No. 695,673. Patented Mar. 18, 1902.

W. DIEBEL.

DIFFERENTIAL SPEED AND REVERSING MECHANISM.

(Application filed May 28, 1901.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

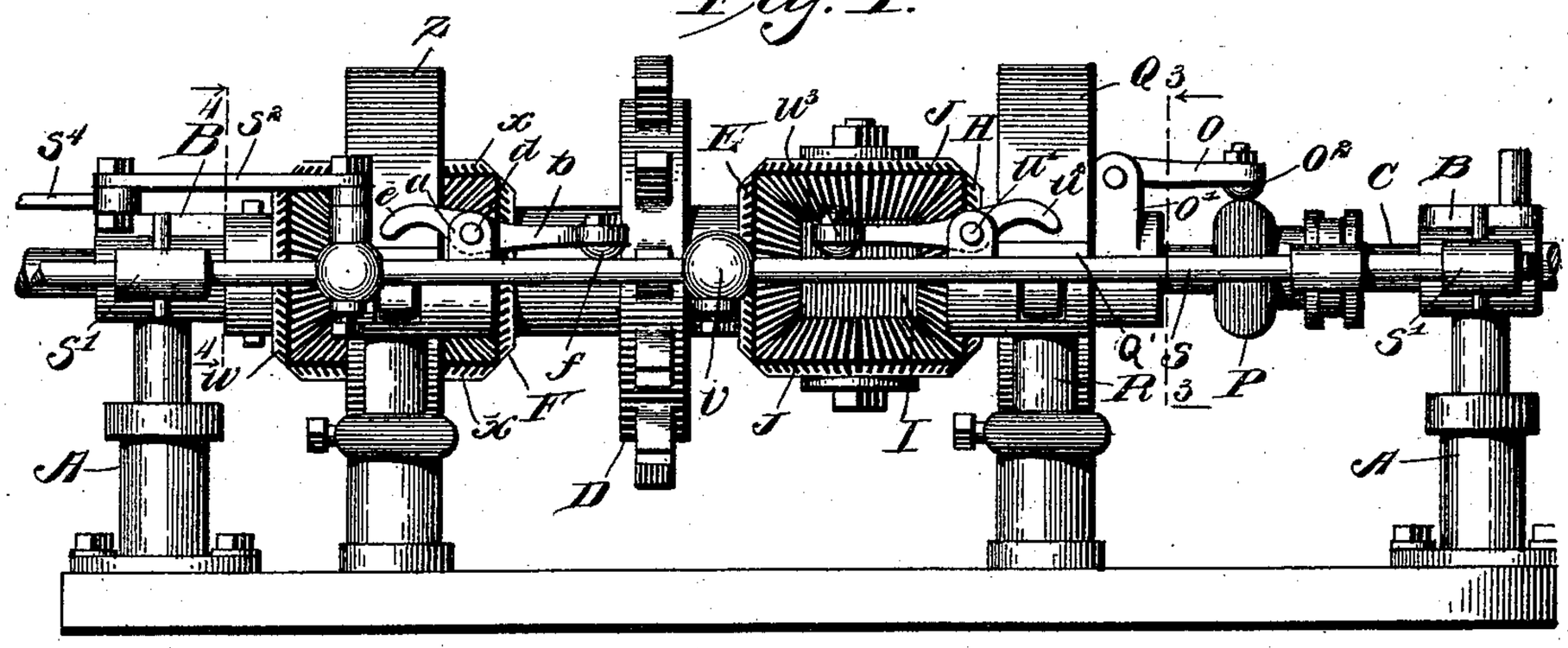
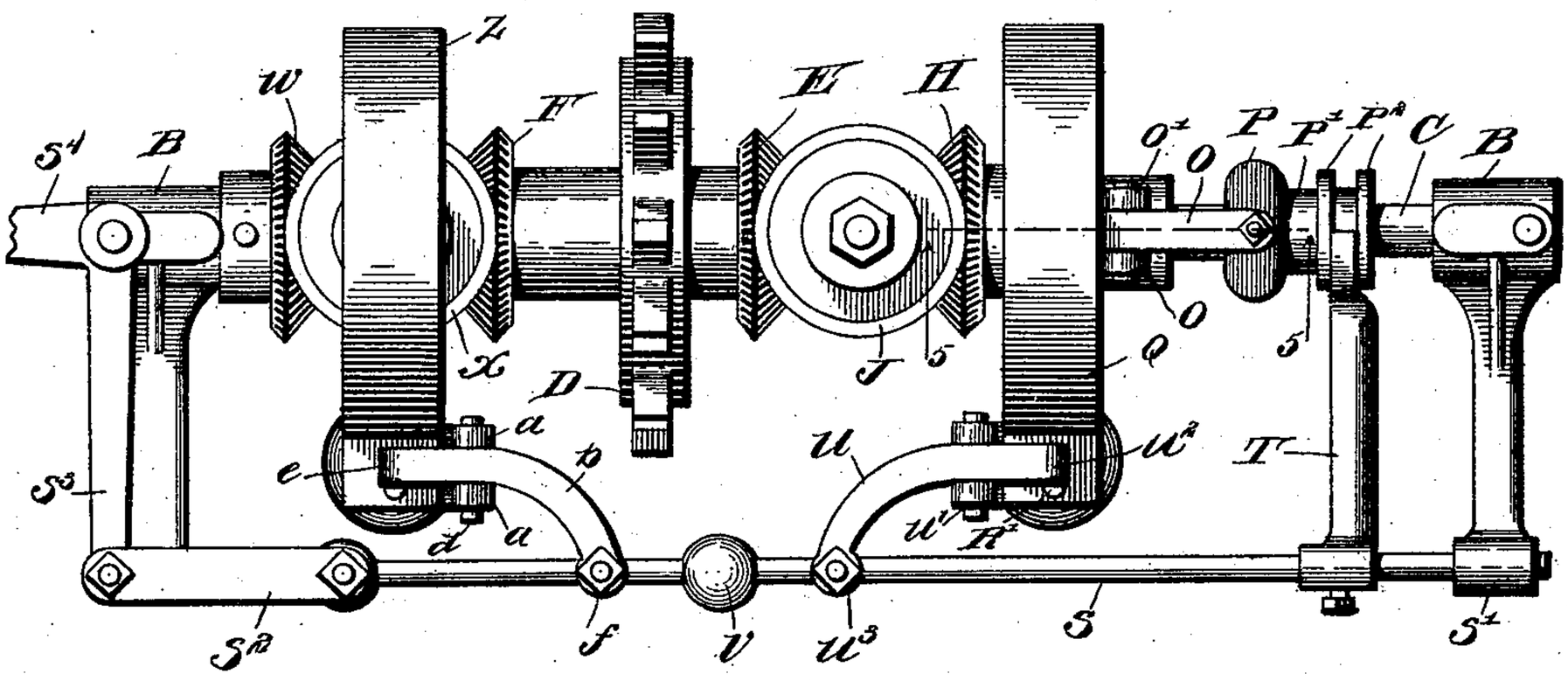


