No. 688,422. Patented Dec. 10, 1901.

O. F. LEIBERT & C. VON PHILP.

MILLING MACHINE.

(Application filed Mar. 16, 1901.)

(No Model.) 7 Sheets—Sheet 1.

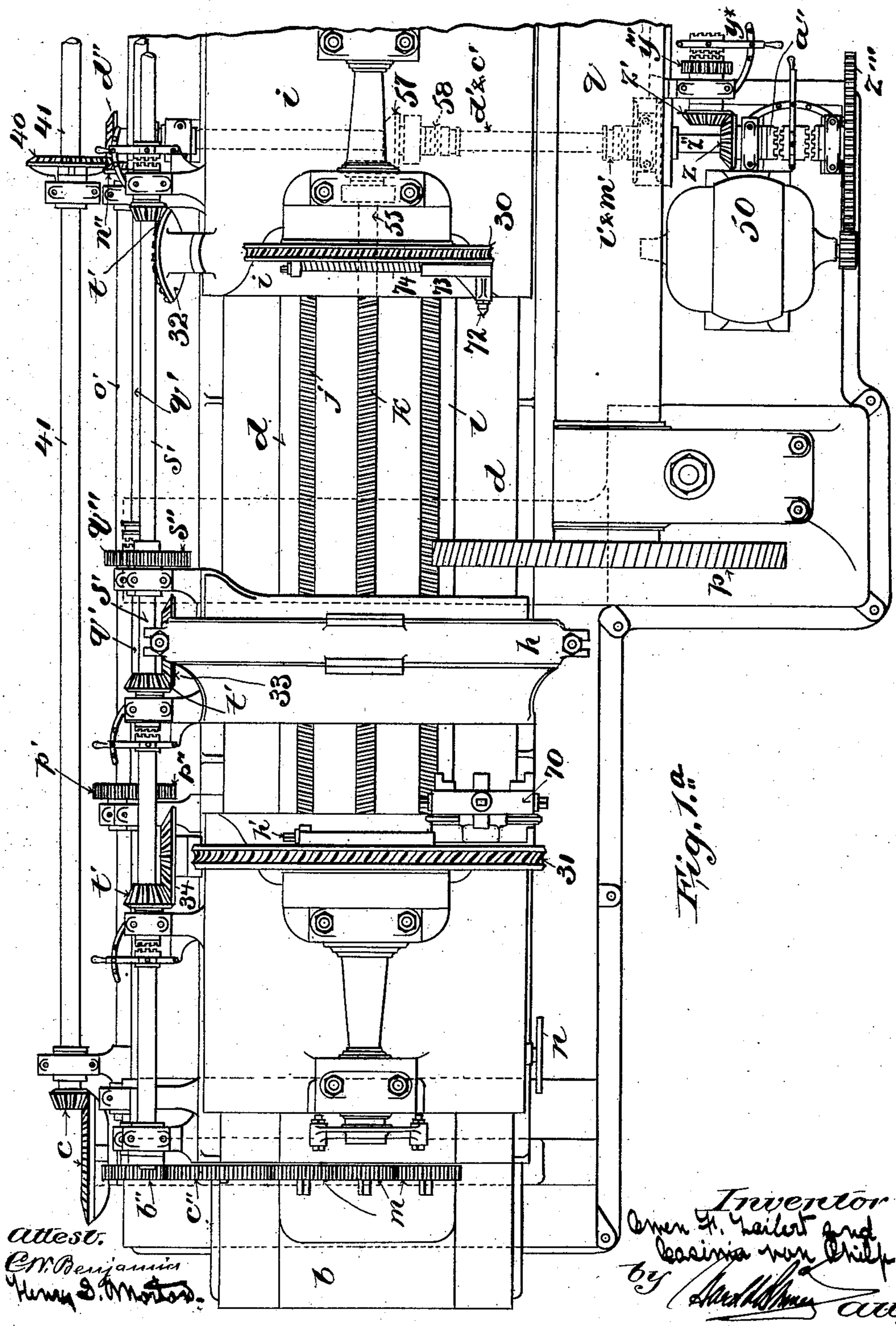


Fig. 1a.

Witnesses:
C. W. Benjamin
Henry D. Morton.

Inventors
Oscar F. Leibert and
Casimir von Philp
by Church & Church
Attys

No. 688,422. Patented Dec. 10, 1901.

O. F. LEIBERT & C. VON PHILP.

MILLING MACHINE.

(Application filed Mar. 16, 1901.)

(No Model.) 7 Sheets—Sheet 2.

