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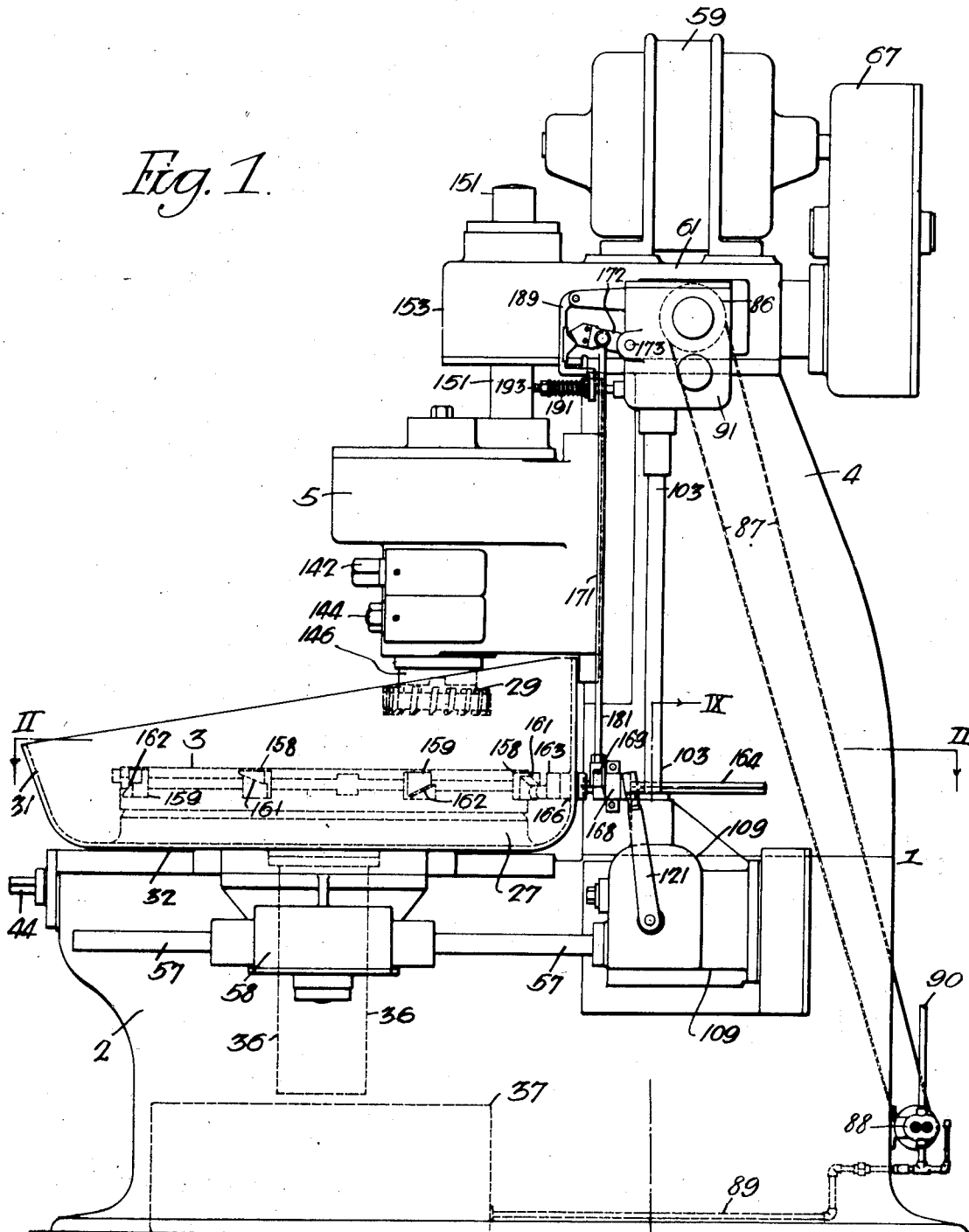
E. J. ROLLINGS

CONTINUOUS MILLING MACHINE

Filed Oct. 29, 1923

12 Sheets-Sheet 1

Fig. 1.



→ IX Inventor.—
Ernest J. Rollings
by his Attorneys.—
Hewes & Hewes.

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E. J. ROLLINGS

1,687,350

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12 Sheets-Sheet 2

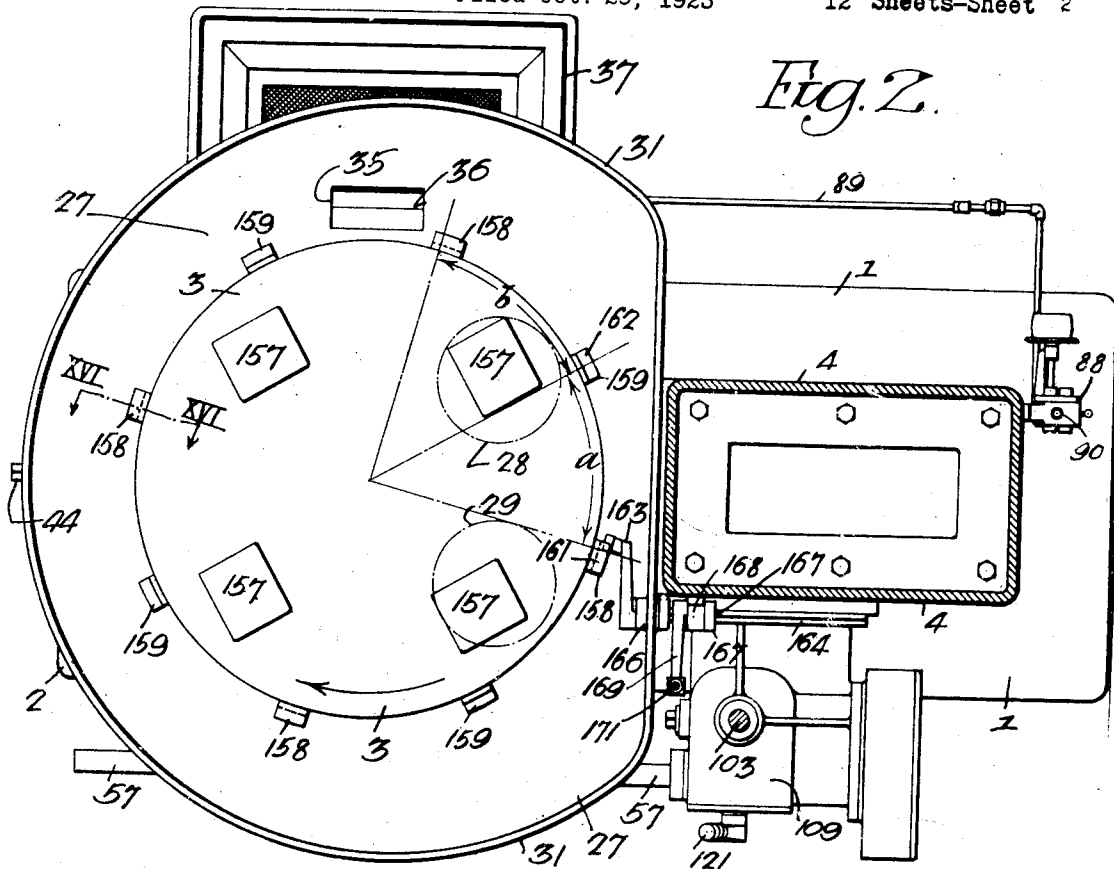


Fig. 16.

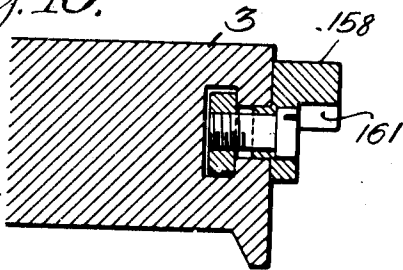
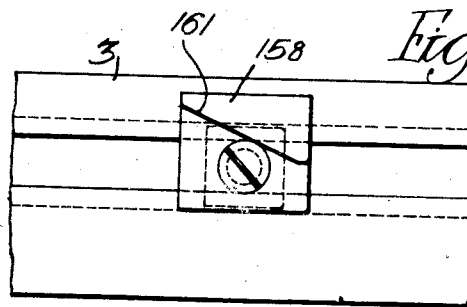


Fig. 17.



Inventor.—
Ernest J. Rollings.
by his Attorneys.—
Howard & Howard

Oct. 9, 1928.

