No. 887,010. PATENTED MAY 5, 1908.

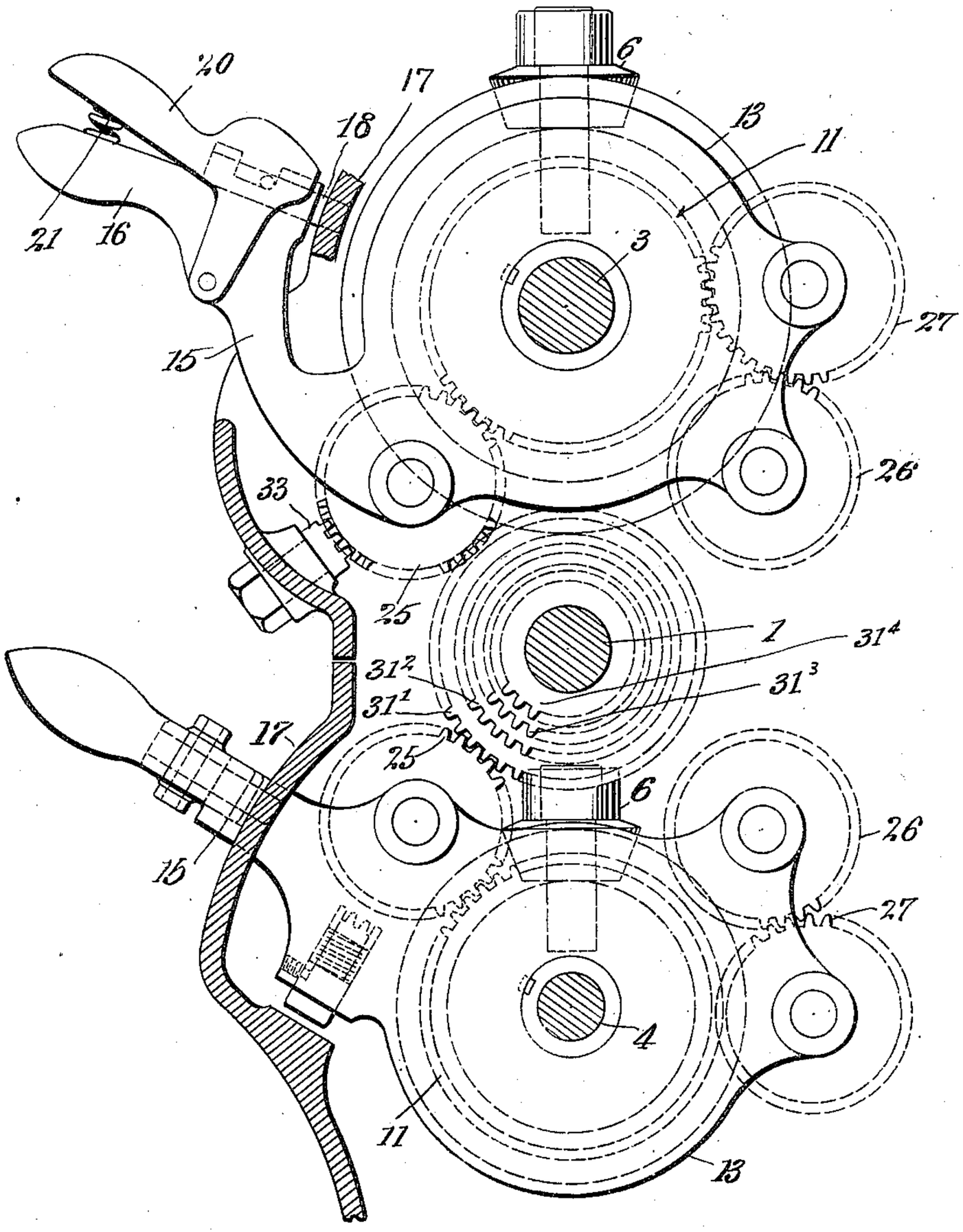
E. J. McCLELLAN.

SPEED CHANGE GEARING.

