to for the lever 26. The levers 26 and 29 are operated in the following manner:

The free end of the lever 26 is pivotally connected to a piston rod 30, connected to a piston 31, contained in a cylinder 32. The upper end of the cylinder 32 has rigidly secured thereto one end of a rod 33, the other end of which is pivotally connected at 34 with the free end of the lever 29. A pipe 35 communicates with the cylinder 32, just above the lower head of the cylinder, for the purpose of admitting suitable fluid, under pressure, to the cylinder between said lower head and the piston 31, and when this is done, it will be observed that the levers 26 and 29 are brought towards each other, and therefore that both of the chucks 19 and 20 are opened. A second pipe, 36, communicates with the cylinder 32 just below the upper head of said cylinder, for admitting fluid under pressure between the upper head and the piston 31, and when this is done, it will be observed that the levers 26 and 29 are forced from each other, which results in moving both of the chucks 19 and 20 forcibly into engagement with the bar 28, since each of the levers, 26 and 29, serves as a relatively fixed stop for the operation of the other lever after the clamping jaws of the chuck connected with the first lever have positively engaged the bar 28. Similarly each of the sleeves of the chucks has but a limited amount of motion towards the adjacent bearing 14 or 15, as the case may be, and the stroke of the piston 31 is sufficient in relation to said amount of motion of the sleeve in a releasing direction to move both of said sleeves so as to completely free the clamping jaws of both chucks.

As more clearly shown in Fig. 3, the bevel pinion is rigidly secured to one end of a driving shaft 37, to the other end of which a gear 38 is rigidly secured.

As indicated in Fig. 1, the gear 38 meshes with the pinion 39, rigidly secured to a

shaft 40, to which there is also rigidly secured a cone pulley 41.

A second cone pulley, 42, is mounted upon the column 12, near its lower end, and is arranged to be driven by the tight pulley 43 through the speed changing mechanism 44. A loose pulley 45 is provided adjacent to the tight pulley 43 to receive the driving belt when it is desired to stop the operation of the machine. The cone pulleys, 41 and 42, are connected in practice with a driving belt, not shown, in a manner well known in the art.

The column 12 carries near its lower end, as shown in Figs. 1 and 2, a carriage 46 arranged to move vertically on the front of the column either by rotation of the hand lever 47, or by rotation of the feed shaft 48, depending on whether the power feed is in operation or is disconnected.

As shown more clearly in Fig. 3, the shaft 37 has rigidly secured thereto adjacent to gear 38, a gear 49 meshing with gear 50, rigidly secured to the shaft 51. The shaft 51 has rigidly secured thereto a worm 52 meshing with a worm wheel 53, which is rigidly secured to the gear 54, which gear in turn meshes with a gear 55, rigidly secured to the upper end of the feed shaft 48, the worm 52, worm wheel 53 and gears 54 and 55 being enclosed in a casing 56 to house and protect them.

As shown more clearly in Fig. 4, the carriage 46 is provided with a shaft 57, extending through it to one end of which the handle 47 is pivotally connected by a pin 58. The shaft 57 has rigidly secured thereto a pinion 59 meshing with a rack 60, extending vertically on the front face of the column as shown in Fig. 2; the feed shaft 48 passes through a casing 61 carried by the carriage 46, and within the casing 61, a worm 62 is feathered on the feed shaft so as to be rotated by said shaft and be capable of longitudinal motion thereon. The worm 62 meshes with the worm wheel 63, which is rotatably mounted on the shaft 57. The worm wheel 63 carries a ring 64, within which a clutch band 65 is mounted, said clutch band being carried upon a hub 66, rigidly secured to the shaft 57. The clutch band 65 is of the well known expanding type, operated by a rocking lever 67, more clearly shown in Fig. 1.

