No. 642,138. Patented Jan. 30, 1900.

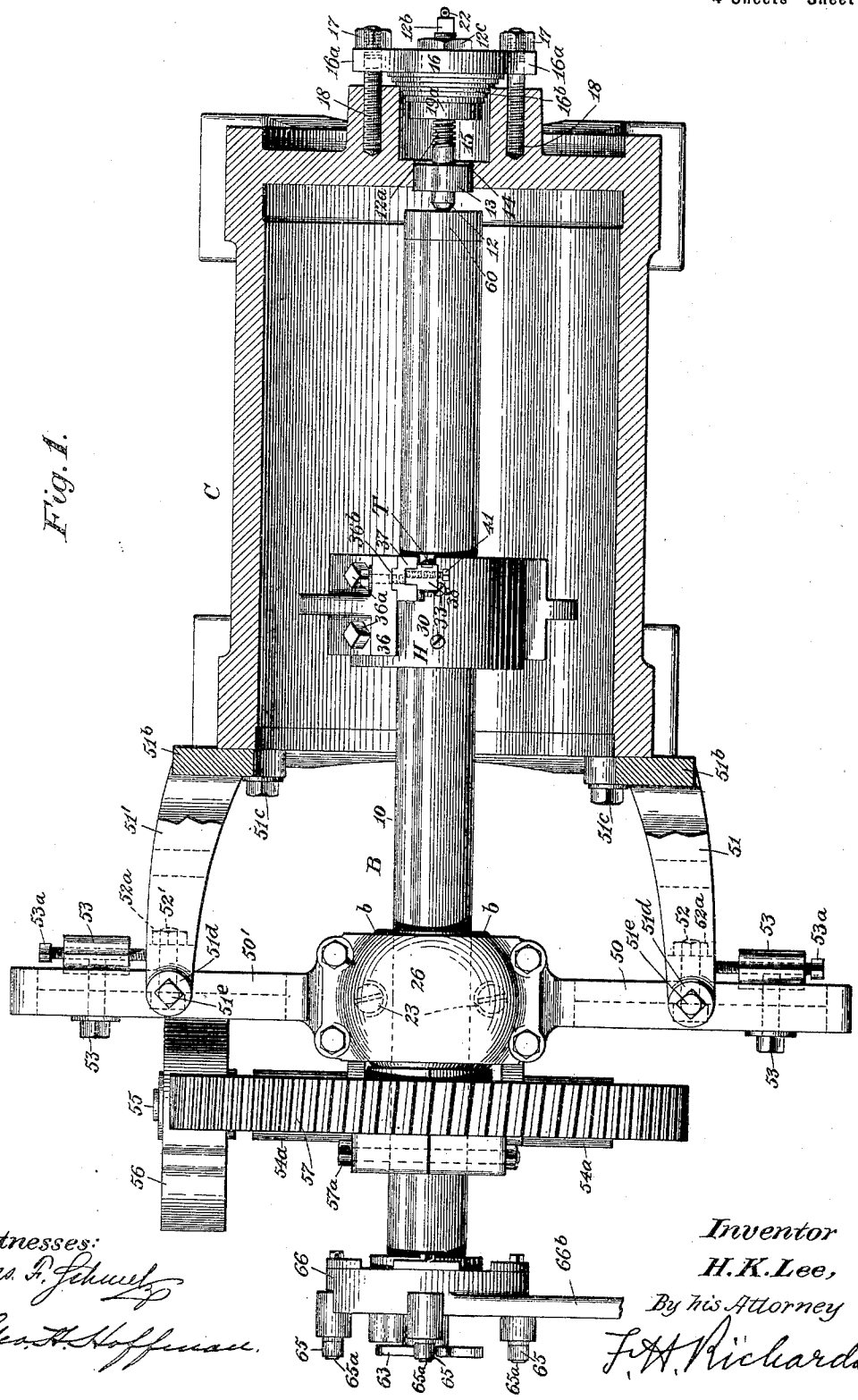
H. K. LEE.

MACHINE FOR BORING METAL.

(Application filed Apr. 24, 1899.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.



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(No Model.) 4 Sheets—Sheet 2.