APPLICATION FILED SEPT. 7, 1907.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

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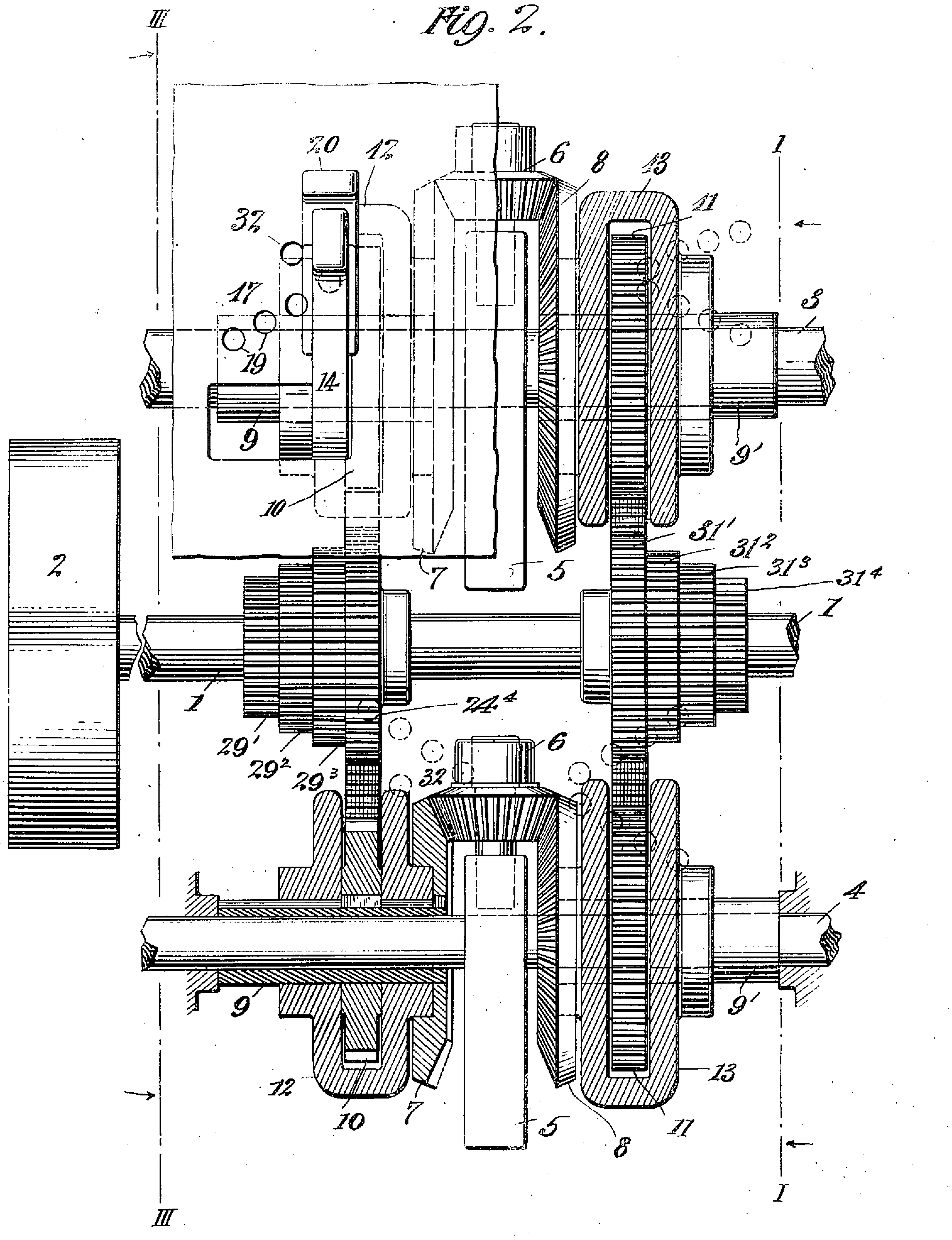
3 SHEETS—SHEET 2.

Fig. 2.