Fig. 2.



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(No Model.) 3 Sheets—Sheet 2.

Fig. 3.

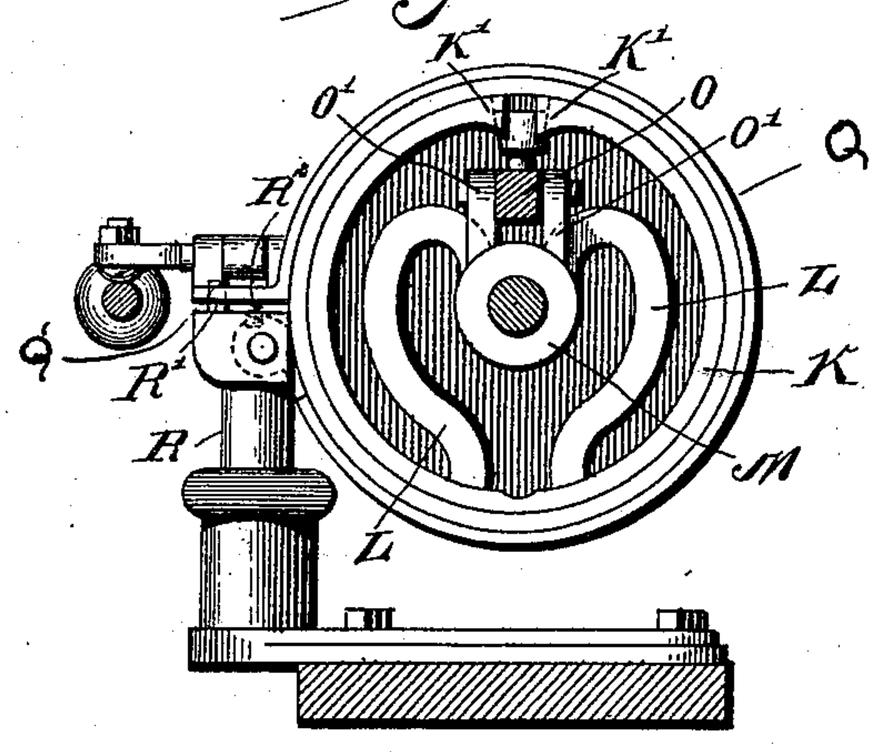

Fig. 4.