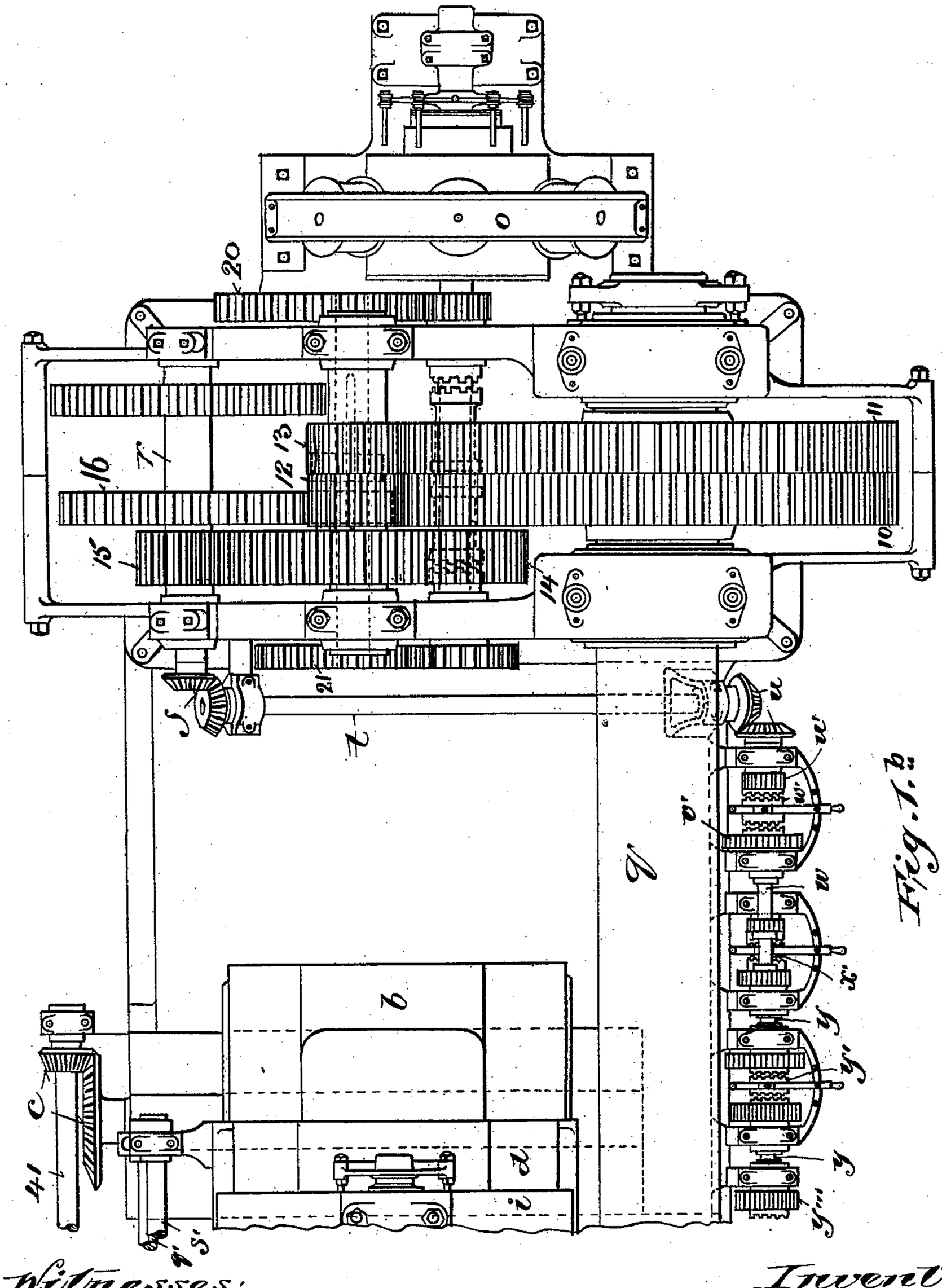


Fig. 1.

Witnesses,
C. W. Benjamin
Henry S. Morton.

Inventors
Oscar F. Leibert and
Conrad Von Philp.
by Hart & Adams
Attys

No. 688,422. Patented Dec. 10, 1901.

O. F. LEIBERT & C. VON PHILP.

MILLING MACHINE.

(Application filed Mar. 16, 1901.)

(No Model.) 7 Sheets—Sheet 3.

Fig. 7.

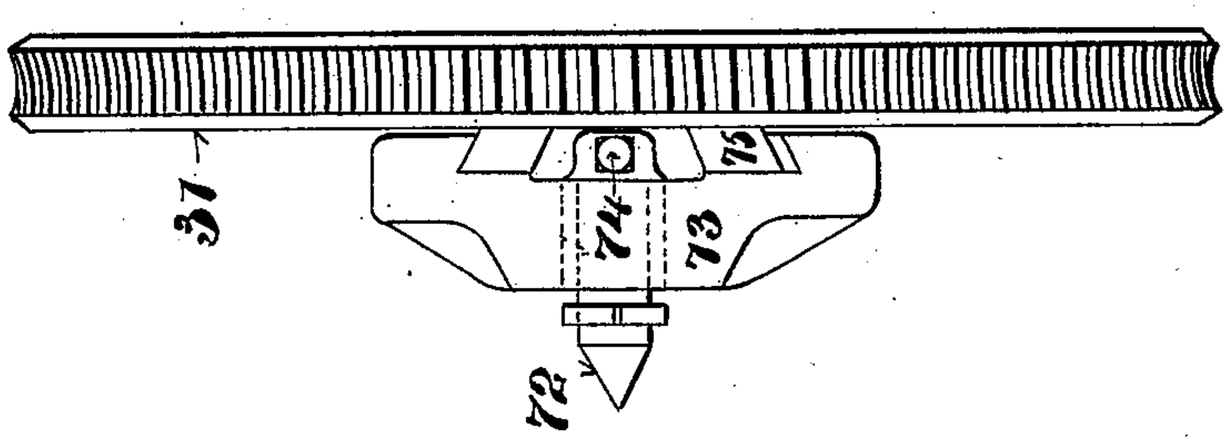
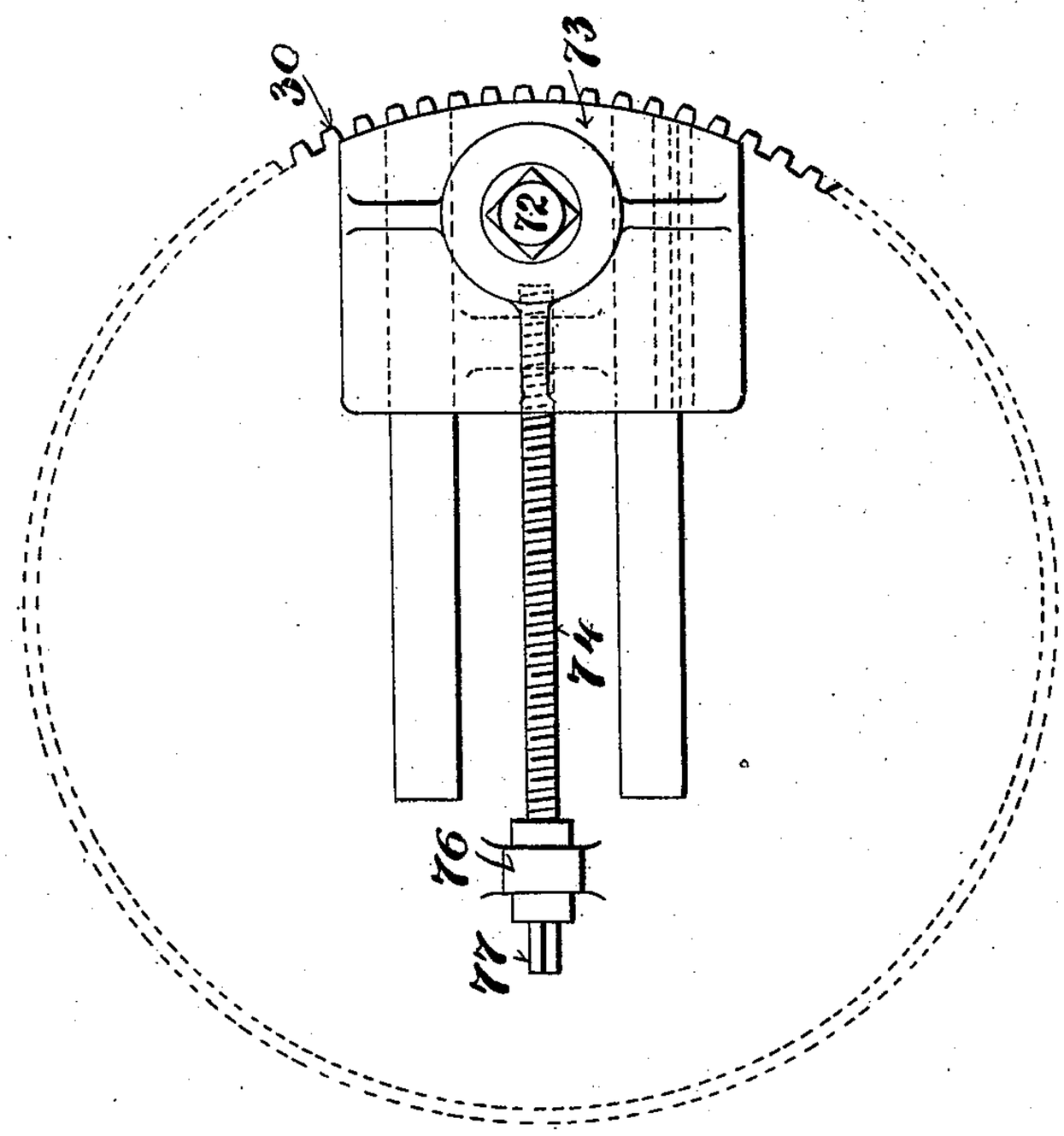


