Jan. 13, 1925. 1,523,360

E. K. MORGAN

BORING MACHINE

Filed April 25, 1921 13 Sheets-Sheet 1

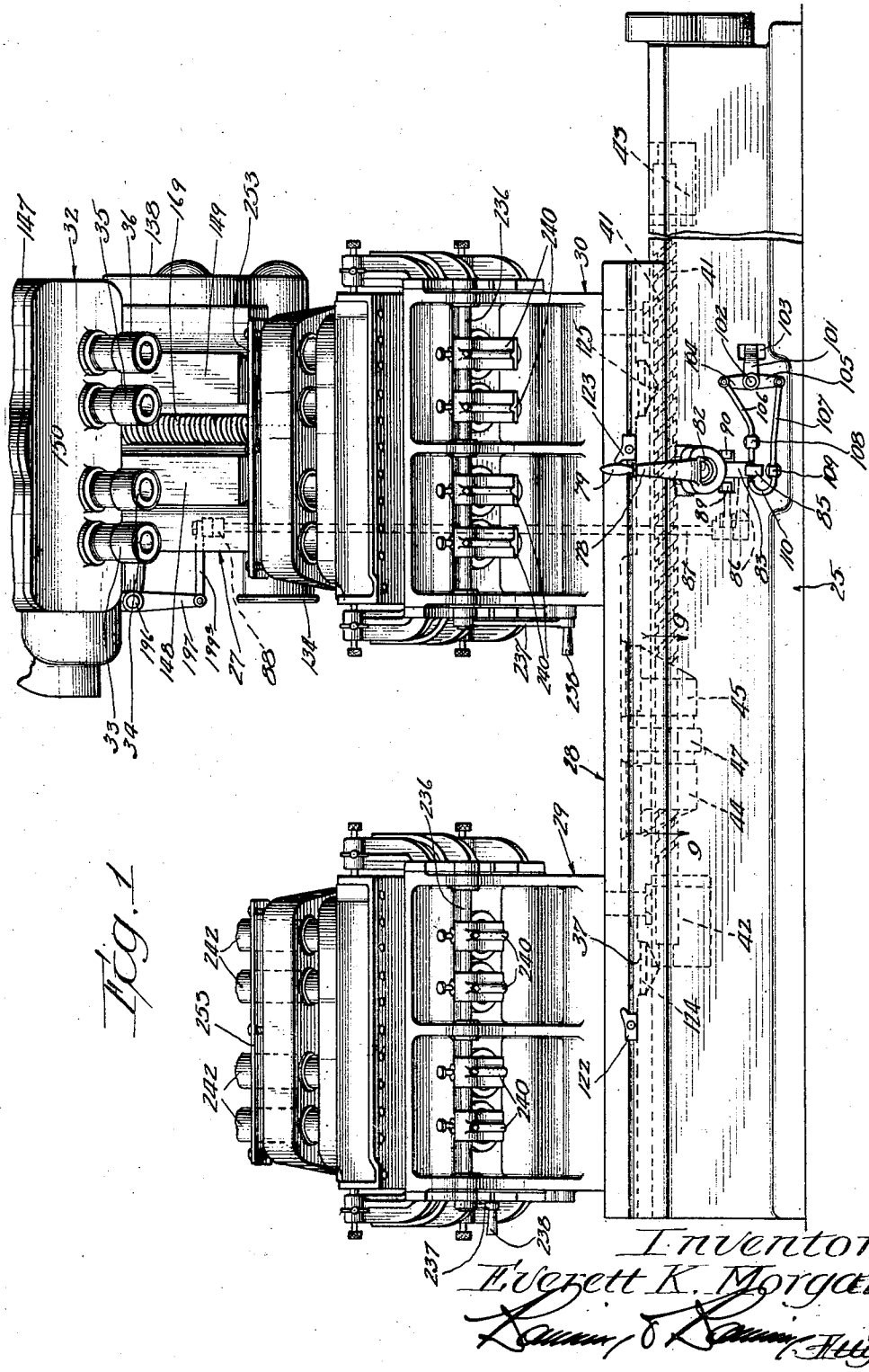


Fig. 1

Inventor:
Everett K. Morgan
Kamm & Kamm, Attys

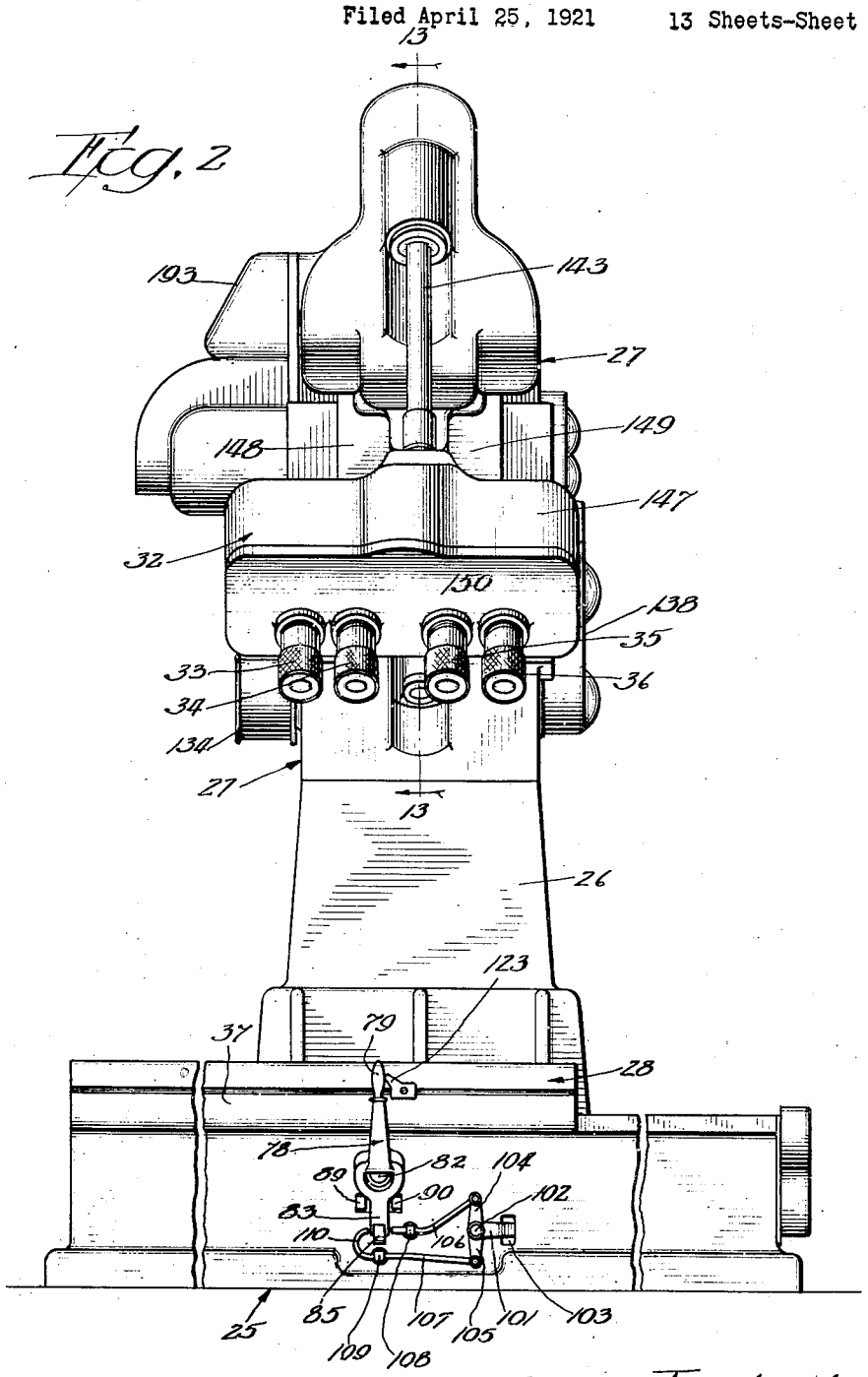
Jan. 13, 1925. 1,523,360

E. K. MORGAN

BORING MACHINE

Filed April 25, 1921 13 Sheets-Sheet 2

Fig. 2



Inventor:
Everett K. Morgan
Dawson & Dawson Attys

Jan. 13, 1925. 1,523,360

E. K. MORGAN

BORING MACHINE

Filed April 25, 1921 13 Sheets-Sheet 3

Fig. 4

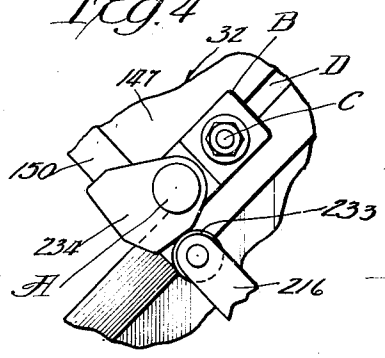


Fig. 3

Inventor:
Everett K. Morgan
Fenning & Fenning Attys

Jan. 13, 1925.

