No. 743,467. PATENTED NOV. 10, 1903.

W. DECKER.

VARIABLE SPEED AND REVERSING MECHANISM.

APPLICATION FILED MAR. 11, 1901.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.

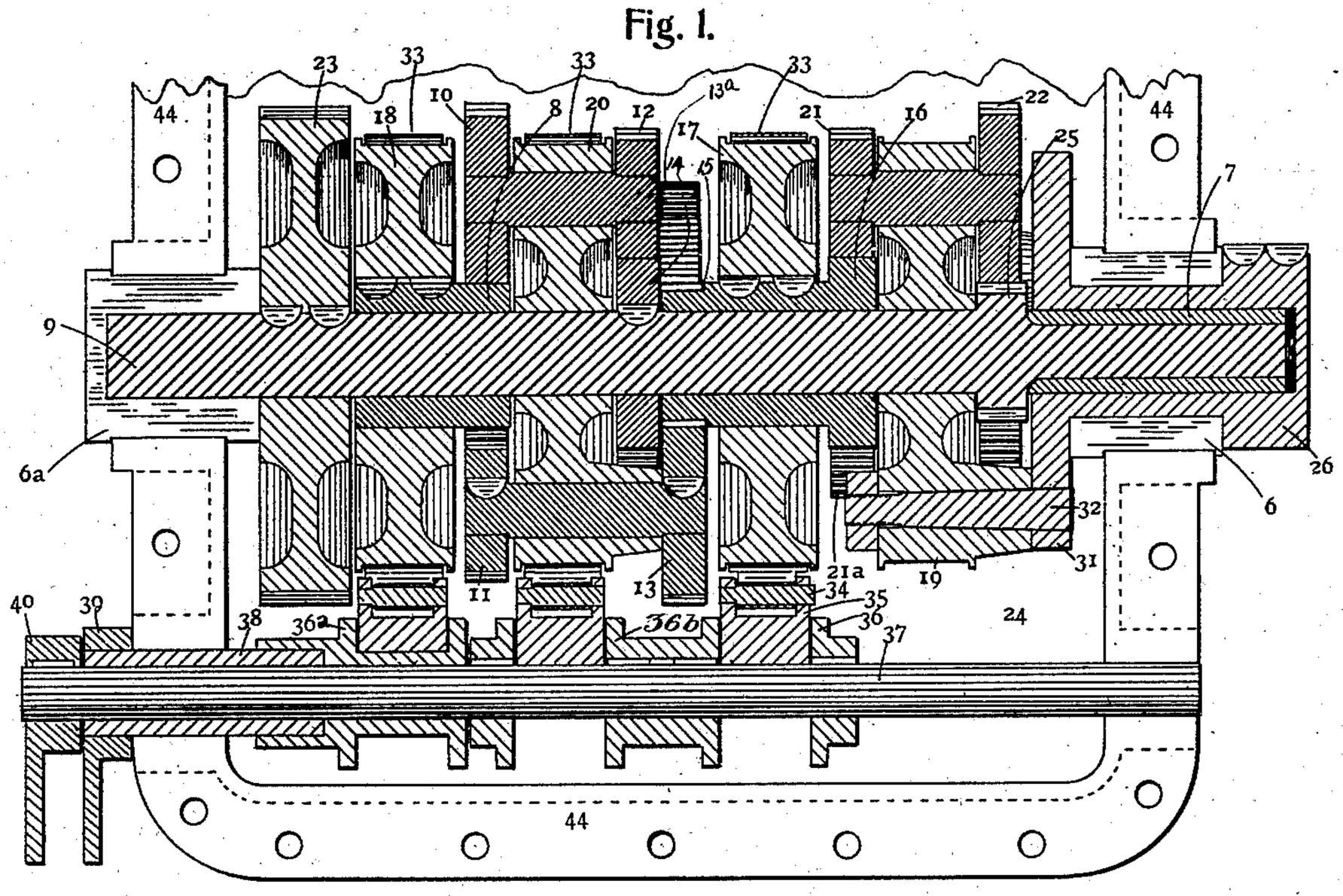


Fig. 2.