Fig. 8.



Witnesses,
C. W. Benjamin
Henry E. Morton

Inventors
Oren F. Leibert and
Carl Von Philp
by Edward A. Brown
Atty

No. 688,422. Patented Dec. 10, 1901.

O. F. LEIBERT & C. VON PHILP.

MILLING MACHINE.

(Application filed Mar. 16, 1901.)

(No Model.) 7 Sheets—Sheet 4.

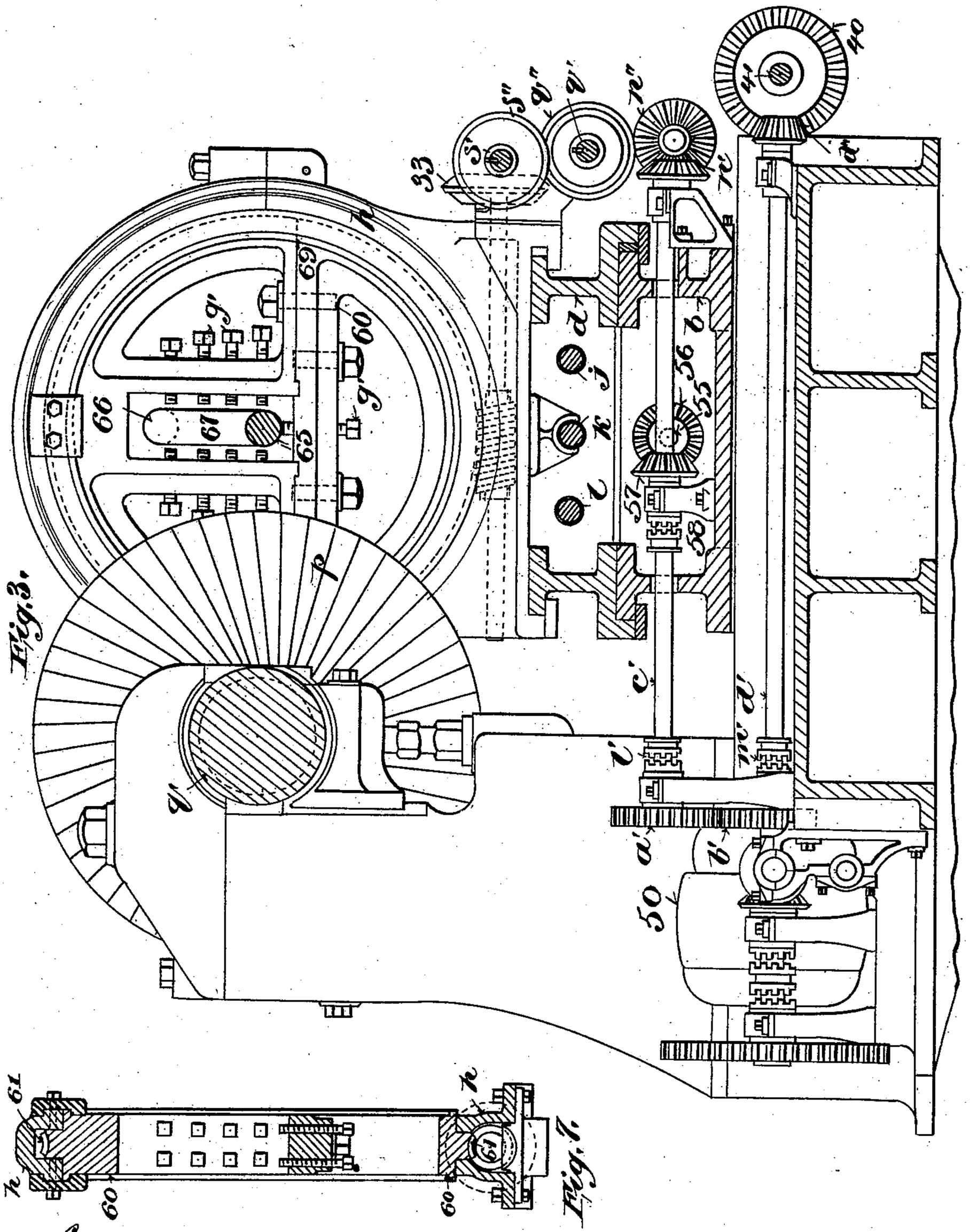


Fig. 3.