1,523,360

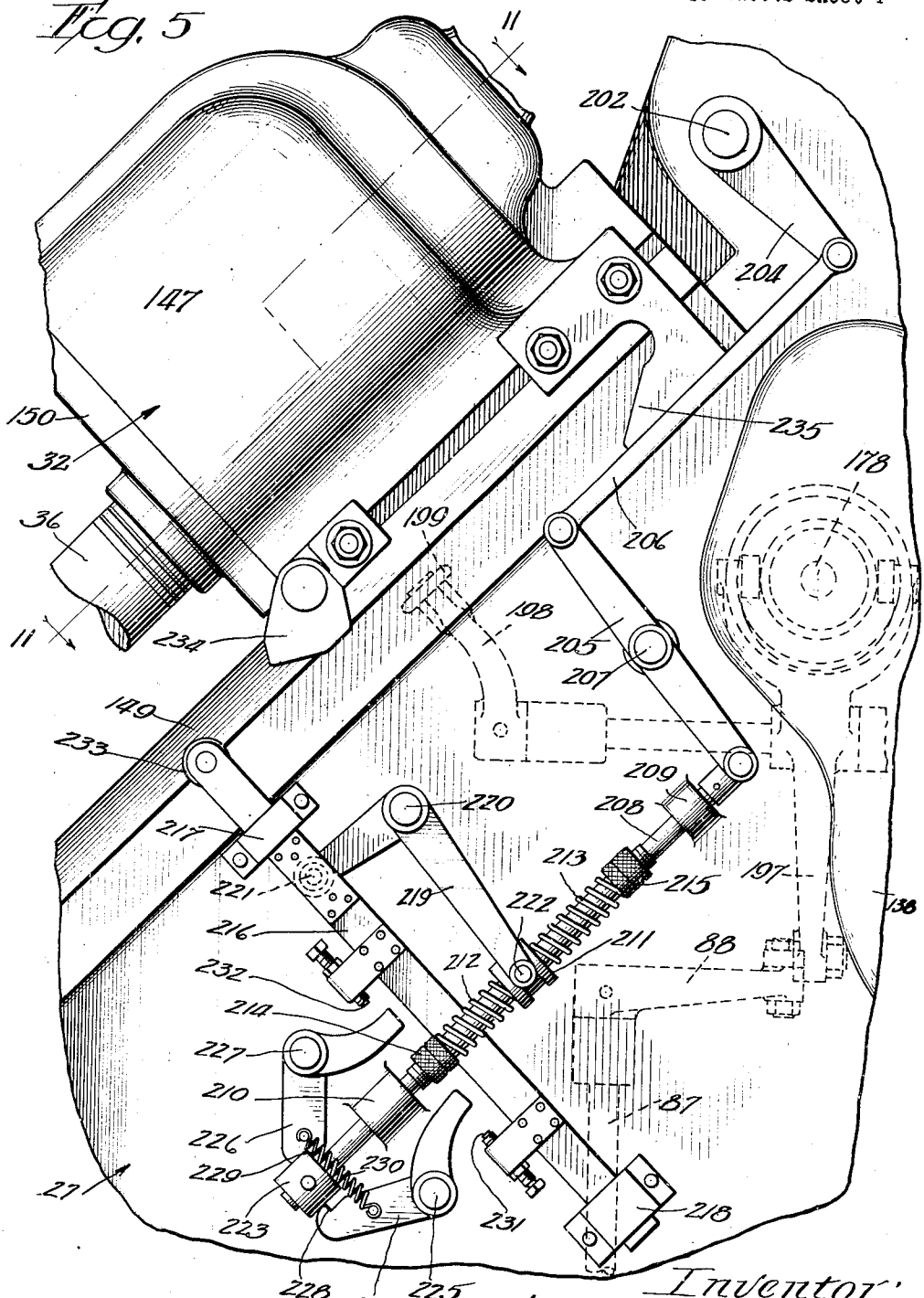
E. K. MORGAN

BORING MACHINE

Filed April 25, 1921

13 Sheets-Sheet 4

Fig. 5



Inventor:
Everett K. Morgan
Lamson & Lamson Attys

Jan. 13, 1925. 1,523,360

E. K. MORGAN

BORING MACHINE

Filed April 25, 1921 13 Sheets-Sheet 5

Fig. 6

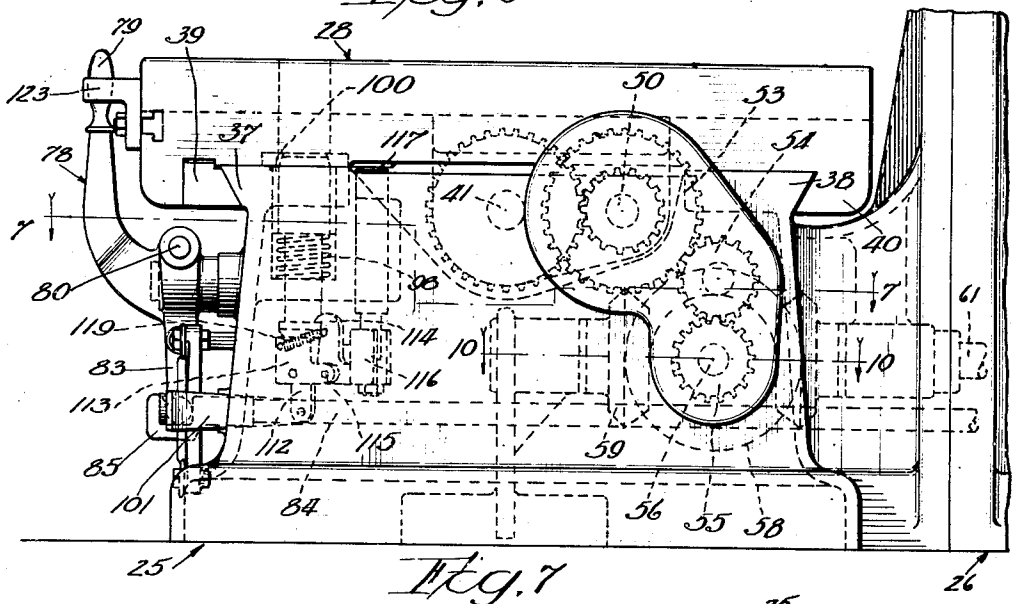
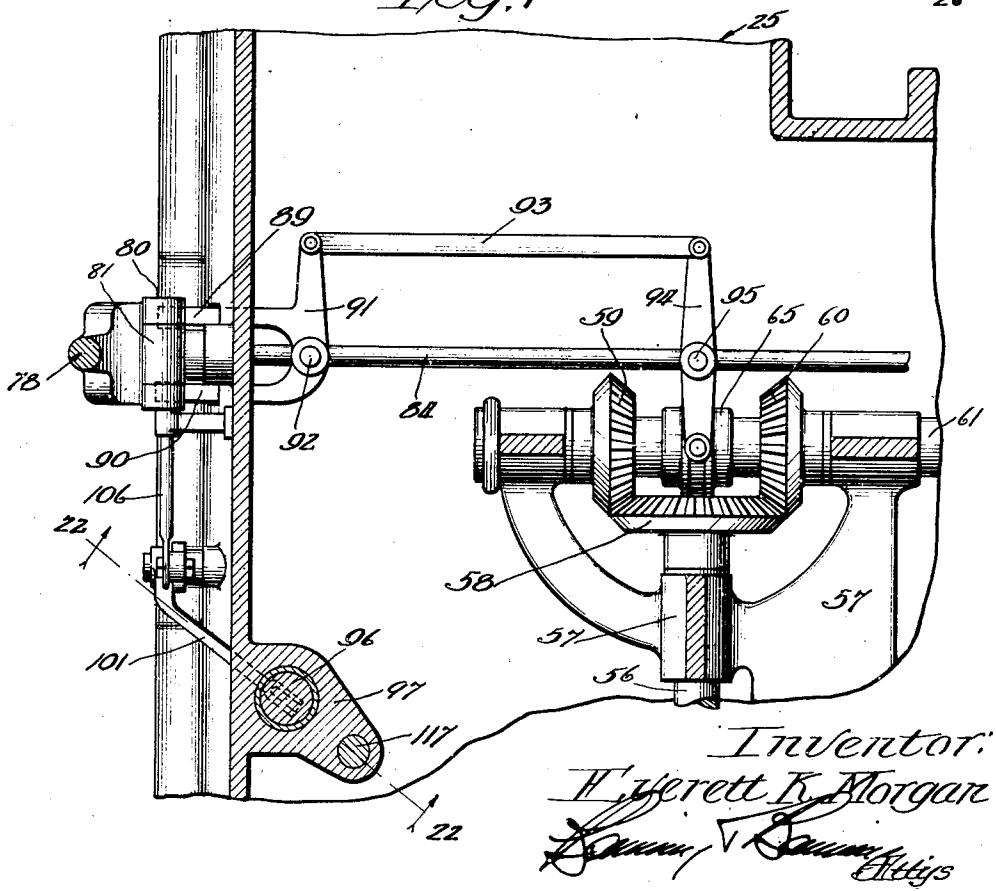


Fig. 7



Inventor:
Everett K. Morgan
Dennis & Dennis Attys

Jan. 13, 1925. 1,523,360

E. K. MORGAN

BORING MACHINE

Filed April 25, 1921 13 Sheets-Sheet 6

Fig. 8

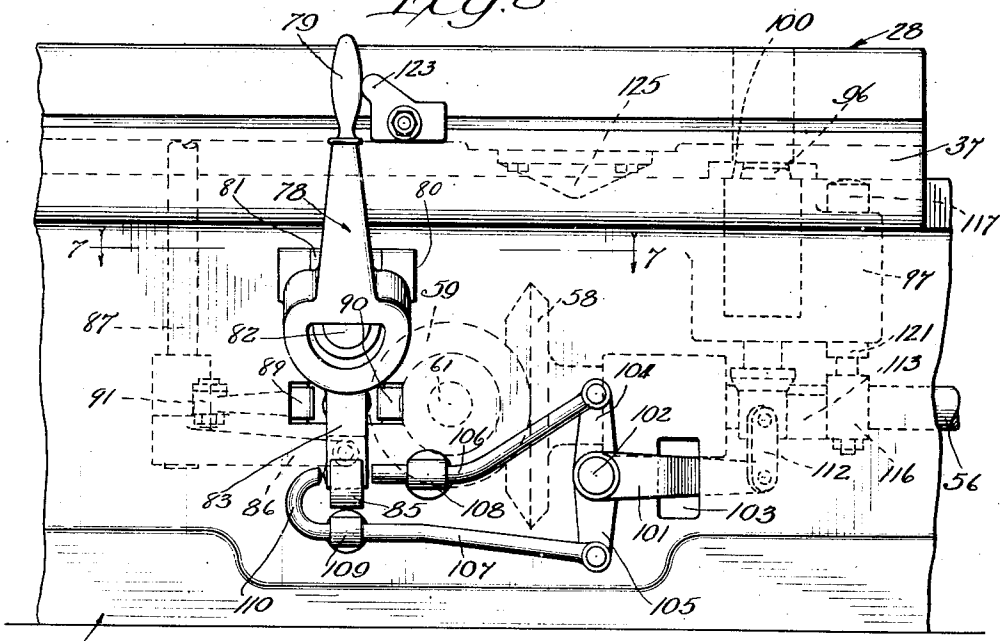


Fig. 9

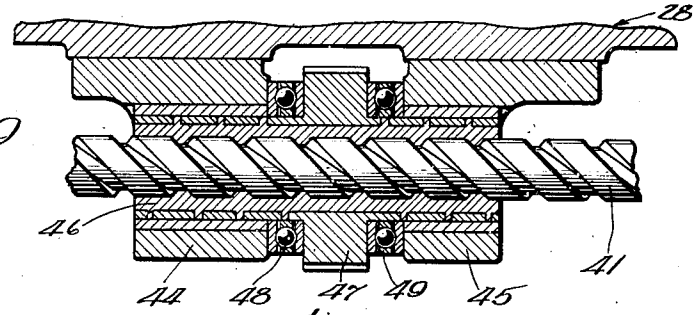
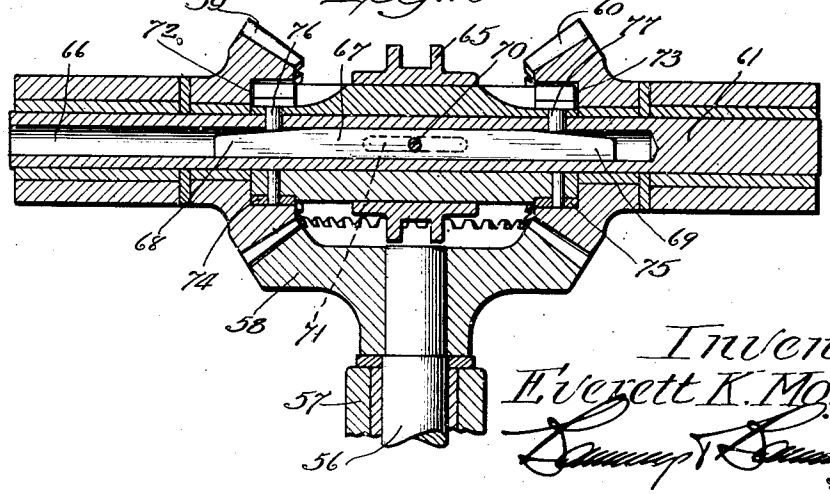