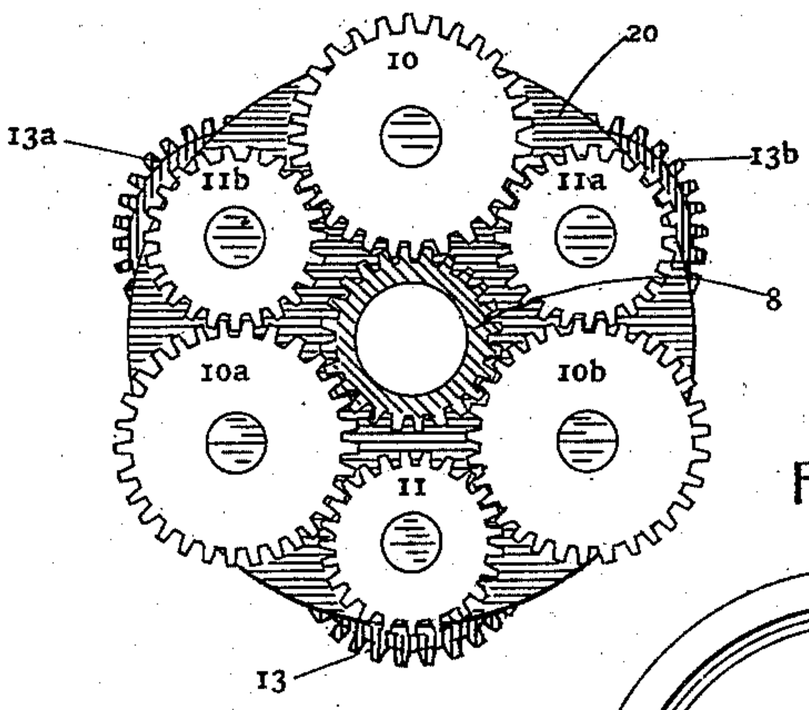


Fig. 3.

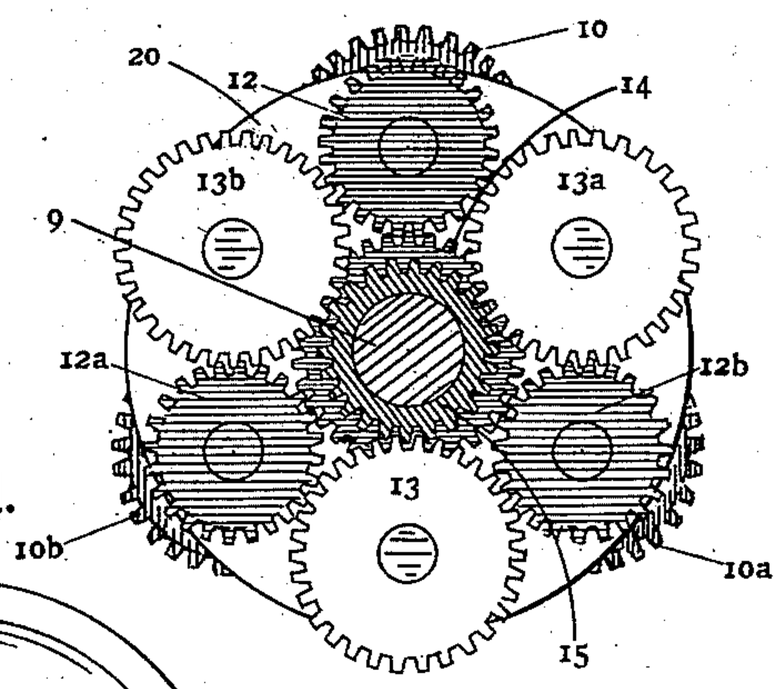
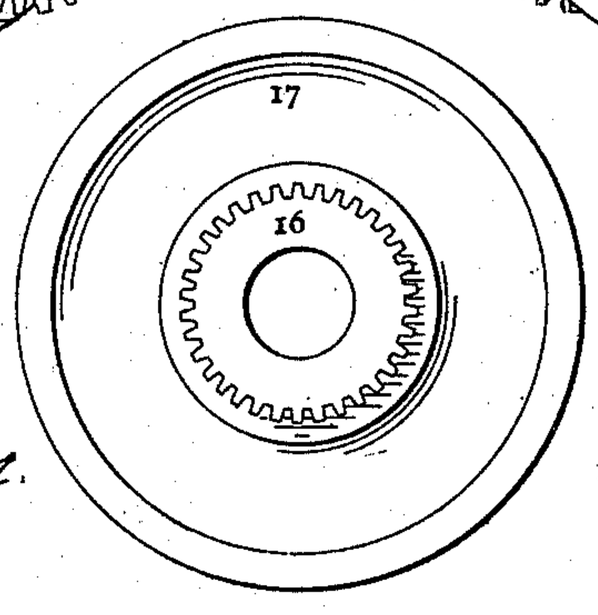


Fig. 4.



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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 5.

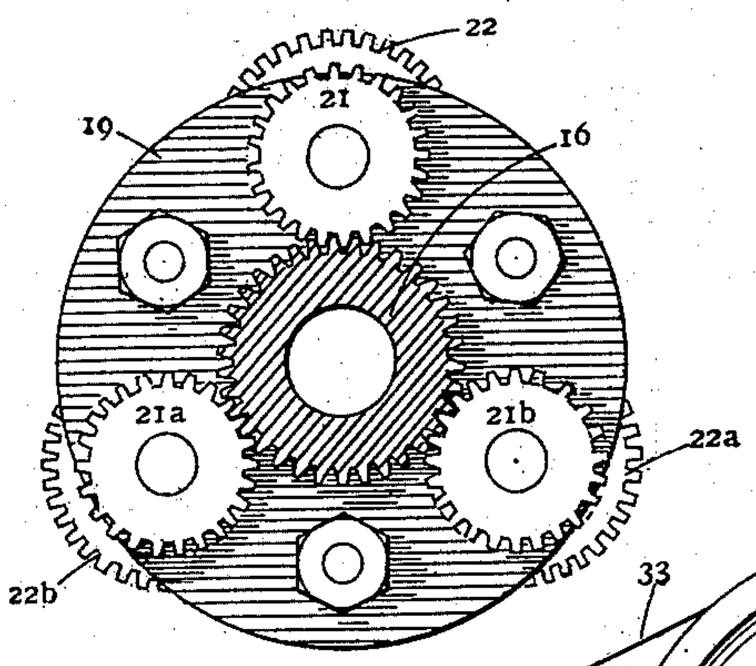

Fig. 6.

