No. 682,391. Patented Sept. 10, 1901.

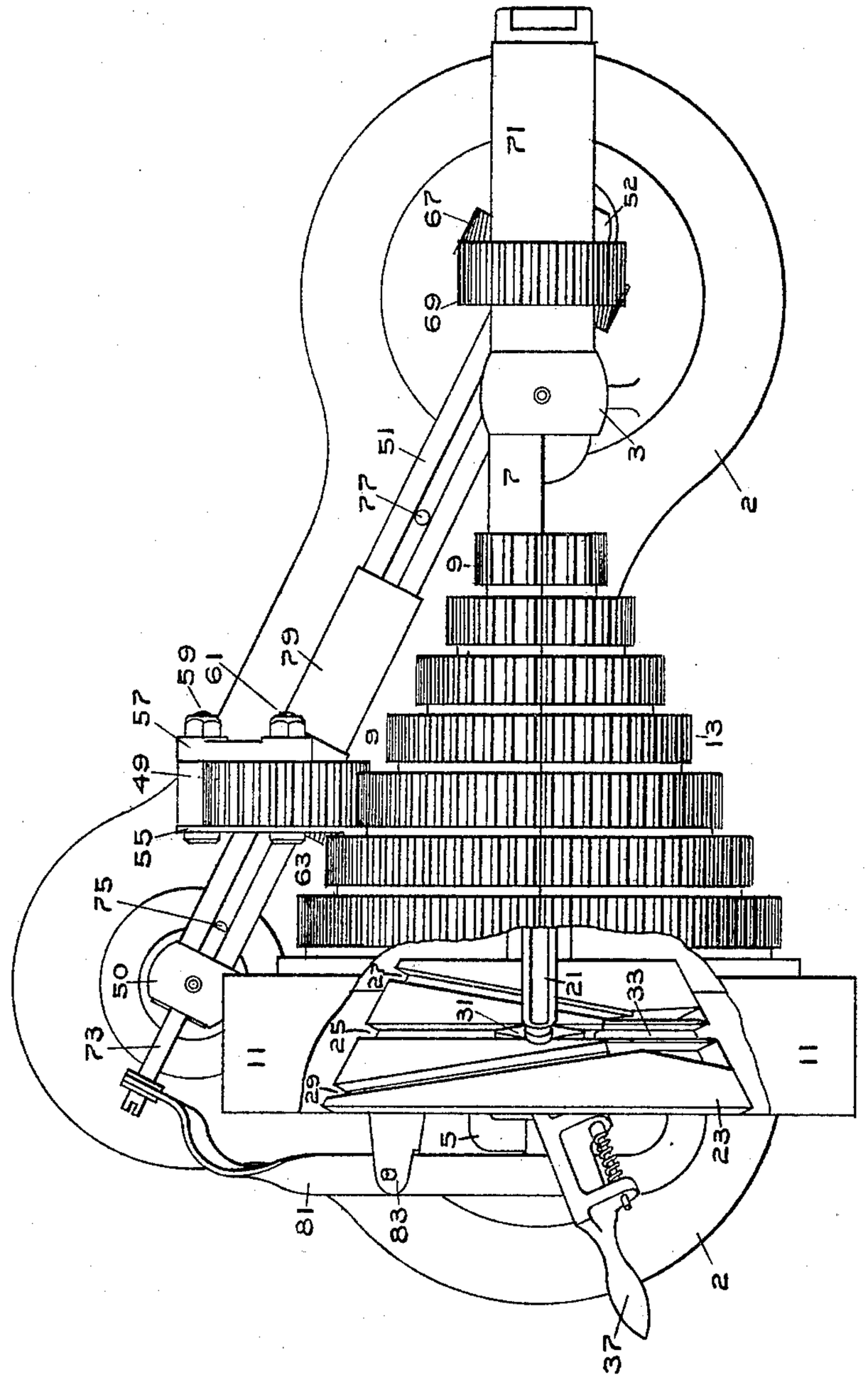
W. P. SHATTUCK.

VARIABLE SPEED GEARING.

(Application filed Mar. 5, 1901.)

(No Model.) 8 Sheets—Sheet 1.

Fig. 1.



Witnesses,
M. E. Gooley
M. C. Noonan.

Inventor,
William P. Shattuck.
by Paul & Hawley
his Attorneys.

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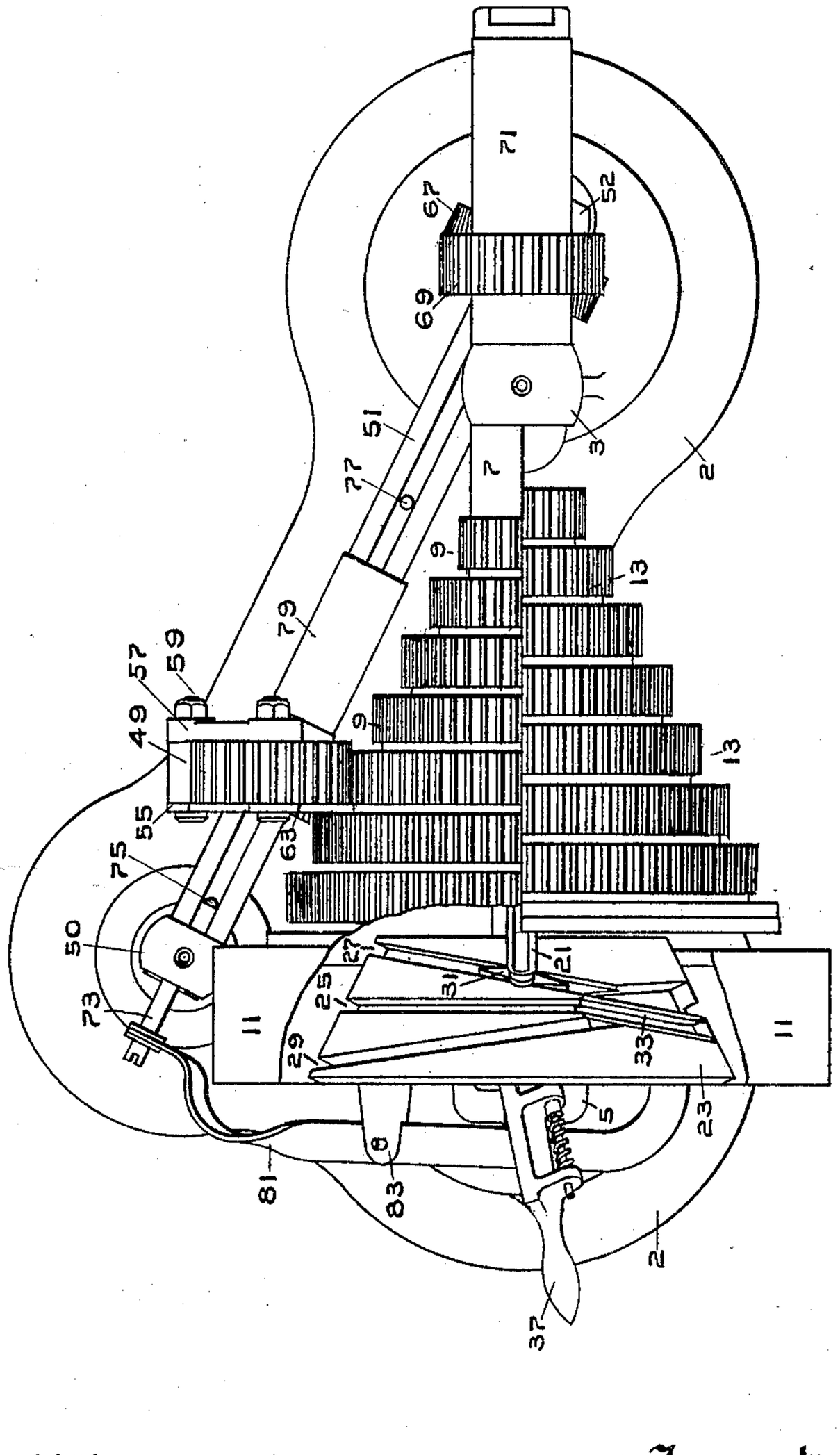
Fig. 2.



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8 Sheets—Sheet 3.

Fig. 3.

