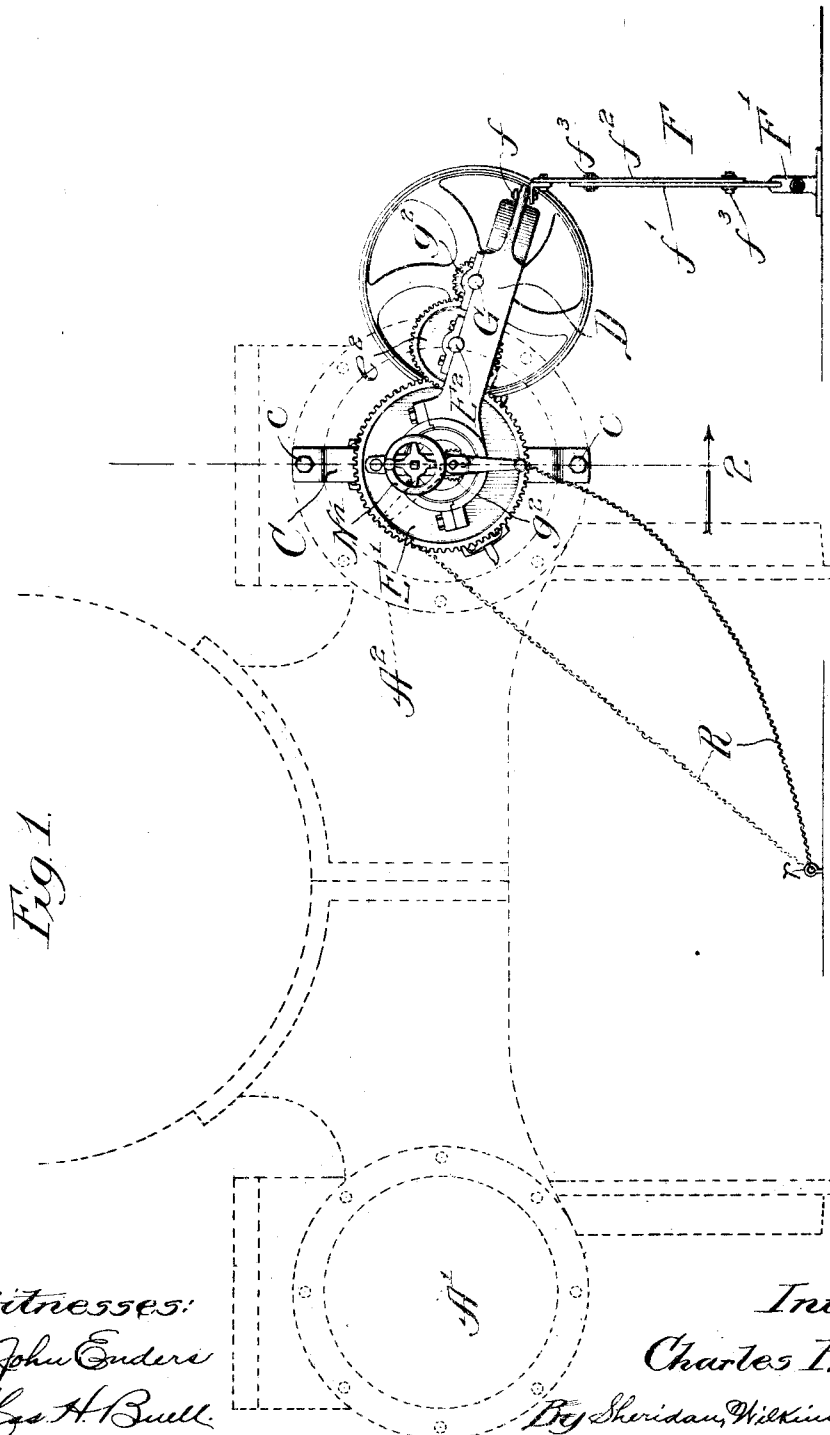


C. F. WINN.  
CYLINDER BORING APPARATUS.  
APPLICATION FILED JUNE 15, 1909.

1,064,676.

Patented June 10, 1913.

6 SHEETS-SHEET 1.

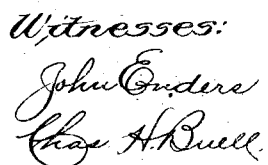


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1,064,676.

6. SHEETS—SHEET 2.



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6 SHEETS—SHEET 3.