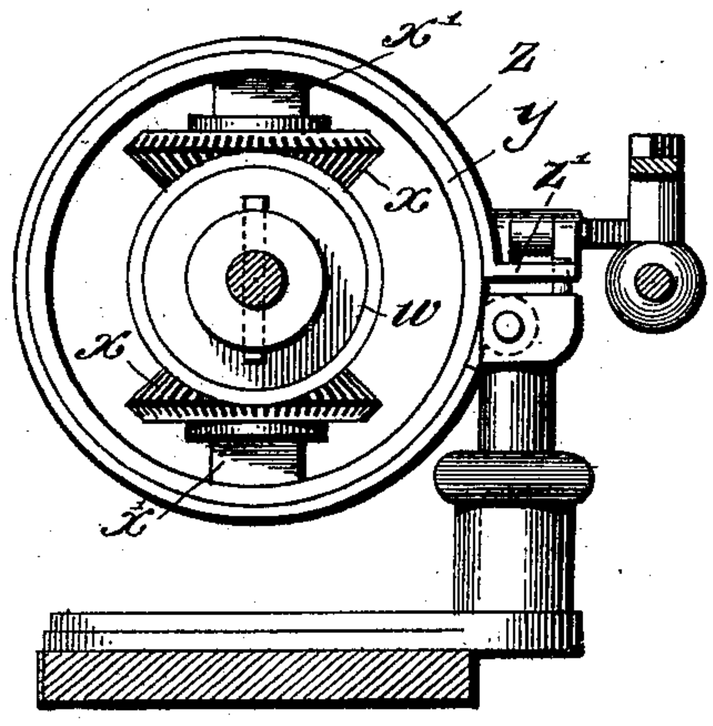

Fig. 5.

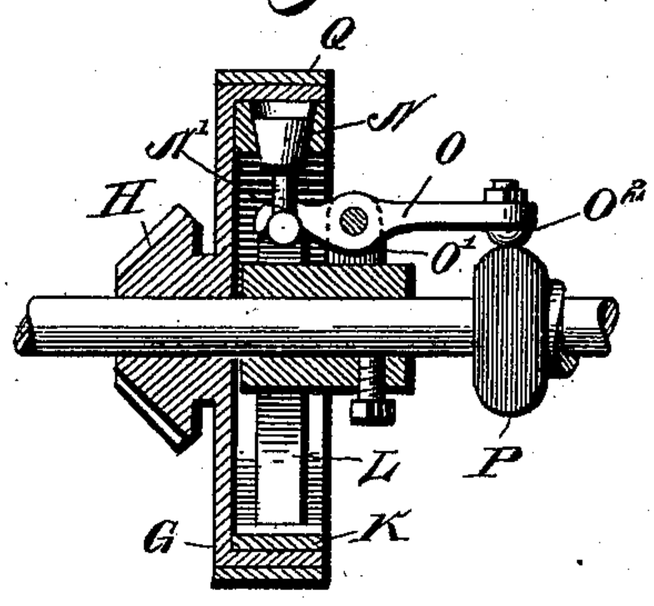

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Fig. 6.