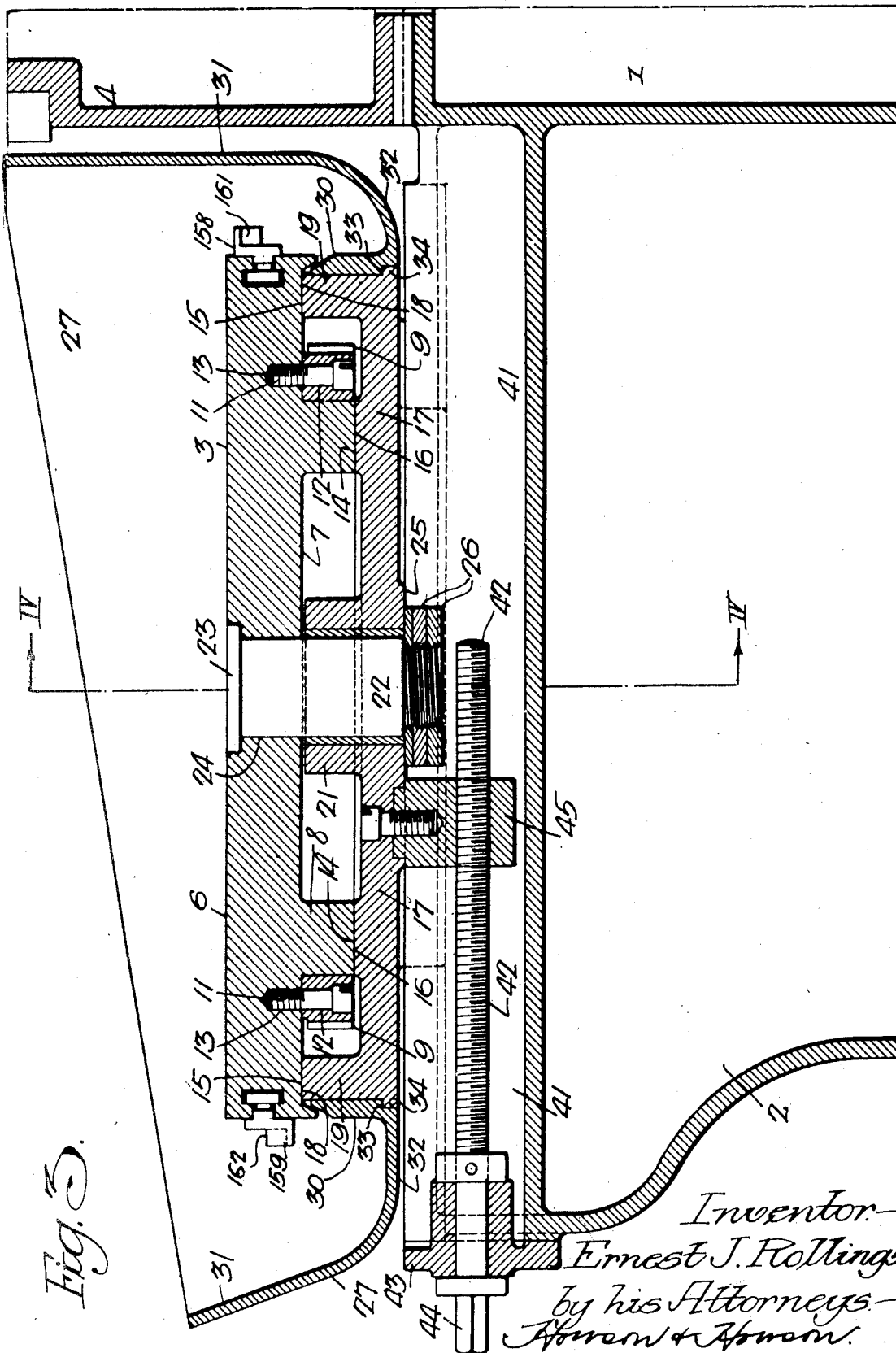
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12 Sheets-Sheet 3



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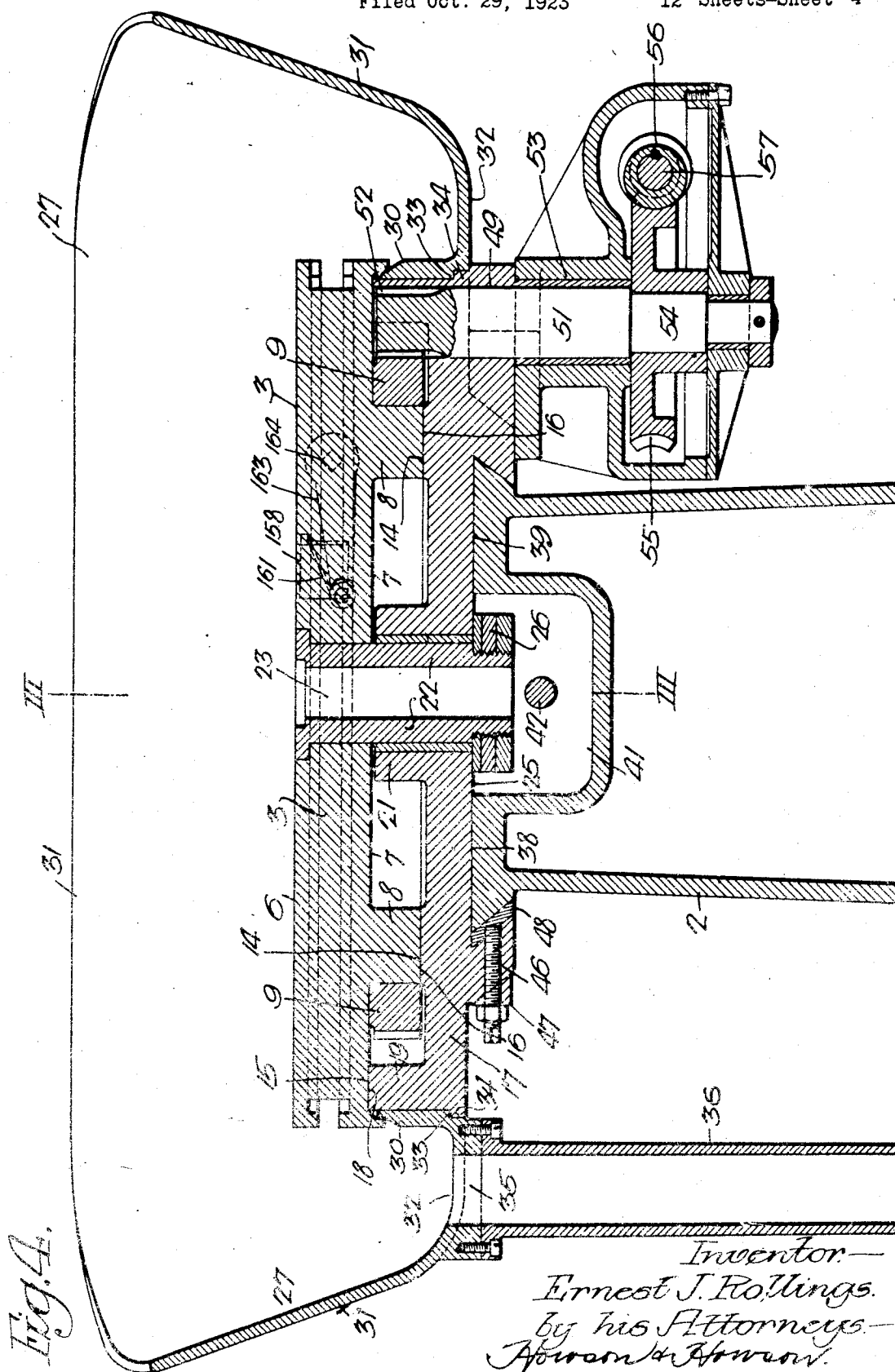
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12 Sheets-Sheet 4



Oct. 9, 1928.

1,687,350

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12 Sheets-Sheet 5

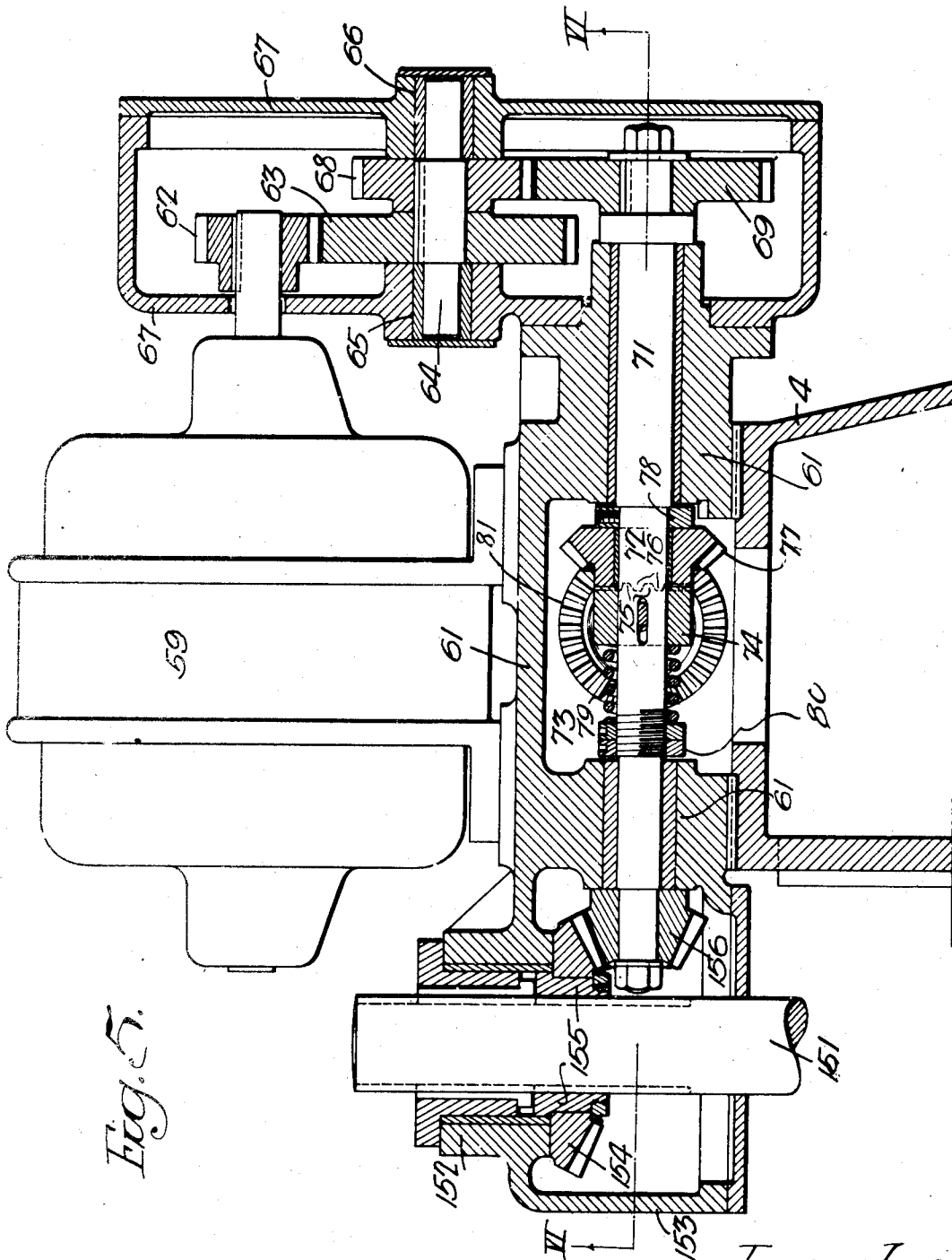


Fig. 5.