*Fig. 4.*

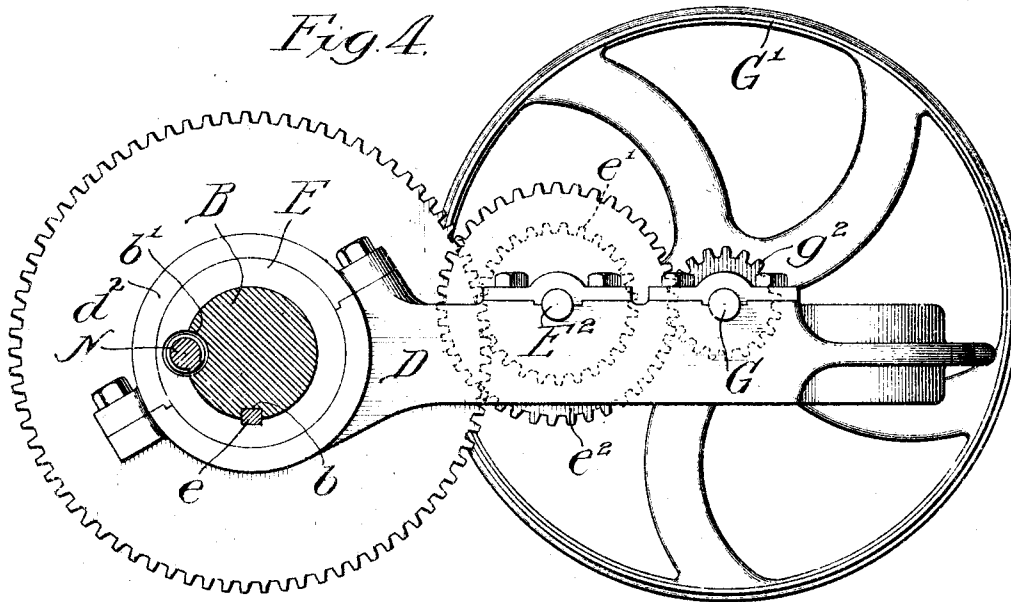
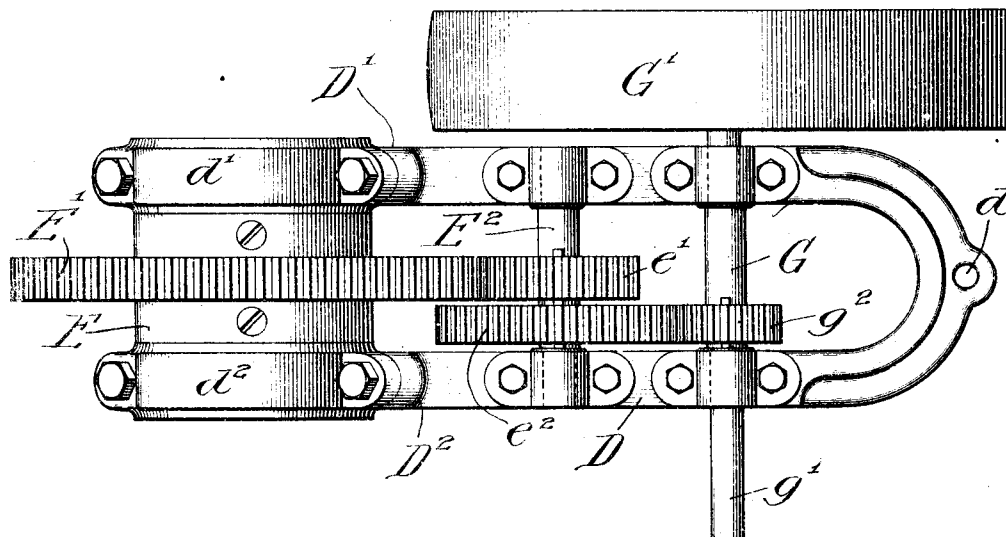


*Fig. 5.*



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6 SHEETS—SHEET 4.

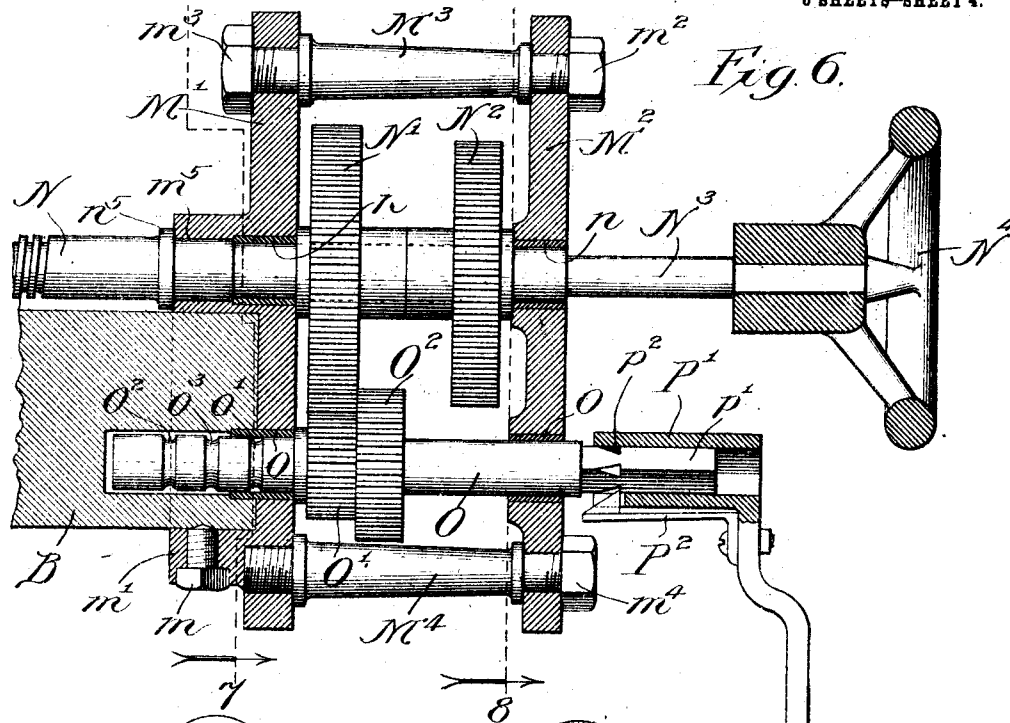


Fig. 6.