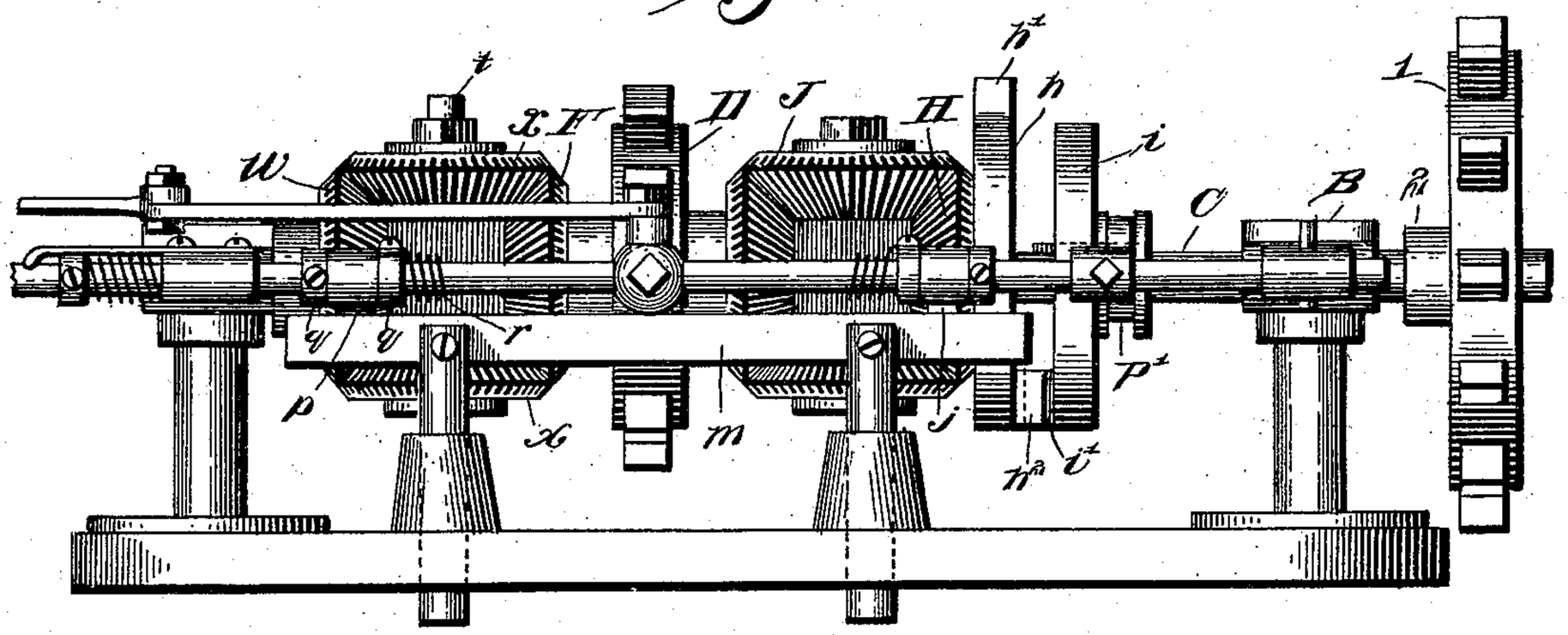


Fig. 7.

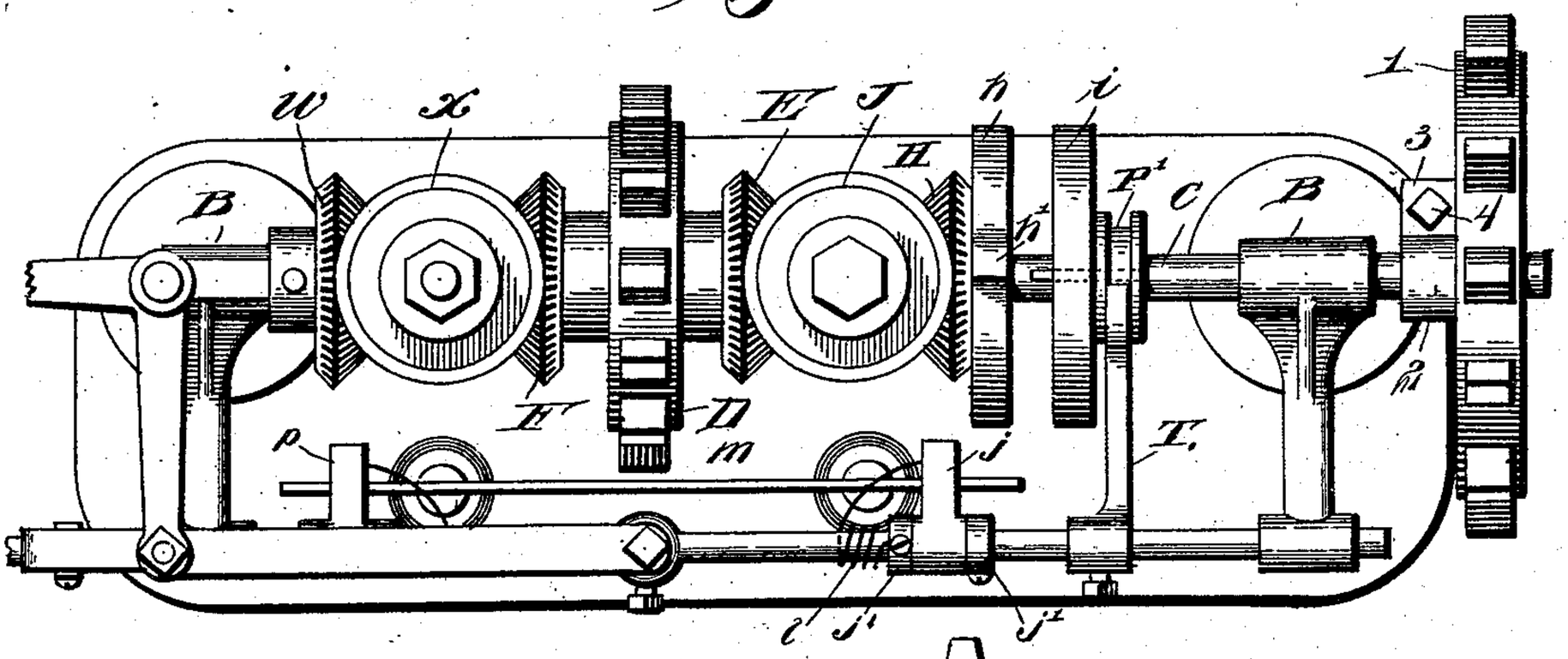
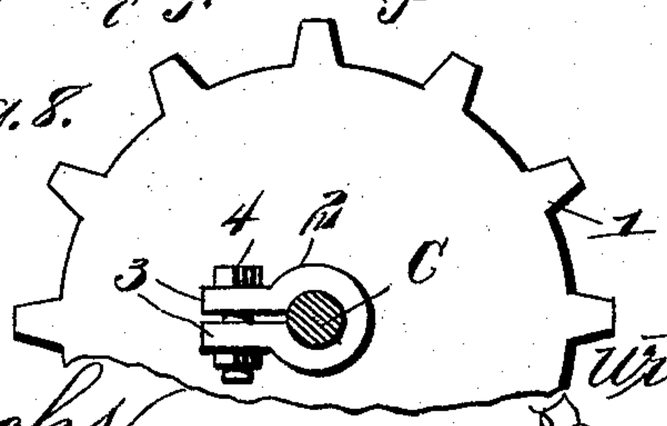


Fig. 8.