The end of the lever 67 is opposite a plunger rod 68, extending through the hub 66 and the shaft 57, the other end of said plunger rod being in engagement with a cam rod 69, pivotally connected to the handle 47 at 70 and mounted in the hub 66 so as to move therein substantially parallel with the axis of shaft 57. The construction of the cam rod 69 is such that when the parts are in the position shown in Fig. 4, the clutch lever 67 is released and the clutch band 65

is in its contracted position, thus permitting the worm wheel 63 to rotate freely on the shaft 57, for which condition the carriage 46 may be moved vertically on the column 12 by rotation of the handle 47. When it is desired to throw in the power feed, the handle 47 is rocked upon its pivot 48 to move the cam bar 69 in either direction, since motion in either direction moves the plunger 68 outwardly against the clutch lever 67, which in turn expands the clutch ring 65 to engage the ring 64, and thus establish a driving connection between the worm 62 and the shaft 57.

The carriage 46 carries on its righthand side, as shown in Fig. 4, a threaded nut 71 for engaging the screw 72 when it is desired to use the machine for threading operations, for which condition, of course, the clutch band 65 is released. The screw 72 is supported at its upper end in a bracket 73, and as more clearly shown in Fig. 5, has rigidly secured thereto a gear 74 meshing with a pinion 75 secured to a gear 76, and rotatably mounted on a suitable stud carried by the bracket 73. The gear 76 meshes with the gear 77, rigidly secured to the bevel gear 17.

By changing gears 74, 75 and 76 different rates of rotation may be imparted to the screw 72 in a manner well known in the art, to form any desired pitch of thread in the work.

The carriage 46, as more clearly shown in Fig. 2, is provided with a tool support 78, for supporting and holding the tool employed, said tool being rigidly held in said support against rotation by the clamping screws 79. The support 78 is mounted upon the studs 80 so that it may be moved bodily with the tool from axial alignment with the work, for which position the carriage may be employed to insert the stock to be worked in the chucks and remove the work therefrom as desired, since it frequently is the case that the bars, which are tooled in the machine, are of considerable length, and too heavy to be conveniently handled by hand. When the work is secured in the machine, and the carriage is again moved to its lower position, the support and tool held therein are moved bodily into operative position again upon the studs 80, in which position they are rigidly held by the keys 81 extending through said studs.

A convenient means of controlling the chuck operating mechanism consists in a valve 82, to which the pipes 35 and 36 are connected, which valve is provided with a controlling handle 83 for connecting either one of the pipes 35 and 36 with a pipe 84 for supplying fluid under pressure to the cylinder 32, and at the same time connecting the other one of the pipes 35 and 36 with a return pipe 85, depending upon the di-

rection in which the handle 83 is moved. Any desired means may be employed for producing pressure upon the operating fluid, and any fluid such as oil or air may be employed as desired, and the details of this mechanism are not shown since they form no part of the present invention.

To protect the rack 62 from the oil and chips that may drop from the tool during its work, a spring roller 86 is mounted in suitable bearings on the front face of the column 12 immediately below the lower chuck, 20, and on this roller a curtain 87 is mounted, the lower end of which is secured to the upper portion of the carriage 46. This curtain and roller are removed from Fig. 2 to more clearly show the arrangement of the rack 60.

The tool 88, employed in the various operations, depends of course upon whether the operation is a boring operation, a reaming operation, or a threading operation, and in any case the machine may operate as above described. For a boring machine operation by which a hole is to be bored in a long solid piece of stock, a tool constructed as shown in Figs. 6 and 7 is found to work admirably. This tool consists of a round bar 89, of steel, having opposite straight flutes 90 extending longitudinally thereof for a length preferably somewhat greater than the maximum depth of hole to be bored by said tool. A cross-section of each flute is nearly a quadrant to provide space for the chips resulting from the boring operation to drop from the work under the action of gravity and the lubricant—such as oil—that may be supplied to the cutting surfaces of the tool. A sufficient web of metal is left between the flutes to properly support the cutter 91, which is inserted in the cutting end of the tool in a groove formed longitudinally in the bar 89 and extending diametrically across the end thereof, so that the opposite faces of the cutter are substantially in the planes of the flutes 90. The cutter is held in the groove referred to by suitable screws 92 and in its cutting edge, I find it desirable to form small grooves 93, dividing the edge of each side of the center of the tool into a plurality of parts, as a result of which the chips formed by each cutting edge are broken up and made of a narrower width than each cutting edge, thus facilitating the dropping of the chips through the flutes.

