C. G. CURTIS.

SLOTTING MACHINE.

APPLICATION FILED OCT. 3, 1902. RENEWED APR. 6, 1906.

911,944.

Patented Feb. 9, 1909.

4 SHEETS—SHEET 1.

Fig. 1

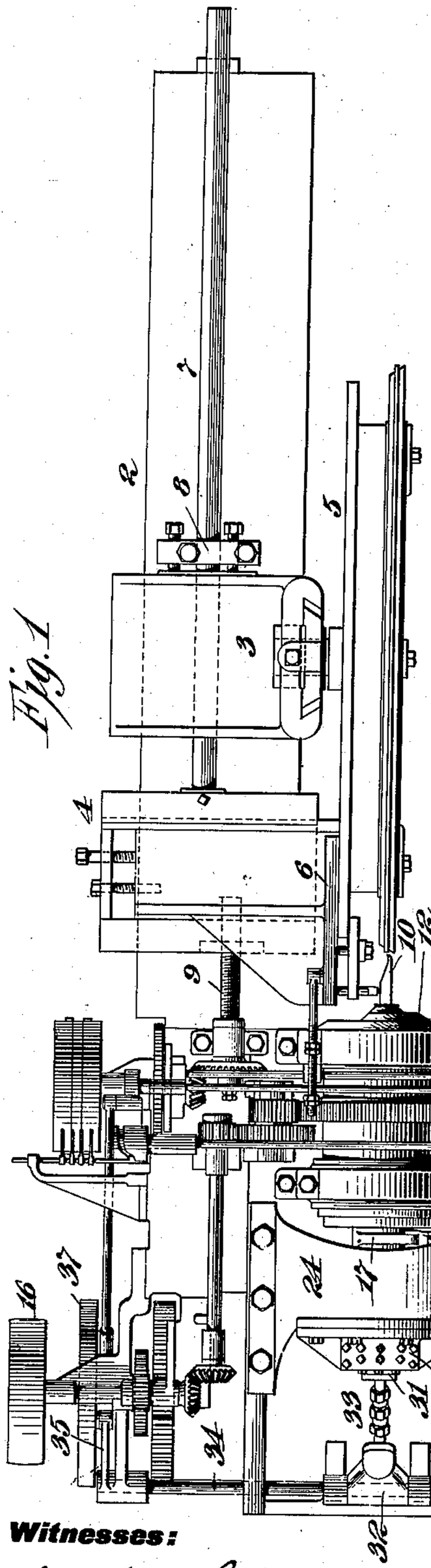
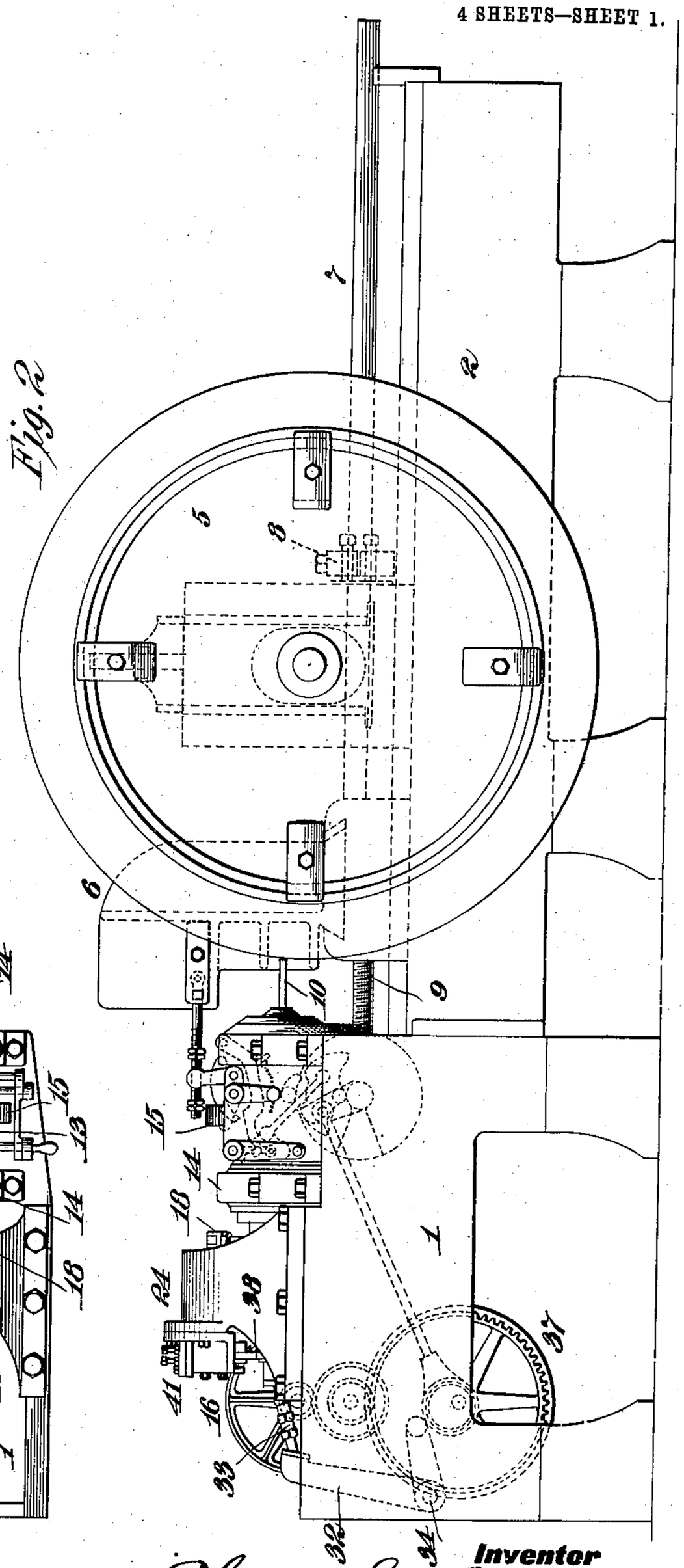