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UNITED STATES PATENT OFFICE.

WILLIAM DIEBEL, OF PHILADELPHIA, PENNSYLVANIA.

DIFFERENTIAL-SPEED AND REVERSING MECHANISM.

SPECIFICATION forming part of Letters Patent No. 695,673, dated March 18, 1902.

Application filed May 28, 1901. Serial No. 62,214. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM DIEBEL, a citizen of the United States, residing at Philadelphia, county of Philadelphia, and State of Pennsylvania, have invented a certain new and useful Improvement in Differential-Speed and Reversing Mechanism, of which the following is a specification.

My invention relates to a new and useful improvement in differential-speed and reversing mechanism, the purpose of which is to provide a changeable-speed gearing and reversing mechanism designed more particularly for motor-propelled vehicles, but equally as well adapted for use upon other machinery, and this mechanism is designed to be interposed between the motor and the point to which the power is desired to be transmitted. In use upon motor-propelled vehicles—such as automobiles, bicycles, and tricycles, for which the invention is especially devised—it frequently becomes desirable to change from high to low speed while ascending hills or traveling over irregular ground and then changing back to higher speed in traveling over smooth surfaces or level ground, and it is also sometimes desirable to reverse the mechanism almost instantly, and I accomplish all of the foregoing with exceedingly simple mechanism and by the manipulation of but one lever.

The object of my invention is to provide mechanism, all located upon one shaft, by which the speed of the machine to which my improvement is applied can be increased or decreased and the direction of rotation reversed without changing the speed of the motor or altering the direction of rotation of the same, all of this to be accomplished through a shifting mechanism operated upon by a single lever; and a further object of my invention is to so construct this shifting mechanism that the machinery will run loose between the different operation of changing from different speeds and reversing.

With these ends in view this invention consists in the details of construction and combination of elements hereinafter set forth and then specifically designated by the claims.

In order that those skilled in the art to which this invention appertains may understand how to make and use the same, the construction and operation will now be described in detail, referring to the accompanying drawings, forming a part of this specification, in which—

Figure 1 is a rear elevation of my invention, showing the parts in the position they would assume when the machine is running in the forward or normal direction at low speed; Fig. 2, a plan view of Fig. 1; Fig. 3, a section on the line 3 3 of Fig. 1; Fig. 4, a section on the line 4 4 of Fig. 1; Fig. 5, a section on the line 5 5 of Fig. 2; Fig. 6, a rear view of my improvement, showing the modified form of clutching and shifting mechanism; Fig. 7, a plan view of Fig. 6; and Fig. 8, a face view of a sprocket-wheel adapted to supply power to the power-shaft, showing its frictional connection with such power-shaft.

In carrying out my invention as embodied in Figs. 1 to 5, inclusive, A represents standards which are secured to any suitable part of the framework of machines or vehicles upon which my improvement is used, and in the upper end of these standards are formed bearings B, in which is journaled the shaft C, and this shaft is adapted to constantly revolve in one direction by being connected by suitable chain and sprocket or gearing with a motor.

D is a sprocket or gear wheel from which the power is retransmitted to the mechanism to be controlled by my improvement. This sprocket or gear wheel D has formed with or secured to it the two bevel-gears E and F. Both of these bevel-gears and also the gear-wheel or sprocket D are journaled loosely upon the shaft C.

G is a friction-wheel which has secured to or formed with it a bevel-gear H, and both the bevel-gear and this friction-wheel are also journaled loosely upon the shaft C.

I is a block which is secured rigidly to the shaft C, so as to always revolve therewith. Extending outward from two opposite sides of this block are studs, upon which are journaled loosely the bevel-gears J, which mesh with both the bevel-gears E and H.

K is a split spring-ring which is adapted to lie within the friction-wheel G and is secured by means of spokes L to a hub M, which is rigidly secured to the shaft C, and the spring portions of this split ring will be ar-

ranged so that the ring will be normally held out of contact with the interior surface of the rim of the friction-wheel G, and for the purpose of forcing this split ring into frictional contact with the interior surface of the rim of the wheel G, and thereby cause the wheel G, and consequently the gear H, to revolve in unison with the shaft C, I provide a tapering plug N, which is located between the two ends K′ of the split ring K, and it is obvious that if this tapering plug N is pulled inward toward the hub the two spring portions of the ring K will be forced apart, and thereby forced into frictional contact with the wheel G. For the purpose of pulling this plug inward I provide a lever O, pivoted between the two lugs O′, formed upon the hub M. The inner end of the lever O is pivoted to or hooked into the stem N′ of the plug N, and the outer end of the lever O is formed with a contact-point O^2, which is adapted to contact a cam P, which is adapted to slide loosely upon the shaft C. When the cam P is shifted so as to raise the contact-point O^2 upon the lever O to its highest position, as illustrated in Figs. 1 and 5, the plug N will be pulled inward, and thus force the spring-ring in contact with the interior surface of the rim of the wheel G. This will thereby cause the wheel G and the gear H to revolve with the shaft C, and as the gear H is in mesh with the gears J, which are journaled upon the studs formed with the block I, which always revolves with the shaft C, the gear E will thereby be caused to also revolve with the shaft C at the natural speed of such shaft, which is the lowest speed desired.

