No. 798,048. PATENTED AUG. 22, 1905.

A. E. SCHAAF & J. A. HERZOG.

VARIABLE SPEED GEAR.

APPLICATION FILED MAY 7, 1904.

2 SHEETS—SHEET 1.

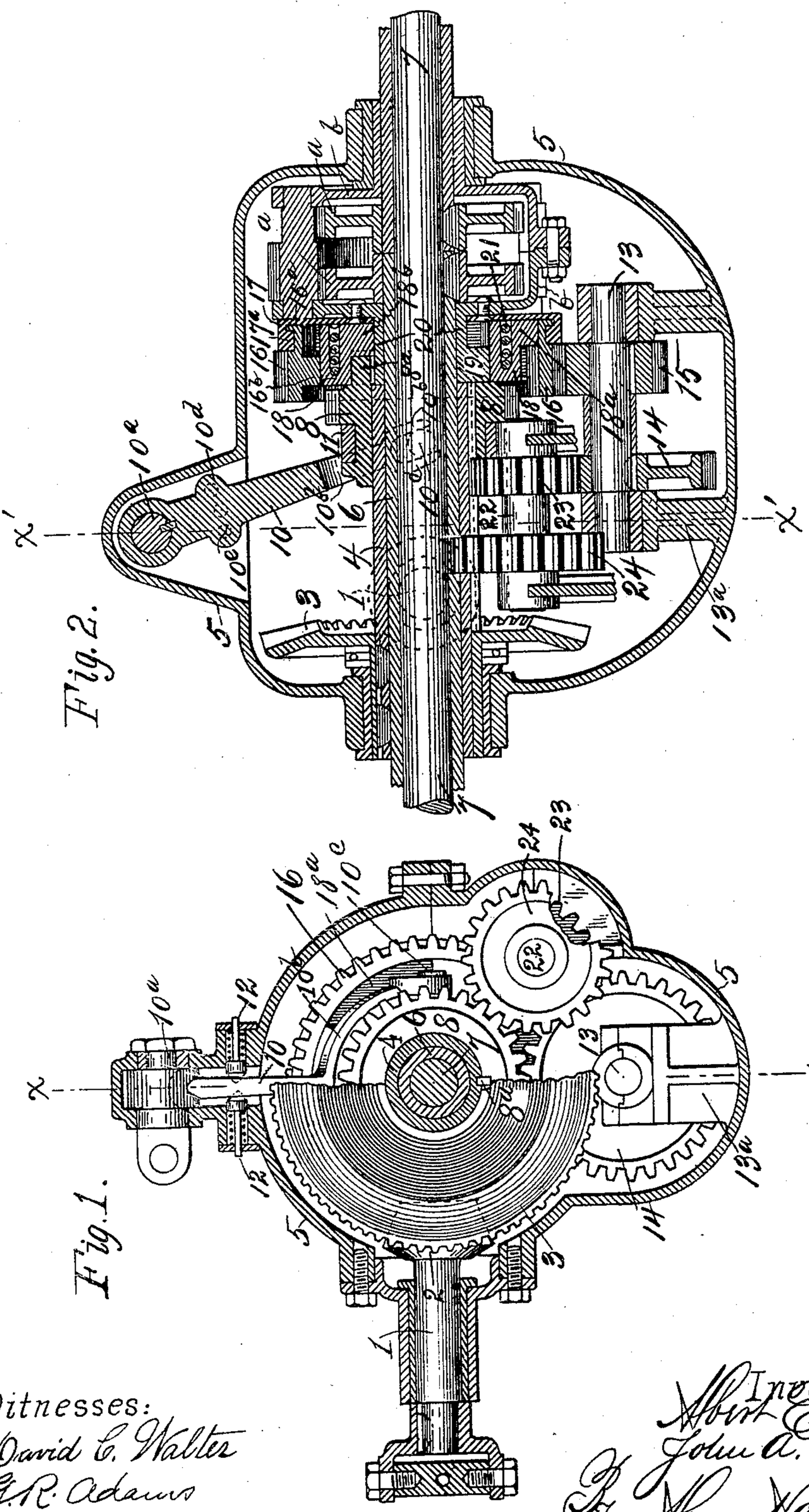

Fig. 2.

Fig. 1.

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2 SHEETS—SHEET 2.

Fig. 3.