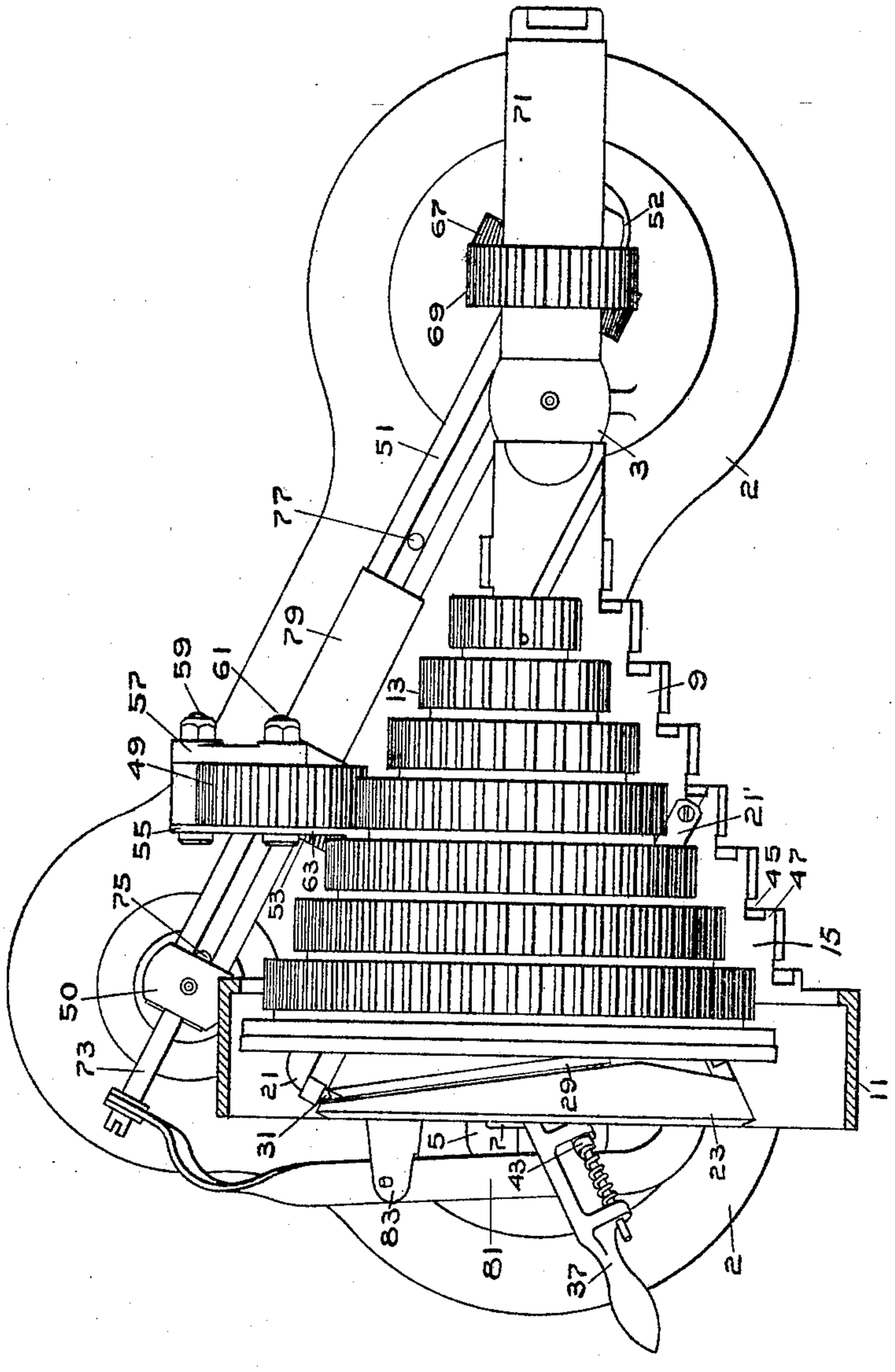

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Fig. 4.

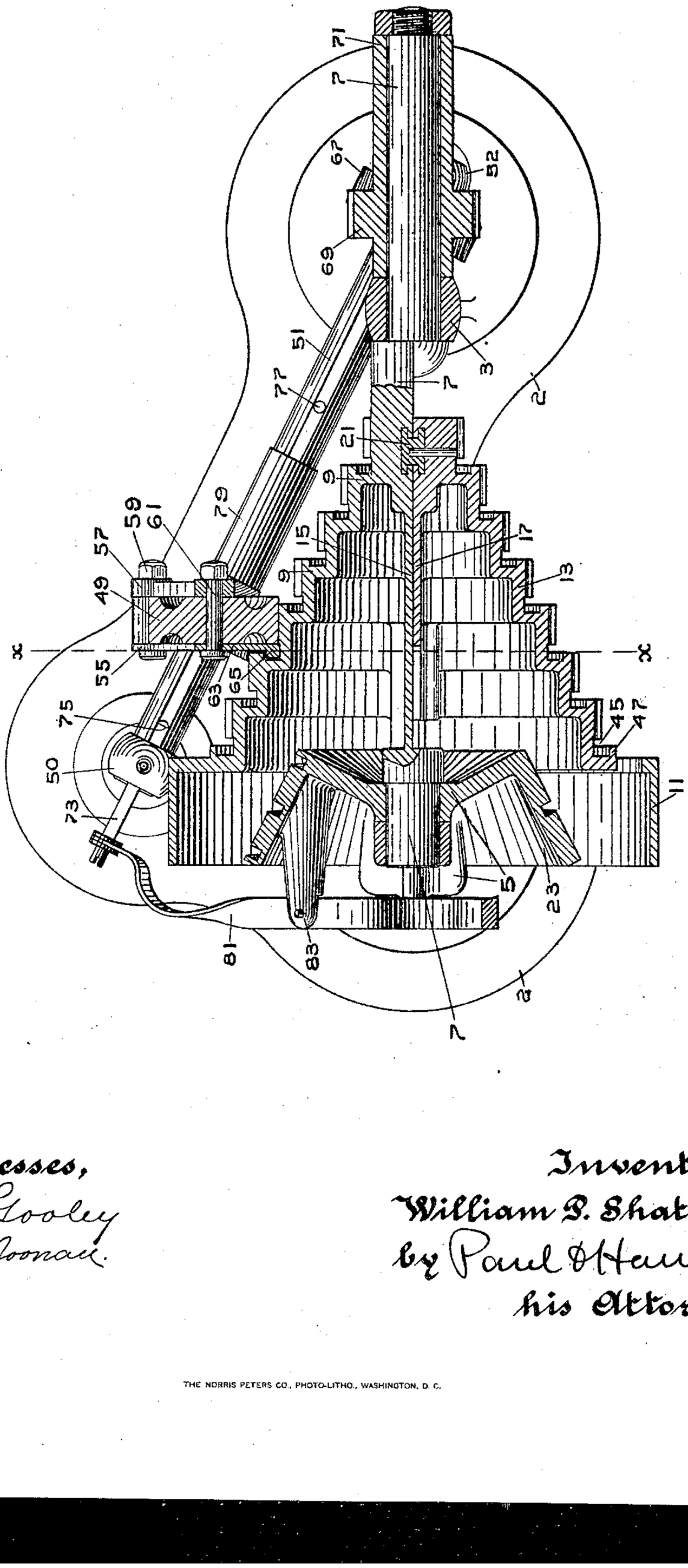

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Fig. 5.