Inventor:-
Ernest J. Rollings.
by his Attorneys:-
Huron & Huron.

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1,687,350

E. J. ROLLINGS

CONTINUOUS MILLING MACHINE

Filed Oct. 29, 1923

12 Sheets-Sheet 6

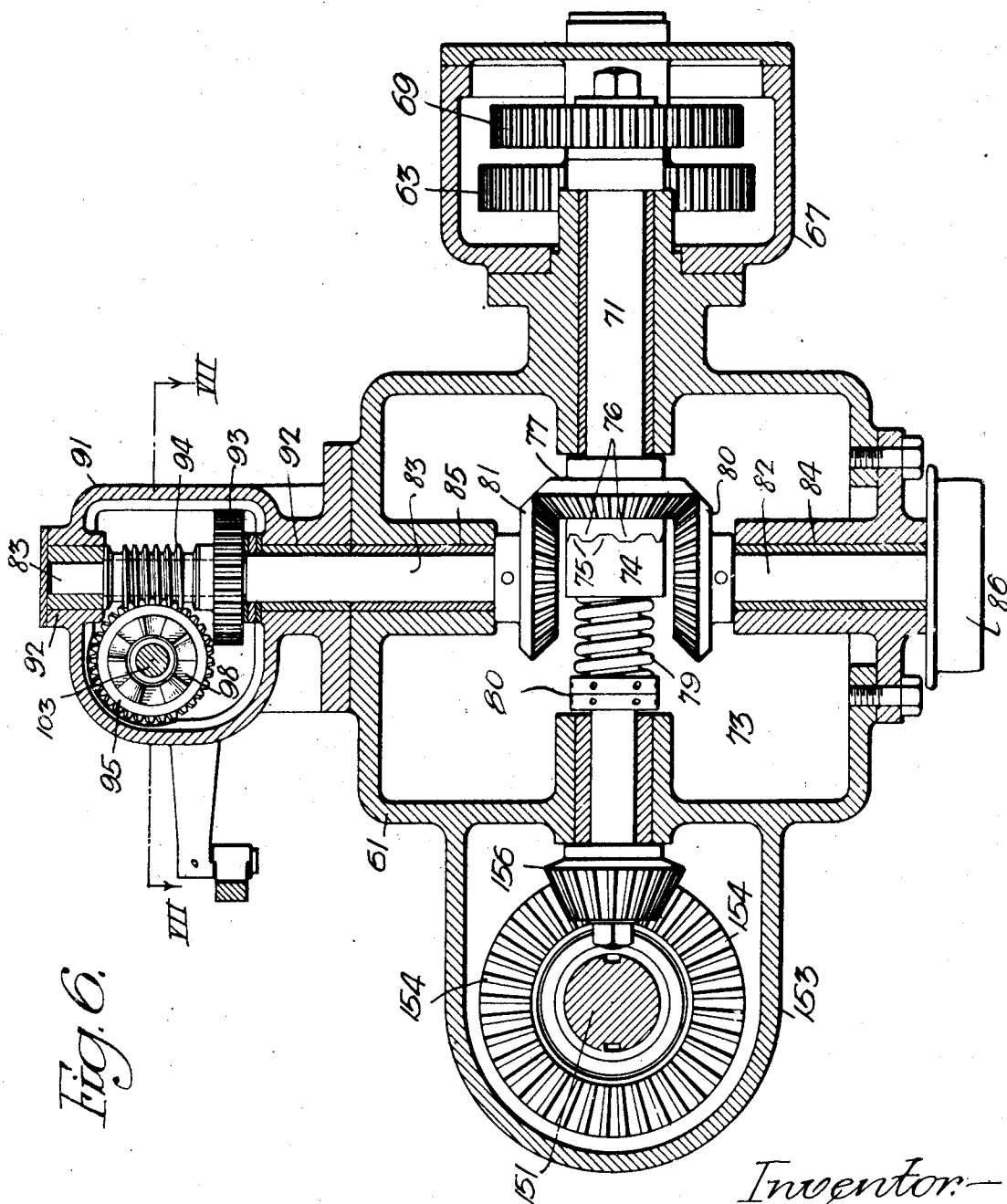


Fig. 6.

Inventor:-
Ernest J. Rollings.
by his Attorneys:-
Howson & Howson.

Oct. 9, 1928.

E. J. ROLLINGS

1,687,350

CONTINUOUS MILLING MACHINE

Filed Oct. 29, 1923

12 Sheets-Sheet 7

Fig. 8

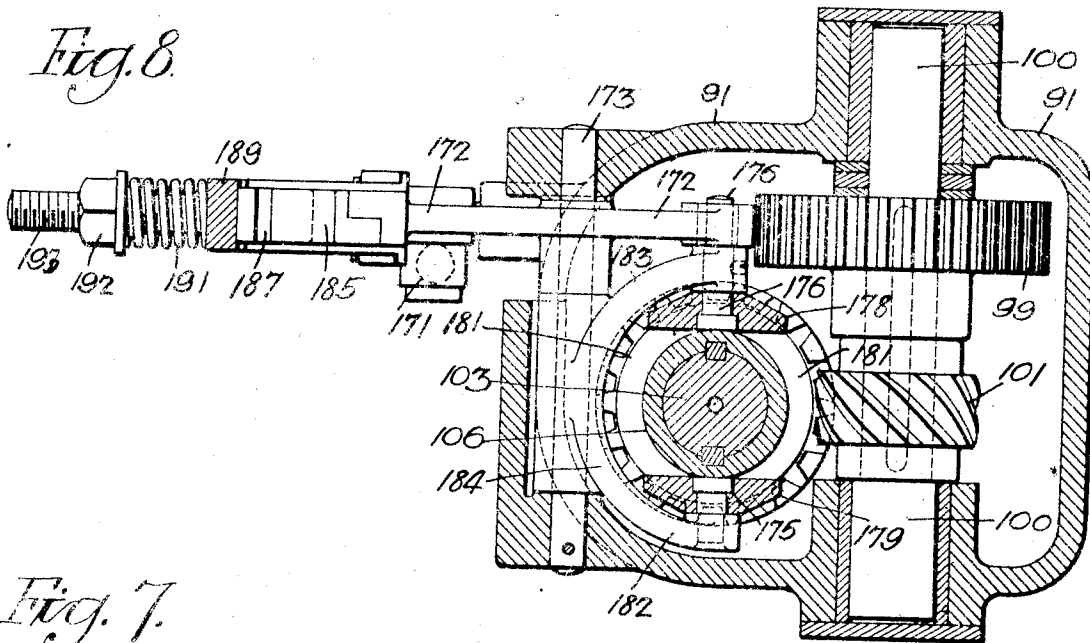
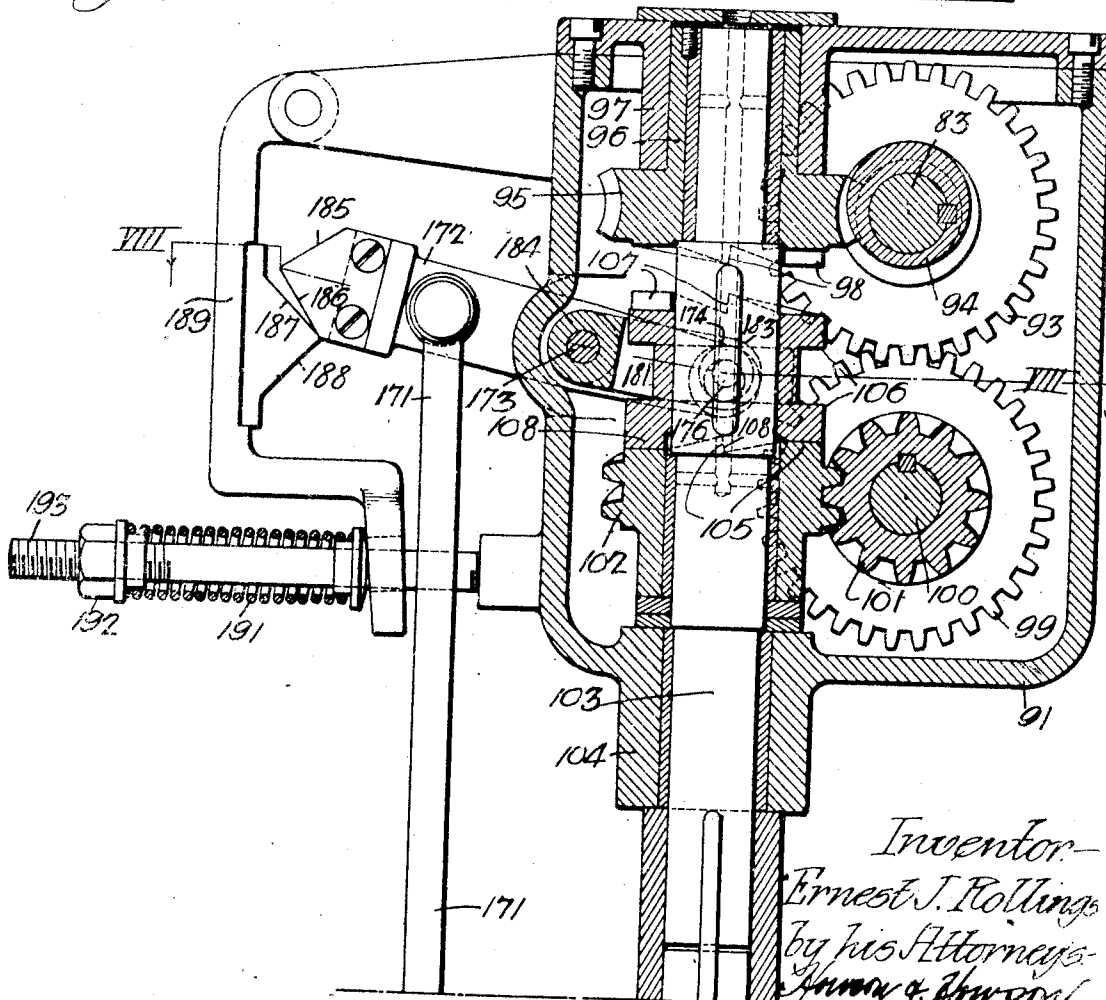