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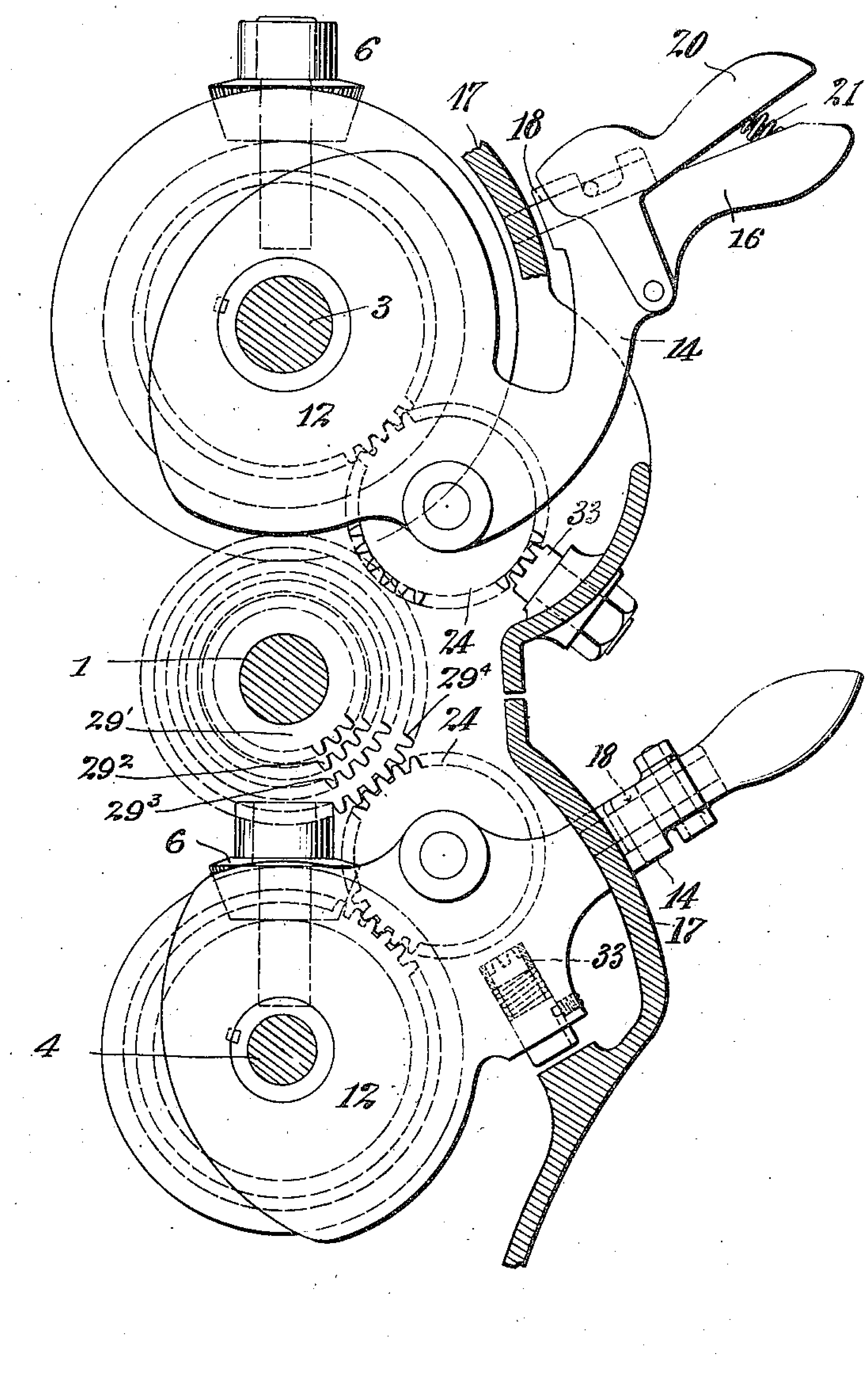
3 SHEETS—SHEET 3.

Fig. 3.



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UNITED STATES PATENT OFFICE.

EDWARD J. McCLELLAN, OF NEW YORK, N. Y., ASSIGNOR TO THE GARVIN MACHINE COMPANY, A CORPORATION OF NEW YORK.

SPEED-CHANGE GEARING.

No. 887,010. Specification of Letters Patent. Patented May 5, 1908.

Application filed September 7, 1907. Serial No. 391,765.

To all whom it may concern:

Be it known that I, EDWARD J. McCLELLAN, a citizen of the United States, residing at the city of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Speed-Change Gearings, of which the following is a full, clear, and exact description.

My invention relates to a change speed transmission system particularly for use in machine tools and analogous uses where it is desired to have a wide range of speeds for the cutting tool or the work feed, or both.

An important need for mechanism of this sort occurs in milling machines where the work is fed against a continuously rotating cutter. Milling machines are now used for almost every kind of machine work and with all ordinary materials, but in order to obtain good results the speed of the cutter and the speed of the work should be widely varied for different materials and different kinds or stages of work. But although such a wide adjustment in the matter of cutter speed and work feed is necessary or desirable, the mechanism should nevertheless be extremely positive under all circumstances. There should be no reliance put on friction drives or other factors of uncertain value.