To supply a lubricant to the cutting edges of the tool, small tubes 94 are imbedded in the solid part of the bar 89 between the flutes 90 and terminate at their ends adjacent the cutting edges of the cutter 91 at the upper end of the bar 89. The tubes 94 connect with inclined holes 95, leading to the center of the bar, and into a central hole 96, extending to the lower end of the bar. The

lower end of the hole 96 is connected with the pipe 97 for supplying lubricant, such as oil under pressure, by means of a pipe connection 98 threaded into the lower end of said hole. The devices employed for supplying the lubricant under pressure to pipe 97 are not shown, since these devices are old in the art and constitute no part of the present invention.

In boring a hole with a tool of the kind described in the solid bar, the carriage 46 forcibly feeds the tool into the bar, and since the bar is rotated and boring tool is held against rotation by the carriage, the tendency is to maintain the tool in central position in the bar being bored, and as fast as the chips are formed by the cutter, they are broken up by the grooves 93 referred to and drop through the flutes 90 under the action of gravity, this action being somewhat facilitated by the lubricant fed to the cutting edges, which finds its way out of the hole being bored through the said flutes and thus serves to wash some of the chips and borings down the flutes, and thus out of the hole being bored, and in this way maintaining the hole free from chips that might tend to jam and interrupt the boring operation.

Heretofore, in the art when it has been attempted to bore a deep hole in solid stock with the boring tool and bar being bored in horizontal position, it has been practically impossible to remove the chips from the hole being bored, as a result of which unless the boring operation is interrupted frequently to remove the chips, they bind between the edges of the boring tool and the surface of the hole being bored, and further operation of the machine is impossible until the tool is removed and the hole is cleaned out. This occurs regardless of whether the chips formed are large or small, and regardless of whether the cutting edges of the tool are broken up into several parts, or are continuous. The same undesirable results occur, only to a greater degree, when it is attempted to bore a deep hole in solid stock by feeding the boring tool downwardly into the stock, with the latter supported below the boring tool, regardless of whether the tool or the bar being bored is rotated. The grooves 93 formed in the edges of the cutter, therefore have a new function in connection with my improved boring machine, namely, breaking the chips and borings in such a manner that they may freely pass through the flutes in the boring bar and thus from the hole being bored, which is impossible with either of the other types of boring machines above mentioned.

The construction of the boring tool referred to provides that the cutter may readily be removed from the boring bar and sharpened or replaced by another cutter, as may be desired in operating the machine.

When a hole has been bored through a long bar, it is frequently necessary for certain purposes to accurately ream the hole by passing a reamer through it. Fig. 10 illustrates the manner in which this may be conveniently done by my machine. As shown in this figure, reamer 99 is supported in a guide bearing 100 secured to the top of the column 12 by a bracket 101, and the reamer is provided with a longitudinal keyway 102 to receive the gibkey 103 carried by the bearing 100, as a result of which the reamer may move freely, longitudinally, between the bearing 100, but is prevented from turning therein.

The reamer 99 is pulled downwardly through the bored bar 104 by a pull rod 105, rigidly secured at its lower end to the carriage 46, and threaded at its upper end into the lower end of the reamer 99. As the carriage 46 is moved downwardly, the reamer 99 is drawn downwardly through the bar 104, and the chips formed by the reaming operation drop through the hole in said bar, thus preventing any clogging of the reamer, and provide that the reamed hole shall be as smooth as the end of the reamer will permit. While any reamer may be employed in this operation, when it is required that the hole shall be smooth and true, I find it desirable to use the form of reamer shown in Figs. 8 and 9. This reamer consists of a bar of steel, 106 having one end cut away to leave a relatively thin web 107, extending diametrically across the end of the bar, and for a short distance from the end thereof, longitudinally of the bar. Cutters 108 and 109 are secured upon opposite sides of the web 107 by suitable screws so that the cutting portions, or ends of the cutters project somewhat beyond the longitudinal outer edges of the web 107. Blocks of hard wood—110 and 111—are secured to the opposite faces of the web 107 by a bolt 112, these blocks being of a conformation to fill the cut-away portions of the end of the bar 106 and having an outer cylindrical surface of the radius of the bore formed by the cutters 108 and 109. The blocks 110 and 111 have recesses 113 and 114 respectively cut in them adjacent the cutters 108 and 109 to permit the chips formed by the cutters to drop freely from the reamer. The reamer may be supplied with lubricating tubes 115, mounted in the bar 106 and supplied with lubricant in substantially the manner described above in connection with the boring bar 89. The web 107 is provided with a threaded central hole 116 for receiving the threaded end of a pull rod, by which the reamer may be drawn through the bored bar. By using a reamer of this kind the cutters are held positively in exact position in the hole that is reamed by the fit of the wood blocks 110 and 111 in said hole, and