Fig. 7



Inventor—
Ernest J. Rollings
by his Attorneys—
Hanna & Brown

Oct. 9, 1928.

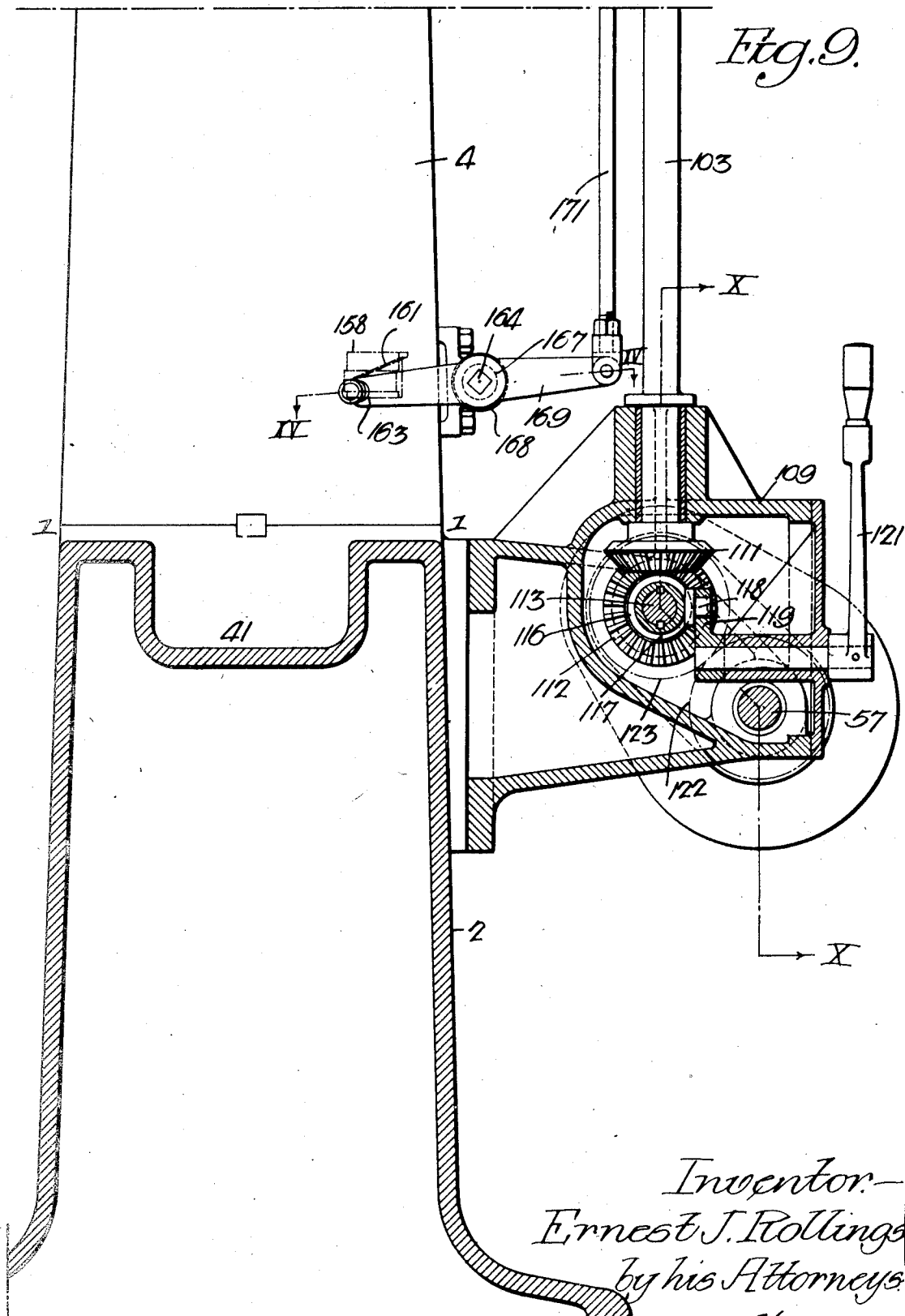
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CONTINUOUS MILLING MACHINE

Filed Oct. 29, 1923

12 Sheets-Sheet 8

Fig. 9.



*Inventor:-
Ernest J. Rollings
by his Attorneys
Johnson & Johnson*

Oct. 9, 1928.

E. J. ROLLINGS

1,687,350

CONTINUOUS MILLING MACHINE

Filed Oct. 29, 1923

12 Sheets-Sheet 9

Fig. 10.

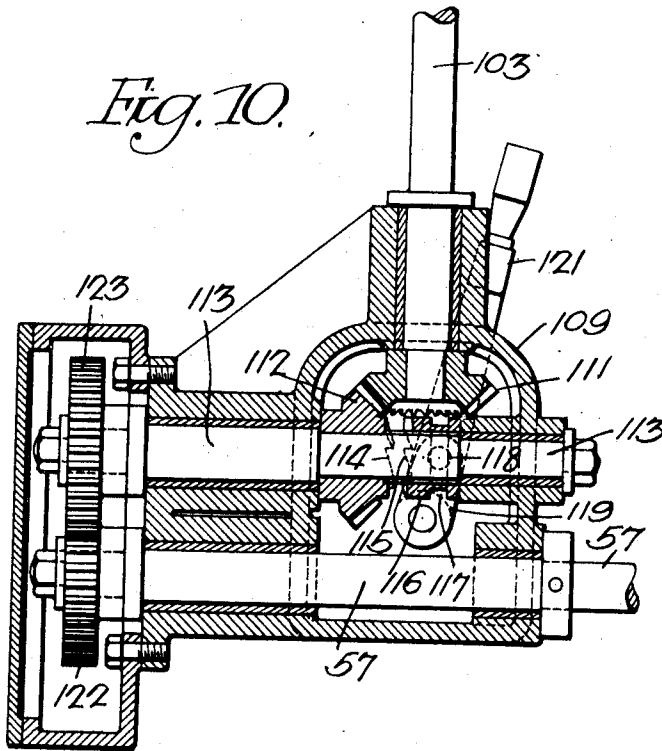
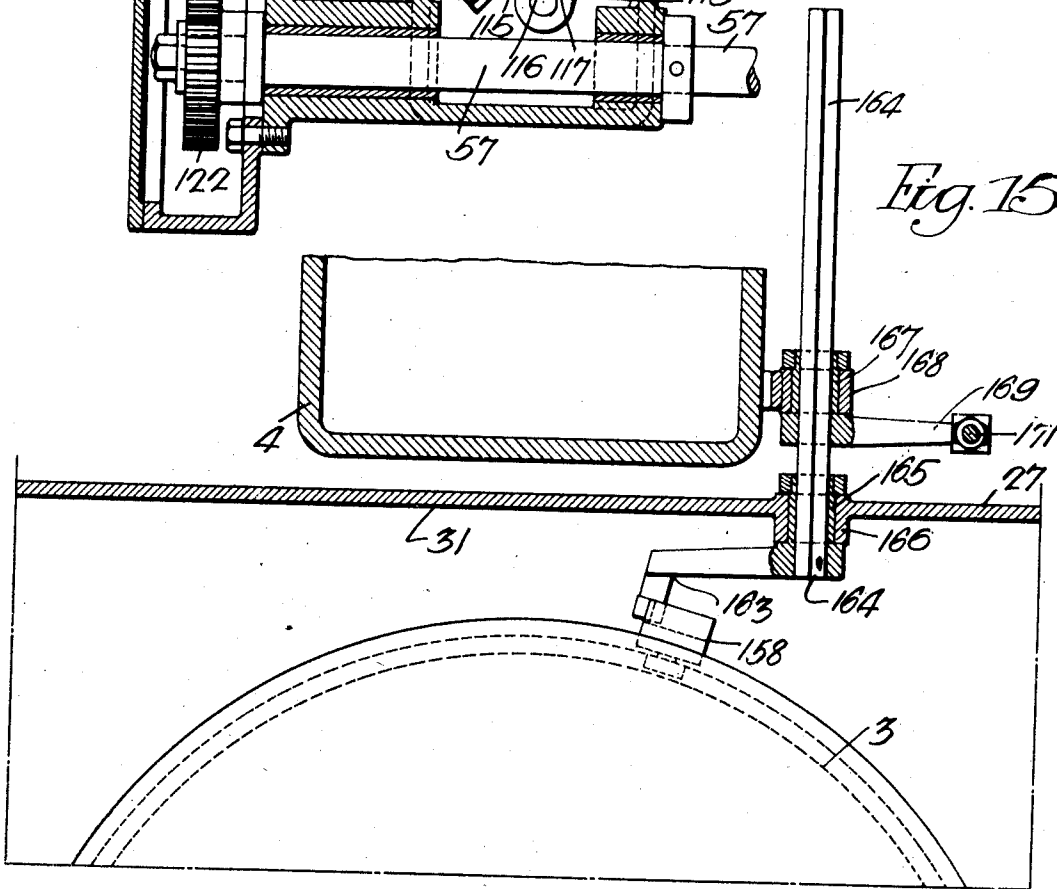