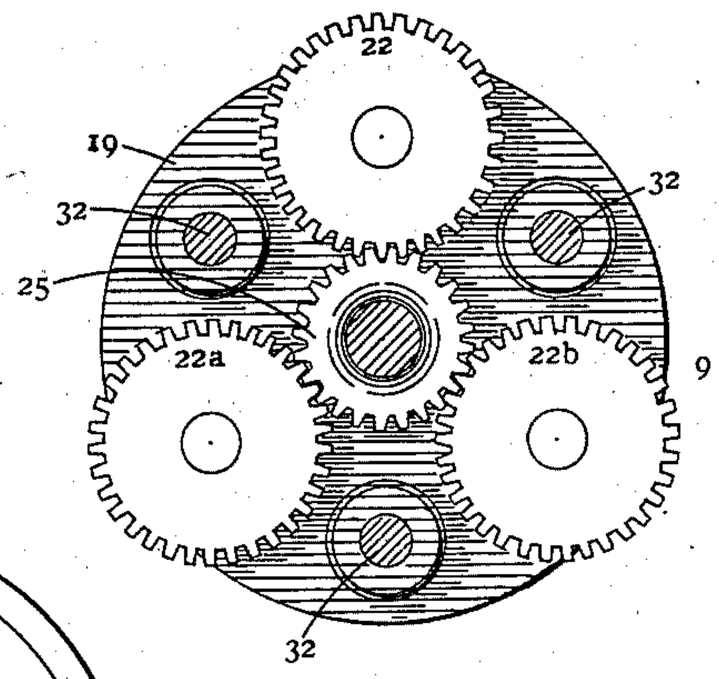

Fig. 7.

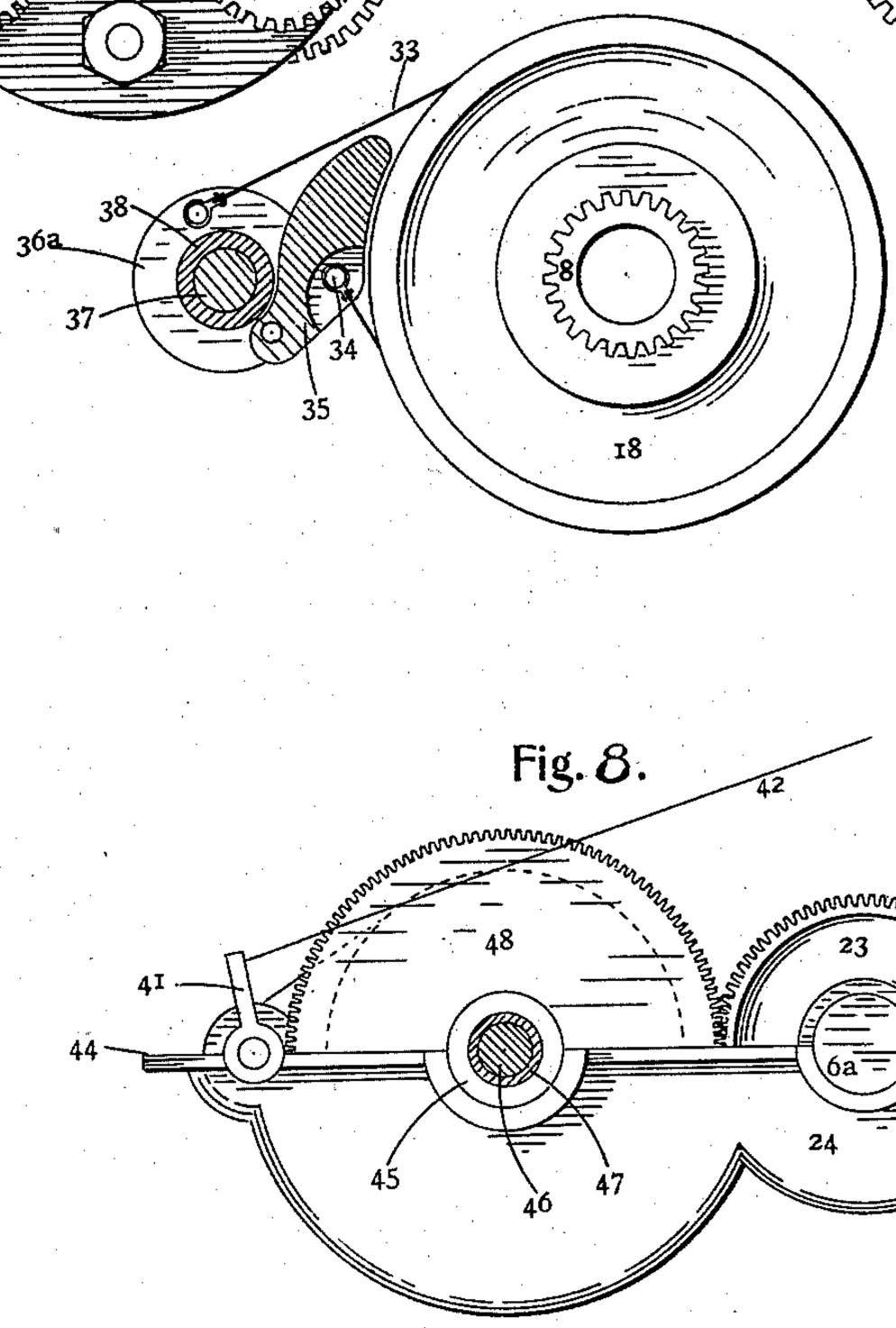

Fig. 8.