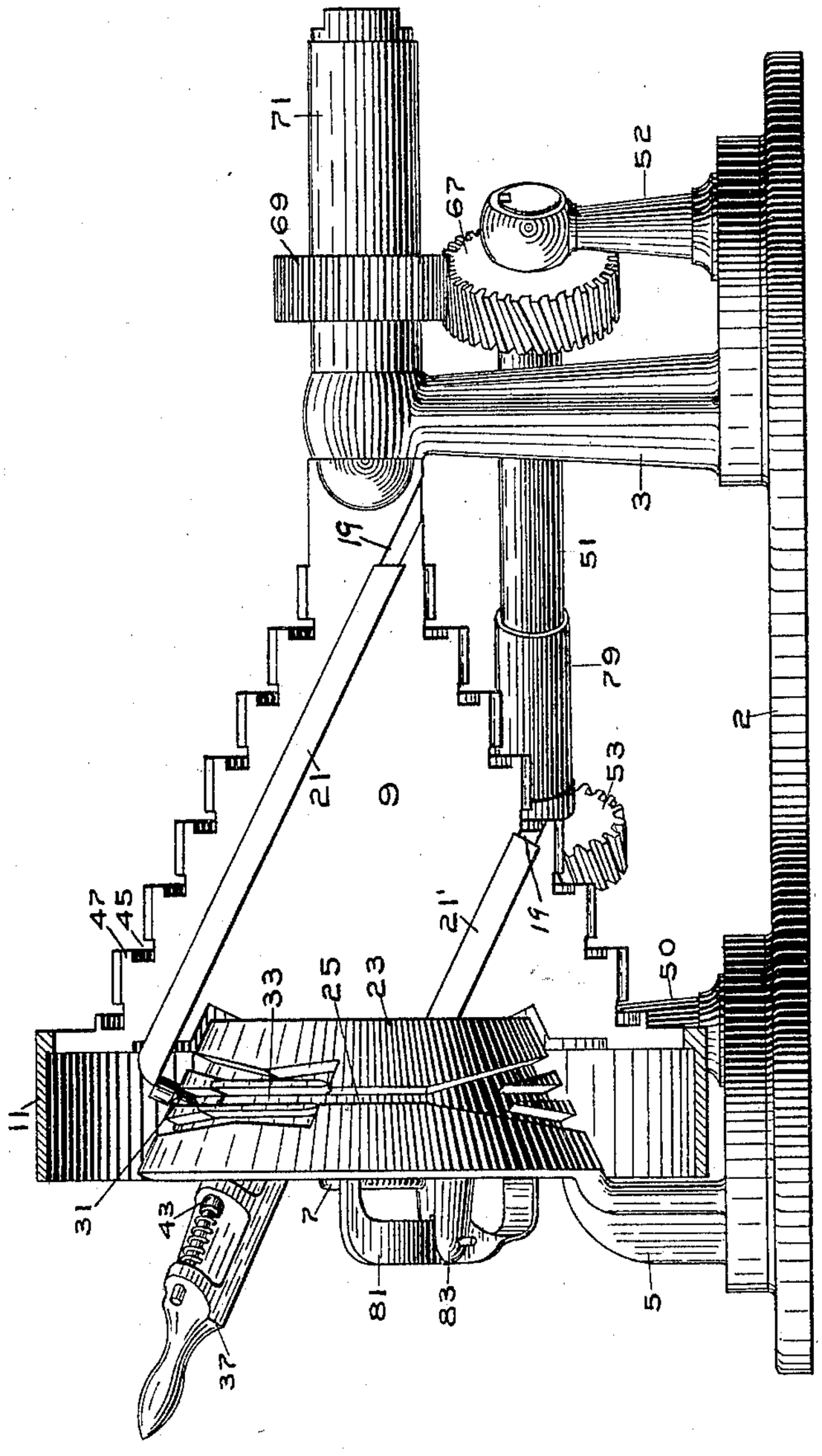

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Fig. 6.

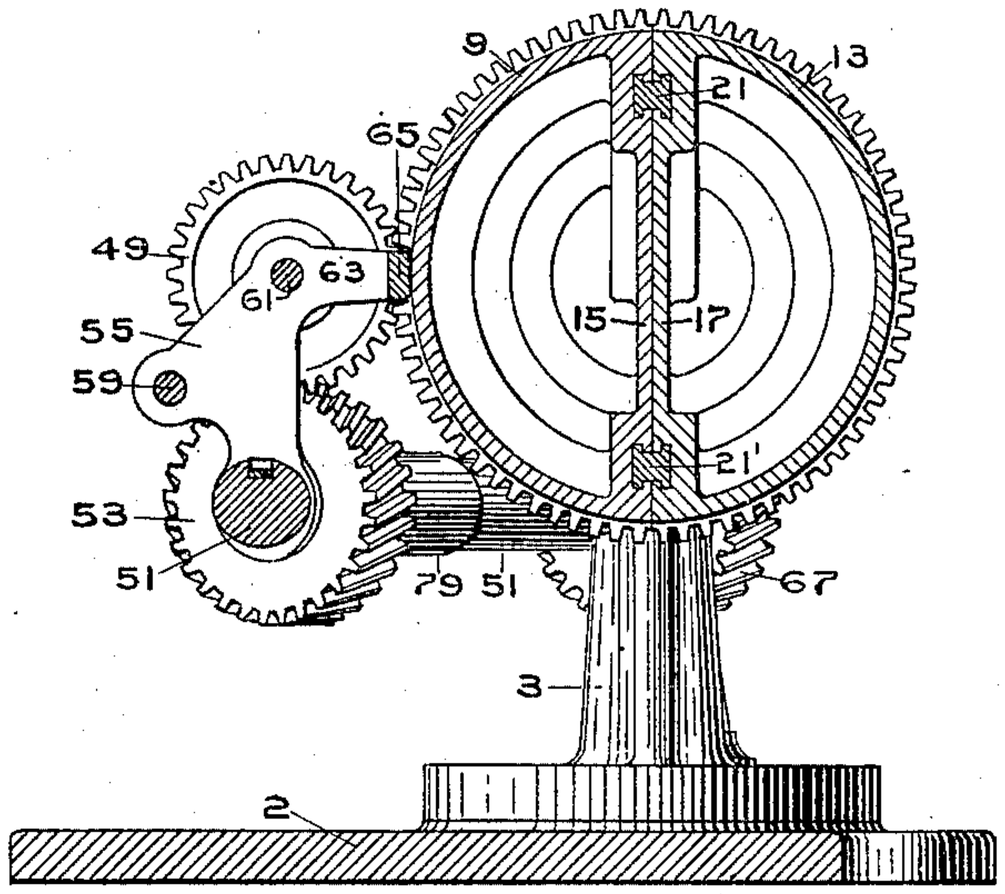

Fig. 7.