Fig. 15.



Inventor.
Ernest J. Rollings.
by his Attorneys.
Howson & Howson.

Oct. 9, 1928.

1,687,350

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CONTINUOUS MILLING MACHINE

Filed Oct. 29, 1923

12 Sheets-Sheet 10

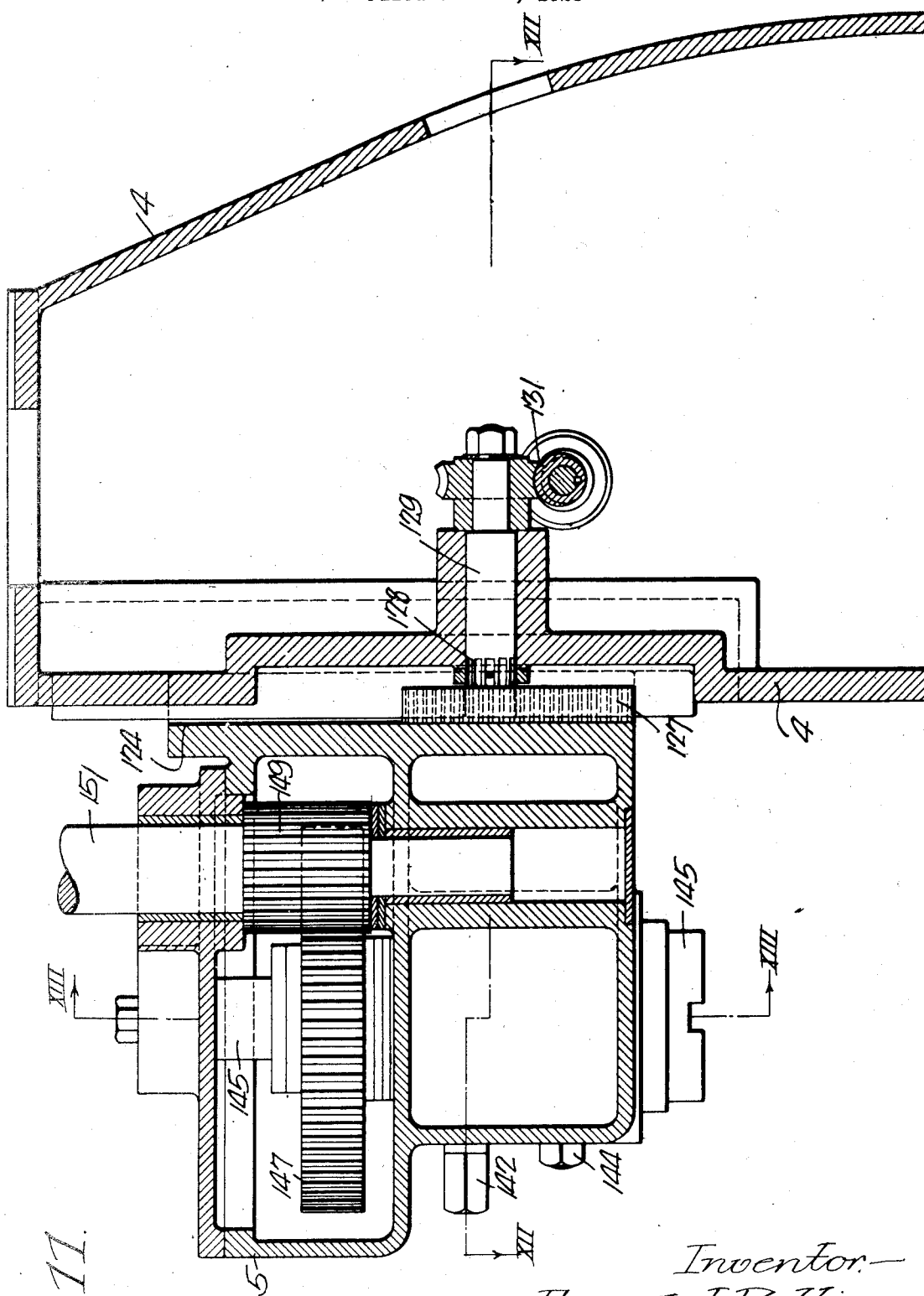


Fig. 11.

Inventor.—
Ernest J Rollings.
by his Attorneys.—
Horn & Horn.

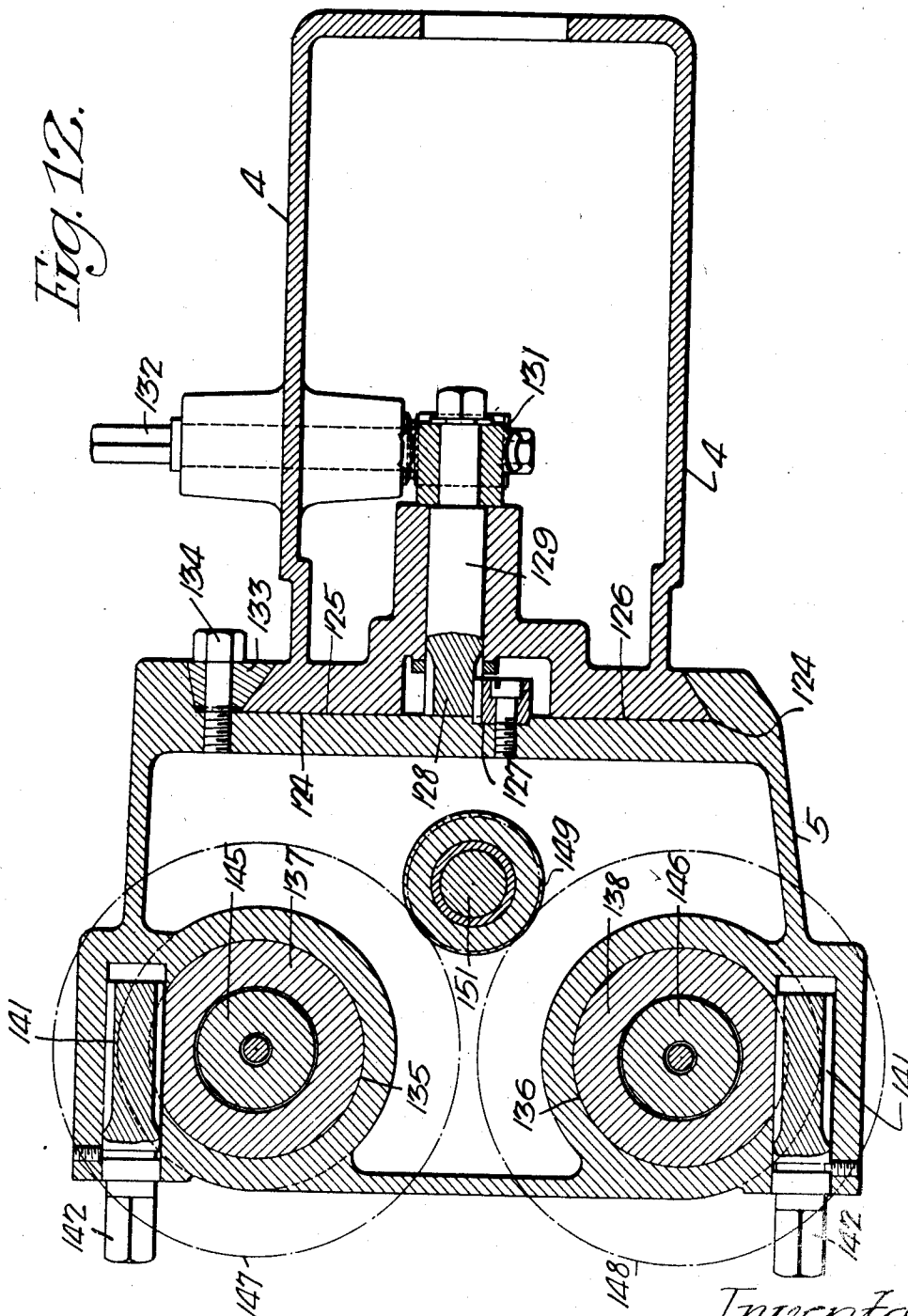
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1,687,350

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CONTINUOUS MILLING MACHINE

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12 Sheets-Sheet 11



Inventor—
Ernest J. Rollings.
by his Attorneys—
H. W. & H. W.