Fig. 10



Inventor:
Everett K. Morgan
Dumm & Dumm
Attys

Jan. 13, 1925. 1,523,360

E. K. MORGAN

BORING MACHINE

Filed April 25, 1921 13 Sheets-Sheet 7

Fig. 11

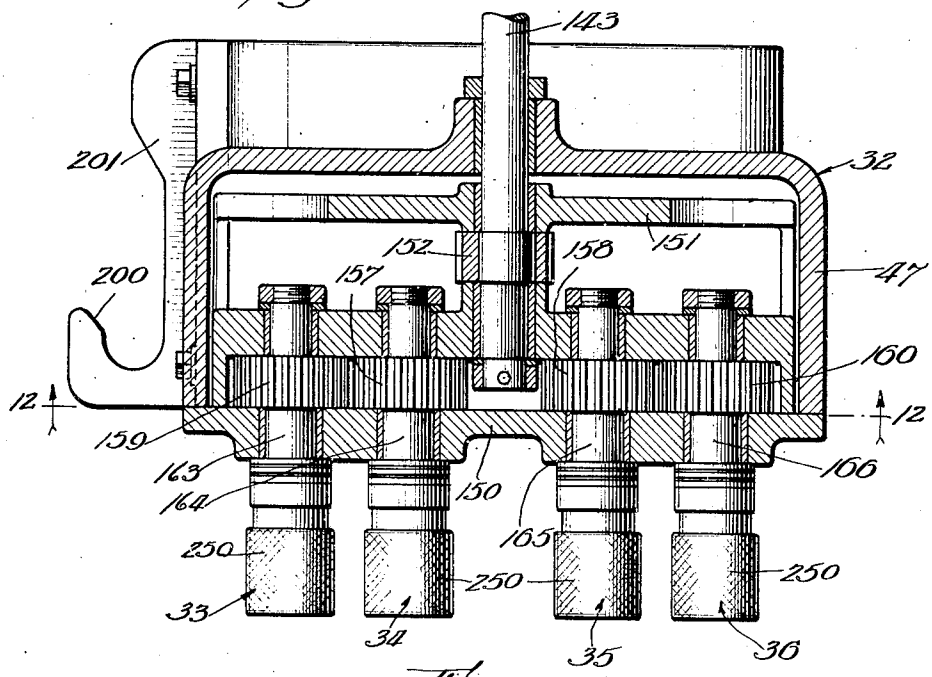
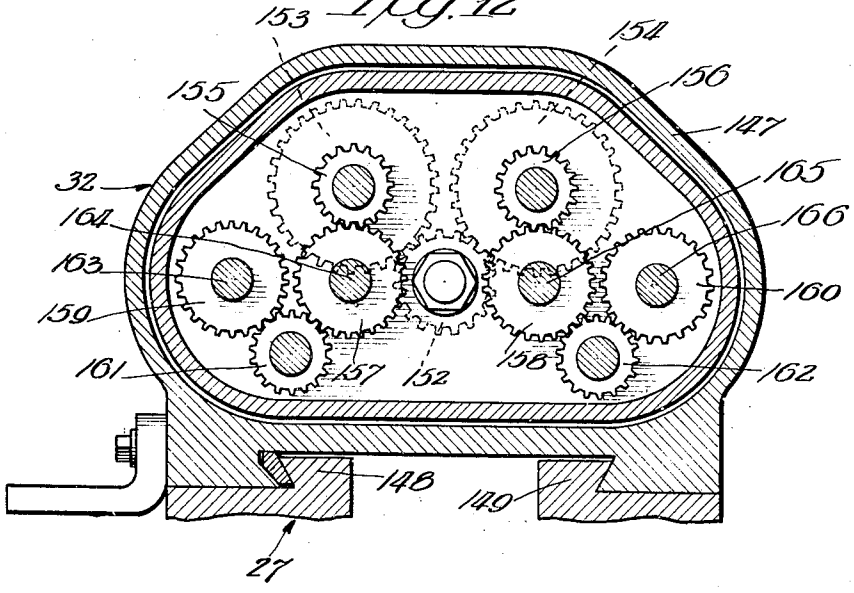


Fig. 12



Inventor:
Everett K. Morgan
Rowley & Rowley
Attys

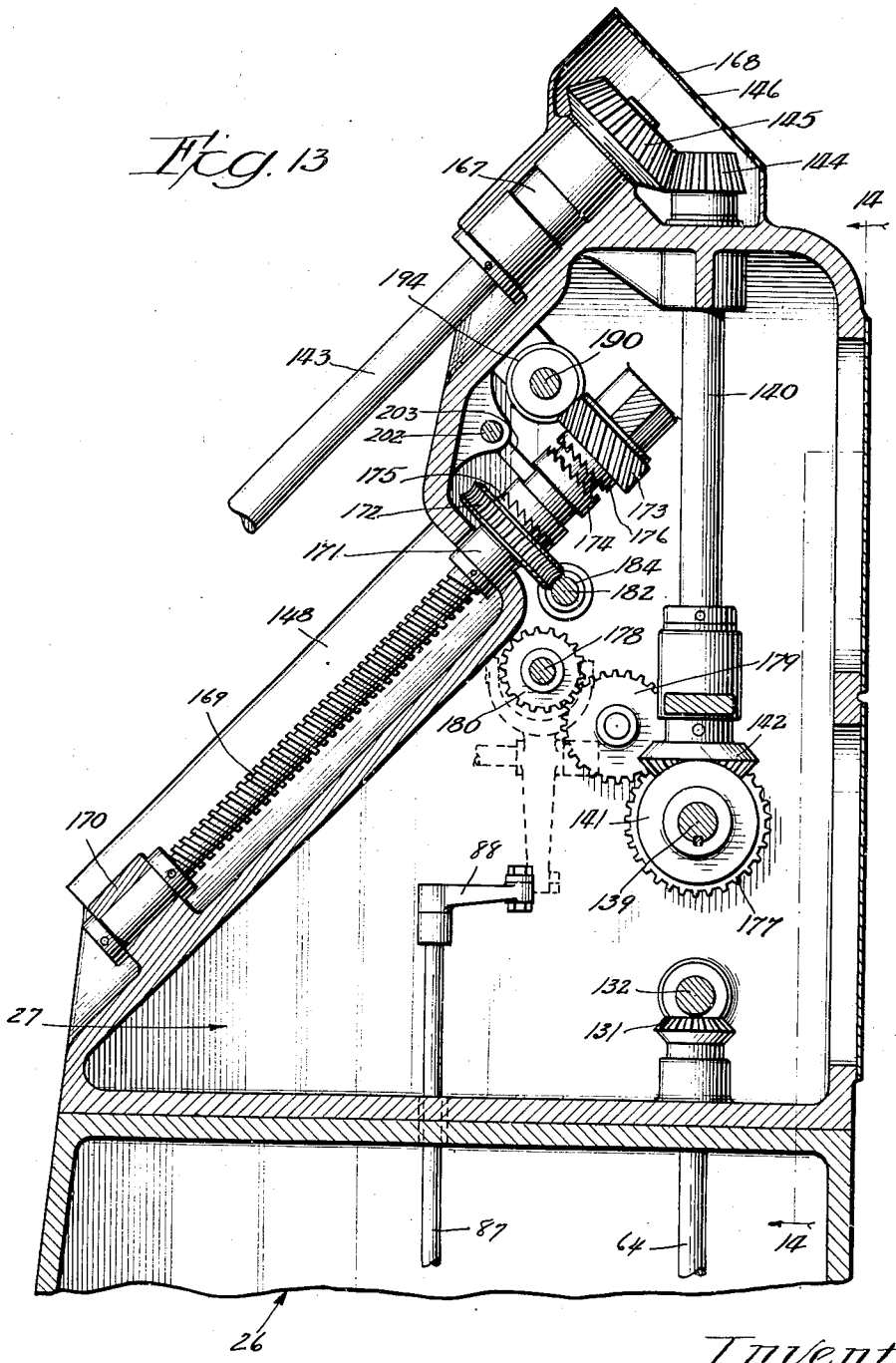
Jan. 13, 1925. 1,523,360

E. K. MORGAN

BORING MACHINE

Filed April 25, 1921 13 Sheets-Sheet 8

Fig. 13



Inventor:
Everett K. Morgan
Attys

Jan. 13, 1925. 1,523,360

E. K. MORGAN

BORING MACHINE

Filed April 25, 1921 13 Sheets-Sheet 9

Fig. 14

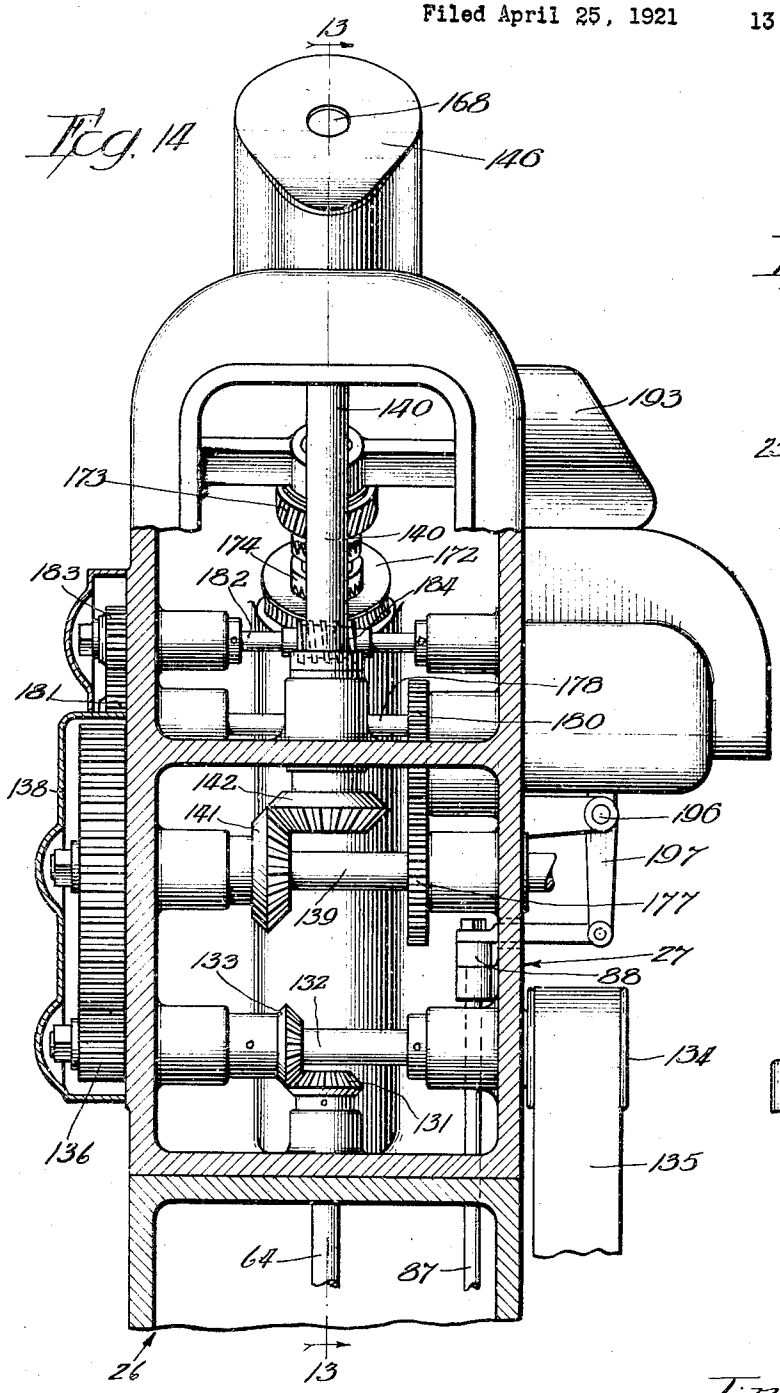
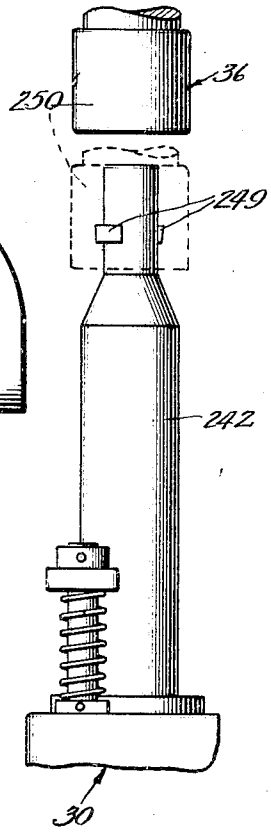