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APPLICATION FILED MAR. 11, 1901.

NO MODEL. 3 SHEETS—SHEET 3.

Fig. 9.

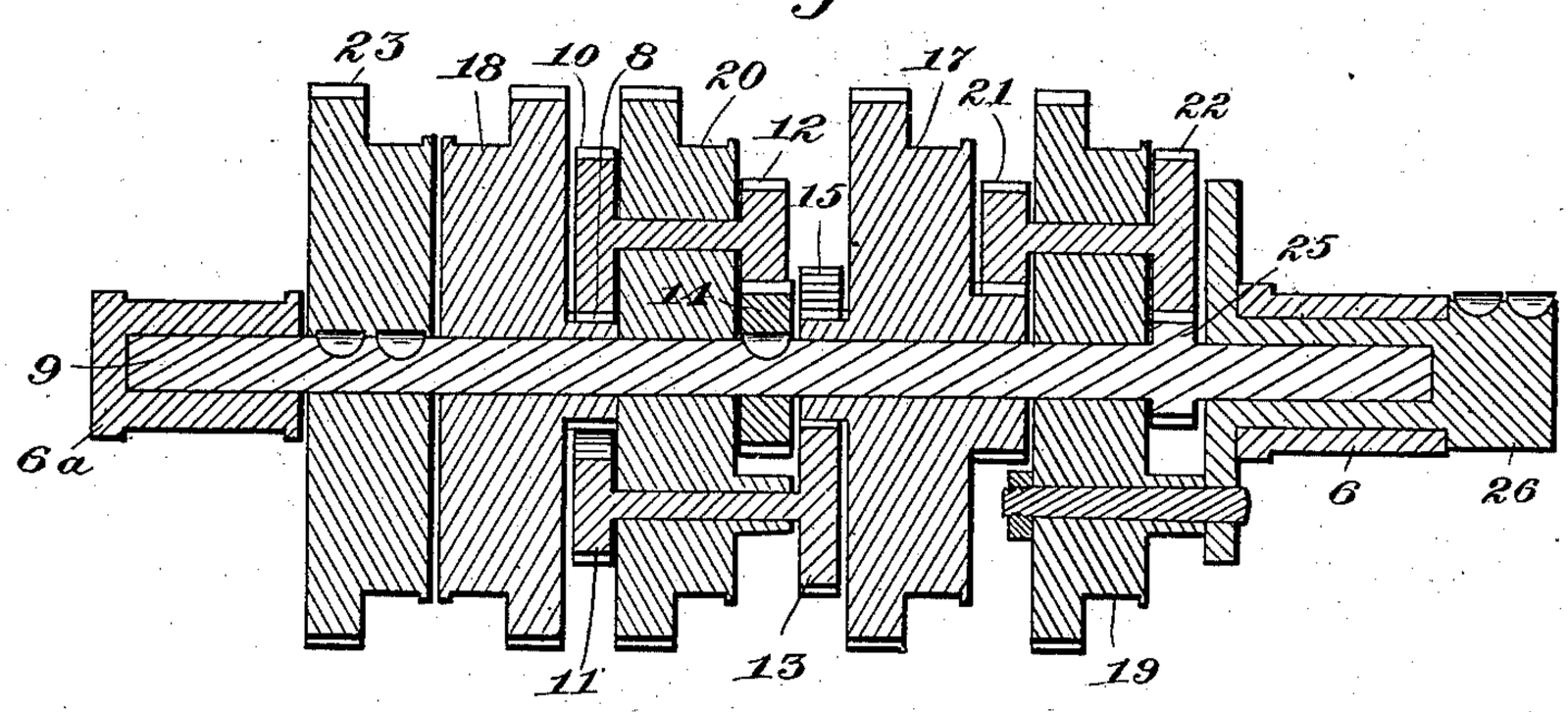
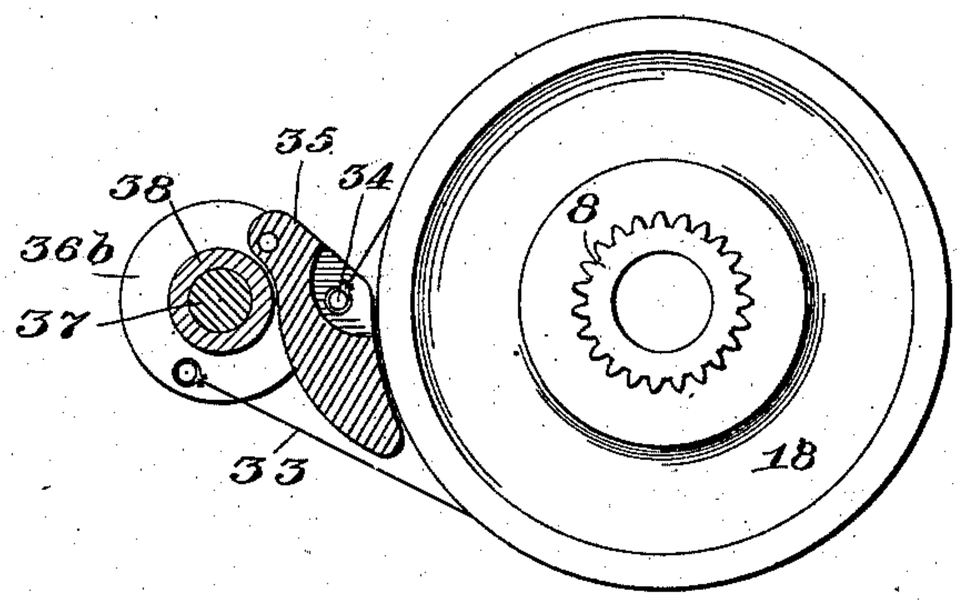