Fig. 2



Witnesses:

Jas. F. Coleman

Jno. Robt. Taylor

Inventor

Charles G. Curtis

By Dyer Edmunds & Dyer

Attorneys

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4 SHEETS—SHEET 2.

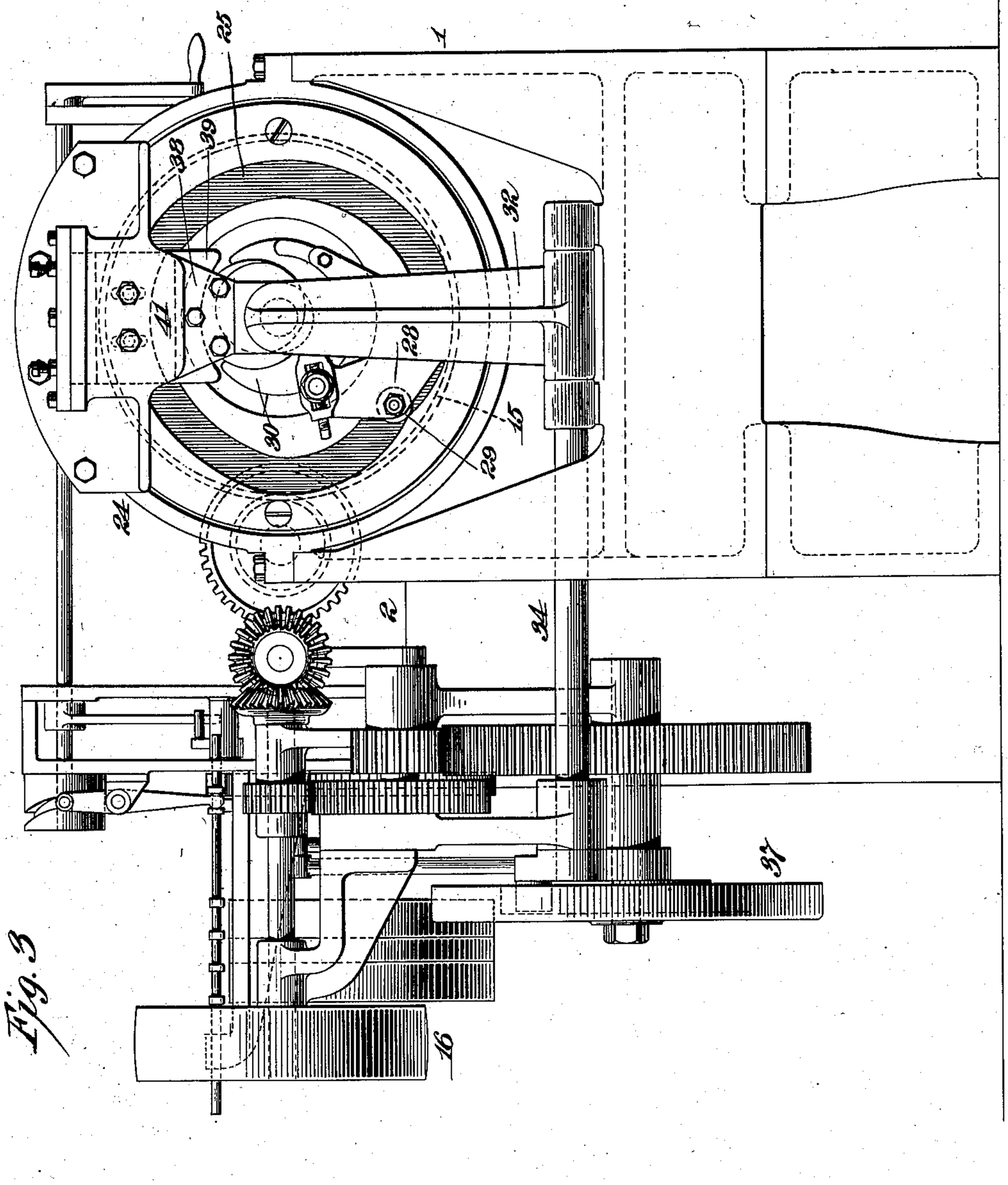

Fig. 3

Witnesses:

Jas. F. Coleman

Jno. Robt Taylor

Inventor

Charles G. Curtis

By Dyer Edmonds & Dyer

Attorneys

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4 SHEETS—SHEET 3.