Fig. 15



Inventor:
Everett K. Morgan
Lawrence & Lawrence Attys

Jan. 13, 1925. 1,523,360

E. K. MORGAN

BORING MACHINE

Filed April 25, 1921 13 Sheets-Sheet 10

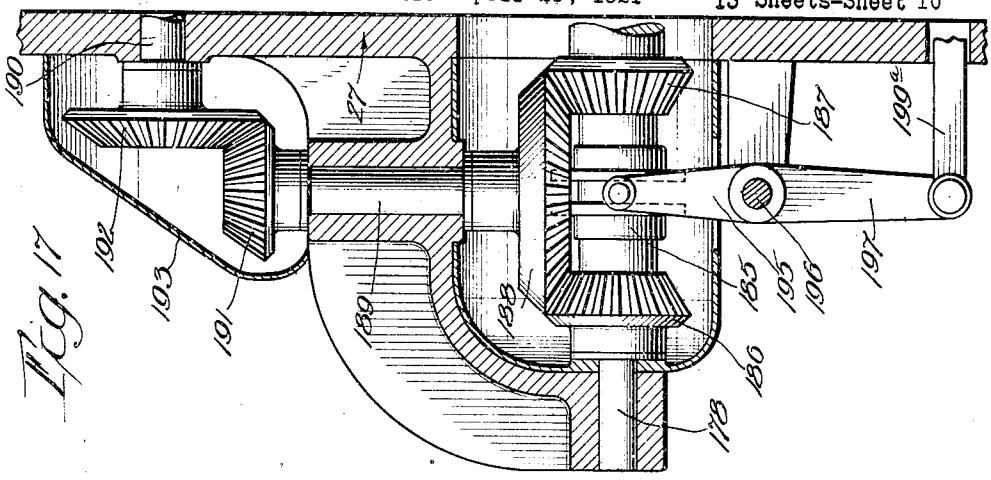


Fig. 17

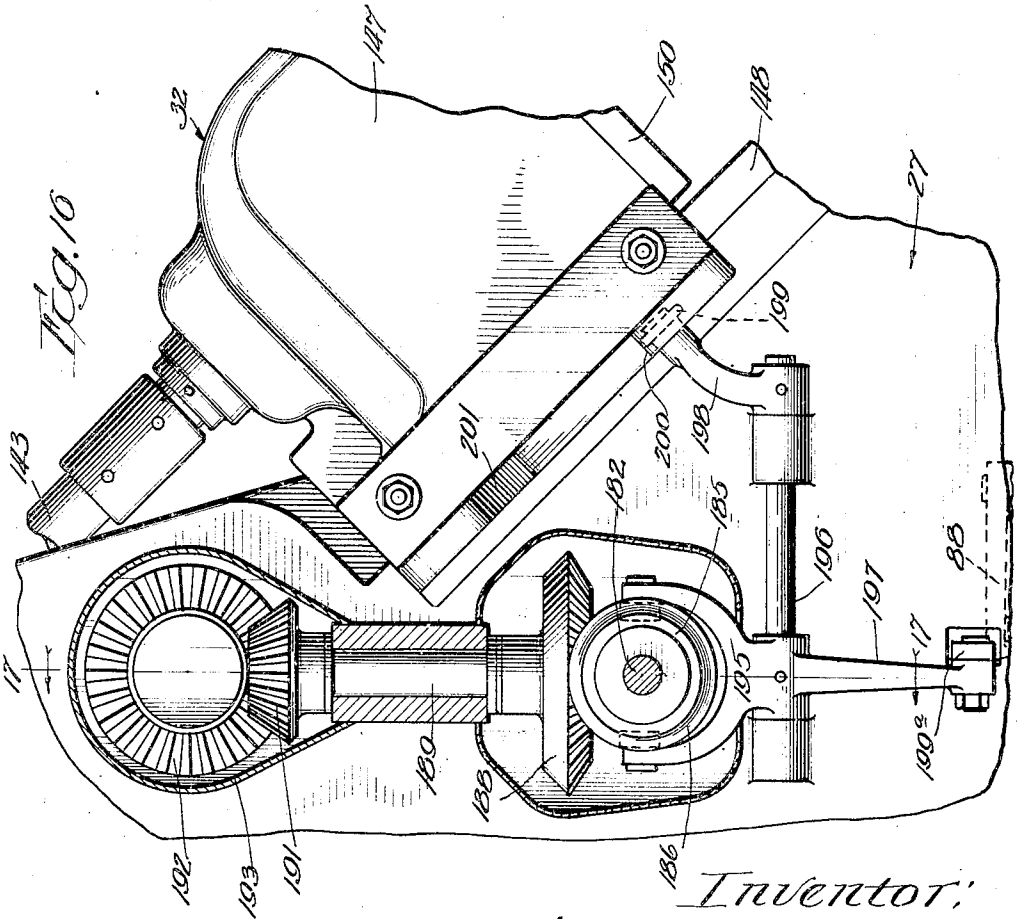


Fig. 16

Inventor:
Everett K. Morgan
Lawrence & Lawrence Attys

Jan. 13, 1925. 1,523,360

E. K. MORGAN

BORING MACHINE

Filed April 25, 1921 13 Sheets-Sheet 11

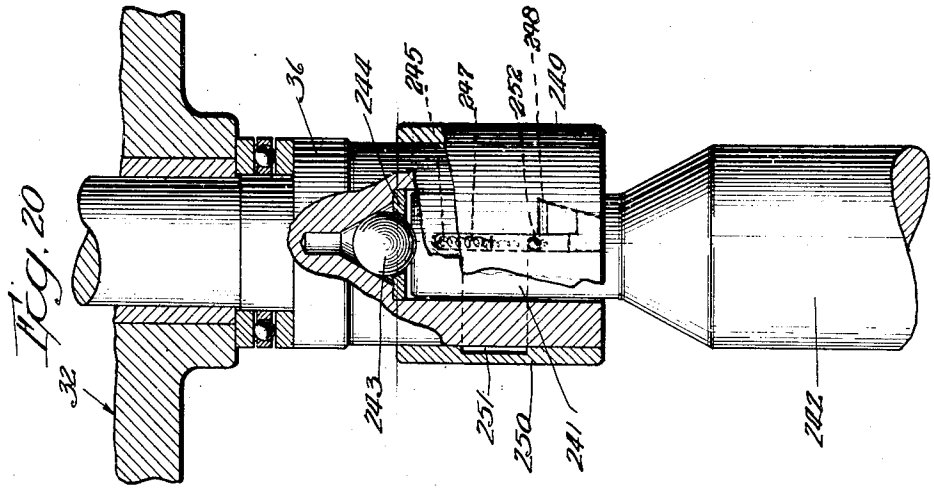


Fig. 20

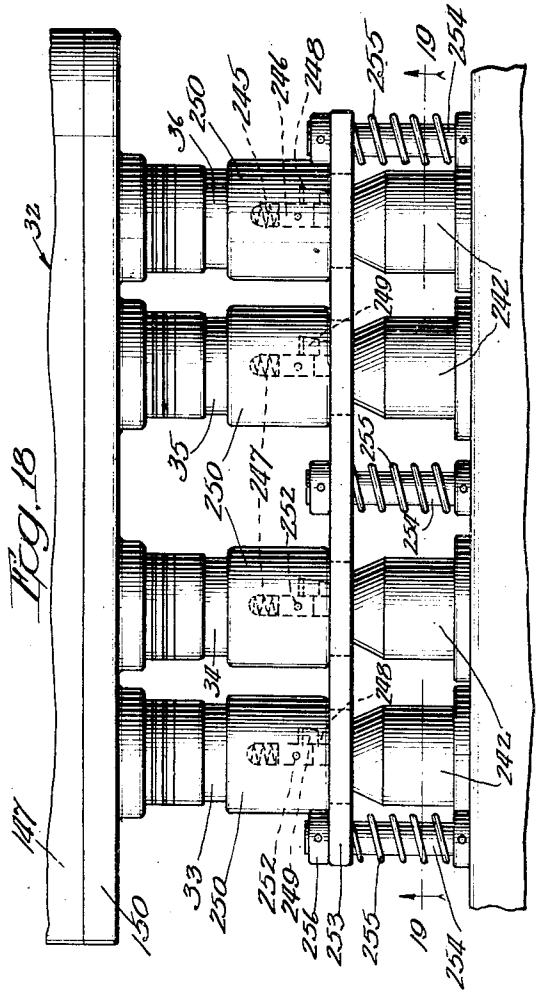


Fig. 18

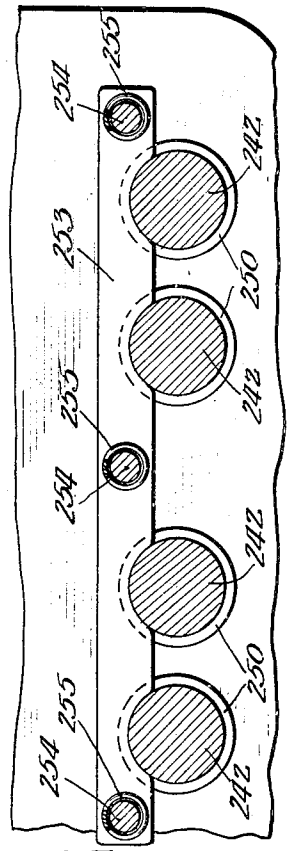


Fig. 19

Inventor:
Everett K. Morgan
Dawson & Dawson Attys

Jan. 13, 1925. 1,523,360

E. K. MORGAN

BORING MACHINE

Filed April 25, 1921 13 Sheets-Sheet 12

Fig. 21

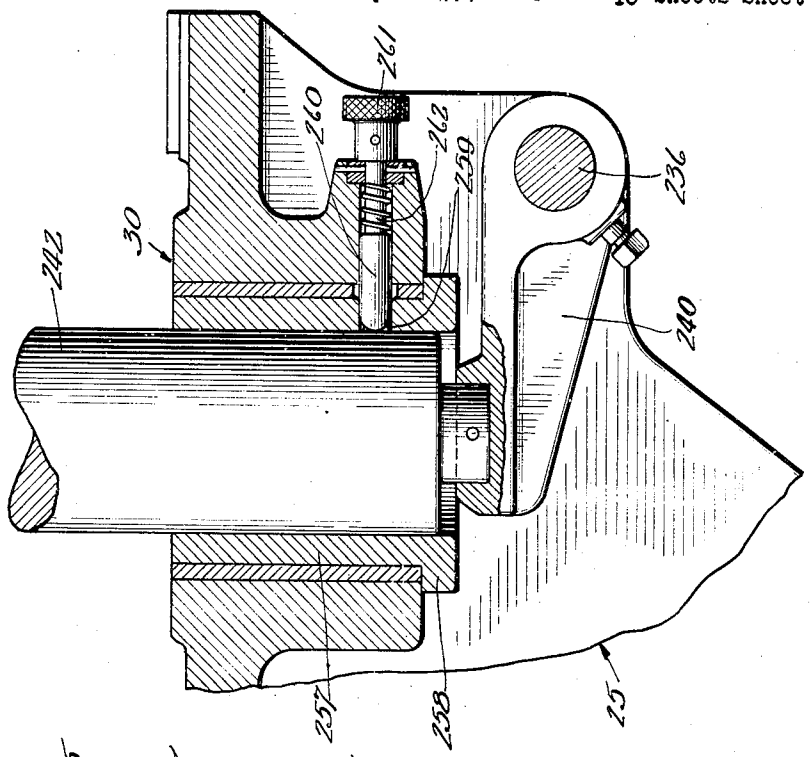
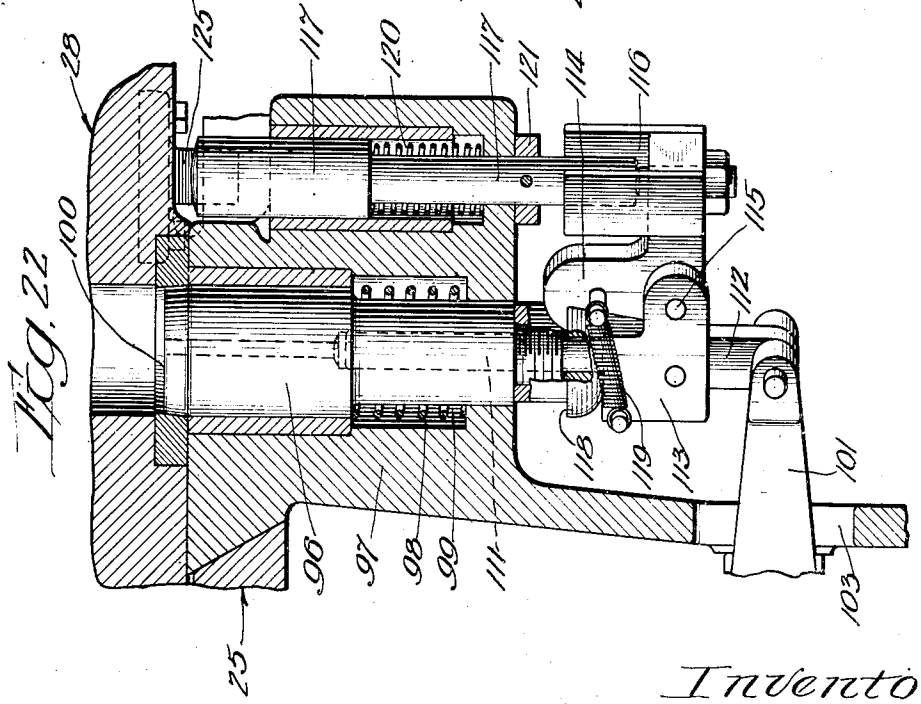


Fig. 22



Inventor:
Everett K. Morgan
Dennis & Dennis Attys

Jan. 13, 1925. 1,523,360

E. K. MORGAN

BORING MACHINE

Filed April 25, 1921 13 Sheets-Sheet 13

Fig. 23

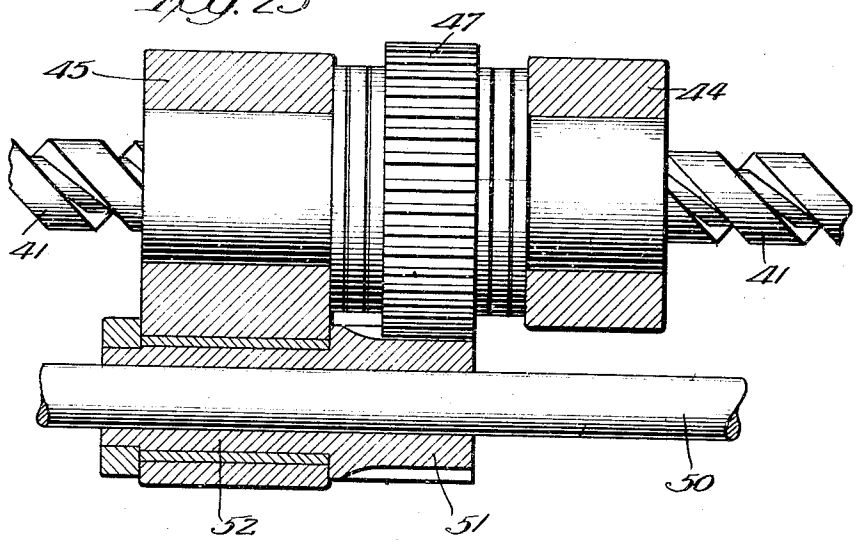
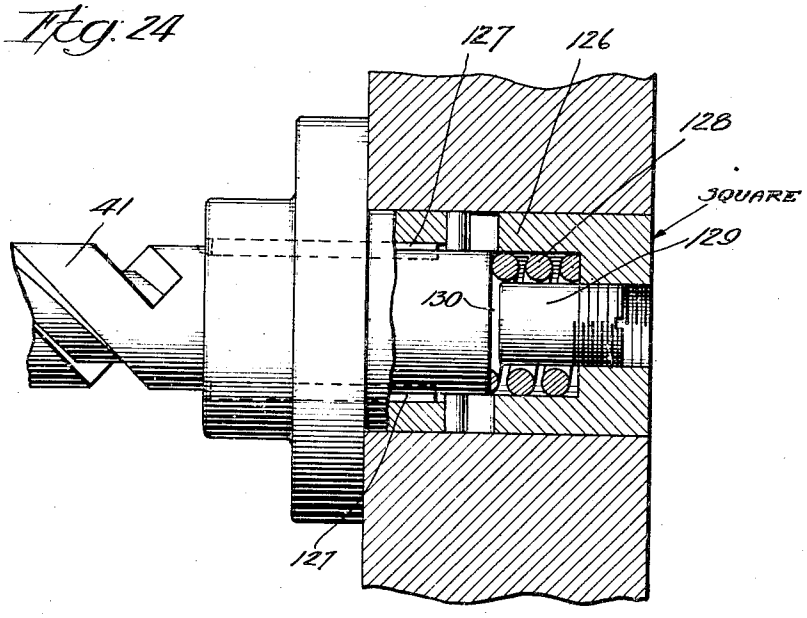


Fig. 24



Inventor:
Everett K Morgan
Dawson & Dawson Attys

Patented Jan. 13, 1925. 1,523,360

UNITED STATES PATENT OFFICE.

EVERETT K. MORGAN, OF ROCKFORD, ILLINOIS, ASSIGNOR TO THE INGERSOLL MILLING MACHINE COMPANY, OF ROCKFORD, ILLINOIS, A CORPORATION OF ILLINOIS.

BORING MACHINE.

Application filed April 25, 1921. Serial No. 464,288.

To all whom it may concern:

Be it known that I, EVERETT K. MORGAN, a citizen of the United States, residing at Rockford, in the county of Winnebago and State of Illinois, have invented certain new and useful Improvements in Boring Machines, of which the following is a specification.

This invention has to do with certain improvements in boring machines. The invention herein disclosed is very well adapted for use in boring cylinder blocks of internal combustion engines and the like; but I do not limit the use of the same to this work nor to any other particular class of work, except as I may do so in the claims. Nevertheless, inasmuch as the machine herein disclosed is particularly intended for this class of work, I will mention its use for this service.

The boring machine herein disclosed is especially intended for boring the cylinders of engines having removable heads, and in which the boring bar may be run clear through the cylinder block and may be supported by both ends. I have, therefore, illustrated a machine in which provision is made for supporting both ends of the boring bars, but certain of the features are not limited to this arrangement.

When a through boring bar is used having a bearing at its lower end, there is of course a natural tendency for the chips to fall down upon and foul the lower bearing. When this occurs it is apt to cause rapid wear of said bearing, and in some cases may jam the bar or throw it slightly out of line. One of the objects of the present invention is to provide a boring machine using through boring bars having lower bearings, but in which machine the boring bars, cylinder blocks, and other necessary parts are set at a substantial angle away from the vertical, so that the chips will naturally fall entirely clear of the lower bearing with all of the attendant advantages.

Another feature of the invention has to do with the provision of an arrangement such that all of the cylinders of the engine may be simultaneously bored so as to greatly expedite the operation with corresponding reduction in operating cost per cylinder.