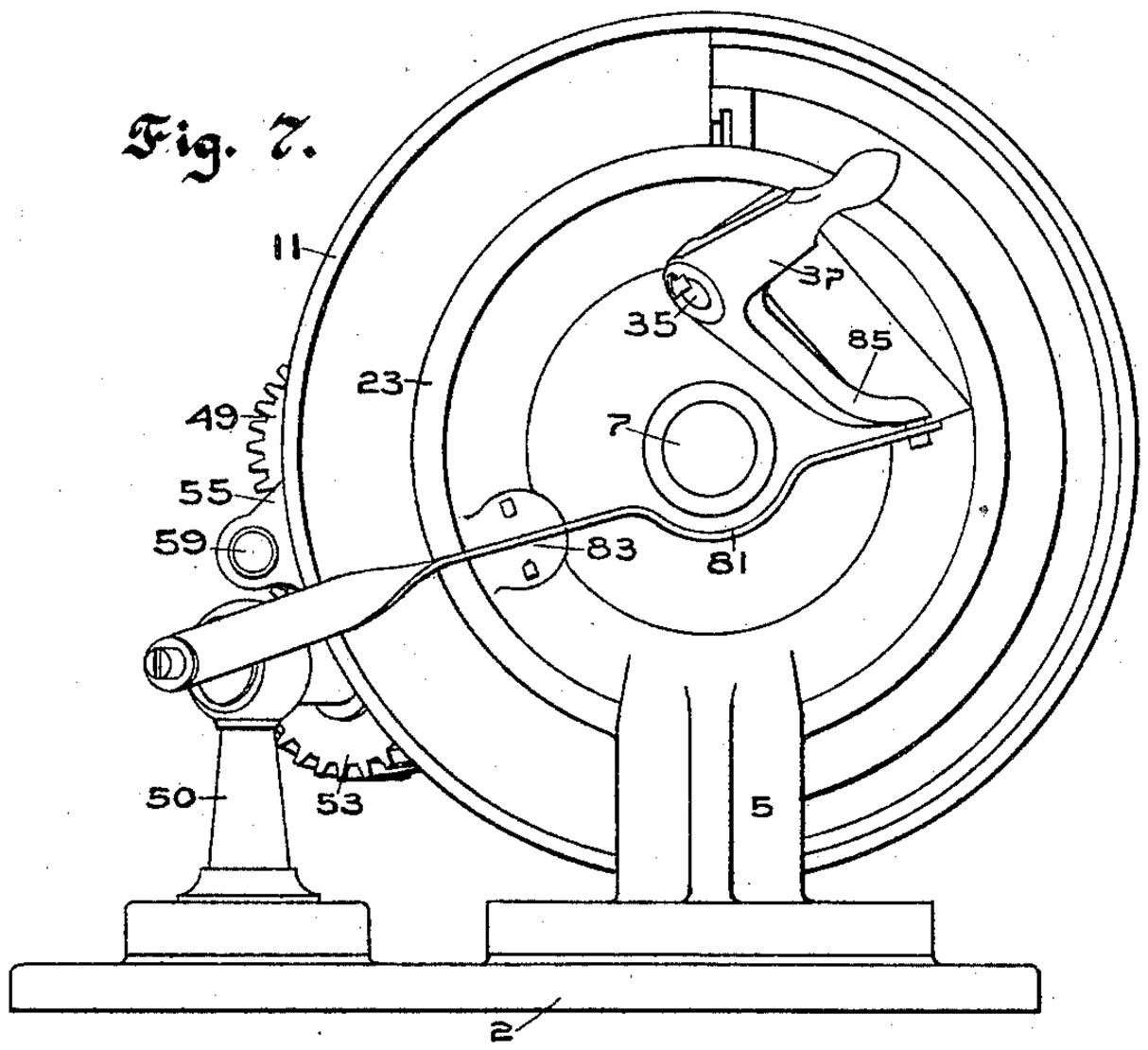

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Fig. 8.

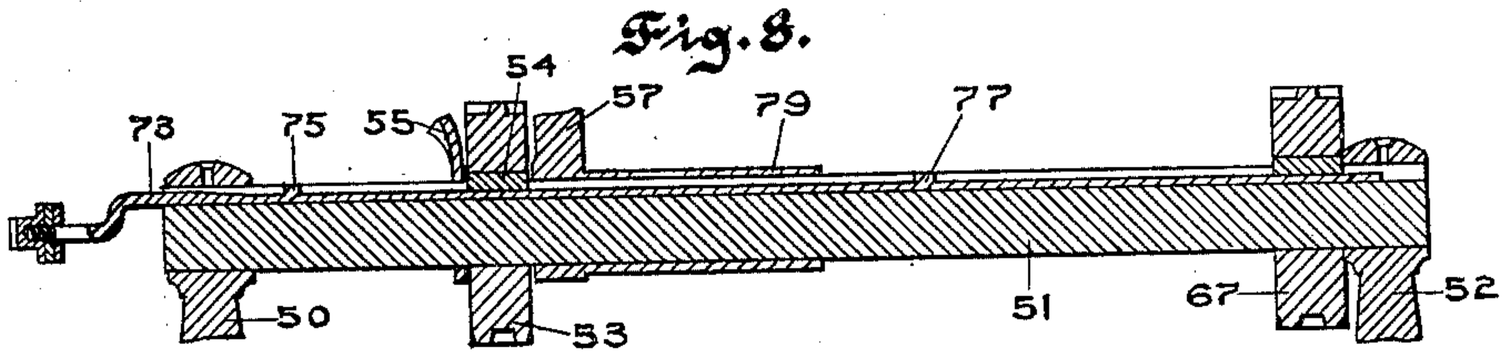

Fig. 10.

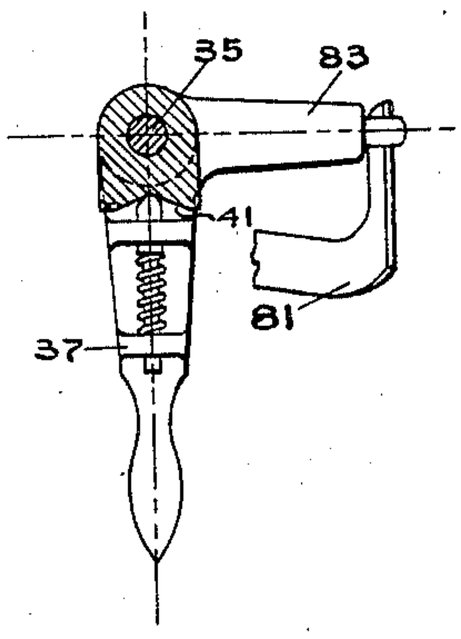

Fig. 9.

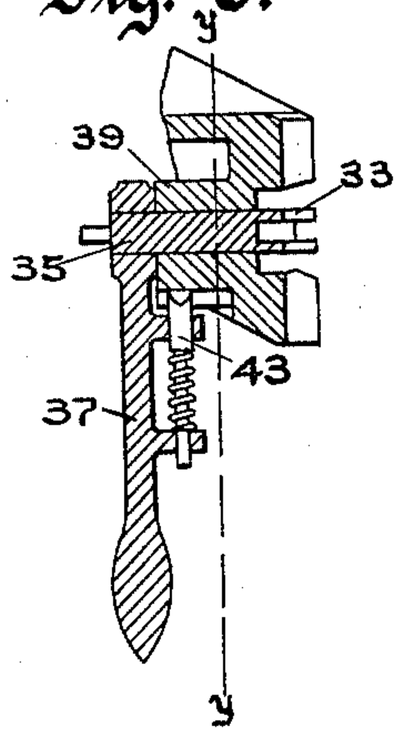

Fig. 14.

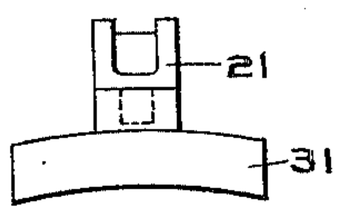

Fig. 15.

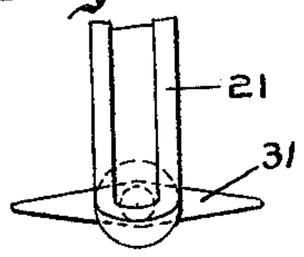

Fig. 11.

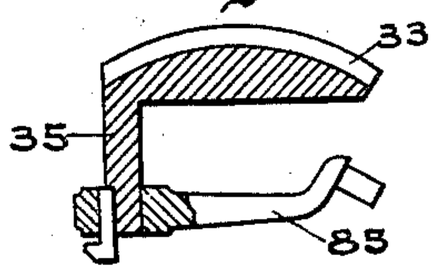

Fig. 12.

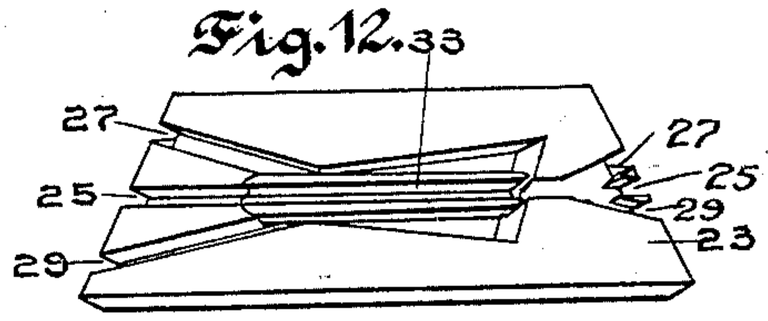

Fig. 13.

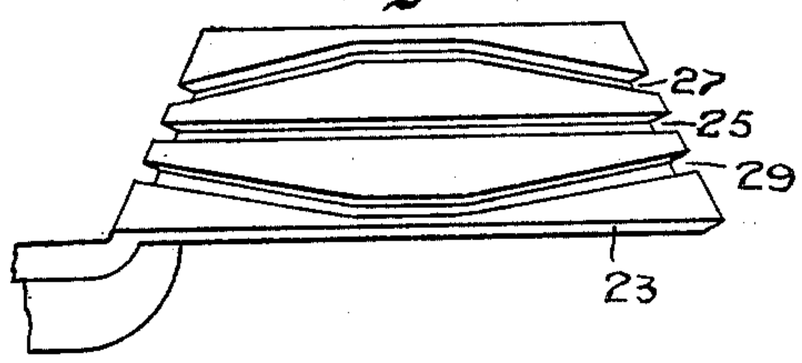

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Fig. 17.