Fig. 4

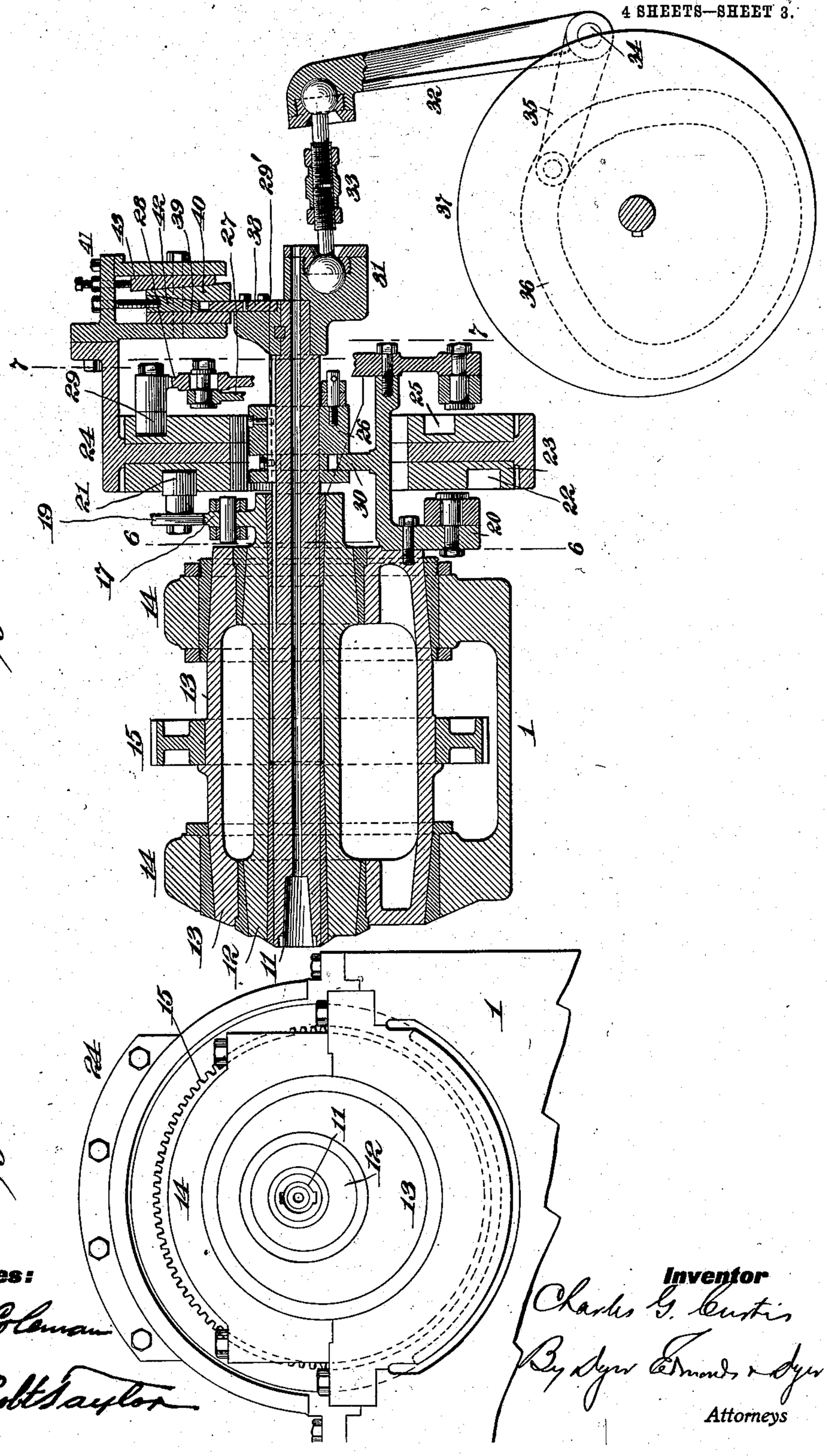

Fig. 5

Witnesses:

Jas F. Coleman

Jno. Robt Taylor

Inventor

Charles G. Curtis

By Dyer Tyndale & Dyer

Attorneys