Fig. 7.

Witnesses,
C. W. Benjamin
Henry C. Morton.

Inventor's
Oscar F. Leibert and
Casimir von Philp.
by Harold Sinnes atty

No. 688,422. Patented Dec. 10, 1901.

O. F. LEIBERT & C. VON PHILP.

MILLING MACHINE.

(Application filed Mar. 16, 1901.)

(No Model.) 7 Sheets—Sheet 5.

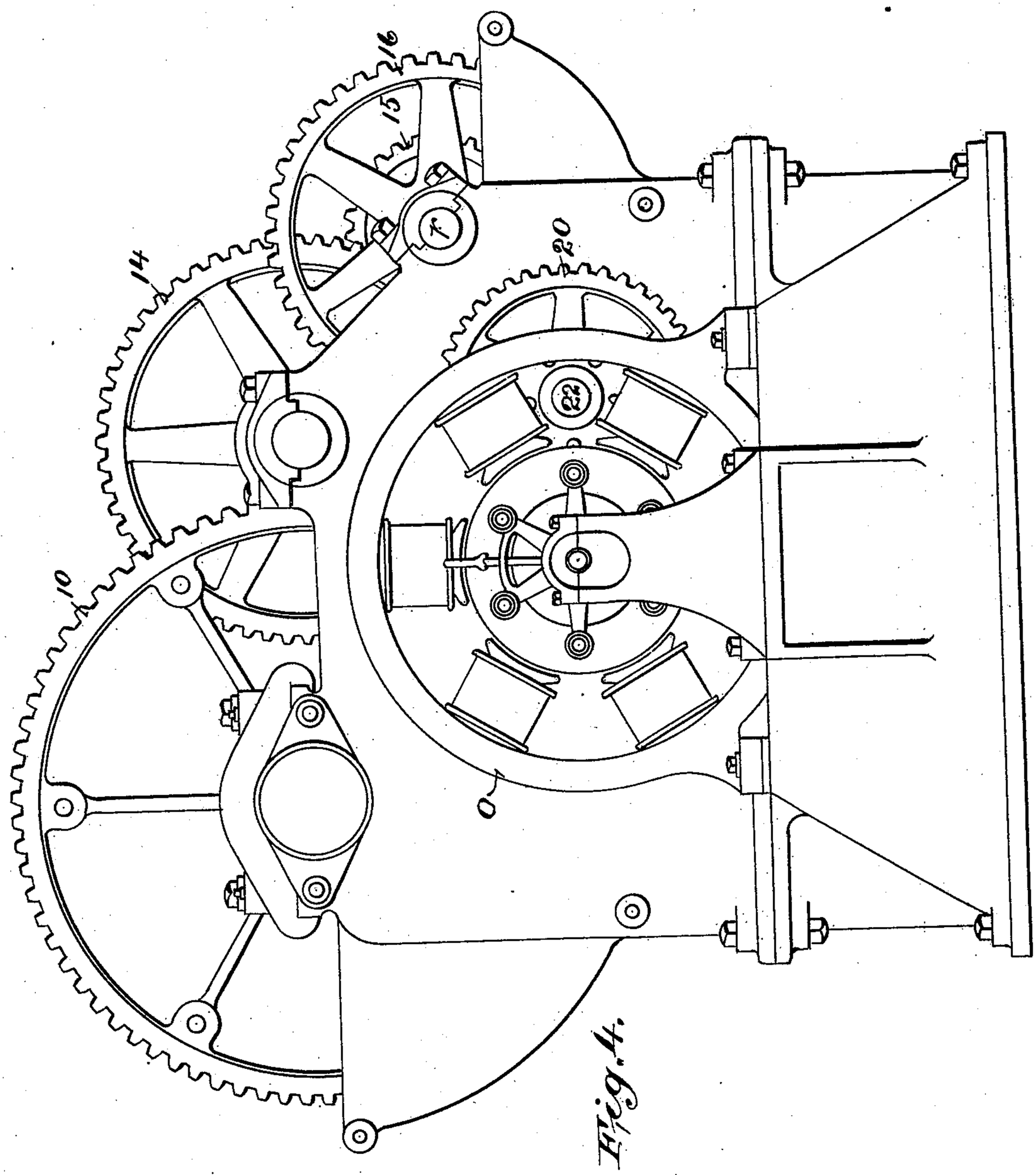


Fig. 4.

Witnesses,
C. W. Benjamin
Henry S. Morton.

Inventors
Owen F. Leibert and
Corinius von Philp
by Harold Thom
Atty

No. 688,422. Patented Dec. 10, 1901.

O. F. LEIBERT & C. VON PHILP.

MILLING MACHINE.

(Application filed Mar. 16, 1901.)

(No Model.) 7 Sheets—Sheet 6.