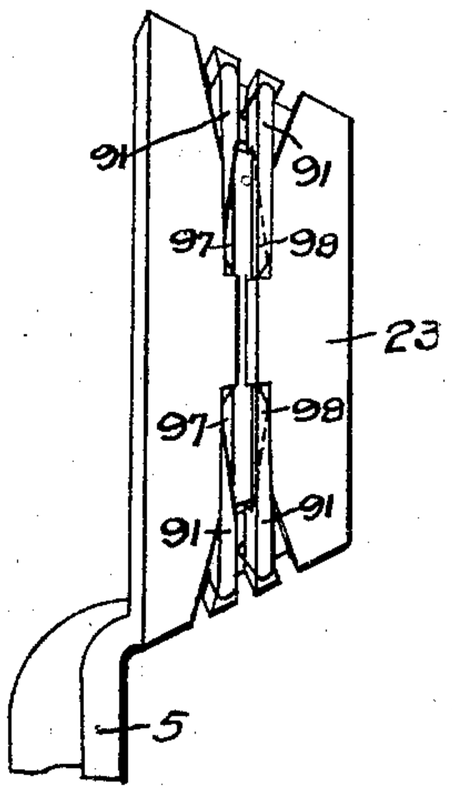


Fig. 16.

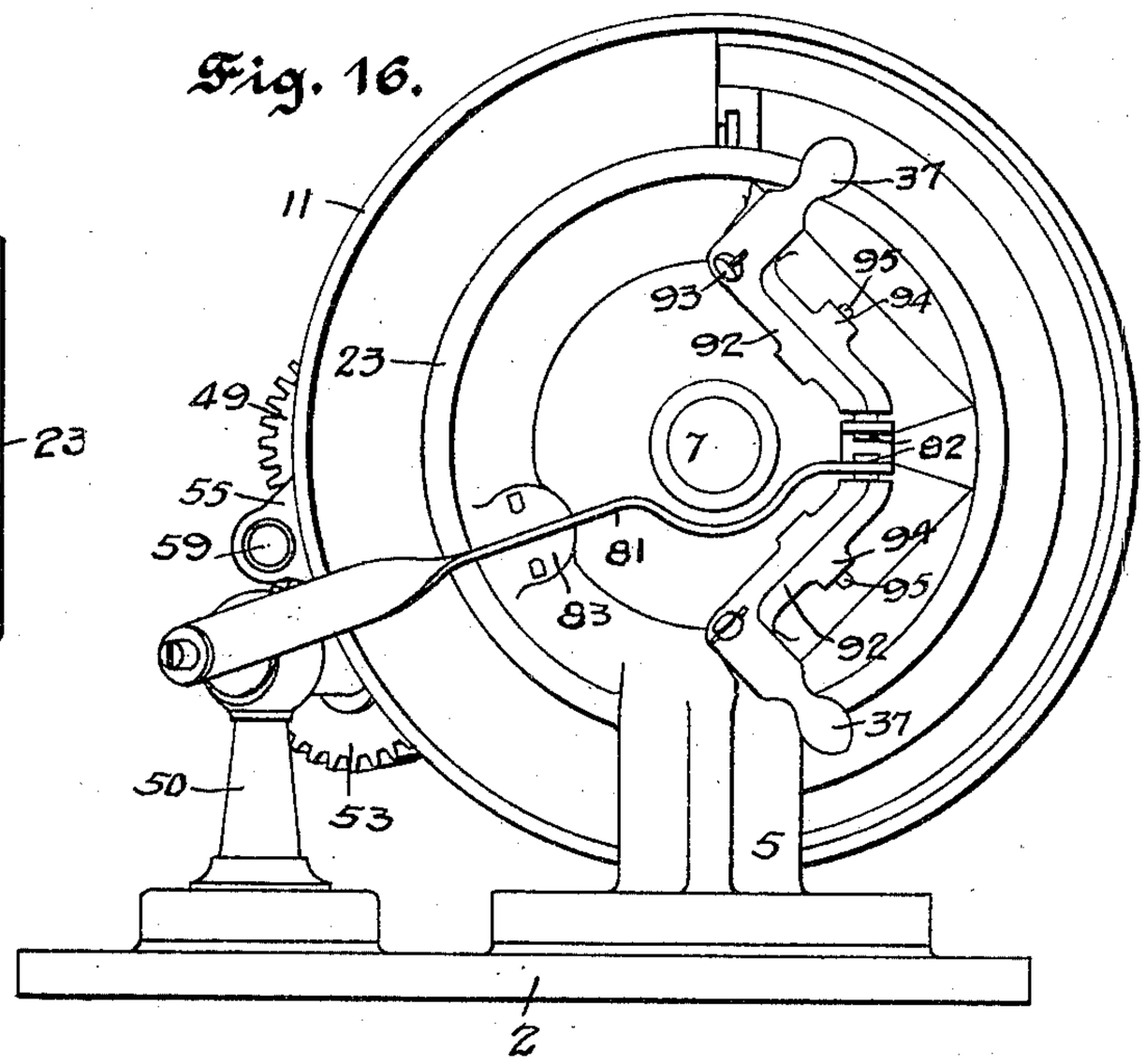


Fig. 19.

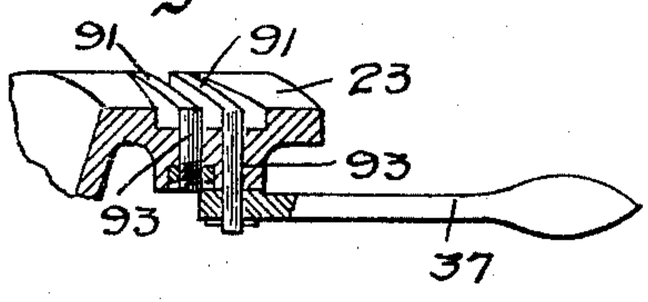


Fig. 18.

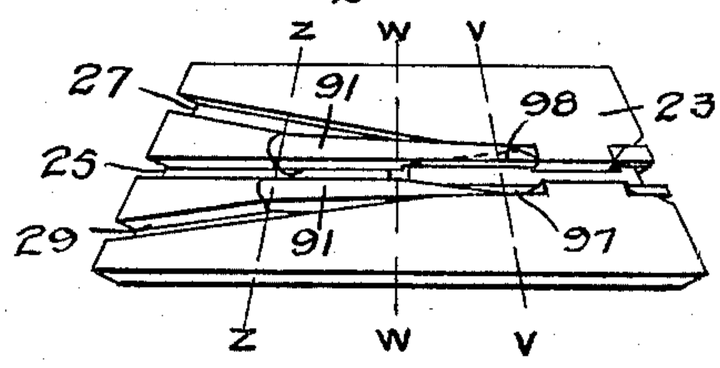


Fig. 22.

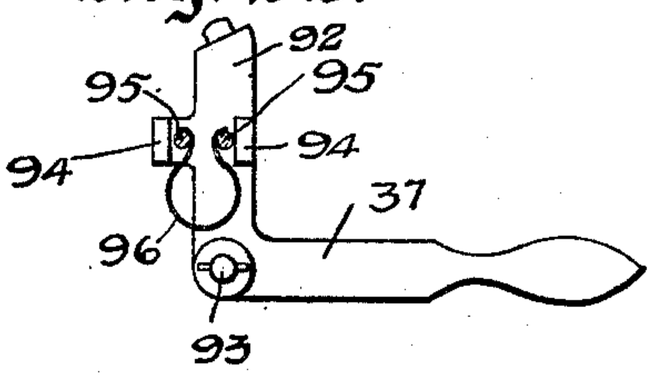


Fig. 23.

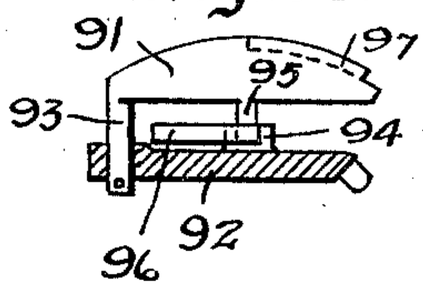


Fig. 20.

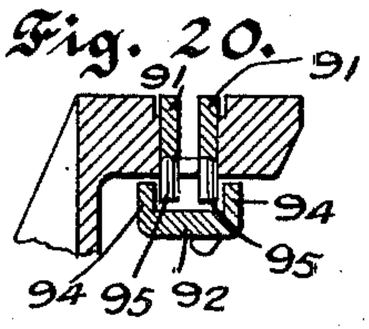


Fig. 21.

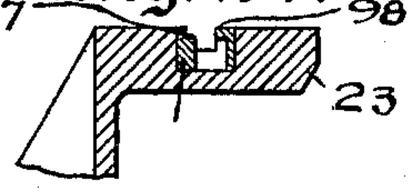


Fig. 24.