Q is a metallic band or strap which passes entirely around the outside of the friction-wheel G. One end of this strap is secured rigidly to a standard R, and the other end is free to move a slight distance vertically upon a stud R′, formed with the standard R. A spring R^2 tends to separate the two ends of the strap Q and normally holds the same out of contact with the wheel G.

When it is desired to change the speed of the machinery to high speed, the strap Q, by means hereinafter described, is forced into contact with the periphery of the wheel G, and thereby will hold the wheel G stationary, as also the gear H. When this occurs, the gear-wheels J, which are journaled upon the studs of the block I, will revolve around the now stationary gear H, and besides having this planetary motion they will also be caused to revolve upon their own axis by being in mesh with the gear H. This double rotary motion will impart to the gear E, which is secured to the gear or sprocket wheel D, double the speed of the shaft C. It is of course understood that when the band Q is clamped around the wheel G the cam P will be moved out of contact with the contact-point O^2, which will allow the outer end of the lever O to drop, and thus relieve the frictional contact between the split ring K and the interior of the rim of the wheel G.

For the purpose of shifting the cam P and also actuating mechanism to clamp the band Q around the wheel G, I provide a shifting rod S, which is adapted to slide within suitable bearings S′, extending outward from the standards A. The shifting of this rod is accomplished through the agency of a system of levers extending to a point within easy reach of the operator. In the drawings it is illustrated by connecting the shifting rod S by the link S^2 to the end of the member S^3 of a bell-crank lever S^4. The other member of the bell-crank lever will be connected to the actuating-lever located within reach of the operator or driver.

T is an arm secured to the shifting rod S and extends inward toward the shaft C and is forked at its inner end for the purpose of straddling the hub P′, upon which the cam P is secured. Collars P^2 are secured to or formed with the hub upon each side of the fork of the arm T. Thus as the rod S′ is shifted the cam P will also be caused to move with it.

For the purpose of clamping the strap or band Q around the wheel G, I provide a lever U, which is pivoted upon the standard R at the point U′, the end U^2 of the lever adapted to rest upon and come in contact with the free end Q′ of the strap Q. The other end of the lever is furnished with a contact-point U^3, which is normally adapted to rest against the shifting rod S. V is a cam adapted to be secured upon the shifting rod S. This cam V as well as the arm T are made adjustable along the shifting rod S. When the shifting rod is shifted so as to bring the cam V underneath the contact U^3, one end of the lever U will be raised, which will depress the end U^2, and thus force downward the free end Q′ of the strap Q and cause a frictional contact between such straps and the wheel G, which will hold the wheel stationary, and thereby double the speed of the mechanism, as before described. The same movement of the shifting rod S which brings the cam V into contact with the contact U^3 will also, through the agency of the arm T, carry the cam P from out of contact with the contact-point O^2 of the lever O; but the cam V and the arm T are so adjusted along the rod that the cam P is moved out of contact with the lever O before the cam V is brought into contact with the lever U. Thus there will be a point between the change from one speed to another, when the shaft C will run free and transmit no motion whatsoever to the gear-wheel D. This is for the necessity of obviating the undue strain which would be exerted upon the mechanism if the change were made directly from low to high speed, or vice versa.

As far as I have described relates only to the mechanism for bringing about the differential speed. The reversing mechanism will now be described.

W is a bevel-gear which is secured rigidly to the shaft C and adapted to revolve constantly therewith.

X represents two bevel-gears which are journaled loosely upon studs extending out from two opposite sides of a block similar to the block I before described; but instead of being secured rigidly to the shaft this block is journaled loosely thereon. These gear-wheels X also mesh with the bevel-gear F, which is secured to or formed with the gear or sprocket wheel D. The studs X′, upon which the bevel-gears X are journaled, are secured at their outer ends to a rim Y.

Z is a band or strap passing entirely around the rim Y, and one end of this strap Z is secured rigidly to the standard *a*, and the other end of the strap Z is free and is bent at right angles, so as to form the foot Z′.

b is a lever which is pivoted to the standards *a* at the point *d*. The end *e* of this lever is adapted to lie over the foot Z′ of the strap Z. The other end of the lever is provided with a contact-point *f*, which is normally adapted to lie in contact with the shifting rod S; but when the shifting rod S is forced to the limit in one direction the cam V will be forced underneath the contact *f*, which will raise that end of the lever and depress the end *e*, which, coming in contact with the foot Z′, will bind the strap or band Z tightly around the rim Y, and thus hold said rim stationary, and the studs X′, being secured to the rim, will also cause the gears X to be held stationary as regards their revolutions around the shaft C; but they are free to revolve around their own axis, and they are so caused to revolve by the bevel-gear W, which will transmit the motion through the gears X to the bevel-gear F, but will drive this bevel-gear, and consequently the wheel D, in the opposite direction to which it has formerly been running.