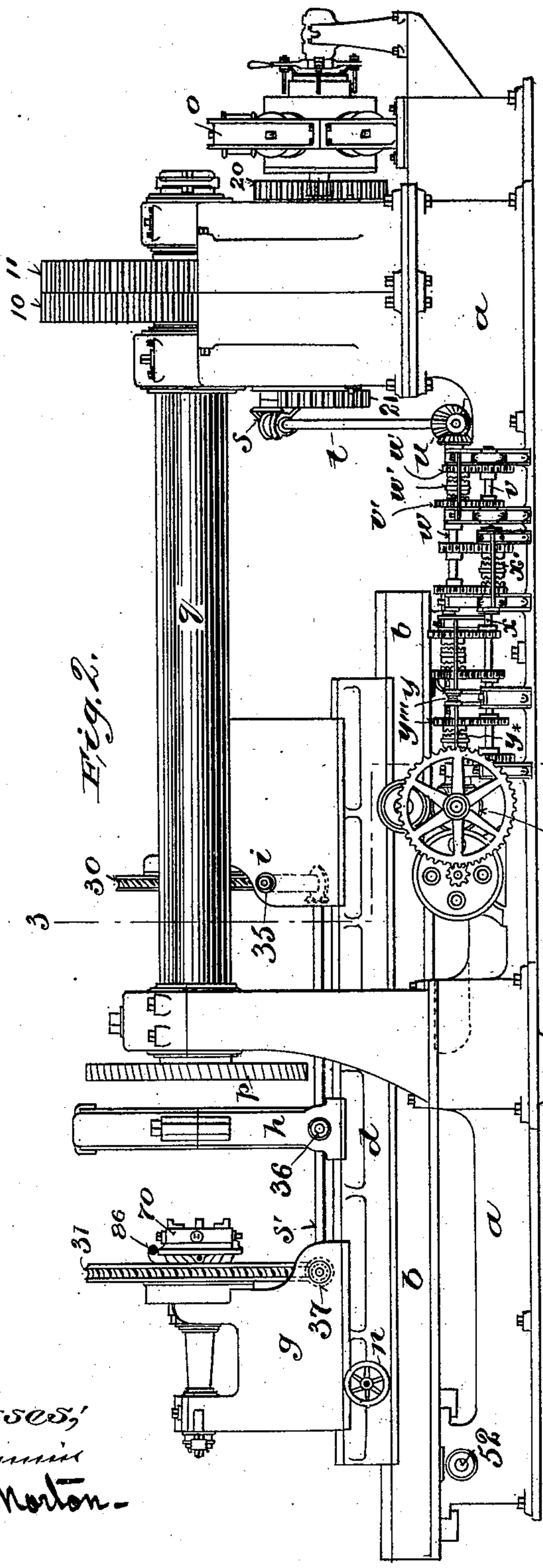


Fig. 2.

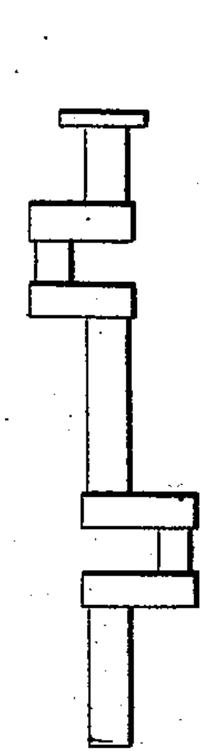


Fig. 6.

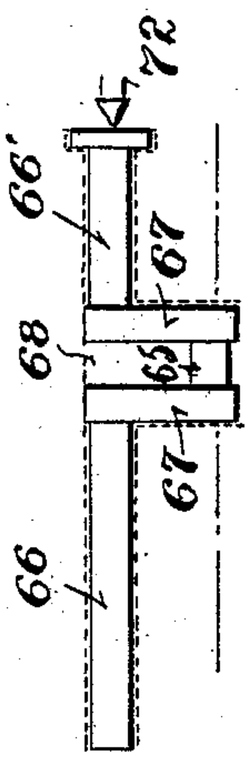


Fig. 5.

Witnesses;
C. F. Benjamin
Henry S. Morton.

Inventors
Owen F. Leibert and
Casimir von Philp.
by Marshall Brown
Atty

No. 688,422. Patented Dec. 10, 1901.

O. F. LEIBERT & C. VON PHILP.

MILLING MACHINE.

(Application filed Mar. 16, 1901.)

(No Model.) 7 Sheets—Sheet 7.