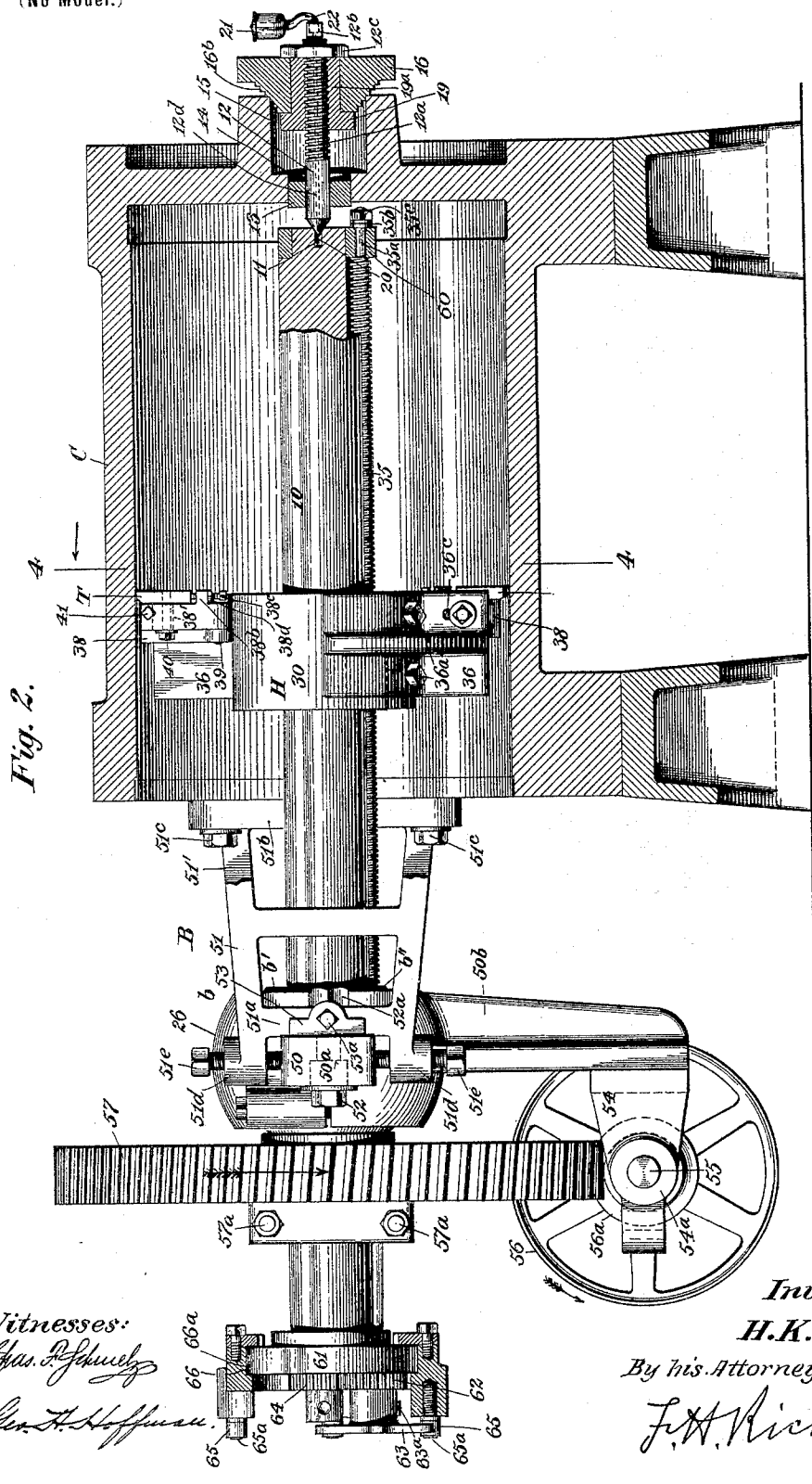


Fig. 2.

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Fig. 4.

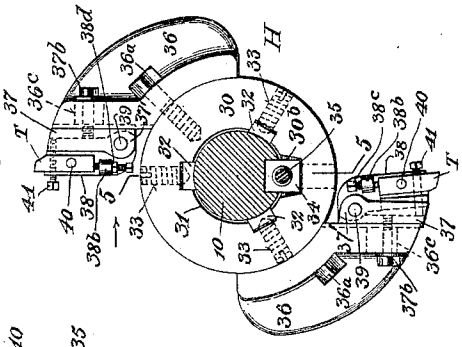


Fig. 6.

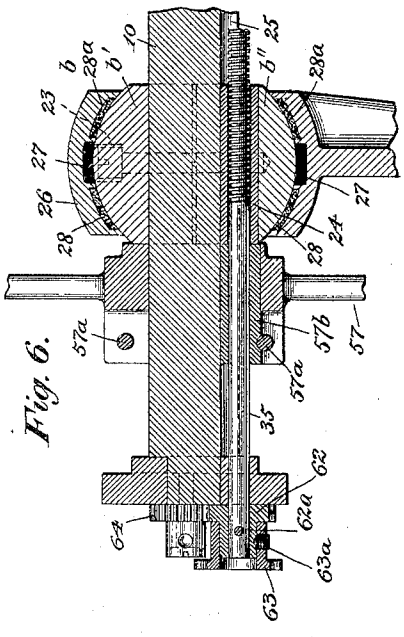


Fig. 5.