Oct. 9, 1928.

1,687,350

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CONTINUOUS MILLING MACHINE

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12 Sheets-Sheet 12

Fig. 13

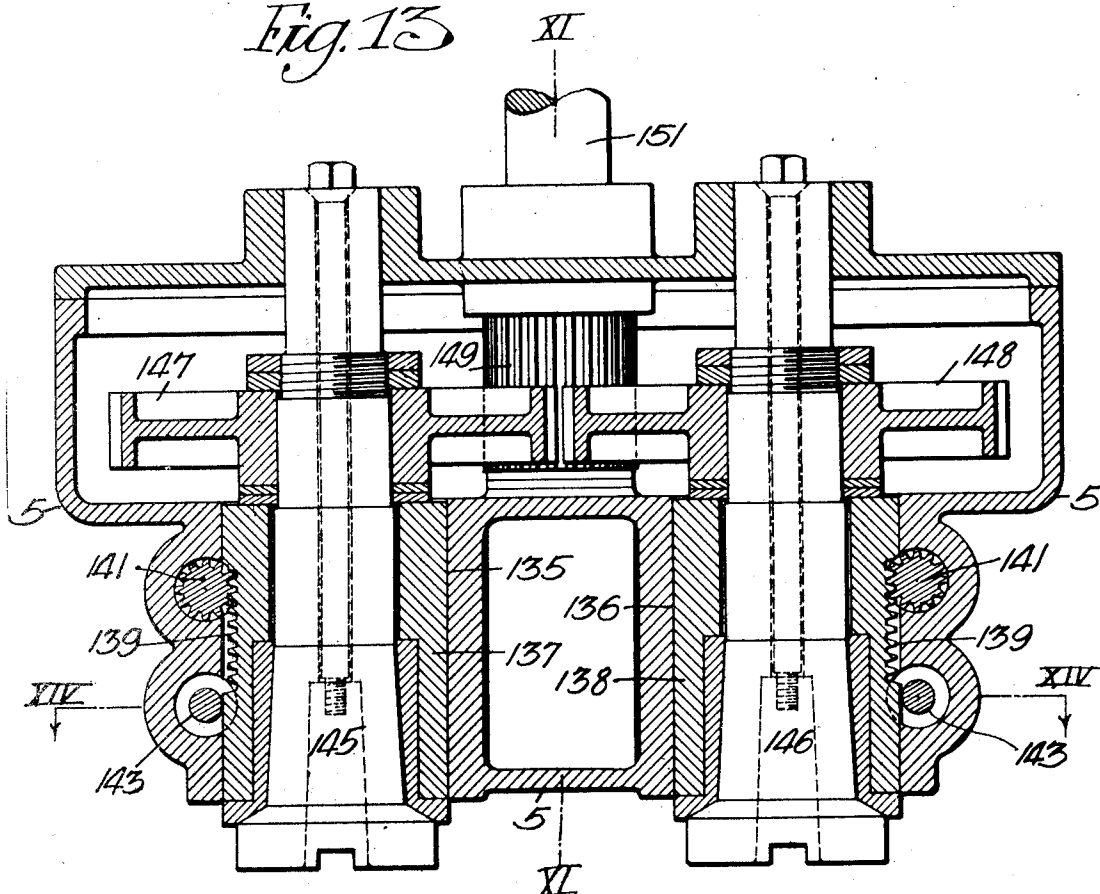
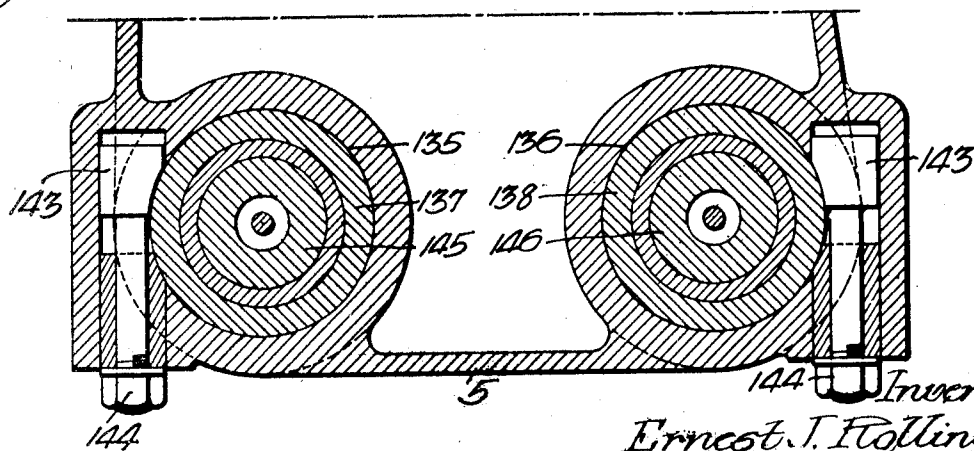


Fig. 14.



Inventor
Ernest J. Rollings
by his Attorneys—
Brown & Brown

UNITED STATES PATENT OFFICE.

ERNEST J. ROLLINGS, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO CONSOLIDATED MACHINE TOOL CORPORATION OF AMERICA, NEWTON MACHINE TOOL WORKS, OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF DELAWARE.

CONTINUOUS MILLING MACHINE.

Application filed October 29, 1923. Serial No. 671,418.

My invention relates to milling machines, having particular relation to continuous milling machines of the vertical spindle type.

One object of my invention is to provide a milling machine, wherein roughing and finishing operations may be simultaneously carried on.

Another object of my invention is to provide a table construction, wherein a work-table is revolubly mounted on a pair of annular bearing surfaces formed on a table saddle, the work-table having a centering pin engaging a bearing in said table saddle, the latter constituting a closure for the table bearings.

A further object of my invention is to provide in combination with the table construction a trough for removing the oil supplied to the cutting tools during the operation of the milling machine.

A still further object of my invention is to provide a control mechanism operable to increase the speed of rotation of the work-table when the tools are not engaged in cutting operations.

A still further object of my invention is to provide safety mechanism automatically operable to disengage the table and the pump actuating-mechanism from the source of driving energy, in the event of the jamming of the same.

With these and other objects and applications in mind, my invention further consists in the details of construction and operation hereinafter described and claimed and illustrated in the accompanying drawings, wherein—

Fig. 1 is a side elevational view of one form of embodiment of my invention;

Fig. 2 is a horizontal sectional view of the milling machine shown in Fig. 1, the sectional plane being taken on the line II—II;

Fig. 3 is an enlarged, detail, longitudinal-sectional view of the movable table, and the table saddle structure for revolubly mounting the same, the sectional plane being taken on the line III—III of Fig. 4;

Fig. 4 is a transverse sectional view of the structure of Fig. 3 illustrating the means for draining the oil from the movable table sup-

plied during the operation of the machine, the sectional plane being taken on the line IV—IV thereof;

Fig. 5 is an enlarged detail view, partially in elevation and partially in section, of the upper end portion of the milling machine frame carrying the driving motor and a portion of the gear wheel mechanism operatively associating the same with the spindle head and with the movable work-table;

Fig. 6 is an inverted horizontal sectional view taken on the line VI—VI of Fig. 5, illustrating the association of the spindle gearing, the movable table gearing and the pump gearing with the main driving pinion, and also illustrating the safety clutch;

Fig. 7 is a vertical sectional view taken on the line VII—VII of Fig. 6, showing the mechanism for selectively interconnecting the table gearing with the driving gearing giving the desired speed ratio;

Fig. 8 is a horizontal sectional view of the apparatus of Fig. 7 taken on the line VIII—VIII thereof;

Fig. 9 is an enlarged detail view, partially in elevation and partially in longitudinal section, of the manually operable mechanism for connecting or disconnecting, at will, the work-table gearing from the driving gearing, the sectional plane being indicated by the line IX—IX in Fig. 1;

Fig. 10 is a longitudinal sectional detail view of the hand control mechanism shown in Fig. 9, the sectional plane being indicated by the line X—X thereof;

Fig. 11 is an enlarged detail longitudinal sectional, view of the spindle head and the means for vertically adjusting the same, the sectional plane being taken on the line XI—XI of Fig. 13;

Fig. 12 is a horizontal sectional view of the structure of Fig. 11, the sectional plane being taken on the line XII—XII thereof;

Fig. 13 is a transverse sectional view taken on the line XIII—XIII of Fig. 11, illustrating the mounting of the roughing and finishing spindles and also the vertically adjusting and locking mechanism;

Fig. 14 is a horizontal sectional view taken

on the line XIV—XIV of Fig. 13, illustrating the clamping mechanism for securing the spindles in a desired vertical position;

Fig. 15 is an enlarged, detail, horizontal-sectional view taken on the line XV—XV of Fig. 9, showing a portion of the trip mechanism;

Fig. 16 is an enlarged, detail, longitudinal sectional view of a portion of the work-table carrying the dogs for actuating the trip mechanism of Figs. 1, 7 and 8, the sectional plane being indicated by the line XVI—XVI of Fig. 2;

Fig. 17 is a side elevational view of the structure of Fig. 16.