Fig. 7a.



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No. 743,467. Patented November 10, 1903.

UNITED STATES PATENT OFFICE.

WARD DECKER, OF OWEGO, NEW YORK.

VARIABLE-SPEED AND REVERSING MECHANISM.

SPECIFICATION forming part of Letters Patent No. 743,467, dated November 10, 1903.

Application filed March 11, 1901. Serial No. 50,747. (No model.)

To all whom it may concern:

Be it known that I, WARD DECKER, a citizen of the United States, residing at Owego, in the county of Tioga and State of New York, have invented a new and useful Variable-Speed and Reversing Mechanism, of which the following is a specification.

My invention relates to the controlling mechanism applied to motor-vehicles. It is not limited to this use, but may be employed wherever controlling, reversing, or speed-changing mechanism is desirable.

The objects of my invention are, first, to provide mechanism for throwing the load onto a moving driving-shaft gradually and easily; second, to avoid the use of frictional clutches, internal gear-teeth, and bevel-gears; third, to vary the speed as required without shifting gear-wheels; fourth, to adapt small spur gear-wheels of the least number of sizes to this use, thereby facilitating manufacture and occupying little space; fifth, to distribute the strains among several gear-wheels, and, sixth, to provide mechanism that can completely and easily be incased, allowing the mechanism to run in an oil-bath. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a plan of a portion of the lower half of the case, showing a cross-section through the center of the mechanism; Fig. 2, a side elevation of part of the gears and their support; Fig. 3, an elevation of the other side of Fig. 2; Fig. 4, an elevation of one of the brake-wheels and one of the gears; Figs. 5 and 6, opposite side elevations of another support and gears; Fig. 7, an elevation of the other brake-wheel and gear, with a cross-section of the brake mechanism; Fig. 7^a, a section of the reversed brake; Fig. 8, a side elevation of the complete mechanism with the upper half of the case removed, and Fig. 9 a sectional view of the mechanism arranged to apply or take off power from various parts.

Similar figures refer to similar parts throughout the several views.

In Fig. 1, 9 shows a section of the main shaft with a main gear-wheel 25 formed thereon. To this shaft is keyed a second main gear 14 and a driving-gear 23. 26 is a sectional plan of the driving-shaft, which is practically a tube with enlarged ends supported in a bearing 6. This driving-shaft also supports one end of the main shaft, which is preferably covered with some anti-friction metal, as represented by 7. The other end of the main shaft is supported by the bearing 6^a. Both bearings 6 and 6^a are held between and in enlargements of the two halves of the case 24, designed to completely cover the gears and hold an oil-bath for them to run in. The end construction of the lower half of the case is clearly shown in Fig. 8, the upper half being a reverse duplicate adapted to be bolted to the lower half through holes in the rim 44, Fig. 1.

The inner end of the driving-shaft 26 is enlarged into a flange 31 and is securely bolted to a wheel 19, freely movable upon the main shaft 9. At equidistant points on the face of this wheel adjacent to the driving-shaft are mounted on short shafts three wheels or gears 22, 22^a, and 22^b, Fig. 6, all meshing with the main gear 25. On the opposite side of wheel 19 and mounted on the shafts extending through the wheel from the 22 series of gears are mounted three more gear-wheels of lesser diameter 21, 21^a, and 21^b, Fig. 5. All the gears in the mechanism mounted on short shafts are securely keyed to them, as shown in Fig. 1 at 11 and 13, and all short shafts are free to revolve in their bearings in the supporting-wheels 19 and 20.