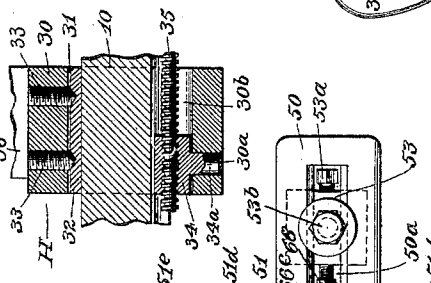
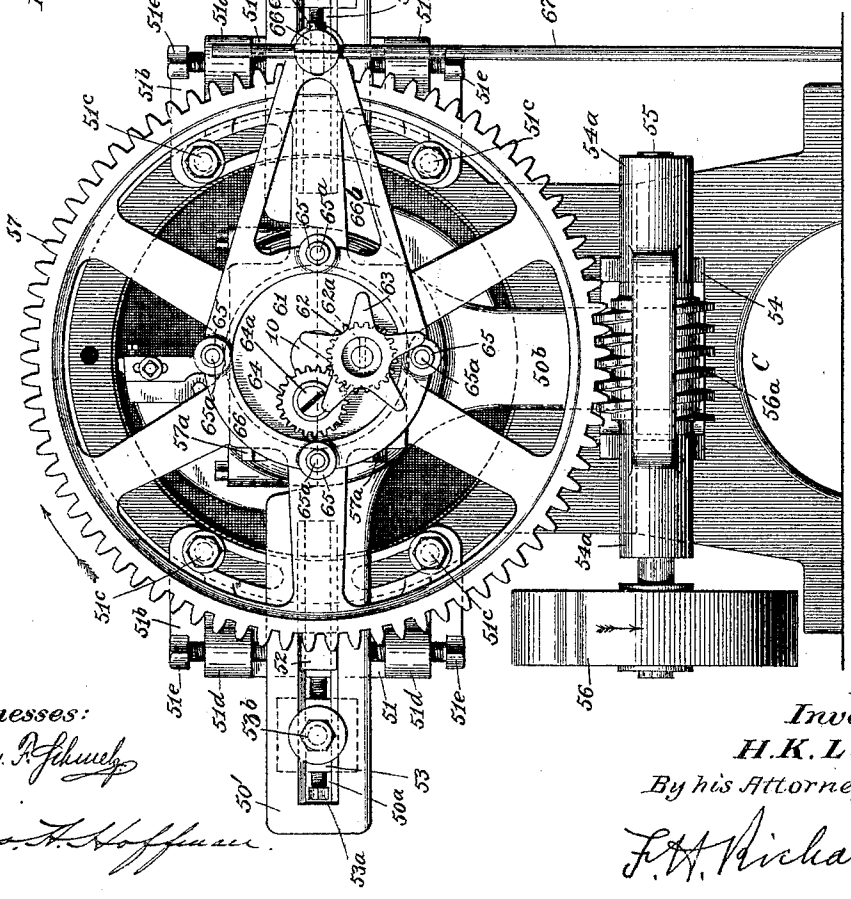


Fig. 3.



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MACHINE FOR BORING METAL.

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(No Model.) 4 Sheets—Sheet 4.

Fig. 7.

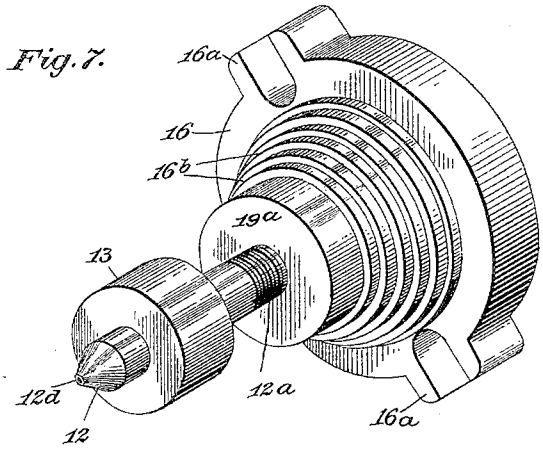


Fig. 9.

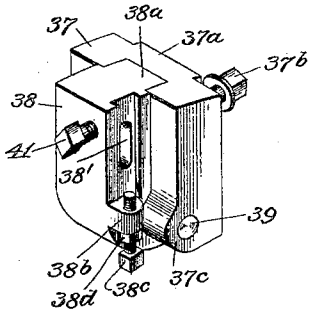


Fig. 8.

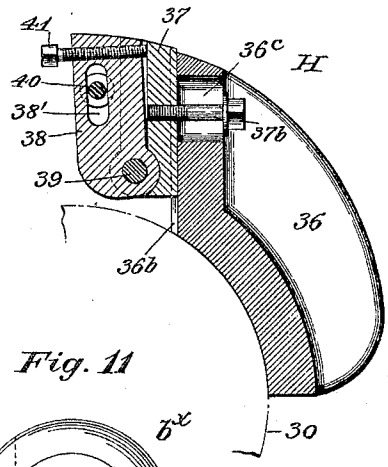


Fig. 10.

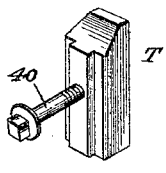
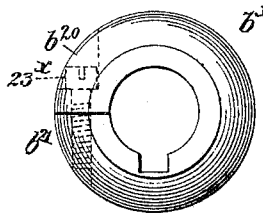


Fig. 11



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UNITED STATES PATENT OFFICE.