these blocks, furthermore, prevent vibration and chattering of the cutters during the reaming operation, and since the chips drop from the cutting edges as fast as they are formed, the reamed hole is smooth and true when completed. By using a lubricant with the reamer in substantially the manner above described, the removal of the chips that might otherwise cling to the surface of the unreamed portion of the hole in the bar being bored, is effected, since the tendency of the lubricant is to wash the chips engaged by it downwardly, and from the lower end of the hole in the bar.

As shown in Fig. 11, the parts of the machine may be differently disposed by clamping the bearings 14^a and 15^a upon the lower portion of the column 12^a and locating the carriage 46^a above said bearings in a position to directly engage the reamer 99^a, the upper end of the reamer being guided by the bearing 100^a of the column 12^a.

With this arrangement of parts, the reaming operation proceeds in substantially the manner above described, as far as freeing the hole from chips is concerned.

From the above it will appear that by my improved construction, I have provided a machine for boring deep holes and for reaming or threading said holes, in which it is practically impossible for the borings and chips to interfere in any manner with the boring, reaming, or threading operations, and that therefore the boring may proceed as rapidly as the strength of the machine and the nature of the cutting edges will permit, and that it is not necessary to interrupt the boring operations, even when boring holes in solid stock, until the hole has been bored to the desired depth. This is particularly advantageous in boring parts for guns and rifles—such as the recoil cylinders for artillery, and even the barrels themselves for smaller guns and rifles.

While I have shown my invention in the particular embodiments above described, I do not, however, limit myself to these exact constructions, as I may employ equivalents thereof known to the art at the time of the filing of this application without departing from the scope of the appended claims.

It is to be understood that the nut 71 carried by the carriage 46 is sectional in

form and is secured in place by devices permitting the opening of the nut when it is not desired to use the machine for threading operations so that the nut may pass freely over the screw 72 without engaging said screw.

It will also be understood that while I have shown chucks of the particular type described in connection with the hollow spindle for holding and rotating the work, that I do not limit myself to this particular type of chucks, but that I may employ any equivalent form of chucking mechanism for the purpose of carrying the work in the revoluble spindle.

What I claim is:

1. In a machine of the class described, the combination of a vertical column, bearings carried by the upper portion of said column, a hollow spindle disposed vertically in said bearings, chucking mechanism carried by said spindle, a tool carriage mounted on the lower portion of said column, means for rotating said spindle, clamping devices carried by said carriage for rigidly holding a tool in axial alignment with said spindle, mechanism for moving said carriage vertically on said column, horizontally disposed studs carried by said carriage supporting said clamping devices and permitting movement thereof, together with the tool held thereby laterally of the column to clear said spindle, return movement of said clamping devices on said studs again bringing said tool into axial alignment with said spindle, and retaining devices for holding said clamping devices on said studs in said alignment.

2. In a machine of the class described, the combination of a work receiving spindle, a block movable towards and away from said spindle for holding a cutting tool, slides extending transversely of the machine for supporting said block to permit movement thereof in line with the spindle or away from the spindle as desired to facilitate placing the work in the spindle and removing the same from the spindle, and clamping devices for holding the block in a position in line with the spindle.

In witness whereof, I hereunto subscribe my name this 26th day of March, A. D. 1918.

CHARLES STECHER.