C. G. CURTIS.

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4 SHEETS—SHEET 4.

Fig. 7

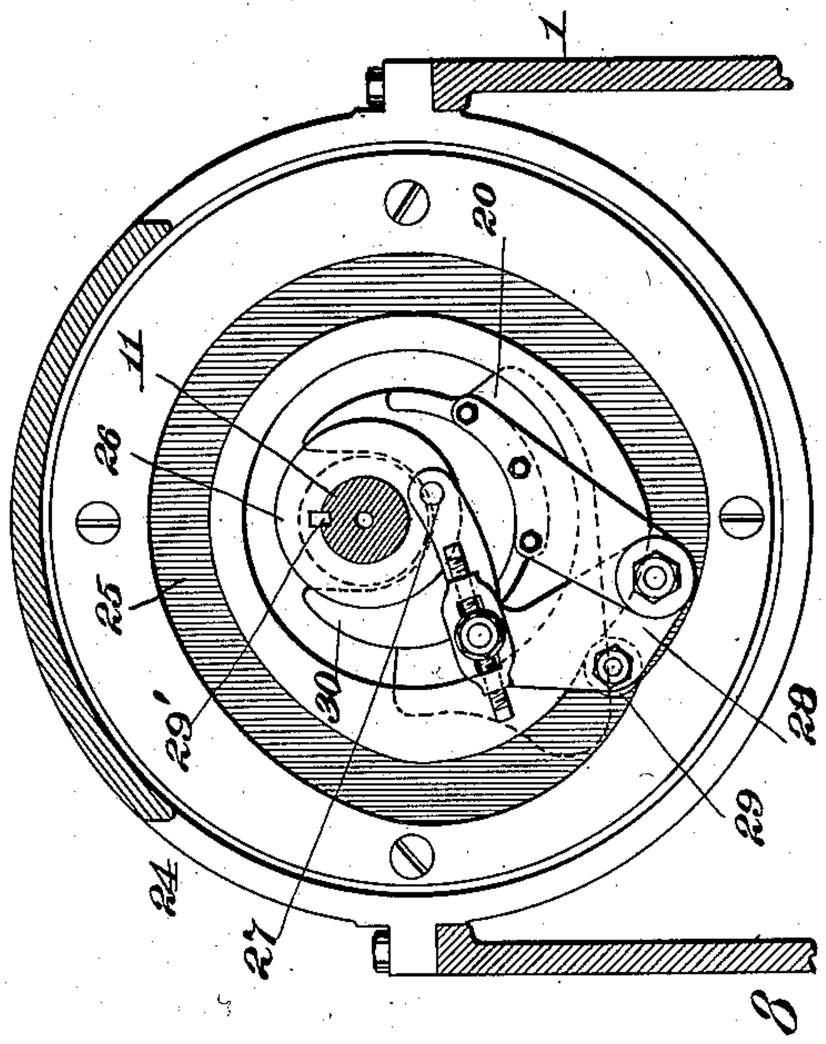
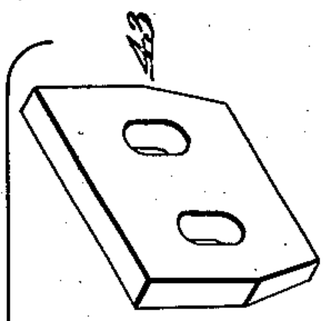