In carrying out the present invention I have aimed to provide a mechanism for driving the cutter and feeding the work table with great strength and positiveness, but which is adjustable to a very wide range and number of speeds.

The essential characteristic of the present invention by which these results are secured is the provision of a differential gear motion, the multiplying or reducing value of which is determined by two separate adjustments both of which may be independently varied. As will later appear, it is possible to obtain an extremely large number of speed change ratios in this way.

In the drawings: Figure 1 is a generally sectional view of a speed change transmission system embodying the principles of my invention; in this view the greater part of the casing is removed; the section is taken on the line I—I of Fig. 2, looking in the direction of the arrows; Fig. 2 is a vertical sectional view of the same; Fig. 3 is a view similar to Fig. 1 from the opposite side of the machine, being taken on the line III—III of Fig. 2, looking in the direction of the arrows.

Referring to the drawings in which like parts are designated by the same reference sign, 1 indicates a driving shaft, having a pulley 2, which may be belted or connected to any suitable power source.

3 denotes a driven shaft, upon the end of which may be directly mounted a milling cutter.

4 indicates an additional driven shaft which is in a position to operate the work table feed in any ordinary milling machine as usually constructed. Each of the shafts 3 and 4 is driven from the shaft 1 through a differential gear train, the increasing or reducing value of which may be varied. For this purpose I have illustrated a preferred construction in which each of the shafts 3 and 4 has permanently keyed or fixed thereto a block or disk 5, which carries bevel gears 6. Each bevel gear 6 is freely revoluble on its supporting block 5 on an axis radial to the supporting shaft.

7 and 8 designate bevel gears sleeved loosely on the shafts 3 and 4 and meshing with the bevel gears 6. The supporting sleeves for these bevel gears 7 and 8 are indicated at 9 and 9′, and they are all longitudinally splined, slotted or formed to slidably receive spur gears 10 and 11 thereon. These spur gears are therefore constrained to rotate with their connected bevel gear, but may be longitudinally positioned wherever desired.

The means for longitudinally positioning these spur gears 10 and 11 include angularly and laterally movable frames 12 and 13, which are formed to loosely surround said spur gears, and are loosely guided on the sleeves 9, 9′. All of these frames have handles projecting therefrom by which they are moved both angularly and longitudinally on their supporting sleeves. These handles are designated 14 and 15, and are bent in any suitable way to pass through holes or openings in the casing of the machine. Each handle has a portion 16, directly overlying a plate 17, of the casing of the machine. Each such handle portion 16 has a bolt 18, movable therein and coöperating with holes 19, in the plate 17.

20 indicate levers by which the bolts are retracted from their holes or openings, and which serve to normally impel the bolts into locking relation through the pressure of the springs 21.

Each of the frames 12 and 13 carries a plurality of gears all permanently in driving relation with the spur gears 10 and 11 corresponding thereto. The frames 12 each carry a single idler 24 supported in this manner while the frames 13 carry three idlers denominated 25, 26 and 27, of which 25 and 27 are permanently in mesh with spur gear 11, while 26 meshes only with idler 27. In this way a reversal of direction as well as change of speed may be obtained in the gears 11.

Referring now again to Fig. 2, it will be noted that the driving shaft 1 has a plurality of gears 29′, 29², 29³ and 29⁴, and also 31′, 31², 31³, 31⁴. These gears are permanently fixed to their supporting shaft, and are preferably all of different sizes and disposed in cones, as shown. The pitch of all the spur gears of the mechanism is made the same so it is evident that an intermeshing engagement may be made between idlers 24, 25 and 26, and any selected gears 29′, 29² . . etc., 31′ . . 31², etc., as desired, by moving the frames 12 and 13 through their respective handles 16. The frames 12 are capable of making only one such meshing engagement when in any particular plane, but the frames 13 are capable of making two intermeshing engagements for each plane of their disposition, respectively through the idlers 25 and 26, such respective engagements producing rotation of gears 11 in opposite directions. The disposition of the holes 19 is such that the various frames are locked when in their proper meshing engagements, and it will be observed that there are double series of holes for the frames 13, while only a single series is provided for the frames 12, as required. The frames 12 have, however, one single additional hole 32, with which bolts 18 may coöperate, and when locked in the position of this hole, idlers 24 engage short rack sections 33, which preclude gears 10 from any movement. The idlers 24 are of course in planes out of mesh with the various cone gears at this time.