When the shifting rod S is shifted so that the cam V will be underneath the contact *f*, of course the said cam V will not be in contact with the lever U, and the band Q will consequently be out of frictional contact with the wheel G, and when the rod S is in this position the arm T will have placed the cam P so that the contact-point O^2 is out of contact with the cam, and consequently the split ring K is out of frictional contact with the interior of the wheel G. When the machinery is in this reversed condition and it is desired to cause the same to travel in its normal direction again, the rod S will be slid toward the right in Fig. 1, and the cam V will pass from beneath the contact-point *f* before the cam P slides underneath the contact-point O^2, and consequently at that time neither of the bands Z and Q nor the split ring K will be operated upon. Therefore the gear or sprocket wheel D will be out of connection with the shaft C; but of course this is only momentarily, for as the rod S continues to slide toward the right the cam P will force the outer end of the lever upward, and thereby clamp the split ring in frictional contact with the wheel G, which will cause the machinery to travel forward at the lowest speed and will then be in the position shown in Figs. 1 and 2. When it is desired to change to a higher speed, the rod S is shifted still further to the right, which will bring the cam V underneath the contact U^3 of the lever U and slide the cam P from underneath the contact O^2 of the lever O, which will release the friction between the split ring and the interior of the wheel G, but cause the band Q to be brought into frictional contact with the exterior of the wheel G, which will bring about the desired high rate of speed, as before described; but between the operation of shifting from low to high speed there will be a point where neither the cams P nor V will be in contact with their contact-points O^2 or O^3. At this point the gear or sprocket wheel D will again be out of connection with the shaft C. In shifting back again from high to low speed and from low speed to the reverse the operation will be just opposite, the rod S being shifted to the left in Fig. 1.

It will be observed that the low speed is always interposed between the high speed and the reverse. Therefore there is never any danger of inexperienced operators injuring the machinery by trying to reverse the machinery directly from high speed in the forward direction to the reverse in the opposite, as it is always necessary to first pass from high speed to low speed before the machinery can be reversed or from the reversed condition to low speed before the high speed can be obtained.

In Figs. 6 and 7 I have shown a modification whereby instead of employing frictional means for clutching the gears I provide positive stops, which may be of advantage in some cases. In this construction, instead of the friction-wheel G, I employ a disk *h*, which has the tooth *h*′ extending outwardly from its periphery and also a tooth h^2 extending outward from the face of the same, and instead of the split ring K and its actuating-lever O and cam P, I provide a disk *i*, which is secured to the hub P′ the same as the cam P. This disk *i* is feathered upon the shaft C and is caused to slide along said shaft by the arm T the same as the cam in the former construction. This disk *i* carries the tooth *i*′ upon its inner face, which will come into engagement with the tooth h^2 upon the disk *h*. When the disk *i* is slid toward the disk *h*, this will cause the two disks *i* and *h* to travel in unison with the shaft C, as also will the gear H, which is secured to the disk *h*. This will give the slow speed in the forward direction, as before described. The shifting rod S in this case carries a finger *j*, which is pivoted upon the rod S and held between two collars *j*′, which collars are secured to the rod S. A coil-spring *l* always tends to keep the finger *j* downward in contact with the horizontal bar *m*. When it is desired to change to high speed, the rod S is shifted until the finger *j* will come opposite the disk *h* and

when in this position will come in contact with the tooth h' upon the disk h, and thus hold the disk h, and consequently the gear H, against rotation. In shifting the finger j to a point opposite the disk h the tooth i' upon the disk i, by means of the arm T, will be carried out of engagement with the tooth h^2 of the disk h. The means provided in this construction to bring about the reversing movement is as follows: Another finger p is pivoted upon the shifting rod S and is held in position upon the rod by means of the two collars q. This finger is also normally held downward against the bar m by means of the coil-spring r. One of the studs upon which the bevel-gears X are journaled extends out a distance beyond the rear face of the gear, as indicated at t, and when it is desired to reverse the machinery the shifting rod is shifted so that the finger p will come opposite the line of travel of the end of the stud, and in revolving this end will strike the finger p, and thus hold the gears X against revolution with the shaft C, and by reason of these gears being stationary movement will then be transmitted from the gear W, through the gears X, to the gear F, which is connected to the gear or sprocket wheel D, and this will revolve the gear or sprocket wheel D in the reversed direction, as before described.