Another object of the invention is to provide a machine of this type having a common drive head and associated mechanism in conjunction with a traversing bed carrying two or more stands for the cylinder blocks and associated parts, so that by shifting the traversing bed back and forth from one position to another or by shifting continuously in one direction, the various stands may be successively brought into position adjacent to the drive head to which the boring bars may then be connected and the boring operation proceeded with. This will make it possible to use the drive head economically, since one boring operation may be proceeded with while the cylinder block for the next operation is being set up on and secured to the free stand preparatory to the next boring operation.

Another object of the invetnion is to provide various automatic or semi-automatic feeds and drives for the different parts, so that the operation may be accelerated and the amount of skilled labor reduced to a minimum. In this connection, another object is to make provision for rapid feeds or traverses on the idle or semi-idle movements, and to provide for relatively slower feeds if necessary during the actual boring operations.

Another object in this connection is to make provision for hand feeds if desired, so that the operation of the machine may be entirely under the control of the operator.

Other objects and uses of the invention will appear from a detailed description of the same, which consists in the features of construction and combinations of parts hereinafter described and claimed.

In the drawings:

Figure 1 shows a front elevation of a machine embodying the features of the present invention with the traversing bed shifted to the left side, one of the cylinder stands being in operative position at the drive stand, and the other cylinder stand being in position to receive a cylinder block. In Figure 1 the upper portion of the drive

stand has been broken away in order to reduce the size of the figure;

Fig. 2 shows a view similar to that of Fig. 1, with the exception that the foundation and the traversing bed have both been broken away in order to shorten up the figure, and the cylinder stands have been moved away from the drive stand so as to expose the lower portion of the same;

Fig. 3 shows an end view corresponding to Fig. 1, the drive block being at substantially the lower end of its movement;

Fig. 4 shows a fragmentary detail view of the lower trip block on the drive block;

Fig. 5 shows a fragmentary side elevation, on enlarged scale, of a portion of the drive stand, the drive block being at the upper limit of its movement;

Fig. 6 shows a fragmentary view on enlarged scale of the end of the foundation and the end of the traversing bed corresponding to Fig. 3;

Fig. 7 shows a fragmentary horizontal section taken on the line 7—7 of Fig. 6, looking in the direction of the arrows, and shows certain of the mechanisms for controlling the traversing of the bed; Fig. 7 also may be considered as a fragmentary section taken on the line 7—7 of Fig. 8 looking in the direction of the arrows;

Fig. 8 shows a fragmentary front elevation of a portion of the foundation and traversing bed, and it shows the traversing bed control lever;

Fig. 9 shows a fragmentary elevation of the traversing bed screw and the associated bearing in vertical section. It may be considered as a section taken on the line 9—9 of Fig. 1, looking in the direction at right angle to the arrows but on enlarged scale;

Fig. 10 shows a fragmentary horizontal section through the reversing gears for the traversing bed control mechanism, and is a section taken on the line 10—10 of Fig. 6 looking in the direction of the arrows;

Fig. 11 shows a longitudinal section through the drive block, and is a section taken on the line 11—11 of Fig. 5 looking in the direction of the arrows. It may also be considered as a section taken on the line 11—11 of Fig. 3 looking in the direction of the arrows;

Fig. 12 shows a cross section through the drive block and may be considered as a section taken on the line 12—12 of Fig. 11, looking in the direction of the arrows;