HENRY K. LEE, OF HARTFORD, CONNECTICUT.

MACHINE FOR BORING METAL.

SPECIFICATION forming part of Letters Patent No. 642,138, dated January 30, 1900.

Application filed April 24, 1899. Serial No. 714,153. (No model.)

To all whom it may concern:

Be it known that I, HENRY K. LEE, a citizen of the United States, residing in Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Machines for Boring Metal, of which the following is a specification.

This invention relates to machines for boring cylinders; and it has for one of its objects the provision of a machine of this character which may readily be placed in position and adjusted with accuracy and rapidity.

Further objects of the invention are to provide improved means whereby the cutter-head of a boring-bar may be fed automatically in either direction during the boring operation and to provide an improved construction of the boring-bar and appurtenances thereof by which it may be retained in position on cylinders of different sizes, as will hereinafter appear.

In the accompanying drawings, Figure 1 represents a horizontal sectional view of a cylinder with a boring-bar of improved construction in place within the same. Fig. 2 is a vertical longitudinal section of a cylinder, showing a side view of the boring-bar with a part thereof broken away. Fig. 3 is an end view looking from the left of Fig. 2. Fig. 4 is a cross-section of the boring-bar, taken on line 4 4 of Fig. 2. Fig. 5 is a section of the cutter-head, taken on line 5 5, Fig. 4; and Fig. 6 is a vertical longitudinal section of the "feed" end of the bar. Fig. 7 is a perspective view of the center spindle and its appurtenances. Figs. 8 to 10, inclusive, are detail views of parts of the cutter-head; and Fig. 11 is a detail view of one form of the sectional ball.

My improved boring-machine, although adapted, as above stated, for boring the cylinders of engines, &c., is especially intended for reboring a cylinder after it has become worn until the inner surface is in an "out-of-true" condition, and hence said machine embodies means whereby it may be accurately placed in position on a cylinder without removing the latter from its foundation and which in connection with the boring-bar constitutes a complete portable apparatus.

In Figs. 1 and 2 of the drawings, C represents the cylinder of an engine or similar machine, and B designates in a general way the boring-bar, a head of said cylinder being removed to permit the bar to be placed in position and said bar consisting of a shaft 10, countersunk at its rear end, as at 11, to receive a center spindle 12, by which the bar is pivotally supported in the head of the cylinder.

In connection with one end of the cylinder I employ a device adapted to fit stuffing-boxes of various sizes and which may be applied to the cylinder by the usual bolts which secure the stuffing-box gland in position, said device serving to retain the center in place and as a convenient means whereby the same may be adjusted. In the form illustrated this device consists of a block having a series of concentric steps or shoulders of various sizes; but the invention is not limited to the precise construction shown, for, as is obvious, these steps or shoulders may be interrupted or the block may be provided with other means to accomplish the result desired.

A bushing 13, having an aperture corresponding with the size of the center 12, is tightly fitted in a passage 14 of the cylinder, through which the piston-rod loosely passes, which passage leads to the interior of the stuffing-box 15, adapted to receive the usual gland. After the removal of this gland a block 16, having the ears 16^a thereof engaged by the nuts 17 on the gland-securing bolts 18, the latter being screw-threaded into the cylinder-head, is placed in position. This block 16 is represented having a series of steps 16^b, adapted to stuffing-boxes of different sizes; but it is evident, as above stated, that other means may be employed to provide a firm seat for the same therein. In the construction of the engine the passage 14 and the interior of the stuffing-box are bored out in true alinement with the center line of the cylinder, and as generally there is no wear on the parts mentioned it is evident that the center spindle 12 will also be in true alinement therewith, said spindle being screw-threaded, as at 12^a, to engage a corresponding screw-thread in a bushing 19, which is tightly fitted in the block 16 and has a flange 19^a at its front end for withstanding the thrust to which the center is subjected by the weight of the bar on its conical end. A squared portion 12^b is

formed at the outer end of the center 12 to receive a wrench for properly adjusting the same in the bushing 19, and a check-nut 12^c serves firmly to hold it in adjusted position. It has been found in practice that the point of the center spindle is frequently ruined for lack of proper lubrication and that consequently its efficiency in producing true work is greatly impaired, a defect which it is difficult to remedy on account of the inaccessibility of the center, and for this reason a chamber 20 is formed in the end of the boring-bar, which may serve as a reservoir for oil or other lubricant supplied thereto through a passage 12^d in the center spindle, said passage being preferably connected with an oil-cup 21 by the pipe 22, so that the center point may be constantly lubricated, as will be readily understood.