To do away with the disadvantge of stopping the gears suddenly by means of the positive stop instead of the frictional means which I employ in the first-described construction, I provide a frictional connection between the power-shaft and the source of this power. As shown in the drawings, 1 is a sprocket-wheel over which a chain is adapted to pass to supply motion to the power-shaft C from the motor. This sprocket-wheel 1 has secured to it the split sleeve 2. This sleeve has two projecting lips 3, which are adapted to be clamped together by means of a nut and bolt 4. The power-shaft C passes through the sleeve and is adapted to be clamped thereto by the bolt 4, and as the sleeve is formed with or secured to the sprocket-wheel 1 this will allow for the sprocket-wheel to slip upon the shaft before it will injure any of the working parts of the mechanism, and the degree of frictional contact can be regulated by the bolt 4.

The principal advantage of my invention is that by a simple arrangement of gears and clutches, all located upon one shaft, I am enabled to obtain different speeds and reverse the movements all through the agency of a single lever. The principal advantage of the clutching mechanism in Figs. 1 to 5, inclusive, is that by the use of frictional contacts the wear and tear upon the machine are lessened, because such frictional contact will not stop the gears instantly, but allow for the momentum of the gears, and another advantage of this construction is that if any obstruction is encountered by the moving parts the frictional contacts will allow such parts to slip, and thus prevent such obstruction from damaging the machinery.

While I have described the higher speed to be just double the low speed, it is obvious that the ratio between the high and low speed could be increased or decreased, as desired, by changing the relative size of the gears.

Of course I do not wish to be limited to the exact construction here shown, as modifications other than those described can be made without departing from the spirit of my invention.

Having thus fully described my invention, what I claim as new and useful is—

1. In a differential-speed and reversing mechanism, a power-shaft, a transmission-wheel D journaled loosely upon said power-shaft, a bevel-gear E secured to and adapted to revolve with the transmission-wheel upon the power-shaft, a bevel-gear H journaled loosely upon the power-shaft, a shifting rod, means for shifting said rod, means adapted to be operated by the shifting of said rod to connect or disconnect the gear-wheel H with the power-shaft, means also adapted to be operated upon by the shifting rod for the purpose of causing the gear-wheel H to remain stationary, bevel-gears J journaled loosely upon an axle, said axle secured rigidly to the power-shaft so as to revolve therewith, said gears adapted to be always in mesh with both the bevel-gears E and H, a bevel-gear W secured to and adapted to revolve with the power-shaft, a bevel-gear F secured to the transmission-wheel D and adapted to revolve therewith loosely upon the power-shaft, gears X, an axle upon the ends of which the gears are adapted to be journaled loosely, said axle adapted to be journaled loosely upon the power-shaft, means controlled by the shifting of the shifting bar to cause the gears X to remain stationary for the purpose of reversing the direction of rotation of the transmission-wheel, substantially as described and for the purpose specified.

2. In a device of the character described, a continuously-running power-shaft, a transmission-wheel D journaled loosely upon said shaft, a bevel-wheel E formed with and adapted to revolve with the transmission-wheel, a bevel-wheel H journaled loosely upon the power-shaft, means under the control of the operator adapted to connect and disconnect the bevel-gear H from the power-shaft, two bevel-gears J interposed between the bevel-gears E and H and adapted to be always in mesh therewith, an axle upon the ends of which the gears are adapted to be journaled loosely, said axle adapted to be rigidly secured to the power-shaft, means under the control of the operator to cause the gear H to remain stationary, a bevel-gear W secured rigidly to the power-shaft, a bevel-gear F secured to and adapted to revolve with the transmission-gear D, two bevel-gears X interposed between and adapted to mesh with both of the gears W and F, an axle upon the

ends of which the bevel-gears X are journaled loosely, said axle journaled loosely upon the power-shaft, means under the control of the operator to cause the bevel-gears X to remain stationary upon the power-shaft, as and for the purpose specified.

3. In combination with a machine of the character described, a power-shaft, a transmission-wheel journaled loosely upon said power-shaft, a bevel-gear E secured with and adapted to revolve with the transmission-wheel, a bevel-gear H journaled loosely upon the power-shaft, two bevel-gears J interposed between the bevel-gears E and H and adapted to mesh therewith, an axle, upon the ends of which the bevel-gears J are journaled loosely, said axle secured rigidly to the power-shaft, a bevel-gear W secured rigidly to the power-shaft, a bevel-gear F secured to and adapted to revolve with the transmission-wheel D, two bevel-gears X interposed between and adapted to mesh with each of the bevel-gears W and F, an axle upon the ends of which the bevel-gears X are journaled, said axle journaled loosely upon the power-shaft, a slide-rod, suitable bearings in which said rod is adapted to slide, means for sliding said rod, means adapted to be actuated by said rod to connect and disconnect the bevel-wheel H with the power-shaft, means adapted to be actuated by said rod to cause the wheel H to remain stationary and to release the same, means adapted to be actuated by said slide-rod to cause the bevel-gears X to remain stationary upon the power-shaft and to release the same, substantially as and for the purpose specified.

In testimony whereof I have hereunto affixed my signature in the presence of two subscribing witnesses.

WILLIAM DIEBEL.

Witnesses:
MARY E. HAMER,
L. W. MORRISON.