Fig. 13 is a vertical cross section through the drive stand, being taken on the line 13—13 of Fig. 2, looking in the direction of the arrows, the drive block being removed. Fig. 13 may also be considered as a section taken on the line 13—13 of Fig. 14 looking in the direction of the arrows;

Fig. 14 shows a back view of the drive stand, the back plate being removed. It may also be considered as a section taken on the line 14—14 of Fig. 13 looking in the direction of the arrows;

Fig. 15 shows a vertical elevation of one of the boring bars and the chuck by which it is driven, the chuck being shown in operative position by means of dotted lines;

Fig. 16 shows a fragmentary view of the upper portion of the drive stand and drive head looking from the direction opposite to that of Fig. 5, the drive head being at the upper limit of movement, and the covers being removed from certain of the gears;

Fig. 17 shows a fragmentary section taken on the line 17—17 of Fig. 16, looking in the direction of the arrows;

Fig. 18 shows a fragmentary front face view of the chucks and the upper ends of the boring bars locked thereto;

Fig. 19 shows a section taken on the line 19—19 of Fig. 18, looking in the direction of the arrows;

Fig. 20 shows a fragmentary view partly in section of the chuck and the upper portion of a boring bar locked thereto, being on enlarged scale as compared to Figs. 18 and 19;

Fig. 21 shows a fragmentary detail view of the lower end of a boring bar and the bushing therefor, showing the manner in which the boring bar may be supported by the feet, and the manner in which the bushing is locked in place;

Fig. 22 shows a fragmentary detailed section on enlarged scale taken on the line 22—22 of Fig. 7, looking in the direction of the arrows, which illustrates the locking mechanism for the traversing bed. This mechanism is shown in dotted lines in elevation in Figs 6 and 8;

Fig. 23 shows a plan view of the traversing bed screw and splined shaft, corresponding to Fig. 9; and

Fig. 24 shows a detail section of one of the end bearings of the traversing bed screw.

Referring now to the drawings, I have illustrated the machine as including a foundation or bed 25. Secured to the rear central portion of this bed is a base member 26 on the upper end of which is located a drive stand designated in its entirety by the numeral 27. This drive stand carries the mechanisms by which the boring bars are driven and controlled.

Working on the foundation or bed 25 is a traversing bed 28 which travels back and forth on the foundation, the foundation being long enough to permit the necessary amount of movement. On this traversing bed 28 are located one or more cylinder stands 29 and 30. Each of these cylinder stands is of proper form and construction to carry and support the cylinder block which is being worked on. For this purpose the cylinder stands are provided with suitable

locking and clamping devices. In Fig. 3 I have shown by means of dotted lines the outline of a cylinder block 31 set in place within the stand 30 and ready to be worked on by the boring bars.

The drive stand 27 carries a drive block 32 which has a plurality of chucks which are properly spaced to correspond to the positions of the various cylinder bores which are to be bored. The number of these chucks and their arrangement within the drive block will, of course, depend in each instance upon the proportions of the cylinder block to be bored, but as a matter of convenience, in the various figures I have shown a drive block having four chucks 33, 34, 35 and 36 respectively.

This drive head 32 is mounted on the drive stand so that it can move up and down in a direction parallel to the cylinder bores and be properly driven in the different positions of its movement.

Examination of Fig. 3 in particular will show that the drive stand is so constructed that the drive block travels back and forth at an angle of substantially 45° with respect to the vertical; and also shows that the cylinder block 31 is supported at the same angle. Consequently, it will be possible to so support both ends of the boring bars, as will be presently explained, as to permit the chips to fall entirely clear of the lower bearings for the boring bars.

The traversing bed 28 travels on suitable track-ways 37 and 38 of the foundation 25, and said traversing bed may be provided with the tongue portions 39 and 40 in order to maintain it securely on the foundation.

The central portion of the foundation is hollowed out or cut away. Within this portion is mounted a screw 41 which has its ends secured in the foundation at the points 42 and 43. Downwardly depending from the traversing bed 28 are the brackets 44 and 45 within which is journaled a sleeve 46 which threads on the screw. This sleeve carries a pinion 47 which works between the brackets 44 and 45. Thrust roller bearings 48 and 49 are set between the pinion 47 and the brackets.

Journaled in the foundation at a point behind the screw 41 is a grooved shaft 50. Splined upon this shaft is a pinion 51 which meshes with the pinion 47. This pinion 51 has a sleeve 52 which engages the sidewise projecting portion of the bracket 44 and is thus compelled to traverse the shaft 50 simultaneously with the traversing of the bed 28. A driving connection is thus established between the grooved shaft 50 and the pinion 47 at all positions of the traversing bed.

In order to cause the traversing bed to traverse the foundation, it is necessary to rotate the grooved shaft 50 in one direction or the other. This is done by means which I will now explain. Referring particularly to Figs. 6, 7 and 10, there is provided a gear 53 on the right hand end of the shaft 50, which gear 53 meshes with an idler 54. The idler 54 meshes with a pinion 55 on the outer end of the stub shaft 56 which is journaled in a bracket 57 of the foundation. The inner end of said stub shaft carries a bevel pinion 58 which meshes constantly with the bevel pinions 59 and 60 of the shaft 61. This shaft 61 is also journaled in the bracket 57; and its rear portion extends into the base member 26. Its rear end carries a bevel pinion 62 which meshes with a bevel pinion 63 on the lower end of a shaft 64 which receives power in the manner presently to be explained.

The gears 59 and 60 serve to drive the grooved shaft 50 in one direction or the other through the train of gearng just explained. This drive is illustrated in detail in Fig. 10. As shown in said figure, a grooved collar 65 is slidably mounted on the shaft 61 between the bevel gears 59 and 60, this portion of the shaft 61 being provided with the bore 66. A key 67 is slidably mounted in said bore, the ends 68 and 69 of said key being tapered or slanted as shown in Fig. 10. Said key is connected to the collar 65 by means of a pin 70, which passes through the slots 71. Therefore as the collar 65 is moved back and forth the key is also moved.

The bevel gears 59 and 60 have inner face circular recesses 72 and 73; and the split clutch collars 74 and 75 work within these recesses. Said split clutch collars are drivingly connected to the shaft 61 and when one or the other of them is expanded it seizes the corresponding bevel gear and establishes a driving connection from the shaft 61 to said gear. This expanding is accomplished by means of the pins 76 and 77 which work between the clutch rings 74 and 75, and the ends 68 and 69 of the key 67. The sliding of this key in one direction or the other from the neutral position of Fig. 10 will bring about the clutching action.

This clutching action may be performed by means of a hand control in the manner which I will now explain. Mounted on the front portion of the foundation at a point convenient to the operator is a traversing bed control lever 78 having the hand grip 79. This lever is pivoted so that it may rock on a longitudinal axis 80 as shown in Figs. 6, 7 and 8, this axis 80 being provided by means of a sleeve 81 which is mounted on a horizontal transverse axis 82 as shown in said figures. It is thus evident that the lever 78 may be rocked either from side to side or from front to back.

Downwardly projecting from the lever is a control finger 83. The lower end of this control finger engages the front bifurcated

end of a rod 84 having the bifurcations 85 so that said rod will be shifted back and forth by the back and forth movements of the lever 78. The rear end of the rod 84 connects to a crank 86 on the lower end of a rock shaft 87 which extends up through the base member 26 and into the drive stand where its upper end carries a crank 88. This crank 88 serves to operate certain mechanisms which will presently be described in detail. Adjacent to the finger 83 of the lever 78 are the forward projecting fingers 89 and 90 of a bell crank 91 which is pivoted to a stationary part at the point 92. This bell crank connects by means of a link 93 to a rock arm 94 which is pivoted to a stationary part at the point 95. The inner end of said rock arm engages the groove of the sleeve 65 so as to shift the same back and forth. It is thus evident that by swinging the control lever 78 back and forth the clutch sleeve 65 will be moved into one position or the other. In this manner the bed will be caused to traverse the foundation in one direction or the other under the hand control.

When the bed reaches one or the other limits of its travel it should be locked in such position during the boring operation. I have therefore provided the locking device which I will now explain in detail. Said locking device is shown particularly in Figs. 7, and 22. It includes a locking pin 96 which is vertically slidable within a bracket 97 of the foundation. A spring 98 is locked in a socket 99 of the foundation and works against a shoulder of the pin 96, tending to raise said pin at all times. The traversing bed is provided with two sockets 100 which are properly positioned to be engaged by the locking pin 96 at the extreme limits of travel of the traversing bed.

When the control lever 78 is moved to one side or the other for the purpose of operating the clutch the locking pin 96 is to be simultaneously disengaged from the traversing bed and such disengagement should be maintained until the traversing bed reaches the limit of its travel. At the same time the arrangement should be such that the reengagement of the locking pin with the other socket will take place in an automatic manner and at the proper instant. Such means I will now explain in detail.

A lever 101 is pivoted to the foundation at the point 102, its inner end reaching within the foundation through a slot 103. Said lever has the bell crank arms 104 and 105 to which are connected the rods 106 and 107 respectively. These rods work through the slide bearings 108 and 109. The rod 107 has its inner end inturned as at 110; and this inturned end and the end of the rod 106 are properly positioned to be engaged by the finger 83 when the same is rocked in one direction or the other. It is thus evident that the lever 101 will also be depressed by rocking the lever 78 in either direction.

A pin 111 is connected to the inner end of the lever 101 by means of a link 112. This pin 111 slides in the lower end of the locking pin 96. A bracket 113 is connected to the pin 111, and a hook 114 is pivoted to the bracket 113 at the point 115. The hook also carries a box 116 within which seats the lower end of a control pin 117.

The lower end of the locking pin 96 has shoulder 118 which is adapted to be engaged by the hook 114; and a spring 119 tends to engage the hook with the shoulder. When so engaged, the downward movement of the lever 111 will draw the locking pin 96 downward.

The control pin 117 is normally raised by a spring 120 into the position indicated in Fig. 22: the upward movement being limited by the stop collar 121.

On the traversing table are the limit stops 122 and 123 respectively (see Fig. 1), which limit stops are in position to engage the control lever 78 and throw the same into the neutral position as the traversing table approaches the end of its movement. On the traversing table there are also provided two cams 124 and 125 respectively, which are properly positioned to momentarily engage the control pin 117 in the manner which will now be explained. These cams 124 and 125 are shown by dotted lines in Figs. 1 and 8 respectively.

Assuming that the traversing table is in the position shown in Fig. 1 and it is desired to shift it towards the right of said figure, the control lever 78 wll be thrown to the left away from the stop 123. Immediately the inner end of the lever 101 will be drawn down on account of the engagement of the hook 114 with the shoulder 118, the locking pin 96 will be drawn down away from the socket 100, thus disengaging the traversing table. At the same time the clutch illustrated in Figs. 7 and 10 in particular will be actuated in the proper direction to cause the table to commence to travel towards the right. Shortly after this travel begins the cam 125 will strike the control pin 117 and depress the same momentarily and to a sufficient extent to strike the box 116 and thus trip the hook 114 from the shoulder 118. The locking pin 96 will immediately disengage from the link 112 and lever 101 so that the locking pin will come into contact with the bottom face of the traversing table and the spring pressure of the spring 98 wil be removed from the lever 101. The operator may then let go of the control lever 78 allowing the same to stand in the left hand position without having to hold it there. As the table continues its travel with the locking pin riding against its bot-

tom face the stop block 122 will finally come into contact with the control lever 78 and begin to move the same into the neutral position, thereby raising the lever 101 and hook 114. The hook will thus be raised to such an extent that it will ride over and above the shoulder 118 before the other socket 100 of the traversing table comes into position to engage the looking pin 96. When the table does finally attain its extreme limit of movement allowing the locking pin to snap into the socket 100 the hook 114 will be above the shoulder 118, so that the parts will return into the position shown in Fig. 22, In the meantime, the restoration of the control lever 78 to the neutral position has automatically disengaged the clutch so that the power is cut off from the traversing table.