Near its front end the shaft 10 carries a ball-shaped member (designated in a general way by *b*,) preferably consisting of two sections *b' b''*, (see Fig. 6,) said sections surrounding the shaft and being clamped together and in place thereon by countersunk bolts 23 in central alinement at right angles to the axis of the shaft 10, while one of the sections, as *b''*, carries a key 24, adapted to slide in a longitudinal groove 25, formed in the shaft 10 and extending from end to end thereof, so that the ball member *b* may be adjusted on the shaft as desired. It will be observed that by this construction the ball member is clamped to the shaft with an even and equal pressure at every point on the circumference of the same and that therefore there is no liability of distorting or springing the shaft, and thereby throwing it out of alinement, which sometimes happens when the ball is clamped thereto by a screw or otherwise at but a single point. Furthermore, another great advantage is gained by constructing the ball member *b* in two separate sections, inasmuch as a solid ball must necessarily have an opening sufficiently large to permit a free sliding movement of the shaft therein for adjustment, so that a certain amount of looseness between the shaft and ball cannot be avoided. If, now, a set-screw or other analogous device is employed for "setting" the ball on the shaft, it is evident that the axes of said ball and shaft will be thrown out of alinement. By forming the ball in two sections and clamping the same firmly in place said ball may be turned in a lathe when in position on the shaft, so that no matter to what position longitudinally thereon the ball may be adjusted the axes of both ball and shaft will always be in true alinement, and consequently the axis of the shaft will not describe a "cone-face" during the operation of the bar, which cannot be avoided when a loose fit exists between the central bore of the bar and the shaft retained therein. The member *b* serves as a universal bearing for the shaft 10 in a correspondingly-shaped journal-box 26, having an annular groove 27 in alinement with the clamp-bolts 23, above referred to, said groove forming a channel for retaining a lubricant, which by the rotation of the shaft 10 and ball member *b* will be conveyed around in the journal-box by the walls of the counterbores for said bolts 23.

The bearing-face of the journal-box 26 is composed of two circular linings 28 28^a, one on each side of the annular groove 27, said linings being so arranged that the greater part of the end thrust of the bar will be carried thereby, as will be readily understood by referring to Fig. 6, and as said linings are kept in a constant state of lubrication, as above stated, the wear on the ball member *b* is reduced to the minimum.

The journal-box 26 forms a part of a yoke having oppositely-disposed arms 50 50', whereby the front end of the bar is supported on the cylinder to be bored, said arms being held in brackets 51 51', having web portions 51^a, against which the arms may be clamped by bolts 52 52', carried in slots 50^a in said arms, and the nuts 52^a in engagement with said bolts. Each of the brackets 51 is provided with a slotted foot-plate 51^b, and each bracket may be secured to the cylinder by the bolts 51^c ordinarily employed for retaining the removable cylinder-head in place, and in order to provide means for readily and accurately centering the boring-bar within the bore of the cylinder the brackets 51 51' are equipped with ears 51^d for the reception of screws 51^e, whereby each of the arms 50 50' may be adjusted vertically individually, while the lateral adjustment of the yoke as a whole may be made by means of the screws 53^a in threaded engagement with blocks 53, which are adjustably secured to the yoke-arms 50 by bolts 53^b, (see Fig. 1,) said screws 53^a having their inner ends in engagement with the sides of the web portions 51^a of said brackets 51 51'. Depending from the journal-box 26 and also forming a part of the yoke is an arm 50^b, carrying at its lower end a bracket 54, provided with the journal-boxes 54^a for a shaft 55, to which rotary movement may be imparted by a belt (not shown) passing over a pulley 56, and on said shaft is mounted a worm 56^a, engaging a worm-gear 57, secured to the boring-bar shaft 10. The hub of the gear 57 is split, as shown in Figs. 1 and 6, and bolts 57^a are employed for clamping the gear to the shaft, while a key 57^b serves for retaining said gear in operative relation therewith, the said key being prevented from endwise movement by one of the bolts 57^a (see Fig. 6) and having a longitudinal aperture formed therein for the free passage of the lead-screw 35, to be hereinafter described. By clamping the gear 57 to the boring-bar shaft in the manner shown the hub thereof bears with equal pressure on all parts of the circumference of said shaft, and all danger of deflecting the shaft at its power end is overcome.

Mounted on the shaft 10 and adapted to

slide longitudinally thereon is a cutter-head, (designated in a general way by H,) said head consisting, substantially, of a collar 30, having an axial bore 31 of slightly-greater diameter than that of the shaft 10 and carrying a series of shoes 32, which are adapted to engage said shaft 10 (see Fig. 4) and each of which may be adjusted in contact-pressure therewith by means of screws 33, having their inner ends pointed to enter correspondingly-formed seats in the shoes, whereby the latter are caused to move with the collar during its travel along the bar, while a nut 34, carried within a recess 30^b of the collar 30, projects into the longitudinal groove 25 of the shaft 10 and serves as a key for rotating the head H in unison therewith. The nut 34 is provided with a stud or projection 34^a, entering an aperture 30^a in the collar 30, and is in threaded engagement with the lead-screw 35, so that when said screw is rotated, as hereinafter described, the head H will be moved longitudinally on the shaft 10. In the drawings the cutter-head is shown carrying two cutting-tools of similar construction, so that the following description will apply equally to either of them. To the periphery of the collar 30 is secured by screws 36^a an interchangeable arm or bracket 36, provided at its front face with a groove 36^b, (see Fig. 1,) located near the edge thereof and adapted to receive in sliding contact a rib 37^a, formed on the radially-adjustable shoe 37, which carries a clamping-screw 37^b, extending through a slot 36^c in the arm 36 and serving to hold said shoe firmly in adjusted position thereon. (See Figs. 1 and 4.) Both of the arms 36 are detachably secured to the collar 30 in order to adapt the bar to receive interchangeable arms of different sizes to enable it to be employed with cylinders of various proportions.