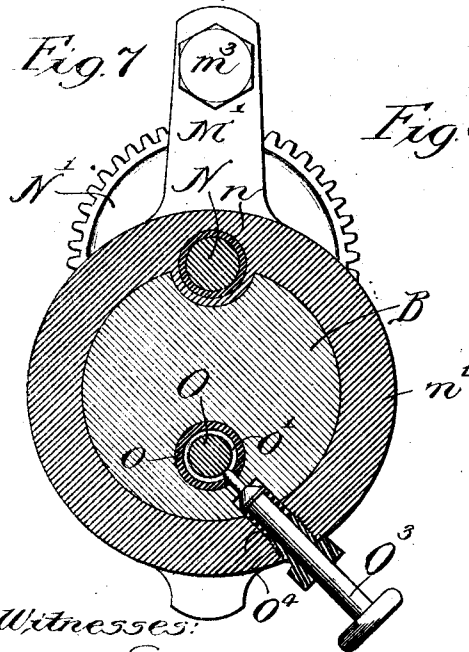


Fig. 7.

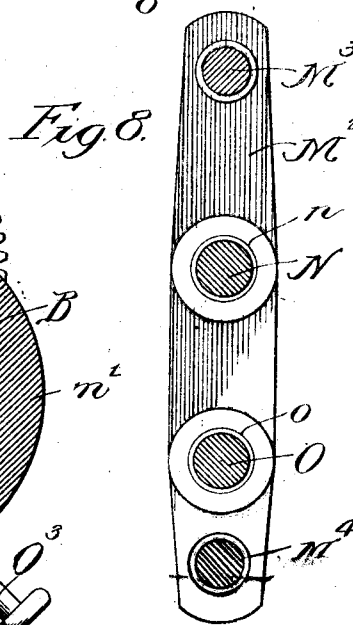


Fig. 8.

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6 SHEETS—SHEET 5.

Fig. 10.

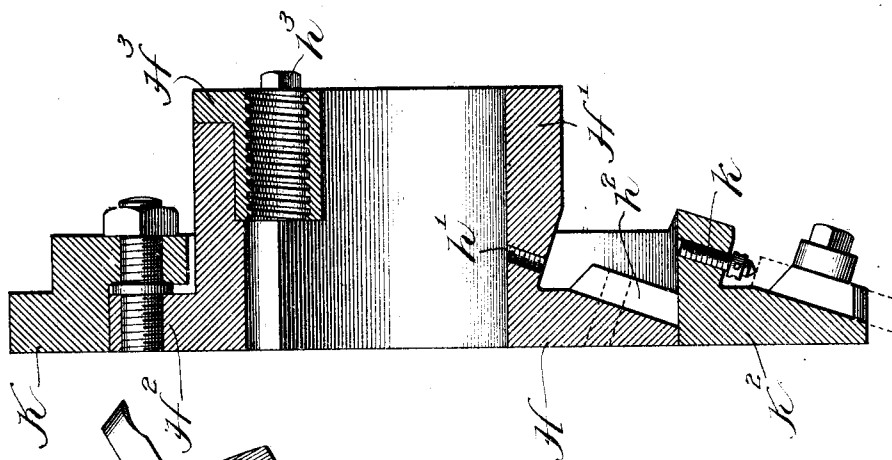
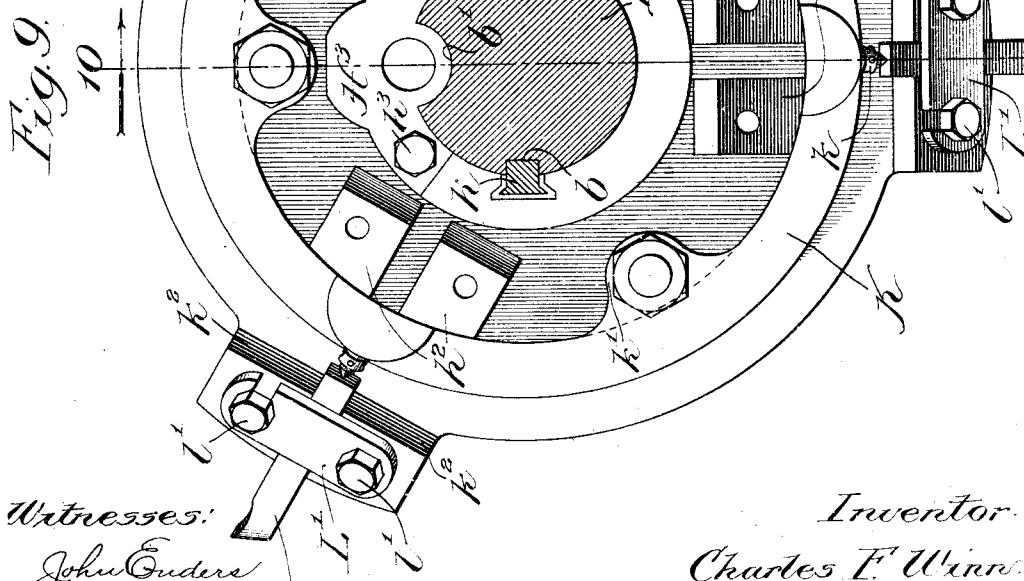


Fig. 9.