Fig. 8



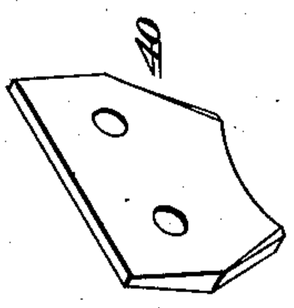
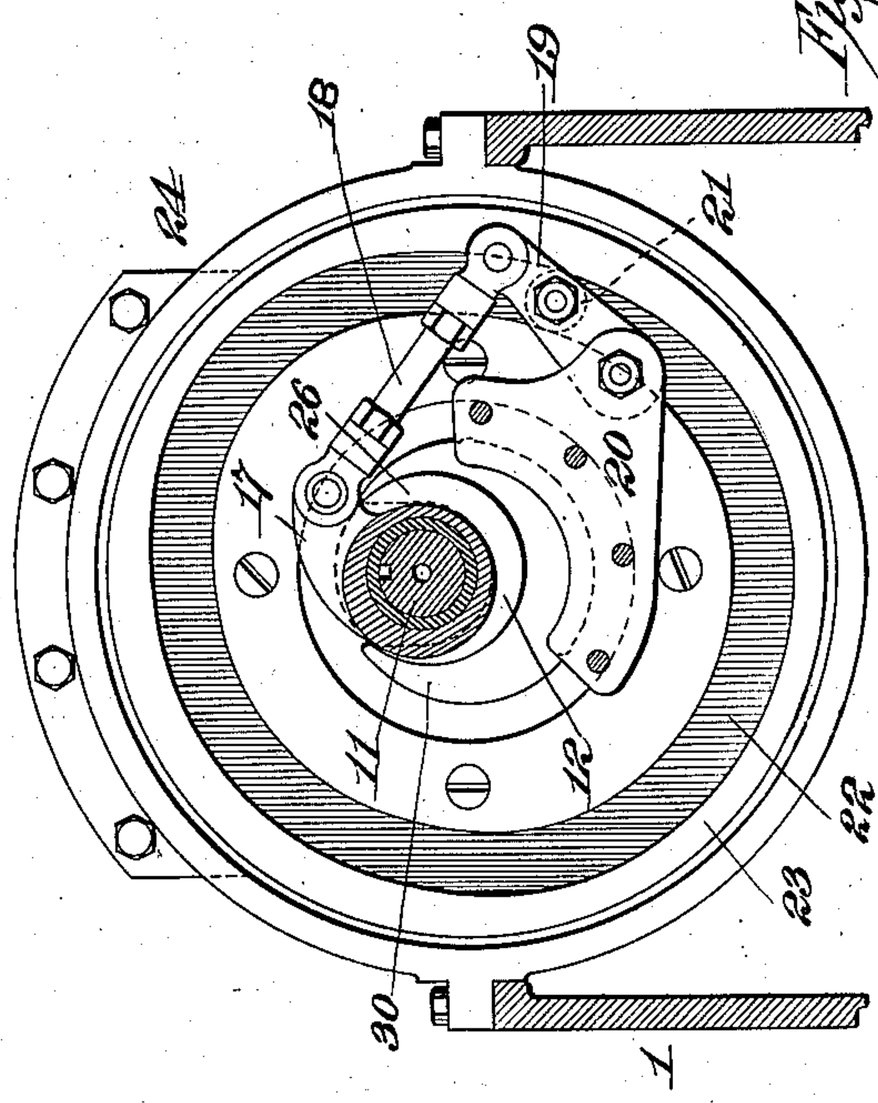
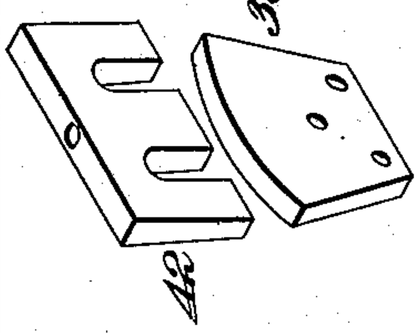
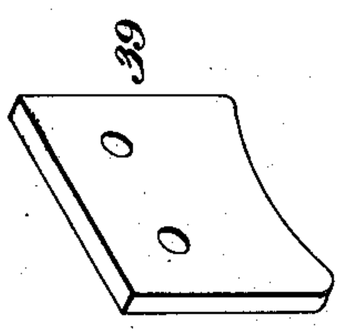