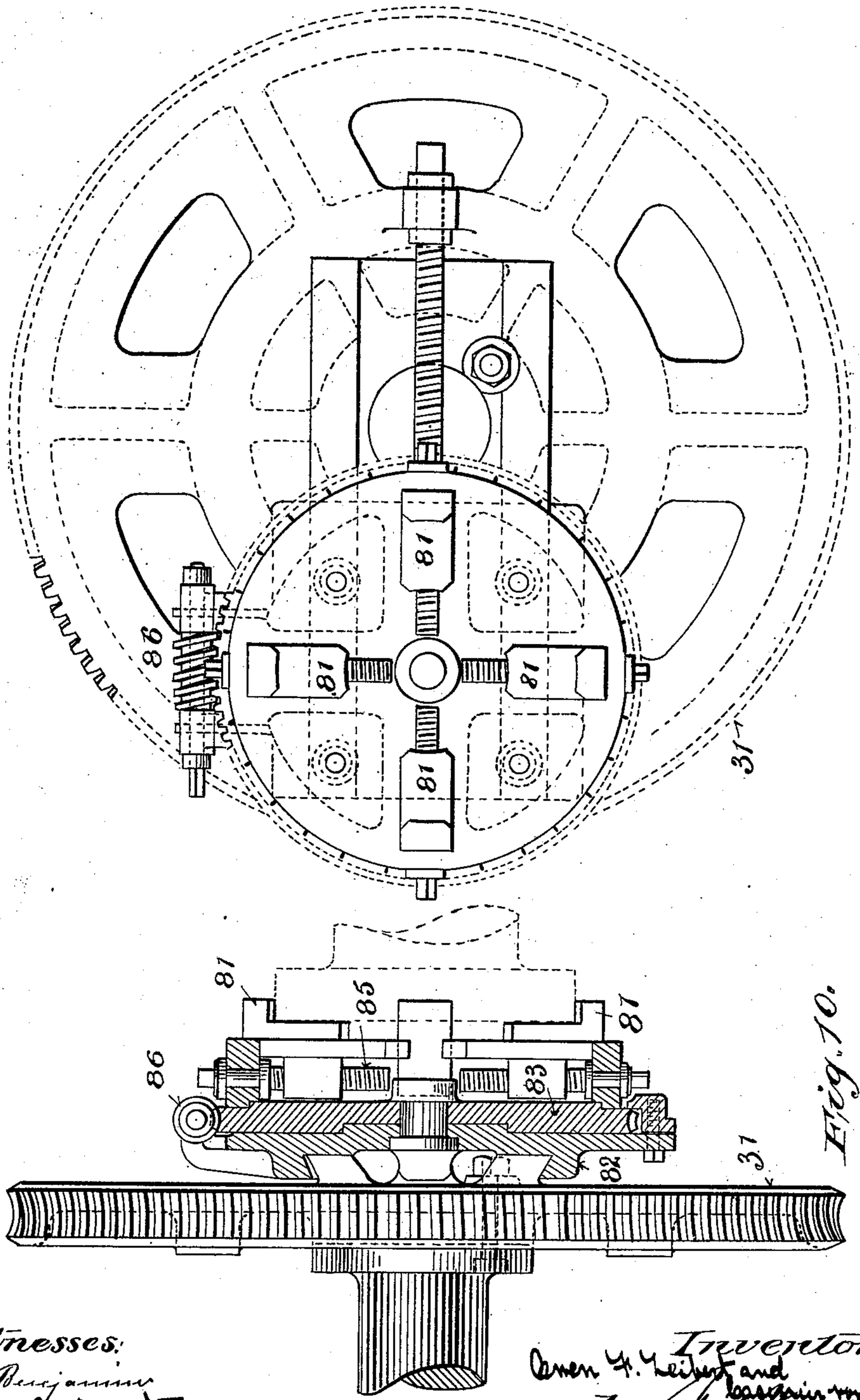


Fig. 11.

Fig. 10.

Witnesses:
C. W. Benjamin
Henry S. Morton

Inventors
Oscar F. Leibert and
Casparus von Philp
by Albert G. Davis
Atty

UNITED STATES PATENT OFFICE.

OWEN F. LEIBERT AND CASIMIR VON PHILP, OF BETHLEHEM, PENNSYLVANIA, ASSIGNORS TO SAID OWEN F. LEIBERT AND CASIMIR VON PHILP, TRUSTEES.

MILLING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 688,422, dated December 10, 1901.

Application filed March 16, 1901. Serial No. 51,458. (No model.)

To all whom it may concern:

Be it known that we, OWEN F. LEIBERT and CASIMIR VON PHILP, engineers, of Bethlehem, in the State of Pennsylvania, have invented certain new and useful improvements in milling-machines especially adapted to milling and finishing solid cranks, both double and single, and to other uses, of which the following is a specification.

The object of the invention is to produce a special machine which shall be more convenient and economical in use than any machine which is to-day procurable for the purpose of milling and finishing solid cranks formed in a single piece embodying single or double cranks, crank-pins, and crank-shafts and also adapted to other special uses.

The nature of the invention will be readily understood from the drawings, wherein—

Figure 1, consisting of two parts, Figs. 1ª and 1ᵇ, is a plan view of the machine. Fig. 2 is an elevation on a much smaller scale. Fig. 3 is a transverse cross-section looking toward the left of Fig. 1ª on the plane 3 3, Fig. 2. Fig. 4 is an end view from the right hand of Fig. 1ᵇ. Figs. 5 and 6 are illustrations, on a small scale, of two examples of cranks such as can be shaped and finished by the machine. Figs. 7 to 11 are detailed views of various parts lettered to correspond to the general views.

Throughout the drawings the same characters of reference indicate the same parts.

The stationary bed-plate *a* of the machine supports the lower bed *b*. The bed *b* travels transversely on the bed-plate and is provided with transverse guides therefor and actuated by beveled gears *c* and transverse screw-shafts, Figs. 1 and 2. An upper bed *d* travels longitudinally upon the bed *b*. Finally upon the bed *d* the head-stock *g*, tail-stock *i*, and chuck-head *h* are mounted to travel longitudinally, being actuated by longitudinal screw-shafts *j*, *k*, and *l*, mounted in the bed *d* and keyed or provided with square ends or otherwise connected to be turned by hand or by spur-gears *m*, fitted with toothed clutches, as usual, so that any one of the screw-shafts *j*, *k*, and *l* may be actuated. The gears *m* are actuated by a gear *c''*, which is driven by gear *b''* on the counter-shaft *q'*. By means which will be presently described the longitudinal and transverse feeding of the respective beds *d* and *b* are accomplished during the operation of the cutter. The face-plates 30 and 31 of the head-stock and tail-stock and the chuck which is within the chuck-head *h* are simultaneously and equally rotated by beveled gears 32, 33, and 34, which are actuated by three corresponding beveled gears *t'* on a spline-shaft *s'* in a manner which will be hereinafter described. The milling-cutter *p*, which should be of a type with inserted teeth adapted to cut on its peripheral surface and also on its plane faces or only on one surface, if desired, is carried by the shaft *q*, mounted in stationary bearings on the bed-plate of the machine. The shaft *q* is driven by the gears 10 and 11, affixed to it, and these in turn are actuated by pinions 12 and 13, turning with the speed-reducing gear 14, which in turn is driven by pinion 15 on the shaft *r*. The shaft *r* is driven at any speed desired by a variable-speed electric motor *o*. The speed of the motor may be varied in any desirable way, as is common. The motor may be connected, as shown in the drawings, to actuate either of the gear-wheels 20 and 21 and thence by reduction-gearing to drive the shaft *r*. From this same shaft *r* all the adjustments of the machine may be actuated. Shaft *t* is actuated by beveled gears *s* from the shaft *r*, and pinion *u'* is in turn actuated therefrom by beveled gears *u*. A shaft *w* in line with the pinion *u'* carries a clutch *w'*, one member of which revolves with it and is adapted to be connected to be driven by the pinion *u'*, as shown. To give a further variation of speed in the shaft *w*, a short counter-shaft *v*, carrying two different-sized pinions, is provided, one of which pinions meshes with the pinion *u'*, while the other drives the gear *v'*, turning loosely on the shaft *w*. The clutch *w'* is also adapted to engage the pinion *v'*, so as to drive the shaft *w* at reduced speed. A shaft *x* is geared to be driven by the shaft *w* at either of two speeds by means of the two sets of gears and the clutch *x'*, as shown in Fig. 2.