In the drawings is shown a continuous milling machine of the vertical spindle type comprising a frame 1 having a horizontally extending base portion 2 providing a revoluble mounting for a work-table 3 and also having a vertically upright portion 4 adapted to carry a double spindle head 5 which is vertically adjustable toward and away from the work-table 3, all as hereinafter more fully explained.

The work-table 3, of which Figs. 3 and 4 are sectional elevations, is circular in form having a top side 6, which supports the work to be machined, and a bottom side 7 having an annular depending flange 8 of reduced diameter. A gear-wheel 9 is so positioned as to embrace the outer periphery of the depending flange 8 and it is secured to the underside of the work-table 3 by screw members 11 which extend through perforations 12 in the gear-wheel 9 into threaded borings 13 in the work-table 3. The work-table 3 is provided with annular bearing surfaces comprising an outer side 14 of the annular ring 8 and a portion 15 of the space between the outer periphery of the work-table 3 and the outer edge of the gear wheel 9, which bearing surfaces respectively cooperate with an annular bearing surface 16 formed on the upper side of a circular table saddle 17 and with a bearing surface 18 formed on the upper side of an upwardly extending peripheral flange 19 on the table saddle 17.

The table saddle 17 is further provided with a centrally positioned, vertically extending bearing 21 for the removable reception of a projecting portion 22 of a bearing pin 23 which is secured in a centrally positioned perforation 24 in the work-table 3. The bearing portion 22 of the pin 23 may be extended below a lower side 25 of the table saddle 17 and threaded to receive locking nut members 26. The peripheral flange 19 thus serves not only to provide the annular bearing surface 18 for the work-table 3 but it also serves to fully enclose the gearing and the remaining bearing surfaces, just mentioned, thereby protecting the same from dust and dirt.

A trough 27, for removing the oil supplied to the cutters 28 and 29 which are carried by

the spindles 145 and 146, respectively, comprises inner and outer side portions 30 and 31 and a base portion 32, the inner side portion 30 being formed to provide a shoulder portion 33 adapted to rest upon an annular flange 34 extending from the table saddle 17. The base portion 32 of the annular trough 27 may be provided with an outlet opening 35 which is associated by means of a communicating pipe 36 with a storage receptacle 37, Fig. 1.

The horizontally extending portion 2 of the milling machine frame 1 is provided with a pair of spaced bearing surfaces 38 and 39 for slidably mounting the table saddle 17, the bearing surfaces 38 and 39 being separated by a parallelly extending recess 41 adapted to receive a screw member 42 having one end extending through a supporting plate 43, which is secured at one end of the recess 41, and terminating in an external portion 44. As shown in Fig. 3, longitudinal adjustment of the table saddle 17 on the supporting surfaces 38 and 39 is effected by securing to the underside thereof a block 45 which is provided with a threaded perforation engaging the unsupported end of the screw member 42. Inasmuch as the screw member 42 is mounted for turning only, the operation thereof is such as to cause the block 45 and consequently the table saddle 17 and the work-table 3 to move in a longitudinal direction on the sliding surfaces 38 and 39 of the milling machine frame 1. The table saddle may be locked in a desired position by means of an adjusting screw 46, which is carried by a depending flange member 47 on the underside of the table saddle 17 immediately adjacent to the outer side portion of the framework defining the sliding surface 38, the end of the screw member 46 extending into a clamping member 48 engaging the portion of the framework just mentioned.

The table saddle 17 is further provided with a vertically extending perforation 49 adjacent to the outer periphery thereof for the reception of a shaft 51 having an upper end portion provided with gear teeth 52 adapted to mesh with the teeth of the gear wheel 9. The lower end of the shaft 51 is revolubly mounted in a housing 53, which is secured to the underside of the table saddle 17. An extension 54, of the lower end portion of the shaft 51 is adapted to carry a wheel 55 which is driven by a worm 56 carried by a shaft 57. The worm is preferably splined to the shaft 57, whereby an operative connection may be maintained between the work-table 3 and the shaft 57 as the former is moved by the table feed screw 42. The housing 53 may be extended to provide a closure for the worm and wheel 56 and 55 and also to provide a slidable support for the shaft 57, as shown in Figs. 1 and 4 of the drawing.

A driving means for effecting the turning of the shaft 57 and the resulting operation of

the work-table 3, of which Fig. 5 is illustrative, comprises a motor 59 which is rigidly secured to a gear casing 61 mounted on the upper end surface of the vertically upright portion 4 of the milling machine framework 1. The motor 59 has a pinion 62 meshing with a gear-wheel 63 which is carried by a shaft 64 mounted in bearings 65 and 66 formed in an enclosing casing 67, the latter being rigidly secured to the gear casing 61. The shaft 64 carries a second gear-wheel 68 which meshes with a driven gear-wheel 69 which is mounted on the end portion of a horizontally positioned shaft 71 rotatably mounted in the gear casing 61. The gear casing 67, just mentioned, is of such dimensions as to enclose the gear-wheels 62, 63, 68 and 69.

The driving shaft 71 has a portion 72 positioned in a rectangular chamber 73 formed in the upper gear casing 61. A collar 74 is slidably keyed to the shaft portion 72 and it has one face thereof provided with a series of teeth or shoulder portions 75 which mesh with a similar series of teeth 76 formed on an adjacent face of a bevel gear-wheel 77 loosely mounted on the shaft portion 72.

The other face of the bevel gear-wheel 77 engages a bearing collar 78 rigidly secured to the shaft portion 72. The collar 74 may be normally held in engagement with the bevel gear-wheel 77 by means of a spring 79 which has one end thereof in engagement with the collar 74 and the other end in engagement with an adjustable nut 80 secured to the shaft portion 72.

The operative connection between the driving motor 59 and the bevel gear-wheel 77 is thus such that, in the event of the failure of the latter to turn, for reasons as will appear more fully hereinafter, the collar 74 is actuated back against the force of the spring 78 and out of operative engagement with the bevel gear-wheel 77.

The bevel gear-wheel 77 cooperates with oppositely positioned bevel gear-wheels 80 and 81, Fig. 6, which are carried, respectively, by shafts 82 and 83 journaled in bearings 84 and 85 formed in the gear casing 61. The shaft 82, which extends transversely of the driving shaft 71, has a pulley-wheel 86 mounted on an outer end portion thereof. The pulley-wheel 86 is operatively associated by means of a belt 87, Fig. 1, with an oil pump 88 having its inlet opening directly connected to the oil reservoir tank 37 by means of a pipe 89 and its outlet opening associated with the various machine parts to be oiled by means of a communicating pipe 90.

A gear box 91, of which Figs. 6, 7 and 8 are detail views, is designed to provide means, whereby the speed of the work-table 3 may be selectively varied in accordance with the position of actuating dogs on the work-table, as will presently appear. The gear box 91 is

secured to the gear casing 61 and it provides spaced bearings 92 for an end portion of the driven shaft 83. The end portion of the shaft 83, which is within the gear casing 91, carries a gear-wheel 93 and a worm 94, the latter being operatively associated with a cooperating wheel 95 having an upwardly extending tubular projection 96 which is rotatably mounted in a vertically positioned bearing 97 formed in the upper portion of the gear box 91. The bottom face of the wheel 95 is provided with a series of teeth or shoulder portions 98 which are designed for a purpose hereinafter more fully explained.

The gear-wheel 93 meshes with a gear-wheel 99 which is carried by a shaft 100 also journaled in the gear casing 91 directly beneath the end portion of the shaft 83. The shaft 100, which is driven by the shaft 83 through the cooperating gear-wheels 93 and 99, carries a spiral toothed gear-wheel 101 which meshes with a second spiral toothed gear-wheel 102 loosely mounted on a vertically positioned shaft 103 journaled in a bearing 104 formed in the gear casing 91. The upper face of the gear-wheel 102 is provided with shoulder portions 105 which are similar to the shoulder portions 98 on the underside of the wheel 95. The vertically positioned shaft 103 extends upwardly and has its upper end portion rotatably mounted within the projecting sleeve portion 96 of the wheel 95 which is journaled in the bearing 97.

When the shaft 83 is rotated by means of the driving motor 59, the wheel 95 and the spiral gear-wheel 102 are turned at different speeds on the shaft 103. The shaft 103 may be selectively actuated in accordance with the rotative speed of either the wheel 95 or the spiral gear-wheel 102 by slidably mounting therebetween on a portion of the shaft 103, a collar 106 having its opposite faces provided with shoulder portions 107 and 108, respectively, which are adapted to engage successively the shoulder portions 98 and 105. When the shoulder portions 105 and 108 are actuated into engagement, the shaft 103 is driven at one desired speed and when the shoulder portions 107 and 98 are brought into engagement, the shaft 103 is actuated at another desired speed, which speeds, in applicant's invention, correspond to the rapid intermediate speed between the cutting operation and to the slow cutting speed. The control mechanism operable to effect the movement of the sliding member 106 will be explained hereinafter.