Meshing with the gear-wheels 21, 21^a, and 21^b, Fig. 5, is a larger gear 16, loosely mounted on the main shaft 9, Fig. 1. This gear-wheel 16 is one end of a sleeve, the other end terminating in a smaller gear 15. Keyed to this sleeve is a brake-wheel 17, (shown in Fig. 4,) the other side being the same as the wheel shown in Fig. 7. Immediately adjacent to small gear 15 is the second main gear 14, keyed to the main shaft. Upon the opposite side of this main gear from small gear 15 is loosely mounted the gear-supporting and brake wheel 20. On the side of this wheel next to the main gear and meshing with it are supported on three short shafts equidistant from each other the gear-wheels 12, 12^a, and 12^b, Fig. 3. These short shafts reach through the support-wheel and terminate in three larger gears 10, 10^a, and 10^b, Fig. 2. These last gears

are meshed with three other gears of less diameter mounted on shafts equidistant from the support-wheel center and from the other short shafts. These last shafts are longer than the other short shafts by a little over the thickness of main gear 14. Mounted on these shafts on the same side of the support-wheel 20 as the gears 12, 12^a, and 12^b are the larger gears 13, 13^a, and 13^b, Fig. 3. Owing to the shafts being longer and being held out by projections on wheel 20, these gears are out of mesh with the smaller ones, but are in mesh with the gear 15, as shown in Fig. 1 and also in Fig. 3, where a section of 15 is shown.

On the opposite side of 20 is loosely mounted on the main shaft gear-wheel 8. This gear is the termination of a sleeve keyed to the brake-wheel 18, Fig. 1 and Fig. 7. Gear-wheel 8 (shown in section in Fig. 2) meshes with the larger gears 10, 10^a, and 10^b. Keyed to the main shaft between brake-wheel 18 and bearing 6^a is the driving-gear 23, adapted to engage with the ordinary compensating gear on the rear axle of a motor-vehicle, as shown in Fig. 10, or with any other gear to which power is to be applied.

Adjacent to the rim of each wheel 18, 20, and 17 are brake-shoes, such as are represented at 35 in Fig. 1 and more clearly in the sectional side elevation Fig. 7. Parallel to the main shaft and supported by the casing 24 is the brake-rod 37, carrying the sleeve 38, Fig. 1. Securely fastened to the brake-rod are disks with hubs similar to 36, Fig. 1. Brazed or otherwise firmly attached to sleeve 38 is the double connected disk 36^a. (Shown in section in Fig. 1 and partly in section in Fig. 7.) Pivoted on the lower side of this disk and extending upwardly toward the brake-wheel is the shoe 35. Fastened to a pin 34 in the brake-shoe is the end of the brake-band 33, which extends around the brake-wheel, where the other end is fastened to a pin in the disk 36^a. Turning the disk in one direction tightens the band and also pulls the brake-shoe against the wheel with something like a toggle action between the brake-rod and the brake-wheel. The force of the brake-band tending to pull the wheel toward the brake-rod is balanced by the shoe forcing it away, and no excessive pressure is put upon the main shaft by the brake-wheel when held stationary.

The brake-rod 37 is provided with similar shoes and brake-bands for the other two brake-wheels, the only difference being that one brake is reversed, the shoe being pivoted near the top of the disk and extending downwardly toward the brake-wheel, Fig. 7^a. This arrangement serves to tighten one brake and release the second when the brake-rod is turned in one direction and release the first and hold the second when the rod is turned in the reverse direction. Brake-rod 37 is actuated by the crank 40, keyed to one end, while sleeve 38 is brazed to and actuated by crank 39, Fig. 1. Rods extended from these cranks allow the brakes to be operated from any convenient place. 43, Fig. 8, shows such a rod, and 42 and 41 show a similar brake arrangement attached to the compensating-gear drum on the vehicle-axle and supported by the case 24.

In describing the operation of the variable-speed and reversing mechanism it will be assumed that the driving-shaft 26, Fig. 1, is keyed to a sprocket-wheel outside the case, which in turn is connected to a motor by a sprocket-chain. The motion of the driving-shaft when driven by the motor is such as to force the upper part of 26 backward as viewed in Fig. 1, or in the same direction as the hands of a clock when viewing shaft 26 directly facing its outward end. This direction of rotation will be denoted in the following description by +, the reverse by —. All the change-gears are either twenty-four or thirty-four teeth wheels.

All the brakes being off, the vehicle standing still, with its main or driving axle directly geared to wheel 23, Fig. 1 and Fig. 8, the motor is started and the following actions take place: The main shaft 9, Fig. 1, and main gears 8 and 25 remain stationary. Driving-shaft 26 and wheel 19, bolted to it, revolve in a + direction. The gears 22, (meaning the series 22, 22^a, and 22^b,) carried by wheel 19 and meshing with the stationary main gear 25, are turned by the latter in a + direction both around their own axes and the main shaft, as are also the 21 series of gears, connected by shafts to the 22 series. The 21 series, meshing with the sleeve-gear 16, carry that along in a + direction, but at practically half the speed of the driving-shaft. The gear 15, connected by sleeve to 16, meshes with the 13 series of gears, supported by wheel 20 and shaft connected to the 11 series, and turns them in a — direction about their own axes, but in a + direction around the main shaft. Also meshing with the 11 series (more clearly shown in Fig. 2) is the 10 series. This 10 series is moved by the 11 gears in a + direction both axially and around the main shaft. The 10 series also mesh with the sleeve-wheel 8, which is moved thereby in a — direction. Attached by shafts to the 10 series is the last or 12, meshing with the stationary main gear 14, keyed to the shaft 9. As the 10 series move in a + direction, so also do the 12 series, and as the gear 14 is stationary the wheel 20, supporting the last series of gears, is moved in a + direction. In the following operations none of the gears having twenty-four or thirty-four teeth, with the exception of the two keyed and fastened to the main shaft, change their direction of rotation around their own axes.