Fig. 6







Witnesses:

Jas. F. Coleman

Jno. Robt Taylor

Inventor

Charles G. Curtis

By Dyer Edmonds & Dyer

Attorneys

UNITED STATES PATENT OFFICE.

CHARLES G. CURTIS, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

SLOTTING-MACHINE.

No. 911,944. Specification of Letters Patent. Patented Feb. 9, 1909.

Application filed October 3, 1902, Serial No. 125,766. Renewed April 6, 1906. Serial No. 310,264.

To all whom it may concern:

Be it known that I, CHARLES G. CURTIS, a citizen of the United States, residing in the borough of Manhattan, city of New York, State of New York, have invented a certain new and useful Improvement in Slotting-Machines, of which the following is a specification.

My invention relates to machines for cutting curved slots across the peripheral surfaces of rings or disks or segments thereof, more particularly to form the vane spaces of steam turbines of the Curtis type. It is an improvement upon the machine invented by Frank M. Leavitt and myself upon which application for patent was filed April 30, 1901 (Serial No. 58,129).

The object of the present invention is to produce a machine of this character which will be more accurate in operation, will have less lost motion and wear, and will be capable of being run at a higher speed.

In the drawing, Figure 1 is a plan view of a machine embodying my present invention; Fig. 2 is a side elevation of the same; Fig. 3 is an end elevation of the same taken from the end to which power is applied; Fig. 4 is a vertical section of the head of the machine taken lengthwise through the tool spindle; Fig. 5 is a front end elevation of the head of the machine; Figs. 6 and 7 are views respectively of the cams and associated parts for controlling the orbital and axial movements of the tool, taken on lines 6—6 and 7—7 in Fig. 4; and Fig. 8 is a perspective view of the plates for holding the tool spindle against longitudinal movement while the tool is cutting the work, these plates being shown as separated.