Witnesses:  
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Chas. H. Bull.

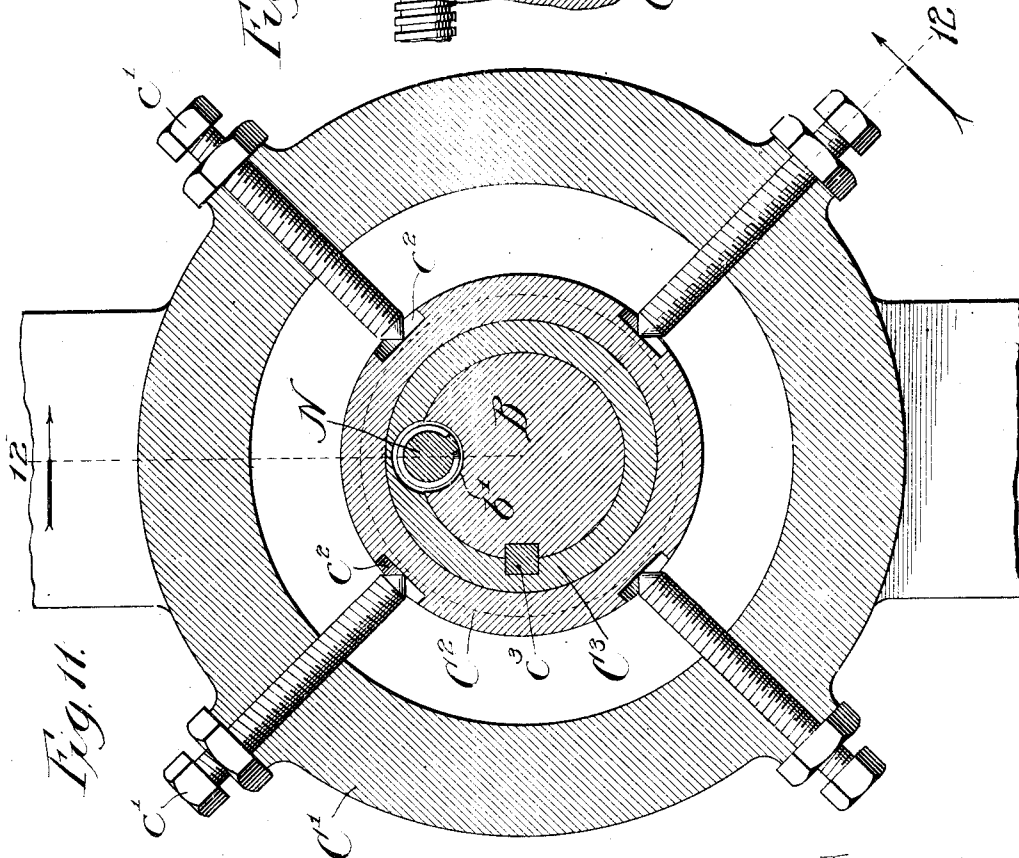
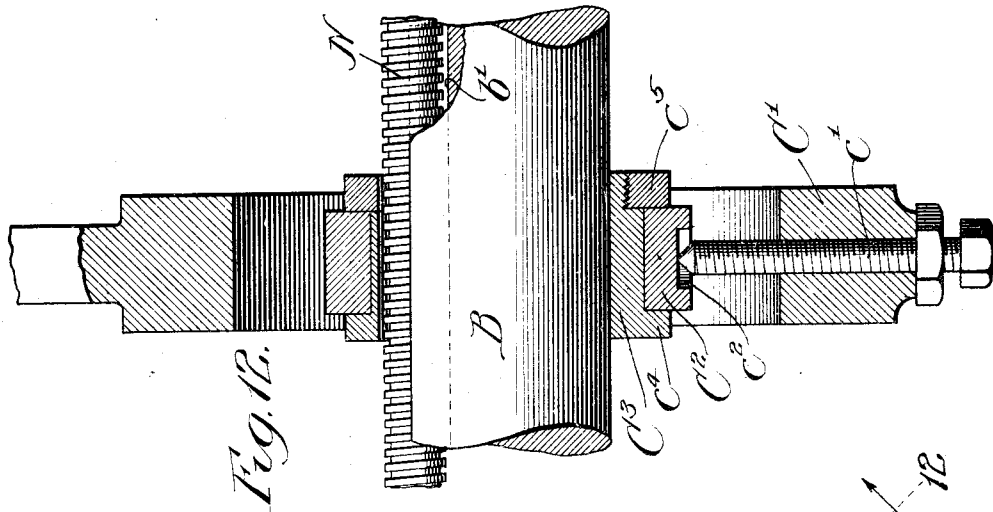
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6 SHEETS—SHEET 6.