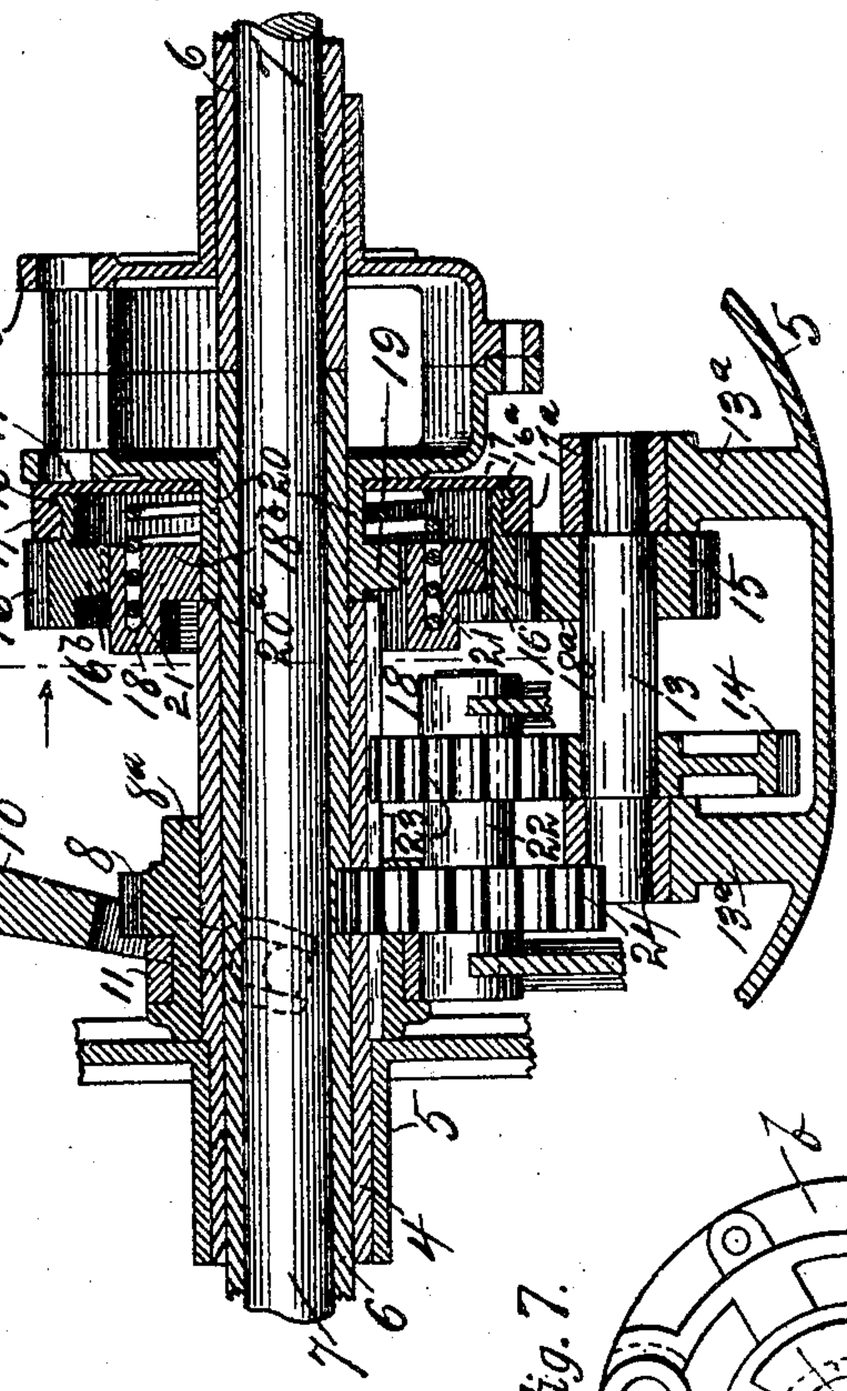


Fig. 4.