As shown, when gear 14 was stationary wheel 20 revolved. It follows that stopping the wheel 20 will cause the main gear 14 to move instead, but in a — direction. This is what takes place when the wheel 20 is

stopped by applying the brake: Main gear 14, shaft 9, and gear 23 all revolve in a — direction, and as the driving-axle of the vehicle is geared direct to 23 said axle is turned in a + direction and the vehicle is driven forward at slow speed. Releasing wheel 20 and stopping wheel 18 will by the planetary action of the 10 gears on the gear 8, attached to wheel 18, force the wheel 20 in a + direction faster than it moved when the vehicle was standing still and gear 14 was stationary. This will move gear 14 in a + direction, for although the motion of gears 12 around their own axes is such as to force 14 in a — direction the + motion of the gears around the main shaft is faster. Consequently gear 14, shaft 9, and gear 23 move in a + direction, the vehicle-axle in a — direction, and the carriage is driven backward at a speed somewhat slower than the forward speed before described. Releasing wheel 18 and stopping wheel 17 puts on the high speed forward. In the slow speeds just described power is applied to the train of gears and transmitted to the main shaft by two gears at each end of the train. In the high-speed arrangement power is applied through one main gear only and part of the train, the remainder running idle. Stopping 17 stops the attached gears 14 and 16. Wheel 19, moving in a + direction, applies motion directly to the shafts connecting the 22 with the 21 series of gears. These shafts therefore represent the ends of levers, the junction of gears 21 with 16 the fulcrums, and the junction of gears 22 with 25 the opposite ends. + motion being given the shaft ends of these levers, the fulcrums being stationary, as wheel 16 does not move, it follows that the opposite ends of the levers will move main gear 25 in a — direction. Gear 25, shaft 9, and gear 23, moving in a — direction, drive the vehicle-axle in a + direction, and the carriage runs forward at high speed. During this action the remainder of the gears are idling, their actions being as follows: The other main gear 14 is also moving in a — direction, driving the 12 gears in a + direction around their own axes, but in a — direction around the main shaft. This latter motion is caused by the 12 gears, shafts, and 10 gears moving in a + direction, driving the 11 and 13 series in a — direction. The latter gears meshing with stationary gear 14 carry the wheel 20 and attached gears in a — direction the same as the main shaft, but at a somewhat reduced rate of speed. Gear-wheel 8 is also running in the same direction faster than wheel 20 and faster than the main shaft.

With gears having twenty-four and thirty-four teeth the high speed forward is very nearly equal to the speed of the driving-shaft. The slow speed forward is a reduction of very nearly seven to one. The backward speed is reduced nearly to nine to one. Other speed ratios are obtained by changing the relative size of the two sets of gears.

The mechanism may be reversed, power being applied to the main shaft 9 and taken from the shaft 26, or it may be applied to or taken from any of the wheels 17, 18, or 20, as shown in Fig. 9, where the gear-wheel 23 is shown combined with a brake-wheel and the brake-wheels 17, 18, and 20 are in turn supplied with gear-wheels.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A main shaft, two trains of planetary gears revolubly supported on said shaft, two main gears permanently fastened to the shaft and each one meshing with one of the planetary trains respectively, connected gears rotatable on said shaft and meshing with both trains of planetary gears, means for applying power to one of the four portions of the mechanism, viz., the main shaft, the first train of planetary gears, the second train, or the connected gears, whereby power may be withdrawn from another portion upon stopping the rotation of a third, and the speed changed by releasing the third portion and stopping the fourth.

2. The herein-described power-transmitting device, the same consisting of the main shaft and the main gears fast thereon, the drive-shaft, the planetary gears carried thereby and meshing with one of said main gears, a second train of planetary gears supported on the main shaft and meshing with the second main gear, a pair of connected gears revolubly mounted on said main shaft and meshing with both trains of planetary gears, a reversing-gear also loosely carried by the main shaft and meshing with the second train of planetary gears, means for separately holding, one at a time, the connected gears, the second train of planetary gears, and the reversing-gear from rotation around the main shaft, whereby, power being applied to the drive-shaft, the main shaft is driven forward at one of two speeds, or backward substantially as described.

3. In a power-transmitting device a driven shaft, a plurality of gear-wheels rigidly attached thereto, a train of gear-wheels constantly in mesh and also constantly in mesh with the shaft-gears, means for driving the train of gears, and further means for modifying the action of said train whereby the motion of the driven shaft is changed.

4. A main shaft, a gear-support freely movable thereon, a hollow driving-shaft supported on the main shaft and rigidly attached to the gear-support, a second gear-support freely movable on the main shaft, two main-gear wheels rigidly attached to the main shaft, trains of planetary gears upon the gear-supports meshing respectively with both main gears, all in combination with a connected pair of gears loosely mounted on the main shaft and meshing with and connecting the free ends of the planetary gears and means for holding and releasing the supports.