1 is the frame carrying the cutting mechanism, from which extends a bed 2 carrying the work to be cut. The work-carrier is divided into two parts, 3, 4, the former supporting the shaft of the index plate 5 which is vertically adjustable thereon. The work is clamped to the index plate. The part 4 of the carrier has a laterally adjustable clamp 6 which clamps the inner edge of the index plate so as to fix the position of the work with relation to the cutting tool. The parts 3 and 4 of the carrier are connected together by a rod 7 and clamp 8, so that they can be separated more or less to accommodate index plates of different diameters. The work-carrier is given an intermittent feed movement so as to advance the work after each cut by a screw 9, which is intermittently rotated by any suitable or usual means. The cutting tool 10 is carried by a tapering socket in the end of a spindle 11 which is mounted eccentrically in a surrounding sleeve 12 in which it has movements both of rotation and reciprocation. The sleeve 12 is in turn mounted eccentrically in a still larger sleeve or barrel 13 in which it has a movement of rotation only, while the outside sleeve or barrel 13 is supported by and rotated in bearings 14 mounted on the frame 1. The barrel 13 carries a gear 15 connected by suitable gearing with the driving pulley 16 by means of which the barrel is rotated, and also the sleeve 12 and tool spindle 11, causing the tool spindle by reason of its eccentric mounting to describe a circular path about the center of rotation. The sleeve 12 is connected with the barrel 13 so as to be turned bodily thereby, and at the same time this connection permits the sleeve to be turned in the barrel so as to move the tool spindle towards and away from the center of rotation and thereby vary the path described by the tool in the work to the extent desired from a true circle. The rotary movement of the sleeve within and independent of the barrel is controlled by a cam and produces the orbital movement of the tool as described in the application for patent already referred to.

By mounting the tool spindle eccentrically in a surrounding sleeve carried by the rotating barrel and varying the curvature of the path described by the tool by turning this sleeve, a more rigid and desirable construction is produced than that described in said application. To this end, the sleeve 12 on its end away from the cutting tool is provided with an arm 17 which is connected by pivoted links 18, 19 (Fig. 6) with a plate 20 bolted to the adjacent end of the barrel 13. The link 19 is provided with a roller 21 which engages a fixed cam groove 22 formed in a plate 23 supported by the stationary housing 24. This orbital cam 22 is properly shaped so as to produce the desired rotary movement of the sleeve 12 in the barrel 13.

The axial movement of the tool spindle to maintain the cutting edges of the tool normal to the cut notwithstanding the variation of its movement from a true circle, is produced by a stationary cam 25 also supported by the housing 24. The plate 20

which is bolted to the end of the barrel 13 is connected with a block 26 mounted on the tool spindle 11 and turning therewith by means of pivoted links 27, 28 (Fig. 7), the latter carrying a roller 29 which engages the axial cam 25. The block 26 while turning with the tool spindle 11 is held against movement when the tool spindle is reciprocated longitudinally. This is accomplished by providing the block 26 with a key 29′ which engages a key-way in the tool spindle (Fig. 4) so that the spindle can slide within the block, the block being prevented from moving lengthwise with the spindle by a projection 30 on the plate 20 which engages a groove encircling the block. This means for giving the tool spindle its axial movements is advantageous over the means described for the same purpose in the application referred to.

For reciprocating the tool spindle so as to retract the tool during the return portion of its revolution and to hold the tool forward in the work while cutting, I provide special devices. Upon the outer end of the tool spindle is secured a coupling block 31, to which is connected an arm 32 by means of a link 33 and ball-and-socket joints. The connection of the link 33 with the block 31 is made approximately in line with the center of rotation of the barrel 13. The arm 32 extends from a rock-shaft 34 supported in bearings transversely upon the frame 1. The outer end of the rock-shaft 34 has a shorter arm 35 carrying a roller engaging with a cam groove 36 in a plate 37 mounted upon a shaft which is driven by gearing from the driving pulley 16. The tool retracting cam 36 is properly shaped so as to turn the rock-shaft 34, throwing back the arm 32 and pulling back the tool spindle after the tool has completed its cut. The tool is thereby caused to clear the work on the return portion of its revolution, after which the retracting cam acts to push forward the tool spindle so that the tool will engage the work for a new cut. To hold the tool forward in the work without relying upon the retracting cam and the connections between it and the tool spindle in which there will be more or less lost motion, the coupling block 31 on the outer end of the tool spindle has secured to it a guide plate 38 projecting radially therefrom and working between plates 39, 40, supported in a stationary housing 41. The separation of the plates 39, 40, is adjusted by means of wedges 42, 43, moved by screws. The plate 40 receives the backward thrust of the tool spindle, and it is important therefore that its position should be accurately adjusted and rigidly fixed. This is accomplished by means of the wedges 42, 43. The guide plate 38 and the thrust plate 40 have such a width that they are in engagement only while the tool is cutting the work and long enough before and after to make the engagement certain and effective.