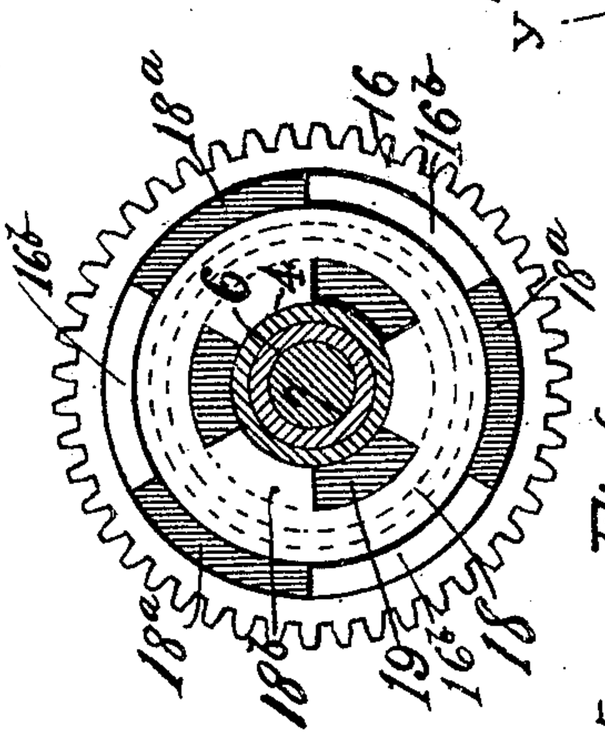


Fig. 7.

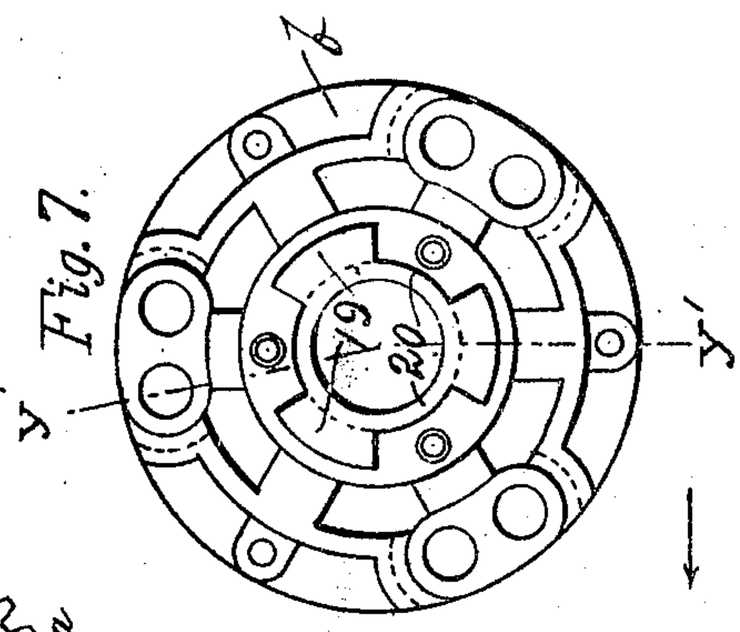


Fig. 6.

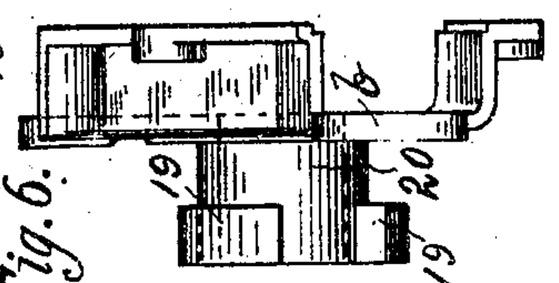
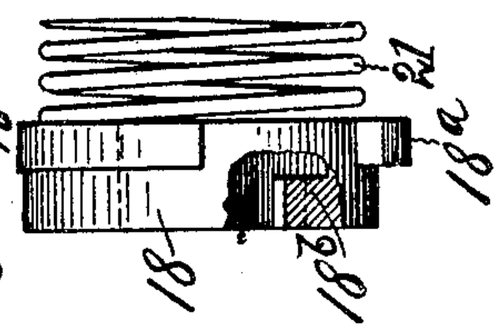


Fig. 5.



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UNITED STATES PATENT OFFICE.

ALBERT E. SCHAAF AND JOHN A. HERZOG, OF TOLEDO, OHIO.

VARIABLE-SPEED GEAR.

No. 798,048. Specification of Letters Patent. Patented Aug. 22, 1905.

Application filed May 7, 1904. Serial No. 206,787.

To all whom it may concern:

Be it known that we, ALBERT E. SCHAAF and JOHN A. HERZOG, citizens of the United States, residing at Toledo, in the county of Lucas and State of Ohio, have invented certain new and useful Improvements in Variable-Speed Gears; and we do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the characters of reference marked thereon, which form a part of this specification.

Our invention relates to variable-speed gears for automobiles, and is designed to furnish a strong compact reliable mechanism for transmitting from the driving-shaft two or more different speeds and for reversing the transmitted motion.

In throwing a rapidly-moving gear-wheel into mesh with another gear standing at rest it frequently happens that the teeth of one or both of the wheels are broken or "stripped."

Another object of our invention is to prevent the mishap here referred to.