This gives a further variation in speed. In a similar manner a shaft y is geared to be driven at either of two speeds from the shaft x, as shown in Fig. 2. Turning loosely upon the shaft y are two pinions y'' and y''', either of which may be clutched to the shaft y by the interposed clutch member y^*, which is splined to turn with the shaft y. The gear y'' turns directly with beveled gear z', and so actuates beveled gear z. Gear y' is geared by a counter-shaft, as shown, so as to turn the pinion y'' at a different speed. By all these variable-speed gears, therefore, the beveled gear z may be driven at any of the great range of speeds from the shaft t. The beveled gear z turns loosely upon the shaft z''; but by means of a clutch a'' the two may be clutched together, so as to drive the shaft z''. This shaft z'' is the main adjusting-shaft of the several feed adjustments. In addition to the slow feed, which may be given to it by means of the connections described, an electric motor 50 is connected to turn the shaft z'' rapidly to effect a quicker adjustment by means of the gear z''', which turns loosely upon the shaft z'', but may be coupled thereto by the clutch shown in Fig. 1ª.

The transverse travel of the bed b is accomplished by a shaft d', which may be connected by a clutch m' to the shaft z''. The shaft d' by means of beveled gears d'' and 40 drives the shaft 41. Shaft 41 is connected at each end by means of beveled gears c to the transverse screw-shafts 52 52, only one of which is plainly seen in Fig. 2 and which feed the bed b transversely. The details of this connection being common practice need not be separately illustrated or described.

The longitudinal movement of the bed d is accomplished by a common form of longitudinal screw-feed, the screw-shaft 55 of which, Fig. 3, carries beveled gear 56 and is actuated by beveled gear 57, which turns loosely upon shaft c', but may be clutched by the clutch 58, so as to cause the shaft c' to turn the gears 57 and 56. Shaft c' is then driven by the clutch l', one member of which turns with the gear a', gear a' being driven by the gear b' on the shaft z'', as seen in Fig. 3. The shaft c' may be mounted to travel transversely with the bed b, in which case the connection with the clutch l' must be by a spline, as well understood. By having the shaft c' so travel with the bed b the bearings for the beveled gear n', Fig. 3, and for the shaft o' may be mounted upon the bed b.

The movements of the head-stock, tail-stock, and chuck are actuated by the two shafts q' and s'. Both these shafts q' and s' are carried in bearings upon the bed d, so as to move longitudinally with it. Rotation is transmitted from the shaft o' to the shaft q' by the gears p' and p'', which may be mounted to travel with the bed d, as shown, in which case the shaft o' is splined to the gear p', or they may be mounted on the bed b, in which case the shaft q may be splined. The shaft q' drives the gears b'', c'', and m at the left-hand end of the bed d for actuating the longitudinal screw-shafts j, k, and l, as already described. The screw-shaft k, as shown in Fig. 3, engages a threaded half-sleeve beneath the chuck-head h and feeds the chuck-head longitudinally. The shafts j and l coöperate similarly with the head and tail stocks.

The shaft s' is driven from the shaft q' by means of the gears q'' and s'', one or both of which must be splined to the corresponding shaft so as to permit of longitudinal travel. Preferably these two gears are both splined to their shafts and are mounted in bearings on the chuck-head h, as shown in Figs. 1ª and 3. Loose upon the shaft s' are three beveled gears t', which are respectively mounted to travel with the head-stock, the chuck-head, and the tail-stock and which mesh with and drive the three beveled gears 34, 33, and 32, which turn with worm-shafts 37, 36, and 35, Fig. 2, for rotating the face-plates of the head-stock and the tail-stock and the rotary chuck in the head h, as will now be explained.

Only the worm-wheel connections for the chuck will be described at length, as those for the head-stock and tail-stock are similar. Figs. 1ª, 2, 3, and 7 show the chuck-head h, which surrounds the chuck 60 in the manner best shown in Fig. 7. The chuck 60 is free to turn circumferentially in the chuck-head h and is provided with worm-wheel teeth 61, which mesh with the worm 62 upon the shaft 36, driven, as already described, by the gear 33. The gear 33 and its coöperating beveled gear l' are thrown into or out of action by means of the clutch (shown in Fig. 1ª) upon the shaft s', so that by this means the chuck 60 may be accurately turned to any angular position desired, either separately or in conjunction with the face-plates of the head-stock and tail-stock. The face-plate 31 of the head-stock is provided on its periphery with worm-teeth, which mesh with the worm-shaft 37, driven by the beveled gear 34. Similarly the face-plate 30 of the tail-stock is actuated by worm-teeth and worm-shaft 35, driven by the beveled gear 32. By means of the clutches on the shaft s' it is therefore possible to turn the parts 30, 31, and 60 at the same angular speed, the gearing being designed for this purpose, and it is also possible to turn any one of them separately or two of them together.

The head-stock, tail-stock, and chuck are mounted so that their axes are in exact alinement. The chuck 60 when designed for the milling of cranks has a rectangular space of a size suitable for receiving the crank and set-screws g', by which the crank—*i. e.*, the webs or crank proper—may be firmly held in place and accurately centered, so as to bring the crank-pin exactly at the center of the rotary chuck 60. In Fig. 3 a crank is shown in position, the crank-pin being marked 65, the crank-shaft 66, and the web or crank proper 67, the crank-pin 65 being shown in section.

When the crank-pin is being shaped and milled by the machine, it is so placed centrally in the chuck 60, and the shaft 66 is centered and held in an eccentric chuck 70, which is adjustably mounted upon and revolves with the face-plate 31 of the head-stock. The other end of the crank-shaft is centered on the eccentric center 72, which is adjustably mounted upon the face-plate 30. These eccentric adjustments are accomplished as follows: The center 72 is carried on a traveling head 73, which is threaded to and is adjustable by a screw-shaft 74, placed diametrically upon the face-plate 30. The head 73 travels upon guides 75, which are parallel with the shaft 74. The shaft 74 turns between collars in the lug 76, fixed on the face-plate 30 and which is provided with a square head 77, by which it may be rotated to accurately adjust the center 72 to the exact eccentricity which exists between the crank-shaft and the crank-pin being milled. The adjustment of the chuck 70 may be similar, as shown in Figs. 10 and 11, and need not be separately described. The four jaws 81 of the chuck are not mounted directly upon the traveling head 82, but upon a worm-wheel plate 83, and they are readily adjustable by means of the four screws 85. The worm-wheel plate 83, which carries them, has its peripheral teeth engaged by the worm 86, so that it may be manually adjusted angularly with great accuracy.