The shoe 37 is provided near its inner end with ears 37′, which are adapted to receive frictionally between them the tool-holder 38, pivoted to said shoe by a pin 39 and having a tongue 38^a fitting in a groove provided therefor in the front face of the shoe 37. In the side of the said tool-holder is formed a groove adapted to receive a corresponding tongue of the cutting-tool T, which may be secured in place by a binding-screw 40, passing through a slot 38′ in the holder 38, which is provided with a lug 38^b for retaining a screw 38^c and its check-nut 38^d, whereby the tool T may be radially adjusted and supported during the cutting operation. By referring to Fig. 4 it will be noticed that the pivot-pin 39 of the tool-holder is located in the rear of a radial line drawn from the cutting edge of the tool, so that when the holder is swung forward the distance from the cutting edge of the tool to the center of the shaft will be lessened, and consequently a lighter chip will be cut, and it will of course be understood that the reverse is true when the holder 38 is permitted to swing in a rearward direction. For the purpose of gaging the cut of the tool by the swinging movement of the holder, as just described, I provide a screw 41 in threaded engagement with the said holder and resting against the shoe 37, so that by rotating said screw the holder may be swung forward or permitted to swing rearward, as desired, and a check-nut may be employed to lock said screw against rotation, so that by these means a very fine adjustment relatively to the size of the chip to be cut may be had.

Means are employed for advancing the cutter-head H in either direction during a continuous cutting operation, such means consisting, substantially, of the lead-screw 35 in threaded engagement with the nut 34 above referred to and having at its end a reduced portion 35^a, which is journaled in a collar 60, rigidly secured to the boring-bar shaft 10 and which carries a washer 35^b and a nut 35^c, whereby said screw is prevented from endwise movement. At the forward end of the shaft 10 is secured a disk 61, in which the lead-screw 35 is journaled, (see Fig. 6,) and the projecting end of said screw carries a pinion 62, attached thereto by a pin 62^a, the hub of which pinion is adapted to receive the hub of a star-wheel 63 for imparting intermittent rotary movement to the screw 35, said star-wheel being held in place by a set-screw 63^a and being adapted to be similarly placed on the hub of another pinion 64, which is journaled on a stud 64^a, the centers of both pinions being arranged equidistant from the axis of the shaft 10, (see Fig. 3,) so that the star-wheel may be properly actuated when attached to either pinion mentioned. It is of course obvious that when the star-wheel is attached to the hub of the pinion 62 the screw will be driven in one direction and that when said wheel is attached to pinion 64 the rotation of the screw 35 will be reversed, so that the cutter-head may be moved longitudinally on the shaft in either direction, according to the position of the star-wheel on either of the pinions above mentioned, or a hand-crank may be applied to either pinion-hub for accelerating the movement of the cutter-head in the desired direction. The means provided for actuating the star-wheel may be of any well-known construction; but I prefer to employ one or more rollers 65, journaled on studs 65^a, which are secured to a stationary frame 66, having an annular bearing-face 66^a (see Fig. 2) for receiving the disk 61 and an arm 66^b, Fig. 3, which carries a split stud 66^c, having an opening for receiving the stop-rod 67, clamped therein by a binding-screw 68 and serving to prevent undue movement of the arm 66^b, and consequently of the rollers 65, as will be readily understood.

The advantages of my improved boring-bar are manifest, since it may be adapted to many varieties of work by virtue of its adjustability to different requirements, and the several parts being of great simplicity as regards construction and operation accurate work may

be done rapidly particularly as by the reversal of the movement of the lead-screw I am enabled to obviate the defect of boring the cylinder larger at one end than at the other end, (a result which is due to the wear of the tool;) but when after a cut has been taken in one direction the tool takes another cut in the other direction the last cut will remedy the defect caused by the first, so that a true surface throughout the cylinder will be obtained. Furthermore, a cutter-head of the improved construction described is particularly advantageous for the reason that the motion of the screw may be reversed and a cut taken the entire length of the bore of the cylinder on both the forward and return movements of the cutting-tool; but if the cylinder requires but slight repairs, which may be finished at one complete movement of the tool, the cutter-holder may readily be swung to such position that the tool will not come into contact with the wall of said cylinder on the return movement of the tool.