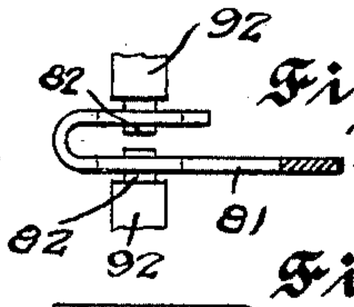
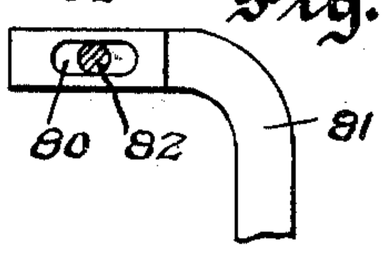


Fig. 25.



Witnesses,
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M. C. Noonan.

Inventor,
William P. Shattuck.
by Paul & Hanley
his Attorneys.

UNITED STATES PATENT OFFICE.

WILLIAM P. SHATTUCK, OF MINNEAPOLIS, MINNESOTA, ASSIGNOR TO SHATTUCK MANUFACTURING CO., OF SAME PLACE.

VARIABLE-SPEED GEARING.

SPECIFICATION forming part of Letters Patent No. 682,391, dated September 10, 1901.

Application filed March 5, 1901. Serial No. 49,949. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM P. SHATTUCK, of Minneapolis, Hennepin county, Minnesota, have invented certain Improvements in Variable-Speed Gearing, of which the following is a specification.

The object of this invention is to provide a simple positive variable-speed gearing or one in which it is possible to vary the speed without disengaging the parts of the gearing, so that the members of the gearing are always in positive engagement.

The invention consists generally in two or more gears of different diameters arranged upon a common center or axis, each of said gears having a movable section that is adapted to be moved into coincidence at one point with either the next larger or the next smaller gear, with a suitable pinion or coöperating gear member adapted to engage any one of said gears, whereby by shifting the movable section of each gear said pinion or coöperating member will pass from the fixed section of one gear into engagement with the movable section of the next gear when in its shifted or moved position, and upon moving said section back to its former position, while the pinion or coöperating member is in engagement with it, said pinion or coöperating member will be shifted from one gear to another without having been at any time disengaged from the gearing.

The invention consists, further, in the constructions and combinations hereinafter described, and particularly pointed out in the claims.

In the accompanying drawings, forming part of this specification, Figure 1 is a plan view of a variable-speed gear embodying my invention, a part of the outer portion of the gearing and belt-pulley being broken away to show the construction of the controller. Fig. 2 is a similar view showing the movable sections of the gears partly shifted, as will be done in changing the pinion or coöperating member from one gear in the series to the next larger gear. Fig. 3 is a plan view, partly in section, showing the movable sections of the gear shifted into position to coincide at one side thereof with the fixed sections of the gears. Fig. 4 is a horizontal section taken through the center of the gear. Fig. 5 is a side elevation with the movable sections of the gear removed. Fig. 6 is a transverse vertical section on line $x\,x$ of Fig. 4. Fig. 7 is an end elevation. Fig. 8 is a detail of the coöperating pinion or key member and the shaft upon which it is mounted. Fig. 9 is an elevation and partial section of the switch and its operating-lever. Fig. 10 is a section and partial plan of the switch-lever, the section being taken on line $y\,y$ of Fig. 9. Fig. 11 is a section of the switch-block. Fig. 12 is a detail of the grooved controller and switch. Fig. 13 is a side elevation of the grooved controller. Figs. 14 and 15 are details of the pivoted shoe. Fig. 16 is an end elevation similar to Fig. 7, but showing the double or reversing switch. Fig. 17 is a side elevation of the controller provided with the double or reversing switch. Fig. 18 is a plan view of the controller shown in Fig. 17. Fig. 19 is a detail section of the controller on line $z\,z$ of Fig. 18, showing also the operating-lever in place. Fig. 20 is a section on line $w\,w$ of Fig. 18. Fig. 21 is a section on line $v\,v$ of Fig. 18. Fig. 22 is a detail of the operating-lever. Fig. 23 is a detail of the switch. Figs. 24 and 25 are details of the connection between the safety locking device and the switch-operating levers.

In all of the drawings, 2 represents a suitable base-plate, upon which the shaft-supporting standards 3 and 5 are supported. Mounted in bearings in the standards 3 and 5 is a suitable shaft 7, which is free to rotate in the bearings in said standards. Formed upon or secured to the shaft 7 are a series of fixed sections 9 of concentric gears of different diameters. Said sections may be formed independently and may be secured to said shaft by any suitable means, or, as here shown, the fixed sections of said gears may all be formed integrally with the shaft 7 and with a suitable belt-pulley 11. Each gear is also provided with a movable section 13. These sections may constitute any suitable segment of the gears, although, as here shown, I have constructed each gear in two equal sections, one of which is secured to or formed integrally with the shaft 7 and the other of which is free to move longitudinally of said shaft,

but at an angle thereto, as hereinafter described. The preferred construction is to form the fixed sections of the gears in one piece with the shaft 7 and with a web 15, that is arranged centrally of the gears and substantially in line with the two parts of the shaft 7. This web is preferably arranged as illustrated in Figs. 5 and 6 of the drawings.

The movable sections of the gears are preferably formed integrally with each other and with a web 17, that fits against the web 15, as shown in Fig. 6 of the drawings. Each of these webs 15 and 17 is provided with two parallel T-shaped grooves 19, extending diagonally, the pitch of the grooves in each instance being equal to the difference in diameters of the gears. Secured in the slot in the web 17 is a bar 21, preferably of H shape in cross-section, and secured in the slot in the web 15 is a bar 21′. One of said bars also fits and is adapted to slide in one of the slots in the web 15 and the other fits and is adapted to slide in one of the slots in the web 17.

Secured to or formed integrally with the standard 5 is a stationary truncated cone or controller 23. This controller is provided with a groove 25, that extends circumferentially in the conical surface of said controller and is in a plane substantially at right angles to the axis of the gears or to the shaft 7. This controller is also provided with the inclined grooves 27 and 29, each branching off from the groove 25 and each leading back into said groove after extending nearly around the controller. (See Figs. 12 and 13.) Each of the grooves 27 and 29 has a short straight portion parallel with the groove 25. (See Fig. 13.) The bar 21 is provided at or near its end with a pivoted shoe 31, that is at all times in engagement with one or another of the grooves in the controller. A grooved switch-block 33 is arranged in the surface of the controller 23 at a point where the grooves 27 and 29 branch off from the groove 25, the groove being enlarged at this point to admit of the location of the switch-block and permitting it to swing in either direction. When in its normal position, as shown in Fig. 1, the groove in the switch-block forms a part of the straight controller-groove 25. This block is formed upon or secured to a pin 35, that extends through the shell of the controller and is secured to an operating-handle 37. (See Figs. 9, 10, and 11.)

The under surface of the controller is provided with a lug 39, having a V-shaped recess 41, and the switch-operating handle 37 is provided with a spring-controlled dog 43, that engages said notch. As the end of the dog is pressed against the surface of the notch by the spring, the dog when the handle is free slides over either inclined surface of the notch and comes to rest at the bottom of the notch, and the switch-block is thus automatically brought to and held in the position shown in Fig. 1 of the drawings, with its groove forming a continuation of the straight groove 25 in the controller, so that the shoe 31 will travel continuously in this groove. By means of the operating-handle the switch-block 33 may be turned in either direction, so as to make a break in the straight groove 25, and its outer surface will then form a wall in the groove and will direct the shoe 31 into one or the other of the inclined grooves in the controller, as illustrated in Fig. 1 of the drawings. The shoe 31 is pivoted on the longer bar 21 and is preferably of substantially diamond form in plan view (see Fig. 15) and of curved form in side elevation, so as to fit the surface of the controller at the bottom of the groove. (See Fig. 14.)