Having now described the principal novel mechanisms of the machine, its operation as applied to a simple double crank, such as is shown in Fig. 5, will be explained. The dotted lines in Fig. 5 may be taken to show the shape of the crank as cast or forged ready to be introduced into the machine. The entire web of the crank is solid, as shown, and has to be milled out. For milling out the metal 68 between the crank-webs 67 the work is placed in the machine with one of the webs 67 clamped in the chuck 60, the crank-shaft 66 66′ being centered at its respective ends in the chuck 70 and on the adjustable center 72. The parts are adjusted so that the axis of the crank-pin 65 will be in exact alinement with the axes of the face-plates 30 and 31. The face-plates 30 and 31 and the chuck 60 are then rotated until the shaft 66 lies in the same horizontal plane with the crank-pin 65 and on the same side as the milling-cutter *p*. Longitudinally the shaft is adjusted so that the milling-cutter will be opposite the metal 68 that is to be cut out. Then, the machine operating, the bed *b* is fed toward the cutter, so that the periphery of the cutter cuts away the space between the cranks 67 until the cutter nearly reaches the crank-pin 65. Then the transverse movement is stopped and a very slow longitudinal feed is given to the bed *d*, causing one of the plane faces of the cutter to cut away the metal 68 until one of the plane faces of the crank is formed. The reverse feeding and cutting forms the inside face of the other crank in a similar manner. After this the face-plates 30 and 31 and the chuck 60 are rotated, causing the crank to be revolved upon the axis of the crank-pin 65, and therefore enabling the periphery of the cutter to round up the crank-pin. By moving the bed *d* endwise the entire length of the crank-pin may be so shaped in the machine. Then the inside cheeks of the crank and the entire crank-pin having been shaped, the cutting is stopped and the position of the crank is changed to bring the axis of the crank-shaft 66 in line with the centers of the disks 31 and 32, whereupon the operations of finishing the shaft and the outer cheeks of the cranks 67 may be accomplished in a manner similar to that described.

For the purpose of more readily handling the work the chuck-head *h* is divided horizontally, as seen in Fig. 3, so that its upper portion or strap may be lifted off and the entire chuck 60 taken out. The chuck itself is bolted together, but divisible horizontally on the plane 69, Fig. 3, so that it may be removed or put in place without taking the crank or other work out of the machine.

What we claim, and desire to secure by these Letters Patent, are the following characteristic features:

1. In a milling-machine, the cutter and means for driving it, means for holding the work, means for feeding the work longitudinally, means for feeding the work transversely, means for rotating the work while it is being milled, and means for changing the axis of rotation of the work, substantially as set forth.

2. In a milling-machine, the cutter and means for driving it, means for holding the work, means for feeding the work longitudinally, means for feeding the work transversely, means for rotating the work while it is being milled, and coöperating driving connections for severally or coactively operating the said several means, substantially as set forth.

3. In a milling-machine, the cutter and means for driving it, means for holding the work, means for feeding the work transversely, means for rotating the work while it is being milled, and mechanical driving connections connected to simultaneously or separately actuate the said several means, substantially as set forth.

4. In a milling-machine, the cutter and means for driving it, an adjustable tail-stock, a head-stock carrying a rotary face-plate, worm-wheel mechanism for revolving the face-plate, and means for feeding the head-stock longitudinally and means for feeding head-stock and tail-stock transversely, substantially as set forth.

5. In a milling-machine, the cutter and means for driving it, a head-stock carrying a rotary face-plate, worm-wheel mechanism for revolving the face-plate, a chuck movably mounted upon the said face-plate, means for

radially adjusting the said chuck upon the said face-plate, and mechanism for rotating the said chuck upon its own axis, substantially as set forth.

6. In a milling-machine, the cutter and means for driving it, a head-stock carrying a rotary face-plate, worm-wheel mechanism for revolving the face-plate, a chuck mounted upon the said face-plate and means for rotating the chuck on its own axis independently of the said face-plate, substantially as set forth.

7. In a milling-machine, the combination of a head-stock, a tail-stock, an independent adjustable chuck mounted between the head and tail stocks, and means for rotating the said chuck independently of the said head-stock, substantially as set forth.

8. In a milling-machine, the combination of a head-stock, a tail-stock, an independent adjustable chuck mounted between the head and tail stocks, and means for actuating the rotary parts of the head-stock, tail-stock and chuck either independently or together, substantially as set forth.

9. In a milling-machine, the combination of a head-stock, a tail-stock, an independent adjustable chuck mounted between the head and tail stocks, means for rotating the said chuck independently of the said head-stock, and means for transversely adjusting the head-stock, the tail-stock, and the said chuck, substantially as set forth.

10. In a milling-machine, the combination of a head-stock, a tail-stock, an independent adjustable chuck mounted between the head and tail stocks, means for rotating the said chuck independently of the said head-stock, and means for longitudinally adjusting the head-stock, the tail-stock, and the said chuck coöperatively or independently at will, substantially as set forth.

11. In a milling-machine, the combination of a head-stock, a tail-stock, an independent adjustable chuck mounted between the head and tail stocks, the head-stock and tail-stock both being provided with revolving face-plates and with means for actuating them, substantially as set forth.

12. In a milling-machine, the combination of a head-stock, a tail-stock, an independent adjustable chuck mounted between the head and tail stocks, the head-stock and tail-stock both being provided with revolving face-plates, means for actuating them, and means for eccentrically adjusting their centers, substantially as set forth.

13. In a milling-machine, the combination of a cutter and driving mechanism, a transversely-traveling bed, a longitudinally-traveling bed, and a head-stock and tail-stock independently adjustable longitudinally and provided with rotary face-plates and means for rotating the same, and an independent rotary chuck mounted between the head and tail stocks provided with means for rotating it, substantially as set forth.

Signed this 12th day of March, 1901, at Bethlehem, Pennsylvania.

OWEN F. LEIBERT.
CASIMIR VON PHILP.

Witnesses:
JOSEPH M. LEIBERT, Jr.,
R. W. LEIBERT.