Our invention also relates to certain details of construction hereinafter described, and pointed out in the claims.

We attain the objects above referred to by means of the devices and arrangement of parts hereinafter described and shown, and illustrated in the accompanying drawings, in which—

Figure 1 is a transverse sectional elevation of our gear, taken on line x' x', Fig. 2; Fig. 2, a central longitudinal sectional elevation of the same, taken on line x x, Fig. 1, showing the reverse-gears in elevation, with the sliding gear thrown into high speed; Fig. 3, the same with the sliding gears thrown into engagement with the reverse-gears; Fig. 4, a side elevation and section taken on line y, Fig. 3; Fig. 5, an edge view of the member 18, hereinafter referred to; Fig. 6, an edge view of that half of the differential-gear case hereinafter referred to which carries the teeth for engagement with its driving member, and Fig. 7 an elevation of the same seen from the left in Fig. 6.

Like characters of reference indicate like parts throughout the drawings.

In the drawings, 1 is a driving-shaft operatively connected with the shaft of the engine and carrying a beveled gear 2, which engages a corresponding gear 3, rigidly secured to driving-sleeve 4.

5 is a case which incloses our gear and is formed, preferably, in two separable halves, the case being provided with bearings for shaft 1 and bearings for the shaft 7 and its sleeves, hereinafter referred to. The sleeve 4 revolves loosely on sleeve 6, which is loose on shaft 7. The sleeve 6 is in two lengths, the meeting ends of which carry, respectively, the two differential gears a a, which may be of the usual or of any preferred form. In automobile practice the sleeves 6 6 may carry either the driving-gears or sprockets, thus forming the "jack-shaft," or they may form axles to which the vehicle-wheels may be secured. This arrangement of the shaft and sleeve may be modified—as, for instance, instead of a shaft having a two-part sleeve the sleeves and shaft may be formed integral, thus forming a solid shaft, which may be in two end-to-end pieces, or, if desired, the shaft may have one loose sleeve.

8 is a gear-wheel secured by a spline and groove 8^a on the sleeve 4, revoluble with the sleeve but movable longitudinally thereon. This movement is effected by means of a forked shipper-arm 10, journaled in the top of the case, as at 10^a, and having suitable devices (not shown in the drawings) for swinging the arm. Opposite its journaled end the shipper-arm is forked, as at 10^b, to engage lugs 10^c on shipper-ring 11, mounted loose in a circumferential channel on the hub of the gear-wheel 8. The arm 10 near its journal is widened, as at 10^d, and in this widened portion are depressions 10^e, which may at will be thrown into coincidence with two spring-controlled pins 12, which catch and hold the arms against swinging unless sufficient force is applied to the arm to cause the tapered ends of the pins to slip out of the depressions 10^e. These depressions correspond with the different working positions into which the gear 8 may be thrown.

13 is a counter-shaft journaled in boxes secured to brackets 13^a, formed on the bottom of the case. Rigidly secured to the shaft 13 is a gear-wheel 14. The gear-wheel 8 may at will be thrown into and out of engagement with the gear 14. On the counter-shaft is also secured a spur-pinion 15, which is in constant engagement with spur-gear 16. This gear has its bearing in a two-part retaining-ring 17, the flange of which, 17^a, engages the

flange 16[a] of the gear 16. The retaining-ring is secured rigidly to the inner side of the differential-gear case *b*, the arrangement being such that the gear 16 is permitted to revolve freely, but is held against longitudinal movement. The gear-wheel 16 is provided with inwardly-projecting teeth or lugs 16[b]. 18 is a sliding ring having outwardly-projecting radial teeth or lugs 18[a] adapted and arranged to slide into and to fit the spaces between the internal teeth or lugs 16[b] on the gear 16. The ring 18 is also provided with internally-projecting teeth or lugs 18[b], which slide between and in constant engagement with corresponding teeth or lugs 19 on sleeve 20. This sleeve is secured to or forms part of the differential case *b* and is mounted on but is revoluble independently of the sleeve 6. On the side of the gear-wheel 8 are laterally-projecting teeth or lugs 8[a], adapted when the gear is moved along its bearing to enter the spaces between the teeth 19 on the sleeve 20. Between the ring 18 and the differential case *b* is interposed a stout spiral spring 21, one end of which rests in an annular groove in the side of the ring, so that when the ring is compressed it will rest wholly within the groove. The ring 18 is limited in its movement away from the part *b* by shoulder 20[a], formed by the end of the sleeve 4, which is of larger diameter than the sleeve 20.