Each gear is provided with a circumferential groove 45, located on the side of the gear that is toward the next larger gear and extending around the entire gear or over both the fixed and the movable section. A lip or flange 47 on the next larger gear extends laterally or partially across the groove 45. The pinion or coöperating gear member 49 may be arranged in any suitable manner, so long as it is kept continuously in mesh with one or another of the gears and is free to move lengthwise of the shaft 7, so as to travel from one gear to the next larger or smaller. The arrangement that I consider preferable and which I have shown in the drawings is as follows: A shaft 51 is arranged at an angle to the shaft 7 and is mounted in standards 50 and 52. This shaft is provided with a pinion 53, having teeth inclined to its axis, but parallel with the teeth of the main gears. This pinion is splined on the shaft 51, which is suitably grooved for the purpose, (see Figs. 1, 2, 3, 4, and 8,) so that while the pinion is free to slide on the shaft it must rotate therewith. Standards 55 and 57 are mounted on the shaft 51, so as to turn and slide freely thereon. These standards are connected by a suitable bolt 59 and also by the bolt or short shaft 61, upon which the pinion 49 is mounted and upon which it turns freely. This pinion is at all times in mesh with one of the main gears on the shaft 7. The standard 55 has an arm 63, provided with a lug 65, that engages one or another of the grooves 45. By this means the pinion 49 is kept in proper mesh with the coacting main gear, the standards supporting this pinion swinging toward or from the axis of the shaft 7, as may be required by the diameter of the gear with which the pinion is in engagement. Power may be transmitted to or from the shaft 51 by any suitable means. I have here shown this shaft provided with a pinion 67, that meshes with a pinion 69 on a hollow shaft 71, arranged on the end of the shaft 7. The shaft 71 may have mounted upon it a suitable pulley or gear, through which power may be transmitted to or from the shaft. It will be obvious that when the pinion 49 is in mesh with the largest main gear the switch should not be capable of operation in the direction required to move the pinion into engagement

with another larger gear, and when in mesh with the smallest gear it should not be capable of being turned in the direction to move the pinion into mesh with a smaller gear. I therefore provide a safety locking device to prevent the movement of the switch in one direction under these conditions. This device, as I have here illustrated it, consists of a rod 73, sliding in the groove of the shaft 51 and provided with the pins 75 and 77. The rod 73 is connected to a lever 81, pivoted on a projection 83 on the under side of the controller 23. The end of this lever is connected to an arm 85 on the switch-operating handle 37. Ordinarily the lever turns freely in either direction with the movement of the handle 37; but when the pinion 53 is brought close to the pin 75, which is its position when the pinion 49 is in mesh with the largest gear, the handle 37 can be moved only in one direction, owing to the striking of the pin 75 against the pinion 53 or the spline 54 in said pinion, and when the pinion 49 is in mesh with the smallest gear the movement of the handle 37 in one direction will be prevented by the striking of the pin 77 against the other side of the pinion 53 or its spline 54. The standard 57 is preferably provided with the sleeve 79, surrounding the shaft 51 and forming a long bearing for the said standard.

With the construction shown in Figs. 1 to 15 of the drawings I have illustrated a single switch—that is, a switch that can be operated only when the gear is running in one direction. With this construction of switch the gear can be run in the opposite direction; but when it is running in the opposite direction the switch cannot be operated. In some instances it is desirable to run the gear in either direction, and it is then necessary to provide a double switch or two switches, one of which is to be operated while the gear is running in one direction and the other to be operated while the gear is running in the opposite direction. I have shown a construction suitable for this purpose in Figs. 16 to 25 of the drawings. As here shown, the controller 23 is of substantially the same construction as that shown in the other figures of the drawings; but it is provided with two switches, one located at each of the points where the branch grooves connect with the main groove. The two switches are similar in construction, and each consists of a short bar 91, mounted upon a pivot-pin 93. One of said pivot-pins 93 has the switch-operating handle 37 pivoted thereon. In this instance the handle 37 is arranged to turn freely on its pivot 93 and is provided with a projecting arm 92, carrying lugs 94. There is a slot in the bottom of the groove, (see Fig. 20,) and each of the switch-bars 91 is provided with a pin 95, that projects downwardly through this slot into the space between the lugs 94 on the operating lever or handle. A spring 96 is arranged to engage these pins and hold them against the lugs 94, thereby tending to hold the switch-bars apart, and to thereby keep the bars in position to form a continuation of the main or straight groove 25. When it is desired to operate the switch, the handle of the switch that is to be used is turned, causing the lug 94, by its engagement with the pin 95 on one of the switch-bars, to crowd that switch-bar over against the other, compressing the spring 96 and making a connection with one of the side or branch grooves 27 or 29 and causing the shoe 31 to enter one or the other of said branch grooves. As soon as the handle is released the spring 96 throws the switch-bar back to its normal position, and at all times, except when the operator has hold of the handle, the switch will stand with the bars separated and forming a continuation of the straight or main groove 25. The two switches are alike, and when the gear is running in one direction one switch will be operated and when it is running in the other direction the other switch will be operated. I prefer to provide the two switch-bars, one with a recess 97 and the other with an overlapping flange 98, (see Fig. 21,) so that when said switch-bars are moved together they will be interlocked and there will be no danger of the shoe striking against and being stopped by the end of the switch-bar that has been moved. The levers of both switches are connected to the lever 81 of the safety device, (see Figs. 24 and 25,) this lever being in this instance provided with a bend at its end, thus forming two parallel parts or branches, and each of said parts is provided with a slot 80, which receives the pin 82 on the arm of the switch-operating handle 37. Normally the pins 82 stand in the center of the slots 80; but when the coöperating pinion has been brought into engagement with either the largest or the smallest gear of the series the lever 81 will have been moved slightly and will prevent operation of either switch in one direction, while permitting it to be moved freely in the other direction.

The operation of the device is as follows: Power may be transmitted to the gearing either through the pulley 11 or through a pulley or gear on the shaft 71. The speed and power transmitted will depend upon which of the main gears the pinion 49 is in mesh with. As the switch-block is normally held straight, so as to form a continuation of the straight groove 25, the pinion will remain in mesh with the same gear until the switch-block is turned by the operating-handle 37. If the switch-block is turned, for instance, so as to direct the shoe 31 into the groove 27, as illustrated in Fig. 1, (the pinion 49 at the time being in mesh with one of the fixed gear-sections,) the movable sections will be moved lengthwise of the slots in the webs 15 and 17, and by the time the gears turn so that the pinion reaches the end of the fixed section with which it is in mesh the movable sections will have moved so that each movable section will now coincide with and form a continua-

tion of, at one side of the gears, each fixed section of the next smaller gear. The pinion will then travel from one fixed section on to the movable section of the next larger gear. It will remain in mesh with this movable section for a half-revolution of the shaft 7. While this half-revolution is being made the movable sections will be moved back to their original positions, and when the half-revolution is completed the movable section will be in coincidence with the corresponding fixed section, and the pinion will remain in mesh with this gear until the switch is again operated. To reverse the operation, the switch is moved in the opposite direction. I have here shown only a single switch, and the gearing is thus capable of being driven in one direction only. By providing two switches or a suitable double switch the gearing will be capable of being driven in either direction and reversed at will.

I do not limit myself to the details of construction herein shown and described, and I believe myself to be the inventor of the broad principle of a variable-speed gearing having movable gear-sections for the purpose of changing the speed of the gearing while the members of the gearing are in operation and are in positive engagement with each other.

I claim as my invention—

1. A variable-speed gearing comprising two members, one composed of a plurality of gears of different diameters, and the other being a pinion, one of said members being made up of movable sections and means for relatively moving said sections to carry the same into mesh with a higher or lower gear.

2. A variable-speed gearing comprising two members, one of which is movable longitudinally upon its axis, one of said members comprising a plurality of gears of different diameters and the other being a pinion, one of said members being made up of relatively movable sections, and means for shifting said sections to carry the same into pitch-line of the adjacent gear to shift said pinion from one gear to another without interrupting the transmission of power from one gear to the other.

3. A variable-speed gearing comprising cooperating gear members, one of said members being provided with a section capable of movement in the direction of its axis, and means for moving said movable section whereby one member of the gearing may be shifted and the speed of the gearing varied.

4. A variable-speed gearing comprising cooperating gear members, one of said members being formed in a plurality of sections, in combination with means for securing a relative longitudinal movement of said sections for the purpose of shifting the other member of the gearing.

5. A variable-speed gearing comprising cooperating gear members, one of said members comprising a plurality of gears and the other member being a pinion, one of said members being in two parts capable of movement for the purpose of shifting the other member, in combination with means for controlling the movement of the parts of said movable member.