The operation is as follows: Power being applied to the driving pulley 2, the shaft 1 is rotated with its various gears 29′, 29² . . etc., 31′, 31², . . etc. The various frames 12 and 13 being locked in any position, it is evident that gear transmission trains are established which rotate the bevel gears 7 and 8 at certain definite speeds. For each change of position of a frame 12 or 13, the corresponding bevel gear is rotated at a different speed. From the bevel gears 7 and 8 the shafts 3 and 4 are driven through the disks or blocks 5, carrying the idle bevel gears 6, which act as an ordinary differential train or mechanism. The speed of driven shafts 3 and 4 will be equal to one-half the sum of the speeds of their corresponding bevel gears 7 and 8, whatever values these may be, either positive or negative.

In a milling machine it may be necessary to drive the cutter only a few revolutions a minute at one time, while at another time it may be called upon to have a speed of several hundred R. P. M Such changes amounting to several hundred fold are practically impossible with any simple cone gear drive, but they may be freely obtained by my differential mechanism. For example, supposing the bevel gear 7 had a speed of 500 R P M in one direction while bevel gear 8 had a speed of 480 R P M in the other direction, it is evident that the driven shaft 3 would have a resultant speed of only 10 R P M. If, however, bevel gears 7 and 8 rotated at the speeds noted in the same direction, the driven shaft 3 would have a resultant velocity of 490 R P M. It is clear that this change amounts to nearly fifty fold, but it is accomplished by only very slight differences in the pitch diameter of the gears 29′, 29² . . etc., 31′, 31² . . etc., altogether within the limits of practical construction. A very great range of possible speed adjustments is thus obtainable and at the same time a large number of ratio values. With the construction shown, it is obviously possible to have thirty-six different gear combinations for driving the cutter and the same number for driving the work table, and as each of these is absolutely independent of the other, one thousand two hundred and ninety-six different speed ratios are obtained between the cutter and the work (providing none of the separate gear trains give identical results). The present mechanism therefore provides for a wide range and a large number of speed ratios in a milling machine.

What I claim, is:—

1. In a change speed mechanism, a differential gear train having a driven member and two rotating devices individually and independently communicating motion thereto, and two separate independent means each including cone gears and a pinion longitudinally movable with respect thereto to selectively mesh therewith, said means acting on said respective devices, for changing the speed of either independently of the other.

2. In a change speed mechanism, a differential gear train having a driven member and two rotating devices individually and independently communicating motion thereto, and two separate independent means each including cone gears and a pinion longitudinally movable with respect thereto to selectively mesh therewith, said means acting on said respective devices for changing the speed and direction of rotation of one independently of the other.

3. In a change speed mechanism, a differential gear train having a driven member and two rotating devices individually and independently communicating motion thereto, and two separate independent means each

including cone gears and a pinion longitudinally movable with respect thereto to selectively mesh therewith, said means acting on said respective devices, for locking one against movement and changing the speed of the other.

4. In a change speed mechanism, a differential gear train having a driven member and two rotating devices individually and independently communicating motion thereto and two separate independent means each including cone gears and a pinion longitudinally movable with respect thereto to selectively mesh therewith, said means acting on said respective devices for locking one against movement and changing the speed and direction of rotation of the other.

5. In a change speed mechanism, a driven member, a gear carried thereby and two devices including gears meshing with said gear and adapted to independently communicate motion thereto, and means each including cone gears and a pinion longitudinally movable with respect thereto to selectively mesh therewith, said means for varying the relative speeds and direction of rotation of said devices.

6. In a machine tool, driven shafts for the cutter and for the work feed, a driving shaft, two sets of cone gears thereon, a differential train of gears driven by any one gear of each of the two sets of cone gears, for driving the cutter shaft, and another differential gear train meshing with any one gear of each of the same two sets of cone gears, for operating the work feed.

In witness whereof, I subscribe my signature, in the presence of two witnesses.

EDWARD J. McCLELLAN.

Witnesses:

CHAS. T. LUTHER,

J. T. WILLIAMS.