The shaft 103 extends downwardly to a hand controlled gear box 109 which is operable to effect, at will, disconnection between the driving shaft 103 and the work-table driving shaft 37, as shown in Figs. 1, 9 and 10 of the drawing. The lower end portion of the shaft 103 is journaled in the gear casing 109 and is provided with a bevel gear-wheel 111

meshing with a cooperating bevel gear-wheel 112, the latter being loosely mounted on a shaft 113 journaled in the gear casing 109. The outer face portion of the gear-wheel 112 is provided with shoulder portions 114 adapted to engage complementarily arranged shoulder portions 115 formed on a member 116 slidably mounted on the shaft 113. The slidable member 116 is provided with an annular groove 117 for the reception of an actuating pin 118 which is carried by an arm 119 having an operating handle 121 secured thereto at the outer side of the gear casing 109. The end portion of the shaft 57 is journaled in the gear casing 109 and it is provided with a gear-wheel 122 which meshes with a gear-wheel 123 carried by the shaft 113. Hence, when the operating handle 121 is moved to actuate the shoulder portions 114 and 115 out of engagement, as shown for instance in Fig. 10 of the drawing, the driving shaft 103 is disengaged from the driven shaft 57.

The double-spindle head 5, of which Figs. 11, 12, 13 and 14 are sectional views, comprises a casting, the rear wall of which is provided with a groove 124 adapted to slidably engage vertically extending plane surfaces 125 and 126 on the upright portion 4 of the milling machine frame. The spindle head 5 may be vertically adjusted by means of a rack and pinion 127 and 128, the former being secured to the double-spindle head in the groove 124, the latter being carried by a shaft 129 which is associated through a worm-wheel mechanism 131 with an externally adjustable shaft section 132. The double-spindle head 5 may be secured in a desired vertical position by means of a clamping member 133 having surfaces in engagement with the upright portion 4 of the milling machine frame and with the side and base of the groove 124. The clamping member 133 may be adjusted by means of a clamping nut 134 which extends through the clamping member 133 into the double-spindle head 5.

The double-spindle head 5 is provided with a pair of spaced vertically positioned borings 135 and 136 for the reception of spindle quills 137 and 138, respectively. Each spindle quill is provided with gear teeth 139 constituting a rack which cooperate with pinions 141 mounted on externally adjustable shaft sections 142, whereby the vertical position of the spindle quills may be independently adjusted. Clamping members 143, which are shown particularly in Fig. 14, are provided with externally-positioned, adjusting nuts 144, whereby the spindle quills may be rigidly secured in any desired vertical position.

The spindle quills 137 and 138 have rotatably mounted therein spindles 145 and 146, respectively, which carry gear wheels 147 and 148 on their upper ends cooperating with a common driving pinion 149. The

driving pinion 149 is rigidly mounted on a vertically extending driving shaft 151, the upper end portion of which is journaled in a bearing 152 carried by a gear casing 153 which is rigidly secured to the gear casing 61. A bevel gear-wheel 154 is mounted on a cylindrical member 155 which is splined to the portion of the shaft 151 extending through the gear casing 153, thereby providing for the vertical movement of the shaft 151 when the spindle head 5 is vertically adjusted by turning the shaft section 132. A cooperating bevel gear-wheel 156 is mounted on a reduced end portion of the horizontally positioned driving shaft 71 in such manner as to mesh with the gear-wheel 154.

In the milling machine shown in the drawing, I further provide mechanism for increasing the speed of rotation of the work-table 3 during the periods when the cutters 28 and 29 are not in engagement with the work to be machined. Referring more especially to Fig. 2 of the drawing, a series of pieces of work 157 are shown disposed in such relation that successive pieces are simultaneously brought into engagement with the cutters 28 and 29, respectively. In one application, the cutters 28 and 29 were designed for roughing and finishing operations, respectively, though of course my invention is not necessarily limited to such arrangement.

In order to increase the speed of rotation of the table 3 as it turns through an angle α which is that necessary to bring successive pieces of work into engagement with corresponding cutters, and to decrease the speed of rotation as the table turns through an angle β , which is that necessary to pass the work completely under the cutters, a series of dogs 158 and 159 are adjustably positioned on the outer periphery of the work-table 3. In Figs. 16 and 17 are shown detail views of one of the dogs 158, wherein it is noted that cam surface 161 thereof is inclined downwardly, differentiating over the dogs 159, wherein cam surfaces 162 thereof are inclined upwardly.

In Figs 2 and 15, the dogs 158 and 159 are shown as serving to actuate an arm 163, which is rigidly secured to a square shaft 164 slidably mounted in a sleeve 165, the latter being mounted for rotative movement in a bearing 166 formed in the outer side wall 31 of the oil trough 27. The construction just defined provides not only for a vertical swinging movement for the arm 163 but also for a lateral movement, whereby the arm 163 may remain in definite relation to the dogs 158 and 159 when the table 3 and the oil pan 27 are moved relative to the upright portion 4 of the machine frame. A portion of the square shaft 164 extends through a cylindrical member 167 which is mounted for rotative movement in a bearing 168 carried by the upright portion 4 of the milling machine

framework 1. A horizontally extending actuating arm 169 from the shaft 164 has secured to the outer end thereof a vertically extending connecting link 171 which is pivotally mounted at its upper end on a trip lever 172 which is designed to actuate the sliding clutch member 106, all as will be explained more fully hereinafter.

The trip lever 172 is pivotally mounted on a horizontally extending pin 173 carried by the gear casing 91, and it is provided with an arm portion 174 which extends inwardly into the gear casing 91 to embrace one of a pair of pins 175 and 176, say the latter. The pins 175 and 176 extend in opposite directions from members 178 and 179, respectively, which are oppositely positioned in an annular recess 181 formed in the clutch member 106. The pins 175 and 176 may extend through arms 182 and 183, respectively, of a yoke member 184, the latter being loosely mounted on the pin 173.

The opposite end of the trip lever 172 is provided with beveled cam faces 185 and 186 which cooperate, respectively, with cam faces 187 and 188 of a lever 189 pivotally mounted for motion toward and away from the trip member 172. The lever 189 is maintained in a forward position, wherein either of the operating faces 186 and 187 or 188 and 185 are in engagement, by means of a spring 191 having a free end thereof in engagement with the end of the lever 189 and the remaining end thereof in engagement with a nut 192 mounted on a rod 193 secured to the gear casing 91.

When the trip mechanism, just described, is in the position shown in Figs. 2, 7 and 8 of the drawing and the work-table 3 moves clockwise, one of the series of dogs 158 actuates the lever arm 163 downwardly, and, as a consequence, the vertically positioned link 171 upwardly. The upward movement of the link 171 causes the trip lever 172 to actuate the slidable clutch member 106 into operative engagement with the spiral gear-wheel 102, as shown in Fig. 7, whereby the speed of the table 3 may be increased as it moves through the angle α .

When the work-table 3 has turned through the angle α , one of the series of dogs 159 is brought into engagement with the lever arm 163 and it operates to effect a downward movement of the trip lever 172, whereby the clutch member 106 is actuated out of engagement with the spiral gear-wheel 102 and into engagement with the wheel 95 to effect a decrease in the speed of rotation of the work-table 3. The work-table 3 then moves at a reduced speed until it has turned through the angle β , whereupon the foregoing cycle of operations is repeated.

Respecting the operation of the spring 191 for rendering positive the operation of the trip lever 172, as the latter moves down-

wardly, the surface 186 thereof is actuated over the cam surface 187 of the spring actuated lever 189 forcing the latter member outwardly until the end of the trip lever 172 has passed downwardly beyond the ridge formed by the junction of the surfaces 187 and 188, whereupon the surfaces 188 and 185 are suddenly brought into engagement through the sudden downward motion of the outer end portion of the trip lever 172 acting under the force of the compressed spring 191. As a result of the sudden downward movement of the outer end portion of the trip lever 172, the sliding member 106, which has been actuated out of engagement with the spiral gear-wheel 102 during the preceding downward movement, is suddenly positively actuated into engagement with the wheel 95 under the force of the compressed spring 191, as just described. When the trip lever 172 is moved upwardly, the reverse procedure obtains. Experience has shown that by enlarging the perforation in the arm portion 174 of the trip arm 172 which receives the pin 176, as shown in Fig. 7, the operation of the trip lever 172 is rendered more certain as it passes the dead center point, that is, where the end of the lever 172 passes the ridge formed by the cam surfaces 187 and 188.

In summary, when power is supplied to the driving motor 59, the roughing and finishing cutters 28 and 29, respectively, in the double-spindle head 5 are simultaneously operated. Coincident with the operation of the cutters, the work-table 3 is rotated at a reduced speed through the angle β , when the work 157 is in engagement with the roughing and finishing cutters 28 and 29, and at an increased speed through the angle α , when the work 157 and the cutting tools 28 and 29 are out of engagement. If the table or the pump driving mechanism becomes jammed, the same is automatically disconnected from the driving motor 59 through the separation of the relatively movable clutch members 74 and 77.

While I have shown but one embodiment of my invention, for the purpose of describing the same and illustrating its principles of construction and operation, it is apparent that various changes and modifications may be made therein without departing from the spirit and the scope of my invention. I desire, therefore, that only such limitations shall be imposed thereon, as are indicated in the appended claim or as are demanded by the prior art.

I claim:

A machine comprising, in combination, a pair of cutters, a revolubly mounted table for carrying work to be machined, a driving shaft having an operative connection therewith for effecting the rotation thereof, a pair of gear-wheel mechanisms operatively associated with the said shaft, each of said mech-

anisms having an element loosely mounted on said shaft, said elements being spaced apart, a member mounted on said shaft intermediate said elements for axial motion, said member
5 having opposite sides adapted to successively engage complementary arranged sides of said elements whereby a rigid connection may be effected between the element and the sliding member in engagement therewith, lever mechanism actuated at predetermined positions of said table to move said member into engagement with one of said elements, and compressible resilient means for forcing the said member into engagement with the said elements. 10

ERNEST J. ROLLINGS.