6. A variable-speed gearing comprising cooperating gear members, one of which is composed of gears of different sizes, one of said members being divided into sections capable of relative longitudinal and lateral movement and means for accomplishing said movement, as and for the purpose specified.

7. A variable-speed gearing comprising cooperating gear members, one composed of different-sized gears, one member being composed of longitudinal sections and means for relatively moving said sections, while the members are in mesh, to shift one section into the pitch-line of the opposed gear, whereby the variation of speed is secured without interruption in the transmission of power, substantially as described.

8. A variable-speed gear comprising cöoperating gear members, one composed of different-sized gears and divided into sections and means for relatively shifting said sections laterally to engage a new gear with the opposed member without interruption in the transmission of power, substantially as described.

9. A variable-speed gear comprising coöperating gear members, one composed of different-sized gears and divided into sections and means for relatively shifting said sections laterally and longitudinally to form a new ratio of engagement with the opposed gear member, substantially as described.

10. A variable-speed gear comprising coöperating gear members, one whereof is composed of gears of different sizes, and automatically-operative means for relatively shifting said gears with relation to their axes, during engagement with the opposed member to increase or decrease the speed without interrupting the power of transmission, substantially as described.

11. A variable-speed gearing comprising opposed gear members, one composed of a plurality of gears and the other being a pinion constantly engaged therewith and means for relatively shifting the gears of the first member during engagement with said pinion to move said pinion longitudinally and transfer the same from one gear to another, substantially as described.

12. A variable-speed gearing comprising opposed gear and pinion members, said gear member comprising a plurality of gears divided into longitudinal sections capable of longitudinal and lateral movement and a switch or shifting mechanism associated with said gear member for relatively moving the sections thereof to shift said pinion member while in mesh therewith, substantially as described.

13. A variable-speed gear comprising opposed gear and pinion members, said gear member comprising a plurality of gears di-

vided into longitudinal sections capable of diagonal movement and a shift or switching mechanism associated with said gear member for relatively moving the sections thereof to shift said pinion member while in mesh therewith, substantially as described.

14. A variable-speed gear comprising coöperating gear and pinion members in constant mesh, said gear member being composed of a plurality of gears of different sizes, said gear member being divided longitudinally and having its sections connected for relative movement and a shifting mechanism for shifting one section of said gear member while the other section is in mesh with the pinion member, substantially as described.

15. A variable-speed gear comprising coöperating gear and pinion members in constant mesh, said gear member being composed of a plurality of gears of different sizes, said gear member being divided longitudinally and having its sections connected for relative movement and a shifting mechanism for shifting one section of said gear member while the other is in mesh with the pinion member and thereafter returning the first section and shifting the pinion member, substantially as described.

16. A variable-speed gear comprising coöperating gear and pinion members, said gear member being composed of a plurality of different-sized gears capable of distortion with relation to the axis thereof, said pinion being movable longitudinally of said gear member, and a shifting mechanism associated with said gear member and momentarily operative to shift or distort the parts of said gear member to shift said pinion from one gear to another of said gear member.

17. A variable-speed gear comprising coöperating gear and pinion members, said gear member being composed of a plurality of different-sized gears, certain teeth of which are in longitudinal line, said gear member having a shiftable section and means for shifting said section to accomplish the transfer of said pinion upon the longitudinally-alined teeth of said gear, substantially as described.

18. A variable-speed gear comprising coöperating gear and pinion members, said gear member being composed of relatively movable sections constituting gears of different sizes and shifting means for moving a section of said gear member into a momentary eccentric position to receive said pinion, as and for the purpose specified.

19. A variable-speed mechanism comprising opposed rotary members in constant engagement, one of said members being composed of a plurality of steps of different diameters and being divided into sections relatively movable into non-corresponding positions to receive and transfer the coöperative member.

20. The herein-described mechanism comprising a divided member having annular grooves of different diameters, the sections of said member being relatively movable to register non-corresponding grooves and a member constantly engaged in one or the other of said grooves.

21. A variable-speed gearing comprising coöperating gear members, one of said members consisting of two or more gears of different diameters, each formed of a fixed and a movable section, and means for moving the movable section of one gear into coincidence with the fixed section of another gear.

22. In a variable-speed gearing, a series of concentric gears of different diameters, each provided with a movable section adapted to be moved into coincidence with the fixed section of the next larger or the next smaller gear, and means for moving said movable sections, in combination with a coöperating gear member.

23. The combination, in a variable-speed gearing, with a series of gears of different diameters, each provided with a movable section, adapted to be moved into coincidence with the fixed section of the next larger or the next smaller gear, of a controller adapted to control the movements of said movable sections, and a coöperating pinion or gear member engaging at all times one of said gears, for the purpose set forth.

24. The combination, in a variable-speed gearing, with a series of gears of different diameters, each provided with a fixed section and a movable section, each of said movable sections being adapted to be moved into coincidence with the fixed section of the next larger or the next smaller gear, of an automatic controller connected with and adapted to control the movements of said movable sections, and a coöperating pinion or gear member engaging at all times one of said gears, for the purpose set forth.

25. The combination, in a variable-speed gearing, with a series of gears of different diameters, each provided with a fixed section and a movable section, of a coöperating pinion or gear member at all times engaging one of said gears, a grooved controller, a shoe arranged to travel in the grooves of said controller, and connected with and controlling the movement of said movable section, for the purpose set forth.

26. The combination, in a variable-speed gearing, with a series of gears of different diameters, each provided with a fixed section and a movable section, of a grooved controller, a shoe adapted to travel in the grooves of said controller, and connected with said movable section, and a switch in said controller for directing the movements of said shoe, for the purpose set forth.

27. The combination, in a variable-speed gearing, with a series of gears of different diameters, each provided with a fixed section and a movable section, each of said movable sections being adapted to be moved into coincidence with the fixed section of the next larger or the next smaller gear, of a grooved

controller provided with three grooves, one of which retains the movable sections in their normal position and the others of which cause said sections to be moved in opposite directions, and means connecting said controller with said movable section, for the purpose set forth.

28. The combination, in a variable-speed gearing, with a series of gears of different diameters, each provided with a movable section, adapted to be moved into coincidence with the fixed section of the next larger or the next smaller gear, of a controller connected with and arranged to control the movement of said movable section, a coöperating pinion and an automatic locking device arranged to lock the section-controlling mechanism when the coöperating pinion has reached the limit of its movement in either direction, for the purpose set forth.

29. The combination, with the shaft 7, the series of fixed gear-sections 9, and the web 15 connected with said shaft, of the movable gear-sections 13 provided with the web 17 arranged to fit against and slide upon said web 15, and means for moving said movable sections diagonally in respect to said fixed sections, whereby each movable section may be made to coincide, at one side of the gears, with the next larger or next smaller fixed section, for the purpose set forth.

30. The combination, with a series of fixed gear-sections 9, a shaft to which said sections are connected, a belt-pulley 11 secured to or formed integrally with said fixed section, of a series of coöperating movable gear-sections, and means for moving said sections, for the purpose set forth.

31. The combination, with the fixed gear-sections 9, a shaft 7 upon which said sections are mounted, a longitudinal web 15 uniting said sections, said web having diagonal grooves, of a corresponding series of movable sections provided with a web 17, uniting said sections, bars connecting said sections, and means for moving said movable sections, for the purpose set forth.

32. The combination, with a series of gears of different diameters, each comprising a fixed and a movable section, and having the circumferential grooves 45 and flanges 47, of the coacting pinion or gear member 49 adapted to engage any one of said gears, swinging standards supporting said pinion or gear member, and a suitable lug secured upon one of said standards and engaging the groove 45, for the purpose set forth.

33. The combination, with the fixed gear-sections 9 and the movable gear-sections 13, and means for securing said sections together while permitting one to move relatively to the other, of the grooved controller 23 and means connecting the movable sections with said controller, for the purpose set forth.

34. The combination, with the fixed gear-sections 9 and the movable gear-sections 13, of the grooved controller 23, a switch-block 33 arranged in said controller, and connected with said movable gear-sections, and means for operating said switch-block, for the purpose set forth.

In testimony whereof I have hereunto set my hand, this 28th day of February, 1901, at Minneapolis, Minnesota.

WILLIAM P. SHATTUCK.

In presence of—
A. C. PAUL,
C. V. HAWLEY.