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# UNITED STATES PATENT OFFICE.

CHARLES F. WINN, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO JOSEPH T. RYERSON & SON, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

## CYLINDER-BORING APPARATUS.

1,064,676.

Specification of Letters Patent.

Patented June 10, 1913.

Application filed June 15, 1908. Serial No. 502,335.

*To all whom it may concern:*

Be it known that I, CHARLES F. WINN, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Cylinder-Boring Apparatus, of which the following is a specification.

My invention relates in general to cylinder boring machines, and more particularly to an improved boring bar for locomotive engine cylinders, Corliss engine cylinders and valves, valve chambers, steam hammer cylinders, air hoists, etc.

The primary object of my invention is to provide a machine for boring cylinders, in which the tool head will be automatically continually fed forward as the work of boring progresses, and at different uniform speeds according to the character of the work.

A further object of my invention is to provide an improved tool head, which may be varied in diameter, and having thereon tool holders in which straight tools of any desired cross section may be firmly supported, and at the same time readily adjusted radially.

A further object of my invention is to provide means for conveniently and firmly supporting the boring bar in operative position upon a cylinder.

A still further object of my invention is to provide an improved cylinder boring machine, which will be comparatively simple in construction, efficient in operation, and durable in use.

My invention will be more fully described hereinafter with reference to the accompanying drawings, in which the same is illustrated as embodied in a convenient and practical form, and in which—

Figure 1 is an end elevation, showing the boring machine in operative relation to a locomotive, the illustrated parts of the latter being shown in dotted lines; Fig. 2, a longitudinal section through the cylinder of a locomotive, showing the boring machine in elevation; Fig. 3, a detail sectional view on line 3, Fig. 2; Fig. 4, an enlarged elevational view, the bar being shown in cross section, taken on line 4, Fig. 2; Fig. 5, a plan view on the same scale as Fig. 4, looking downwardly thereon; Fig. 6, a longitudinal sectional view through the feed box, showing its position upon the end of the bar; Fig. 7,

a sectional view on line 7, Fig. 6; Fig. 8, a sectional view on line 8, Fig. 6; Fig. 9, an elevational view of the tool supporting head, the bar being shown in section, the plane of this view being indicated at line 9, Fig. 2; Fig. 10, a sectional view on line 10, Fig. 9; Fig. 11, a sectional view on an enlarged scale, taken through ring C', Fig. 2; and Fig. 12, a sectional view on line 12, Fig. 11.

The same reference characters are used to designate the same parts in the several figures of the drawings.

Reference characters A' and A<sup>2</sup> indicate the engine cylinders of a locomotive. It will, however, be understood that my invention is not limited to boring engine cylinders, but is adapted for use in boring any cylindrical receptacles or chambers.

B indicates the boring bar upon which the tool supporting head is concentrically supported. The bar B extends concentrically through the cylinder to be bored, such, for instance, as the locomotive engine cylinder A<sup>2</sup>. The inner end of the bar may be conveniently supported by extending a reduced portion B<sup>2</sup> thereof through the usual piston rod opening in the cylinder head A<sup>3</sup>. A collar B' is fixed upon the bar B and is located within the stuffing box recess of the back cylinder head. The reduced portion B<sup>2</sup> of the bar which extends through the usual stuffing box a<sup>3</sup> is surrounded by a centering tapered bushing b', which is held in position within the stuffing box by a gland B<sup>2</sup>, provided with open radial slots through which extend bolts b<sup>2</sup> into engagement with the usual screw threaded opening in the flange around the stuffing box a<sup>3</sup> for receiving the piston gland studs. Thrust screws b<sup>3</sup> also extend through the gland B<sup>2</sup> and engage against the adjacent surface of the flange around the stuffing box.

The portion of the bar B which lies outside of the front end of the cylinder, from which the cylinder head has been removed, is supported by means of a saddle C having thereon a circular support C' which surrounds the bar B and supports the same. The saddle C may be conveniently secured to the end of the cylinder by screws c passing through the ends thereof into engagement with the usual screw threaded openings for the studs which secure the cylinder head in position. Adjustable centering bolts c' extend through the ring C' and engage within

recesses  $c^2$  formed in a ring  $C^2$  concentrically located within the ring  $C^1$ . The ring  $C^2$  rotatably surrounds a collar  $C^3$  rigidly connected by a key  $c^3$  to the bar B. The collar  $C^3$  is recessed to permit the free rotation of the feed rod N between the same and the bar B. The collar  $C^3$  is provided with side flanges  $c^4$  and  $c^5$  between which the ring  $C^2$  is rotatably located. The flange  $c^5$  is removable, as shown in Fig. 12, to permit the assembling of the ring  $C^2$  around the collar  $C^3$ .

D indicates a frame for supporting the mechanism for rotating the boring bar, such frame being conveniently in the form of a yoke, the ends  $D^1$  and  $D^2$  of the parallel portions of which are provided with semi-circular seats which partially surround a sleeve E keyed upon and revolving with the boring bar.  $d^1$  and  $d^2$  indicate caps for the circular bearings around the sleeve E, which may be readily removed to permit the driving gear supporting frame to be detached from the bar when setting up or taking down the bar.