In Fig. 11 I have illustrated another form of the ball member consisting of a split ball $b^{\times}$ to be secured to the boring-bar shaft by a bolt or bolts $23^{\times}$, the two divisional or sectional portions of said ball being designated by b^{20} and b^{21}. This form of ball member may be readily clamped in position on the boring-bar shaft and will bear upon said shaft at all points of its circumference in the same manner as the other ball member above described. It is therefore distinctly to be understood that the term "sectional" as employed in this specification is intended to cover either of the ball members illustrated.

Many changes may be made in the construction of the various parts of the machine without departing from the spirit of the invention, and the invention is not limited to the exact details thereof illustrated and described.

Having thus described my invention, what I claim is—

1. In a machine of the class specified, the combination with a boring-bar and means for operating the same of a center; a bushing closely fitting said center and adapted to engage the opening for the piston-rod in the cylinder; a device for engaging the stuffing-box of said cylinder; and a nut mounted in said device and adapted to engage a thread on the center.

2. In a machine of the class specified, the combination with a boring-bar and with means for actuating the same of a cutter-head on said boring-bar; a screw-threaded center; a block having surfaces adapted to fit various sizes of openings in cylinders; and a nut carried by said block and in engagement with the thread of said center.

3. In a machine of the class specified, the combination with a boring-bar and with means for actuating the same, of a cutter-head on said boring-bar; a screw-threaded center; a bushing fitted on said center and adapted to fit the opening for the piston-rod in the cylinder; a block having a series of steps for fitting various-sized openings in cylinders; and a flanged nut mounted in said block and in engagement with the thread of said center.

4. In a machine of the class specified, the combination, with a boring-bar shaft, of a split or divided ball member adapted exactly to fit said shaft; and means for clamping the ball member to the shaft, whereby said ball member engages the shaft at all points around the circumference thereof.

5. The combination, with a boring-bar shaft, of a split or divided ball member adapted snugly to fit and engage the same at all points around its circumference; a journal-box for receiving said ball member; and means for adjusting said journal-box, and consequently the ball member, longitudinally of the boring-bar shaft.

6. In a machine of the class specified, the combination with a boring-bar shaft of a split or divided ball member attached thereto means for clamping said ball member to the shaft at all points around the circumference thereof; a sectional journal-box for receiving said ball member provided with a groove for the reception of a lubricant; and linings at the sides of said groove and fitting upon the periphery of the ball member.

7. In a machine of the class specified, the combination with a boring-bar shaft of a split or divided ball member clamped thereto at all points around the circumference of said shaft; and a tubular key fitted in grooves of the ball member and boring-bar shaft.

8. In a machine of the class specified, the combination with a boring-bar shaft of a split or divided ball member clamped thereto at all points around the circumference thereof; bolts for clamping said member to the shaft; a tubular key carried by one of the sections of the ball member and engaging a groove in said shaft; a sectional journal-box for sustaining said ball member; and means within said journal-box for permitting the constant lubrication of the ball member, substantially as and for the purpose specified.

9. In a machine of the class specified, the combination with a boring-bar shaft of a split or divided ball member; means for clamping the same to the shaft at all points around the circumference thereof; a tubular key carried by the ball member and engaging a groove in said shaft; a journal-box for sustaining said ball member; a cutter-head carried by the boring-bar shaft; and a screw passing through said tubular key and adapted to feed said cutter-head to its work.

10. In a machine of the class specified, the combination with a boring-bar shaft of a split or divided ball member adjustably secured to said shaft and clamped to the same at all points around its circumference; a journal-box in which said ball member is mounted; a key carried by the ball member and fitting a groove in the shaft; a feed-screw loosely fit-

ted in said key; and gearing for intermittingly actuating said feed-screw.

11. In a machine of the class specified, the combination with a boring-bar shaft of a cutter-head mounted thereon; a device for feeding said cutter-head to its work; gearing for actuating said feed device in either direction; a star-wheel adapted to be fitted to any member of said gearing; and means carried by the framework for actuating said star-wheel and thereby intermittingly turning the feed device as the shaft of the boring-bar rotates.

12. In a machine of the class specified, the combination with a boring-bar shaft and with means for sustaining and for operating the same, of a boring-tool carried by said shaft; a device mounted on the end of the shaft; a feed-screw one end of which passes through said device; a gear attached to said feed-screw; a second gear mounted on the device above mentioned; a star-wheel having a hub adapted to be attached to either of said gears; and means for intermittingly actuating said star-wheel as the shaft rotates.

13. In a machine of the class specified, the combination with a boring-bar shaft having a longitudinal groove or keyway of a cutter-head mounted on said shaft and carrying a boring-tool; a feed-screw; a nut having a stud fitted in the cutter-head, said nut being located in the longitudinal groove of said shaft; gearing, one member of which is attached to said feed-screw; a star-wheel adapted to be applied to one or another member of said gearing; and means for actuating said star-wheel.