The operation of the machine will be understood without further description.

What I claim is:—

1. In a slotting machine, the combination with a main rotating element, of an auxiliary rotating element, carried eccentrically by the main rotating element, a tool spindle carried eccentrically by said auxiliary rotating element and means for rotatively adjusting the auxiliary element within the main element operated automatically by the rotation of the parts, whereby the path described by the tool spindle will be automatically varied from a true circle by the rotative adjustment of said auxiliary element, substantially as set forth.

2. In a slotting machine, the combination with a main rotating element, of an auxiliary rotating element carried by the main element and rotatively adjustable therein, a tool spindle carried eccentrically by the auxiliary element, a connection between the main and auxiliary elements, whereby the latter will be driven rotatively by the former, and means for automatically varying said connection as the parts rotate so as to adjust the auxiliary element rotatively in the main element, substantially as set forth.

3. In a slotting machine, the combination with a main rotating element, of an auxiliary rotating element carried by the main element and rotatively adjustable therein, a tool spindle carried eccentrically by the auxiliary element, a link connection between the main and auxiliary elements, whereby the latter will be driven by the former, and a cam coacting with said link connection to lengthen and shorten the distance between its ends, whereby the auxiliary element will be adjusted rotatively in the main element and the curvature of the path described by the tool spindle will be varied, substantially as set forth.

4. In a slotting machine, the combination with the rotating barrel, of the sleeve mounted therein, the tool spindle carried eccentrically by the sleeve, and the orbital cam and connections between the barrel and sleeve for rotatively adjusting the sleeve within the barrel, substantially as set forth.

5. In a slotting machine, the combination with the rotating barrel, of the sleeve mounted eccentrically therein, the tool spindle mounted eccentrically within the sleeve, and the orbital cam and connections between the barrel and sleeve for rotatively adjusting the sleeve within the barrel, substantially as set forth.

6. In a slotting machine, the combination with the tool spindle mounted eccentrically in a rotating element and adjustable therein so as to describe a path of varying curva-

ture, of a link connection between the tool spindle and the rotating element which carries it, and a cam engaging such connection and lengthening and shortening the distance between its ends for rotating the tool spindle axially within its rotating carrier, so as to maintain its cutting edges normal to the cut, substantially as set forth.

7. In a slotting machine, the combination with the main and auxiliary rotating elements, and means for automatically adjusting the auxiliary element rotatively in the main element, of the tool spindle carried eccentrically by the auxiliary element, and means for automatically adjusting the tool spindle rotatively within said auxiliary element, and means for moving said tool spindle longitudinally in said auxiliary element to retract the tool, substantially as set forth.

8. In a slotting machine, the combination with the tool spindle mounted eccentrically in a rotating support and having automatically effected orbital and axial adjustments, said spindle being longitudinally movable in its support, of a retracting cam and a connection between said cam and said spindle approximately in line with the center of rotation for effecting the retraction of the spindle by the cam, substantially as set forth.

9. In a slotting machine, the combination with the tool spindle mounted eccentrically in a rotating support and having automatically effected orbital and axial adjustments, said spindle being longitudinally movable in its support, of a retracting cam, a rocker-arm moved by said cam, and a universally jointed connection between said rocker-arm and said spindle approximately in line with the center of rotation, substantially as set forth.

10. In a slotting machine, the combination with the tool spindle carried eccentrically by a rotating element and having automatically effected orbital and axial adjustments, said spindle being longitudinally movable in its support, of a retracting cam and connections for moving said spindle longitudinally, and a thrust plate or block for holding said spindle in a fixed forward position during a portion of its rotation, substantially as set forth.

11. In a slotting machine, the combination with a tool spindle carried eccentrically by a rotating support and having automatically effected orbital and axial adjustments, and also movable longitudinally in its support, of a thrust plate or block adjustable by means of wedges, and a guide plate carried by said spindle which passes in front of said thrust plate or block during a portion of the revolution of the spindle, substantially as set forth.

This specification signed and witnessed this 30th day of Sept. 1902.

CHARLES G. CURTIS.

Witnesses:
JNO. ROB'T TAYLOR,
JOHN LOUIS LOTSCH.