The sleeve E is provided with a feather or key  $e$  which engages within a longitudinal groove  $b$  in the bar B.

The end of the gear supporting frame D opposite to its connections with the bar may be conveniently supported by a standard F, the lower end of which is provided with a foot  $F^1$  adapted to be secured to the underlying supporting surface. The upper end of the standard is provided with a bolt  $f$  which connects the standard with the gear frame D by extending through an opening  $d$  therein. The standard is preferably adjustable in height in any suitable manner, as by forming the same of two overlapped portions  $f^1$  and  $f^2$ , which are adjustably connected by bolts  $f^3$ .

A power shaft G is supported transversely upon the two members of the gear frame D. The shaft G may be rotated in any suitable manner, as by means of a belt pulley  $G^1$  fixed on one end thereof, or by any suitable power generator, such as an air motor, electric motor, flexible shaft, engaging the end  $g^1$  thereof, or a device for rotating the shaft by hand may be attached thereto. A pinion  $g^2$  is fixed upon the shaft G which meshes with a gear wheel  $e^2$  fixed upon a counter shaft  $E^2$  also journaled upon the members of the supporting gear frame D. A small gear wheel  $e^1$  is also fixed upon the shaft  $E^2$  and meshes with a large gear  $E^1$  surrounding and fixed to the sleeve E. The meshed gear wheels which operatively connect the power shaft G with the boring bar serve to reduce the speed and increase the power transmitted to the bar.

A tool supporting master head H concentrically surrounds the bar B and is connected to rotate therewith by means of a key

or feather  $h$  which extends into the longitudinal groove  $b$  in the bar. The head H is provided with pairs of lugs  $h^2$  between which the tools L are received, a latch  $L^1$  being pivotally supported upon one of the lugs in each pair and adapted to engage a bolt  $V$  upon the other lug in each pair, thereby firmly retaining the tool between the lugs and against the inclined seat between the lugs. Consequently each tool is retained between three solid surfaces. The hub  $H^1$  of the head H is provided with screw threaded holes  $h^1$  alining with the spaces between the several pairs of lugs  $h^2$ , such holes being adapted to receive an adjusting screw such as indicated at  $k$  for adjusting the radial positions of the several tools. The head H may be properly termed a master head, as it is always located around the bar B and is adapted to itself directly support the tools when the cylinder to be bored is of minimum diameter. In order that cylinders of larger diameters may be bored, one or more removable tool supporting spiders of different diameters are provided, any one of which may be secured to the head H. One of such spiders is shown at K which is provided with inwardly projecting ears overlying the radial flange  $H^2$  of the head H, bolts  $k^1$  being shown as extending through registering reamed holes in such ears, and in the flange on the master head H, to rigidly secure the spider to the master head. It is obvious that spiders of various diameters may be secured to the master head H according to the interior diameter of the cylinder which is to be bored.

The spider K is provided with spaced lugs  $k^2$  similar to the lugs  $h^2$  on the master head between which the tools are supported, latches  $L^1$  being provided to removably retain the tools between the lugs  $k^2$  in the several pairs. The tools are adjustable radially upon the flange  $K^2$  of the spider K by means of adjusting screws  $k$  extending through holes in the inner circular flange of the ring K, as clearly shown in Fig. 10.

The surfaces between the pairs of lugs on the master head or auxiliary surrounding spider are inclined so that straight tools L may be employed, and when seated between the pairs of lugs and retained against the inclined surfaces between the lugs by the latches  $L^1$  they will project past the inner surface of the master head or spider, and thereby bore the cylinder to its inner end without the use of bent tools as usually heretofore employed in order that the cutting ends of the tools may project beyond the inner surface of the cutter head. The openings for the tools between the lugs are milled accurately of exact size to receive the tools, thereby enabling the tools to fit snugly between the lugs and against the inclined

seat, thus preventing all chattering and rough and inaccurate working of the tools.

In order that the master head may be fed forward as the work of boring progresses, I provide a screw threaded rod N which extends through a solid screw threaded nut H<sup>3</sup> detachably secured by cap bolts h<sup>3</sup> to the hub H' of the master head. The portion of the hub H' alining with the opening in the nut H<sup>3</sup> is recessed as shown in Fig. 10, while a recess b' is provided longitudinally in the bar B to permit the screw threaded rod N to extend longitudinally of the bar, and be supported at its inner end in a bearing in the collar B' fixed upon the bar.

The outer end of the feed rod N extends through bearings in parallel supporting plates M' and M<sup>2</sup>, such plates being spaced apart and rigidly connected by posts M<sup>3</sup> and M<sup>4</sup> having shoulders thereon which rest against the inner surfaces of the plates. The posts extend through openings in the plates and are provided with nuts on the ends thereof, as shown in Fig. 6. m<sup>2</sup> and m<sup>3</sup> indicate the nuts on the ends of the post M<sup>3</sup>, while m<sup>4</sup> indicates the nut on the end of the post M<sup>4</sup> which projects through the plate M<sup>2</sup>, while the opposite end of the post M<sup>4</sup> engages within a screw threaded opening in the plate M'. Bronze bushings n, n surround the portions of the rod N which extend through the supporting plates M' and M<sup>2</sup>. The plates M' and M<sup>2</sup>, together with the interposed posts M<sup>3</sup> and M<sup>4</sup>, constitute a carriage for the feed mechanism.