14. In a machine of the class specified, the combination with a boring-bar shaft of a cutter-head mounted on said shaft; a nut having a stud fitted in an aperture of the cutter-head, said nut being located in a longitudinal groove of the shaft; a feed-screw passing through said nut; gearing, one member of which is attached to said feed-screw; a device adapted to be applied to one or another member of said gearing; and means for intermittingly actuating said device upon the rotation of the boring-bar shaft.

15. In a machine of the class specified, the combination, with a boring-bar shaft, of a cutter-head mounted thereon and consisting of a collar; an interchangeable arm or bracket attached to said collar and shaped to fit the periphery thereof; and a boring-tool carried by said arm or bracket.

16. The combination, with a shaft, of a collar secured thereto; interchangeable arms or brackets attached to said collar and each shaped to fit the periphery thereof; and boring-tools carried by said brackets.

17. The combination, with a shaft, of a cutter-head secured thereto, said cutter-head comprising interchangeable arms or brackets shaped to fit the periphery thereof; and boring-tools adjustably mounted on said brackets.

18. The combination, with a shaft, of a collar keyed thereon; shoes carried by the collar and bearing at different points upon the periphery of the shaft; interchangeable arms or brackets attached to said collar and shaped to fit the periphery thereof; and boring-tools carried by said arms or brackets.

19. An attachment for machines consisting of a block having a series of steps adapted to fit various-sized openings; a center; and a device carried by the block for adjusting said center.

20. A cutter-head comprising a collar and means for securing the same at different points to a shaft; a grooved interchangeable block attached to said collar; a device fitted in the groove of said block; a tool-holder pivoted to said device; a cutting-tool mounted in said tool-holder; means for adjusting said cutting-tool; and means for adjustably securing the device carrying the tool-holder to the block.

21. The combination with a boring-bar shaft and a cutter-head carrying a boring-tool mounted thereon of a feed-screw for actuating said cutter-head in either direction; a gear attached to one end of said screw; a second gear mounted adjacent to the first-named gear; a star-wheel having a hub adapted to fit the hub of either of said gears; and means for intermittingly actuating said star-wheel.

22. In a machine of the class specified, the combination with a boring-bar shaft and a cutter-head having a boring-tool carried thereby of means for sustaining said shaft at both ends of the cylinder to be bored; a sectional ball member clamped to the shaft at all points of the circumference thereof; a journal-box for sustaining said ball member; and a gear-wheel for operating the boring-bar shaft also clamped to said shaft at all points of the circumference thereof.

23. In a machine of the class specified, the combination, with a boring-bar shaft, of brackets for adjustably sustaining said shaft upon the cylinder to be bored; a split or divided ball member clamped to the shaft at all points around the circumference thereof; a journal-bearing for said ball member; means for clamping said journal-bearing to the brackets; and means connected with said brackets for adjusting the journal-bearing in a line perpendicular to the axis of said shaft.

24. In a machine of the class specified, the combination with a boring-bar shaft and a cutter-head mounted thereon of means for sustaining said shaft at one end of the cylinder to be bored; brackets adjustably connected to the cylinder at the other end of the same; a sectional ball member carried by the shaft; a journal-box for sustaining said ball member, said journal-box having an arm projecting from each side of the same; means carried by the brackets attached to the cylinder for adjusting the journal-box, and consequently the ball member and shaft, in a line perpendicular to the longitudinal axis of the shaft; and means for clamping the arms of said journal-box to said brackets.

25. The combination, with a boring-bar shaft, of a cutter-head mounted thereon; a screw for feeding said cutter-head to its work; a device for actuating said screw; an annular frame carrying means with which said device engages; a bearing carried by the boring-bar shaft over which said frame is fitted; and a stop-rod carried by said annular frame.

26. The combination, with a boring-bar shaft, of a cutter-head mounted thereon; a screw for feeding said cutter-head to its work; a star-wheel for intermittingly actuating said screw; an annular frame carrying a series of studs or rollers and having an arm; a disk carried by the boring-bar shaft; a stud carried by said arm; and a stop-rod secured to said stud.

27. A cutter-head comprising a body portion in the shape of a collar; a series of arms or brackets shaped to fit the periphery of said collar and detachably secured thereto, each of said arms or brackets having a slot and a groove; a shoe having a rib fitted in said groove and adjustably attached to the cutter-head by clamping means passing through the slot; a tool-holder pivoted to said shoe and having a tongue fitting in a groove of the shoe; a cutting-tool adjustably secured to the tool-holder; and means for adjusting said tool-holder on its pivot.

28. A cutter-head consisting of a block or collar, a series of interchangeable arms or brackets, grooved and slotted on their front faces, detachably secured to said collar; a radially-adjustable shoe fitted to the front face of each of said brackets; a tool-holder mounted for swinging movement in each of said shoes and provided with a grooved face for receiving the cutting-tool; means for clamping said tool when adjusted; and a screw carried by the tool-holder and bearing against the shoe.

29. An attachment for machines consisting of a block having a series of concentric steps of different diameters; a nut carried by said block; a threaded center; and a bushing carried by said center.

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Witnesses:
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