In Fig. 24 I have shown in detail one of the end mountings for the traversing bed screw. It includes a socket 126 into which the end portion of the screw seats, the screw being splined to said socket by means of the spline 127 so that it can slide back and forth a slight distance but is prevented from rotating. A heavy spring 128 is located in the socket and bears against the end of the screw. A stop pin 129 is screwed into the socket so that its position can be adjusted in order to normally allow a slight clearance 130 at the end of the traversing bed screw. A similar clearance is established at each end of the screw. As soon as the traversing bed clutch is brought into operation it moves the traversing bed in either direction and heavy pressure is exerted on the traversing bed screw, which screw is allowed to yield a slight amount under the pressure of the spring 128 until the inertia of the traversing bed and cylinder blocks carried thereby has been overcome.

Considering now the drive stand and the drive block, I will explain the construction and operation of the same more in detail. The upper end of the shaft 64, shown in Figs. 3, 13 and 14 in particular, carries a bevel pinion 131 (Fig. 13). A drive shaft 132 extends across the drive stand 27 and carries a bevel pinion 133 which meshes with the bevel pinion 131. This drive shaft 132 may be driven in any suitable manner as by means of a pulley 134 and belt 135.

The drive shaft 132 carries at its right hand end (when looking at Fig. 1), a pinion 136 (left hand side of Fig. 14). This pinion 136 meshes with a gear 137, both pinion and gear being protected by a housing 138. The gear 137 drives a jack shaft 139 which extends across the drive stand. This jack shaft drives a vertical shaft 140 through the medium of bevel gears 141 and 142. (See Figs. 13 and 14.) The upper end of the vertical shaft 140 drives a drive block drive shaft 143 through the medium of bevel gears 144 and 145 which are enclosed by a suitable housing 146.

The drive block 132 is illustrated in detail in Figs. 11 and 12. It includes a housing 147 which traverses on dove-tail trackways 148 and 149 of the drive stand. The lower end of this drive block housing is closed by a plate 150. The drive block drive shaft 143 enters the housing 147 wherein it is supported by a spider 151 and it has a pinion 152 on its lower end. This pinion 152 meshes with a pair of gears 153 and 154 which are connected to the pinion 155 and 156. These pinions in turn drive the spindle gears 157 and 158. Said spindle gears in turn drive the other spindle gears 159 and 160 through the medium of the idlers 161 and 162.

The spindle gears drive the spindle shafts 163. 164, 165 and 166 which extend through the bottom plate 150 and carry the chuck heads 33, 34, 35 and 36 which have been previously referred to.

With this arrangement all of the chuck heads are driven simultaneously at the same speed and in the same direction.

As the drive block moves up and down with respect to the drive stand, the shaft 143 moves with it, said shaft being splined to the bevel gear 145 by means of the hub 167 of Fig. 13. The upper end of the shaft 143 may at such times work through a hole 168 in the housing 146.

The up and down movements of the drive block are controlled by means of a drive block screw 169 which is best shown in Fig. 13. This drive block screw is journaled in the drive stand at the points 170 and 171.

On the upper end of the drive block screw there are freely mounted a low speed worm gear 172 and a high speed spiral gear 173. A clutch block 174 is splined onto the upper end of the drive head feed shaft at the point between the worm gear and the spiral gear. Suitable clutch faces 175 and 176 are provided on the worm gear and on the spiral gear; and these clutch faces engage similar clutch faces on the block 174.

On the jack shaft 139 is mounted a gear 177 (Figs. 13 and 14) which drives a cross shaft 178 through the medium of an idler 179 and pinion 180. The righthand end of the cross shaft 178 (left side of Fig. 14) carries a gear 181 which drives back onto a return shaft 182 through the medium of another gear 183. This return shaft 182 carries a worm gear 184 which meshes with the worm gear 172 and drives the same.

The left hand end of the cross shaft 178 (see Figs. 16 and 17) carries a splined clutch block 185 which works between the bevel gears 186 and 187. These bevel gears both mesh with a bevel gear 188 on the lower end of a stud shaft 189. The construction

of the clutch block 185 and bevel gears 186 and 187 is similar to the construction shown in detail in Fig. 10 of this case. The upper end of the stud shaft 189 drives a spiral pinion shaft 190 through the medium of bevel gears 191 and 192 enclosed within a suitable housing 193. The spiral pinion shaft 190 carries a spiral pinion 194 which meshes with the spiral gear 173, to drive the same in either direction depending upon the position of the clutch block 185.

Said clutch block is controlled by means of a rock lever 195 pivoted on a rock shaft 196. Said rock shaft may be rocked either by a lever 197 or a crank 198. The lever 197 connects by means of a link 199[a] with the crank 88 on the upper end of the rock shaft 87 which in turn is controlled manually by means of the control lever 78.

By this arrangement the movement of the drive head up or down along the drive stand is controlled by the back and forth movements of the control lever 78 manually.

The crank 198, previously mentioned, carries a roller 199 which is adapted for engagement by cam surfaces 200 and 201 on the drive head. The engagement of the surface 201 in Fig. 16 with the roller 199 will force the crank 198 towards the observer and thus tends to throw the clutch block towards the left in Fig. 17 and thus bring about the rapid up traverse of the drive head; and this rapid up traverse will continue until the cam surface 200 reaches the roller 199 and draws it away from the observer in Fig. 16, towards the right in Fig. 17 and into the neutral position. When this takes place, the up traverse of the drive head will cease. Thereafter the operator by proper movement of the control lever 78 may continue the movement of the clutch block 185 to a sufficient extent to throw the same into the down traverse position and thus commence the down feed of the drive head.

The down feed of the drive head when thus commenced will be a rapid feed; and it is desirable that when the boring bars are about ready to begin the work a slow feed or traverse should commence. I will now explain the mechanism whereby this result is brought about; extending across the drive stand is a rock shaft 202, best shown in Figs. 3, 5 and 13. This rock shaft carries a finger 203 which engages the groove of the clutch block 174 previously mentioned.

On its right hand end the rock shaft 202 carries a crank 204 which connects with a rock arm 205 by means of a link 206. Said rock arm is pivoted to a stationary part at the point 207. The lower end of the rock arm connects with a pin 208 which slides through the journals 209 and 210 on the drive stand. On the pin 208 is slidably mounted a grooved collar 211. This grooved collar is spring pressed into a neutral position on the pin 208 by means of springs 212 and 213, and the neutral position may be established by means of thumb screws 214 and 215 on the pin 208.

A slide block 216 is slidably mounted on the drive stand, working through the slide bearings 217 and 218. A bell crank 219 pivoted to the drive stand at the point 220 has its end 221 connected to the slide block and its end 222 in engagement with the grooved sleeve 211. The movement of the slide block 216 in one direction or the other will throw a spring pressure on the rod 208 in the corresponding direction.

On the lower end of the rod 208 is a block 223. A bell crank 224 is pivoted to the drive stand at the point 225, and another bell crank 226 is pivoted to the drive stand at the point 227. These bell cranks have the contrary hook faces 228 and 229 respectively, which are adapted to engage the opposite faces of the block 223. A spring 230 tends to draw the hook portions of the bell cranks towards each other, so that one or the other of them will be effective.

The slide block 216 carries the contact pins 231 and 232 which are adapted to engage the bell cranks 224 and 226 respectively and thus trip them. These contact screws may be adjusted so as to secure the correct operation.

It will be evident that upon forcing the slide block 216 downwardly or towards the right in Fig. 5, the spring 213 will be compressed tending to force up the pin 208, and by the time the contact screw 232 reaches the bell crank 226, to trip the same, a substantial pressure will be exerted on the pin 208. This pin will therefore snap up suddenly and rock the lever 205, thus drawing the crank 204 downwards, rocking the shaft 202 and throwing the clutch block 174 into the position shown in Fig. 13 which causes a slow downward traverse of the drive head. On the contrary, if the slide block 216 be forced upwards or towards the left in Fig. 5, the spring 212 will be placed under compression tending to draw the pin 208 downwards, and by the time the contact screw 231 reaches the bell crank 234 a heavy pressure will be exerted on the spring 212 so that when the bell crank is tripped the pin 208 will snap down, rocking the lever 205, and throwing the crank 204 upwards in Fig. 5. This will throw the clutch block 174 up in Fig. 13 so as to throw in a rapid traverse action. Owing to the fact that the cam surface 201 is in engagement with the roller 199 at the lower limit of movement of the drive head, the spiral gear shaft 190 will be rotating in the proper direction for a rapid traverse upwards, so that the drive head will be rapidly raised.

The slide block 216 carries the roller 233 which is adapted to be engaged by the cams

234 and 235 of the drive head. As the drive head traverses downward the cam block 234 will first engage the roller 233 and force the slide block downward; and as the drive head approaches the lower limit of its movement the cam block 235 will engage the roller 233 and raise the slide block so as to reverse the operation and bring about a rapid traverse upwards.

Cam 234 is pivoted by means of stud "A" on adjustable block "B," held in position on drive stand 32 by means of key bolt "C" in T slot "D." When the drive stand 32 traverses upward, the cam 234 swings out of the way as shown in Fig. 4 so that the roller 233 is not depressed at this time.

It is now apparent that when the operator throws the control lever 78 into the proper position for a down traverse, such down traverse will commence with a rapid movement, that at the proper time the down traverse will be converted from a rapid to a slow movement, this taking place by the engagement of the cam block 234 with the collar 233; and at approximately when the boring bars reach the work; and that when the boring operation has been completed the slow down traverse will be converted into a rapid up traverse by reason of the engagement of the cam block 235 with the roller 233.

I have provided an arrangement such that the boring bars may be set up through the cylinders of the cylinder block and mounted in proper position before the traversing bed is shifted over to bring such cylinder block into position adjacent to the drive stand; such that when this position has been reached the boring bars will line up with their respective chucks, such that when the drive head has been moved down to bring the chucks into engagement with the boring bars they will automatically engage the boring bars in clutching fashion; such that as the downward traverse of the drive head continues the boring bars may be passed through the cylinder block and projected from the lower side of the cylinder stand, and such that when the boring operation is completed the boring bars will be automatically disengaged from their respective chucks, so that they can be drawn out at the lower side of the cylinder stand by the operator. I will now describe these mechanisms in detail.

Referring to Fig. 1 in particular, there will be observed a cross shaft 236 extending across each of the cylinder stands and journaled therein. Each of these shafts carries in its left hand end a lever 237 having a handle 238 by means of which it may be rocked so as to rock the shaft. Said lever and handle may be locked in either the raised or lowered position in any convenient manner as by means of a pin carried in the handle and working in sockets such as 239 shown in Fig. 3.

The shaft 236 of each cylinder stand carries a series of fingers 240 which, when the shaft is properly rocked, stand across the positions of the lower ends of the boring bars as clearly illustrated in Fig. 21. These fingers thus serve when in such position to support the boring bars until they are engaged by their respective clutches as the drive head moves downwards.