The plate M' is provided with a circular flange m' which surrounds the end of the bar B and is secured thereto in any suitable manner, as by means of a set screw m. The circular flange m' is provided with a circular opening m<sup>5</sup> alining with the opening through the plate M' and surrounding the rod N, the inner end of such opening m<sup>5</sup> constituting a stop against which a collar n<sup>5</sup> on the rod N engages.

The portion of the rod N between the plates M' and M<sup>2</sup> has fixed thereon two gear wheels N' and N<sup>2</sup>, the former being of greater diameter than the latter. The portion N<sup>3</sup> of the rod N which projects beyond the plate M<sup>2</sup> has removably fixed thereon a hand wheel N<sup>4</sup> in any suitable manner, as by means of a set screw n<sup>4</sup>. A counter shaft O extends through bearings in the plates M' and M<sup>2</sup>, bronze bushings o, o being provided around the shaft where it passes through such plates. The shaft O has fixed thereon two gear wheels O' and O<sup>2</sup>, the former being smaller than the latter, and being of a diameter to mesh with the large gear wheel N' upon the rod N. The gear wheel O<sup>2</sup> is of a diameter to mesh with the gear wheel N<sup>2</sup> when the shaft O is adjusted axially into position to bring the gear wheel O<sup>2</sup> into mesh with the gear wheel N<sup>2</sup>. The

inner end of the counter shaft O extends into a cylindrical chamber in the end of the boring bar B, and is provided with three annular grooves o', o<sup>2</sup> and o<sup>3</sup>. A plunger O<sup>3</sup> extends through the circular flange m' and into an alining recess in the bar B, the inner end of such plunger being reduced so as to project through a small opening in the bushing o into engagement with any one of the annular grooves in the shaft O, according to the axial position of such shaft. A spring o<sup>4</sup> surrounds the plunger O<sup>3</sup> and is interposed between a shoulder thereon and a fixed shoulder around the plunger the tension of such spring serving to project the inner end of the plunger into engagement with the annular grooves in the shaft O. In order to axially adjust the shaft O, the portion thereof which projects through the plate M<sup>2</sup> is squared as shown at p', and is surrounded by the interiorly squared hub P' of a crank arm P, the outer end of such crank arm being provided with a handle p. A spring latch P<sup>2</sup> is secured to the crank arm P and is provided with a pawl adapted to be projected into any one of a series of notches p<sup>2</sup> formed in the adjacent squared portion of the shaft O. It is obvious that by applying pressure to the crank arm P in the direction of the axis of the shaft O, such shaft may be moved axially and any one of the annular grooves therein brought into register with the plunger O<sup>3</sup>. When the annular groove o' registers with the plunger, the gear wheel O' meshes with the gear wheel N', while when the groove o<sup>2</sup> registers with the plunger, the gear wheel O<sup>2</sup> meshes with the gear wheel N<sup>2</sup>. Both of the gear wheels O' and O<sup>2</sup> are disconnected from the gear wheels N' and N<sup>2</sup> when the groove o<sup>3</sup> registers with the plunger.

R indicates a chain, one end r of which is anchored to a fixed support and the other end of which is secured to the handle p on the crank arm P to prevent the rotation of the shaft O. Any suitable means, such as a weight, may be provided for preventing the handle from revolving, and consequently retaining the shaft O against rotation about its own axis.

The operation of my improved cylinder boring bar is as follows: The boring bar is inserted through the end of a cylinder from which the head has been removed, and its inner end passed through the stuffing box in the opposite cylinder head. The tapered bushing b' is then placed around and centers the portion of the bar which extends through the usual stuffing box, and is held in such position by means of the gland B<sup>2</sup>. The saddle C is secured to the open end of the cylinder by means of the studs c. The ring C' is of an interior diameter slightly greater than the diameter of the bar in order

to permit the rotation of the feed rod N with the bar. The standard F is then secured in position to support the outer end of the frame D of the driving gears. It will, of course, be understood that before securing the boring bar in position upon a cylinder, the tools have been so supported upon the master head, or surrounding spider, as to project radially around the shaft the proper distance to produce the desired cut in the cylinder. When the cylinder is of minimum diameter, the tools are secured directly to the master head H, but when the cylinder is of greater diameter, then a spider, such as K, is secured to the cutter head, such spider being of a size to conform to the cylinder to be bored. Power is applied to the shaft G which is communicated through the train of gearing to the sleeve E keyed to the bar B, thereby rotating the latter. As the speed gearing carriage comprising the plates M' and M<sup>2</sup> is fixed upon the end of the bar, such carriage rotates with the bar, the feed screw-threaded rod N also rotating with the carriage and bar. As the counter shaft O is located eccentrically with respect to the bar B, it will also have a circular path of movement with the bar, the radius of such circular path being equal to the eccentricity of the shaft O relatively to the axis of the bar. The shaft O is prevented from rotating by any suitable retaining means applied to the handle p, such, for instance, as the chain R. As the shaft O is prevented from rotating about its own axis the rod N will be rotated during each revolution of the bar B a distance corresponding to the relative diameters of the meshed gear wheels on the shafts N and O. When the gear wheels O' and N' are in mesh, as shown in Fig. 6, a revolution of the bar B will carry the gear N' completely around the gear O', thereby rotating the gear N' a distance equal to the circumference of the gear O', and the distance which the gear wheel N' is rotated determines the extent of rotation of the rod N, and consequently the automatic forward feed of the cutter head.