5. A shaft, a train of permanently-meshed

gears terminating at either end in gear-wheels rigidly attached to the shaft, means for applying power to some portion of the train, and further means for manipulating the train whereby the speed of the shaft is changed.

6. The combination of a main shaft and two main gears fast thereon, a train of gears supported on and rotatable about said shaft, said train meshing at each end with the main gears, means for applying power to the gear-train, and further means for preventing the rotation of the gear-supports to start and alter the speed of the main shaft.

7. The combination of a main shaft and the main gears attached thereto, a series of gears supported upon and rotatable about the main shaft, means for preventing rotation of portions of the gear series which are meshed with the main gears whereby power being applied to the series of gears, the main shaft may be driven in one direction at a high speed through one of the main gears, and in the same and reverse direction at a slow speed through both of the main gears.

8. A main shaft and two main gears rigidly attached thereto, two connected gears loosely mounted on said shaft between the two main gears, a fifth gear also loosely mounted on the shaft, two gear-supports loosely mounted on said shaft, the first one between the connected gears and a main gear, the second one between the fifth gear and the other main gear, the latter main gear being situated on the shaft between the second support and the connected gear, a train of reverted epicyclic gears carried by the first support and meshing with a main gear and one of the connected gears, a second train of reverted epicyclic gears carried by the second support, one half of the latter train being adapted to rotate in an opposite direction to the other half, one of the said halves also meshing with the fifth gear, said second train of epicyclic gears meshing with the remaining main gear and the free connected gear, all in combination with brake-wheels attached to the connected gears, the second train of epicyclic gears, and the fifth gear, and suitable brakes for controlling the same.

9. A main shaft and two main gears rigidly attached thereto, two connected gears loosely mounted on said shaft between the two main gears, a fifth gear also loosely mounted on the shaft, two gear-supports loosely mounted on said shaft, the first one between the connected gears and a main gear, the second one between the fifth gear and the other main gear, the latter main gear being situated on the shaft between the second support and the connected gear, a train of reverted epicyclic gears carried by the first support and meshing with a main gear and one of the connected gears, a second train of reverted epicyclic gears carried by the second support, one half of the latter train being adapted to rotate in an opposite direction to the other half, one of the said halves also meshing with the fifth gear, said second train of epicyclic gears meshing with the remaining main and the second one of the connected gears, brake-wheels attached to the connected gears, the second train of epicyclic gears, and the fifth gear, suitable brakes for controlling the same, and means for applying power to the first gear-support, whereby stopping the connected gears will rotate the main shaft at a high rate of speed in an opposite direction from the first gear-support, releasing the connected gears and stopping the second support will decrease the speed, and releasing the last support and stopping the fifth gear will still further decrease the speed of the main shaft and reverse its direction of rotation, while releasing all the brakes will allow the main shaft to stop.

10. A main shaft, a main gear, two connected gears, a second main gear, and a fifth gear, all mounted on said main shaft, the two main gears rigidly, the others loosely; a hollow driving-shaft also loosely mounted on the main shaft, a train of epicyclic gearing supported on the main shaft, and connecting the first main gear and one of the connected gears, all in combination with a second train of epicyclic gearing connecting the remaining one of the connected gears and the second main gear together and with the fifth gear and also supported on the main shaft, and means for holding and releasing the loose gears and the epicyclic gearing.

11. A shaft, a train of permanently-meshed gears terminating at either end in a gear-wheel rigidly attached to the shaft, means for applying power to some portion of the train, and further means for modifying the action of the train without altering any gear's relation to an adjoining gear, whereby the speed of the shaft is changed, all in combination with another gear meshing with the train adapted to be so manipulated as to change the direction of rotation of the shaft.

12. A reversing mechanism in a power-transmitting device consisting of a main shaft, a main gear attached thereto, a support loosely mounted on the main shaft, a driving-gear also loosely mounted on the main shaft, planetary gearing carried by said support and meshing with the driving-gear and also with a second train of planetary gears carried by said support and adapted to move in reverse direction to the first planetary gears, said second train also meshing with the main gear, a reversing-pinion loosely mounted on said main shaft engaging with the second train of planetary gears, means for applying power to the driving-gear in one direction, means for holding the gear-support against rotation about the main shaft whereby motion is transmitted to the main shaft, all in combination with means for releasing the gear-support and holding the reversing-pinion whereby the direction of motion of the main shaft is reversed.

13. A reversing mechanism in a power-trans-

mitting device consisting of a main shaft, a main gear rigidly attached thereto, a driving-gear, a gear-support and a reversing-gear all loosely mounted on said shaft, a primary and secondary train of planetary gears moving in opposite directions and carried by the gear-support, and meshing constantly with the first-named gears, all so proportioned and arranged that stopping the rotation of the gear-support and applying power to the driving-gear will rotate the main shaft in one direction and releasing the gear-support and stopping the reversing-gear will allow the secondary series of planet-wheels to carry itself around the reversing-gear in a reverse direction faster than it can drive the main gear in the first direction thereby reversing the motion of the latter all in combination with means for holding and releasing the reversing-gear.

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