After the boring bars have been engaged by the chucks, the operator will throw the lever 237 downwards into the position at the right hand side of Fig. 1, so as to carry the fingers 240 away from the line of travel of the boring bars and allow them to move through the cylinder stand.

Each of the chucks is of the form shown in detail in Fig. 20. It has a socket 241 adapted to receive the upper end of the boring bar 242. A ball 243 is seated in the upper end of each of the sockets 241, being retained in such position by means of the collar 244. This ball permits a free turning of the chuck with respect to the boring bar during the latching operation and to provide a positive feed to the boring bar after latching. Each chuck has a longitudinally extending slot 245 within which works a locking block 246 normally forced downwards under pressure of a spring 247. A lateral projection 248 is provided for each of these slots 245; and each boring bar has a dove-tail shaped lug 249 adapted to set into the lateral projection 248. The side wall of each lateral projection is also dove-tailed. When the end of the boring bar is forced into the socket 241 the lug 249 will raise the block 246 against the pressure of the spring 245, and by a slight turning movement the lug 249 will be carried up and over into the sidewise projection 248 so as to permit the block 246 to snap down and lock the boring bar in place.

Each chuck is provided with a slidable sleeve 250 having an interior groove 251 which engages a pin 252 projecting from the laterally extending block 246. By raising the sleeve 250 the block 246 will be raised so as to disengage the boring bar.

Each cylinder stand is provided in its upper portion with a bar 253 working on a series of pins 254 and normally raised by springs 255 to an upper limit as determined by means of stops 256 as shown in Fig. 18. This bar 253 is located in such a position that as the drive head approaches the lower limit of its traverse the sleeves 250 will come against the bar 253 and eventually a sufficient pressure will be exerted on the said sleeves to make them move upwardly with respect to their chucks. This will cause the blocks 246 to disengage the various boring bars which may then be

withdrawn downwardly through the cylinder stand, by reason of the tapered form of the blocks 249 as shown in Fig. 20.

In order to support the lower ends of the boring bars during the boring operation, I have provided lower bearings for them, one of which is shown in detail in Fig. 21. Each of these lower bearings includes a bushing 257 for the lower portion of the boring bar. In order that the cutting tools carried by the boring bars may be passed through the lower bearings when the boring bars are removed it becomes desirable to provide an arrangement permitting the removal of the bushings 257. I have, therefore, illustrated each of said bushings as having a flange 258 on its lower end, and as being provided with a socket 259. A spring pressed pin 260 having a milled head 261, and pressed inwards by the spring 262 is provided for engagement with the socket 259 to hold the bushing in place.

With this arrangement the bushings may be removed in a simple manner in order to permit the boring bars to be passed down through the lower bearings.

As previously stated, suitable means may be provided for supporting and positioning the cylinder block within the cylinder stand. Such means includes, in the construction illustrated, a rear stand 263 which carries the upper boring bar bearings and within which are a series of pins 264 which may be set into different positions and there locked by means of the set screw 265. This means also includes a series of lugs 266 located at convenient points on the cylinder stand and having set screws 267 for clamping the convenient parts of the cylinder block.

While I have herein shown and described only a single embodiment of the features of my present invention, still I do not limit myself to said embodiment except as I may do so in the claims.

I claim:

1. In a cylinder boring machine for cylinders having through bores, the combination of a cylinder stand, suitable supports thereon for supporting a cylinder block at an angle of substantially 45° to the vertical, a drive stand behind the cylinder stand, a drive head, a trackway for the drive head on the drive stand extending in a direction substantially parallel to the direction of the cylinder bores, chucks drivingly mounted in the drive head in line with the bores of the cylinder block, upper and lower boring bar bearings in the cylinder stand for boring bars passing through the cylinder bores, means for detachably connecting the upper end of each boring bar to the corresponding chuck of the drive head, a downwardly removable bushing for each lower boring bar bearing, each lower boring bar bearing being clear of the lower end of the cylinder block, means for feeding the drive head up and down on the drive stand, and means for driving the chucks of the drive head in all positions of such feed, substantially as described.

2. In a cylinder boring machine for cylinders having through bores, the combination of a cylinder stand, suitable supports thereon for supporting the cylinder block with its bores at a substantial angle to the vertical, a drive stand behind the cylinder stand, a drive head, a trackway for the drive head on the drive stand extending in a direction substantially parallel to the direction of the cylinder bores, chucks drivingly mounted in the drive head in line with the bores of the cylinder block, upper and lower boring bar bearings in the cylinder stand for boring bars passing through the cylinder bores, means for detachably connecting the upper end of each boring bar to the corresponding chuck of the drive head, each lower boring bar bearing being clear of the lower end of the cylinder block, means for feeding the drive head up and down on the drive stand, and means for driving the chucks of the drive head in all positions of such feed, substantially as described.

3. In a cylinder boring machine for cylinders having through bores, the combination of a cylinder stand, suitable supports thereon for supporting a cylinder block with its bores at a substantial angle to the vertical, a drive stand behind the cylinder stand, a drive head, a trackway for the drive head on the drive stand extending in a direction substantially parallel to the direction of the cylinder bores, upper and lower boring bar bearings in the cylinder stand for boring bars passing through the cylinder bores, means for drivingly connecting the upper end of each boring bar to the drive head, each lower boring bar bearing being clear of the lower end of the cylinder block, means for feeding the drive head up and down in a drive stand, and means for driving the boring bars by means of the drive head in each position of the drive head, substantially as described.

4. In a cylinder boring machine for cylinders having through bores, the combination of a cylinder stand, suitable supports thereon for supporting a cylinder block with its bores at a substantial angle to the vertical, upper and lower boring bar bearings in the cylinder stand for boring bars passing through the cylinder bores the lower bearing being of such size as to allow the boring bar and cutting tool thereon to pass through it, a downwardly removable bushing for each lower boring bar bearing, each lower boring bar bearing being clear of the lower end of the cylinder block, means for

feeding the boring bars through the cylinder bores, and means for driving the boring bars during such feed whereby, when the bushing of a lower boring bar bearing has been removed downwardly the boring bar and tool can be passed downwardly through the bearing, substantially as described.

5. In a cylinder boring machine for cylinders having through bores, the combination of means for supporting a cylinder block with its bores at a substantial angle to the vertical, upper and lower boring bar bearings in such supporting means adjacent to the upper and lower ends of the cylinder bores, the lower bearing being of such size as to allow the boring bar and cutting tool thereon to pass through it, a downwardly removable bushing for each lower boring bar bearing, means for feeding the boring bars downwardly through said bearings, and means for driving the boring bars during such feed whereby, when the bushing of a lower boring bar bearing has been removed downwardly the boring bar and cutting tool can be passed downwardly through the bearing, substantially as described.

6. In a cylinder boring machine for cylinders having through bores, the combination of means for supporting a cylinder block with its bores at a substantial angle with respect to the vertical and substantially above the horizontal, lower boring bar bearings adjacent to the lower ends of the cylinder bores and clear of the cylinder block, boring bars extending through the cylinder bores and through said bearings, means for supporting the upper ends of the boring bars, and means for driving and feeding the boring bars downwardly and for releasing them through the lower boring bar bearings, substantially as described.

7. In a cylinder boring machine for cylinders having through bores, the combination of a traversing table, a pair of cylinder stands thereon, a drive stand behind the traversing table, a drive head, trackways on the drive stand for the drive head extending at a substantial angle with respect to the vertical, a plurality of chucks in the drive head, means for feeding the drive head towards the traversing table, means for driving the chucks in the drive head during such feed, means for supporting a cylinder block in each cylinder stand with its bores in line with the chucks of the drive head, suitable boring bar bearings in each cylinder stand for boring bars extending through the bores of the cylinder block on such stand the boring bar bearings permitting removal of the boring bars and cutting tools downwardly, means for detachably connecting the boring bars to the chucks of the drive head, means for traversing the table, and means under the control of the operator for locking the table with either cylinder stand in position adjacent to the drive stand, substantially as described.

8. In a cylinder boring machine for cylinders having through bores, the combination of a traversing table, a pair of cylinder stands thereon, a drive stand behind the traversing table, a drive head, trackways on the drive stand for the drive head extending at a substantial angle with respect to the vertical, means for supporting a cylinder block in each cylinder stand with its bores extending in a direction parallel to the direction of feed of the drive head, upper and lower boring bar bearings in each cylinder stand for boring bars extending through the bores of a cylinder block thereon, boring bars in said bearings, means for detachably connecting the upper ends of the boring bars to the drive head, means for feeding the drive head towards the traversing table, means for driving the boring bars during such feed, means for traversing the table, and means for locking the table with either cylinder stand in position adjacent to the drive stand, substantially as described.

9. In a cylinder boring machine for cylinders having through bores, the combination of a traversing table, a pair of cylinder stands thereon, a drive stand behind the traversing table, a drive head, trackways on the drive stand for the drive head extending at a substantial angle with respect to the vertical, means for supporting a cylinder block in each cylinder stand with its bores extending in a direction parallel to the direction of feed of the drive head, lower boring bar bearings in each cylinder stand for boring bars extending through the bores of the cylinder block thereon, boring bars in said bearings, means for detachably connecting the upper ends of the boring bars to the drive head, means for feeding the drive head towards the traversing table, means for driving the boring bars during such feed, and means for locking the table with either cylinder stand in position adjacent to the drive stand, substantially as described.

10. In a cylinder boring machine for cylinders having through bores, the combination of a traversing table, a pair of cylinder stands thereon, a drive stand behind the traversing table, a drive head, trackways on the drive stand for the drive head extending at a substantial angle with respect to the vertical, a plurality of chucks in the drive head, means for driving said chucks from the drive stand as the drive head traverses on said trackways, means under the control of the operator for effecting a rapid downward traverse of the drive head at the be-

ginning of its downward movement, means for thereafter automatically effecting a slow downward traverse of the drive head during the balance of its travel, means for thereafter automatically effecting a rapid up traverse of the drive head to its upper limit, means for disconnecting the traversing mechanism of the drive head at the upper limit of its movement, and means for traversing the traversing table in either direction, substantially as described.

11. In a cylinder boring machine for cylinders having through bores, a pair of cylinder stands thereon, a drive stand behind the traversing table, a drive head, suitable trackways on the drive stand for the drive head extending towards the traversing table, a plurality of chucks in the drive head, means for driving said chucks from the drive stand as the drive head traverses on said trackways, means under the control of the operator for effecting a rapid downward traverse of the drive head at the beginning of its downward movement, means for thereafter automatically effecting a slow downward traverse of the drive head during the balance of its travel, means for thereafter automatically effecting a rapid up traverse of the drive head to its upper limit, means for disconnecting the traversing mechanism of the drive head at the upper limit of its movement, and means for traversing the traversing table in either direction, substantially as described.

12. In a cylinder boring machine, the combination of a traversing table, a pair of cylinder stands thereon, a drive stand behind the traversing table, a drive head, suitable trackways on the drive stand for the drive head extending towards the traversing table, a plurality of chucks in the drive head, means for driving said chucks from the drive stand as the drive head traverses on said trackways, means under the control of the operator for commencing a traversing movement of the traversing table in either direction, means for automatically stopping said traversing movement at the end of the traverse and for locking the traversing table, means under the control of the operator for effecting a rapid downward traverse of the drive head at the beginning of its downward movement, means for thereafter automatically effecting a slow downward traverse of the drive head during the balance of its travel, means for thereafter automatically effecting a rapid up traverse of the drive head to its upper limit, and means for disconnecting the traversing mechanism of the drive head at the upper limit of its movement, substantially as described.

EVERETT K. MORGAN.