When it is desired to feed the cutter head at greater speed, the gear wheel O<sup>2</sup> is brought into mesh with the gear wheel N<sup>2</sup> by axially adjusting shaft O, thereby imparting a greater movement to the rod N during each revolution thereof with the bar B. The feed may also be discontinued, if desired, to permit the cutter head to rotate without axial motion on the bar by adjusting the shaft O to a position to disengage both of the gear wheels thereon from the gear wheels on the rod N, as, for instance, when feeding by hand across the live steam opening in a valve chamber.

It will be observed that in the operation of my improved boring machine the key on the master head which engages the longi-

tudinal groove in the bar relieves the feed rod N from all distortion, thereby preventing the same from being damaged. The key of the construction shown in Fig. 9 is preferably employed, as it affords a secure connection with the master head. The feed nut H<sup>3</sup> is solid and is, therefore, rigid and durable and permits a tight fit around the shaft without lost motion.

The hand wheel N<sup>4</sup> is secured upon the end of the shaft N<sup>3</sup> and used to impart reverse rotation to the rod N, in order to withdraw the head from within the cylinder.

From the foregoing description it will be evident that I have invented an improved cylinder boring bar, in which the cutting tools are automatically and continuously fed forward at a speed adjustable according to the character of the work; in which the effective diameter of the tool supporting head may be adjusted so as to readily adapt the machine for boring cylinders of different diameters; in which the boring bar is conveniently and securely supported in operative relation with the cylinder; in which the tools are securely supported upon the cutter head in incline position so as to present the cutting edges at the most efficient angle, and also so as to avoid the use of offset tools; and in which the feed mechanism is positive in operation and is relieved from all torsional strain.

While I have described more or less in detail the specific construction in which I have illustrated my invention as embodied, yet it will be understood that my invention is capable of embodiment in other specific forms than that herein illustrated, and is capable of structural changes without departing from the spirit of my invention.

I claim:

1. In a cylinder boring machine, the combination with a rotary bar, of means for supporting said bar in operative relation to the cylinder, a tool supporting head mounted upon said bar, power transmitting mechanism for rotating said bar, a frame supporting said mechanism and itself pivotally supported at one end upon said bar, and a standard supporting the other end of said supporting frame.

2. In a cylinder boring machine, the combination with a rotary bar, of means for supporting said bar in operative relation to a cylinder, a master tool supporting head mounted upon said bar to rotate therewith and to move longitudinally thereon, an auxiliary tool support removably surrounding said master head, and means for securing tools either upon said supporting head or upon said auxiliary tool support.

3. In a cylinder boring machine, the combination with a rotary bar, of means for supporting said bar in operative relation to a cylinder, a master tool supporting head

mounted upon said bar to rotate therewith and to move longitudinally thereon, an auxiliary tool support removably surrounding said master head, pairs of lugs on said tool support having inclined tool seats between the lugs in each pair, and means for clamping the tools against said seats between the lugs in said pairs.

4. In a cylinder boring machine, the combination with a rotary bar, of means for supporting said bar in operative relation to a cylinder, a tool supporting head mounted upon said bar to rotate therewith and movable longitudinally thereon, means for rotating said bar, a screw threaded shaft extending longitudinally of said bar, a nut on said head engaged by said screw threaded shaft, a speed mechanism carriage fixed upon and rotating with the end of said bar and through which said shaft extends, differential gear wheels fixed upon said shaft, a counter shaft journaled upon said carriage, differential gear wheels fixed upon said counter shaft, means for preventing the rotation of said countershaft and means for axially moving said counter shaft to engage one of the gear wheels thereon with the corresponding gear wheel on the screw threaded shaft.

5. In a cylinder boring machine, the combination with a rotary bar, of means for supporting one end of said bar adjacent the back end of a cylinder, a saddle adapted to be secured to the other end of a cylinder and

having a ring surrounding the bar, a collar fixed to said bar, means for rotatably supporting said collar within said ring, said means and collar comprising radially overlapping portions to prevent longitudinal movement of said bar, a tool supporting head, means for connecting said head to said bar to rotate therewith but to move longitudinally thereon, and means for rotating said bar.

6. In a cylinder boring machine, the combination with a rotary bar, of means for supporting one end of said bar adjacent the back end of a cylinder, a saddle adapted to be secured to the other end of a cylinder and having a ring surrounding the bar, adjustable bolts extending radially through said ring, a second ring supported concentrically within the first ring by said bolts, a collar fixed to said bar and rotatably engaging said second ring, said collar and second ring having radially overlapping portions to prevent longitudinal movement of said bar, a tool supporting head, means for connecting said head to said bar to rotate therewith and to move longitudinally thereon, and means for rotating said bar.

In testimony whereof, I have subscribed my name.

CHARLES F. WINN.

Witnesses:

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W. A. MOREY.