22 is a shaft journaled in bearings on brackets formed within the case 5. On this shaft is fixed spur-gear 23, which is in constant engagement with gear 14. On the same shaft is also fixed spur-gear 24, with which the gear 8 may be thrown into and out of engagement.

The operation of our device is as follows: Assuming that the engine is running, motion is communicated to the beveled gears 2 3 and sleeve 4 through driving-shaft 1. If a slow movement ahead is to be transmitted to the sleeves 6, the shipper-arm is thrown into such position that gear 8 engages gear 14. Motion is now communicated to the sleeves 6 through shaft 13, pinion 15, gear 16, and toothed ring 18, engaging toothed sleeve 19 20 on differential-gear case *b*. The parts being now in the position here described, should it be desired to communicate to the device a more rapid motion ahead the shipper-arm is thrown into the position indicated in Fig. 2, thus disengaging the gear 8 from the gear 14. The teeth 8[a] now enter the spaces between the teeth or lugs 19 on the sleeve 20, pushing against the ends of the teeth 18[b] and forcing the toothed ring 18 from engagement with the gear 16. The counter-shaft 13 is now at rest, and power is transmitted directly to the differential-gear case through sleeve 4 and gear 8 8[a]. To change from high speed to low speed, the shipper-arm is thrown so that the teeth 8[a] are withdrawn from engagement with teeth 19, thus permitting the spring 21 to force teeth 18[a] and 16[b] into engagement with each other. If, however, these teeth should not mesh, the friction between the contacting sides of the teeth will impart motion to the gear 16, so that the relative speeds of the two contacting members will permit their falling into engagement with each other. It will be seen that the advantage of this arrangement is that if the ring 18 were moving with considerable velocity, the gear 16 being motionless, the two members would not fall into engagement with each other at all; but now the frictional engagement caused by the thrust of the spring 21 gives the gear 16 a motion nearly equal to that of the ring 18, thus permitting the two members to readily fall into gear with each other without shock. The gear 16 being in gear with pinion 15, the change from high to low speed is completed by bringing the sliding gear 8 into engagement with gear 14 on counter-shaft 13. To reverse the movement of the sleeve 6 without changing the direction of the driving mechanism, the gear 8 is thrown still farther from the differential case and into engagement with gear 24 on shaft 22. Now by means of intervening gear 23, meshing with gear 14 on counter-shaft 13, a reverse motion is communicated to the driven members, as above described.

In addition to the advantages above referred to it will be seen that by our construction we are enabled to change from low speed to high speed with no intervening gear running, and thus by means of a direct drive to do away with the wear and tear and waste of power incident to the running of idle parts. Another advantage is that in passing from high to low speed the slow gear is picked up with little or no danger to the teeth, owing to the initial frictional contact above referred to and in consequence of the fact that any shock due to the sudden engagement of the two gears is distributed between all the teeth of an internal gear and all the teeth of an external gear. This arrangement overcomes the difficulties encountered in the use of pairs of gears having only two teeth or cogs in peripheral engagement.

Having described our invention, what we claim, and desire to secure by Letters Patent, is—

1. In a variable-speed gear, a driven member having a sleeve, teeth on said sleeve, a ring slidable longitudinally on the sleeve and having internal teeth which slide in engagement with the teeth on the sleeve, external teeth upon the ring, a gear-wheel adapted for engagement with the external teeth of the ring, a spring which holds the ring and gear-wheel normally engaged, means for forcing the ring out of engagement with the gear-wheel and for driving the sleeve, independently of the gear-wheel, and mechanism cooperating with said means for driving the gear-wheel when engaged with the ring.

2. In a variable-speed gear, a driven member having a sleeve, teeth on said sleeve, a ring slidable longitudinally on the sleeve, internal teeth upon the ring which slide in engagement with the sleeve-teeth, external teeth upon the ring, a gear-wheel having internal teeth and external teeth, a train of gears engaging said latter external teeth, a spring which holds the sliding ring normally with its external teeth in engagement with the internal teeth of said gear, a sliding gear-wheel having, on its side, teeth corresponding with the internal teeth of the sliding ring, and means for shifting the sliding gear-wheel into engagement either with the internal teeth of the ring, thereby overcoming the stress of the spring and forcing the external teeth of the ring out of gear, or with said train of gears.

3. In a variable-speed gear, a shaft, a revoluble sleeve thereon, a gear-wheel slidable on and revoluble with said sleeve, a train of gears having two members adapted for engagement with said sliding gear, one of said two members driving said train in one direction, the other of said two members driving the train in the opposite direction, said train of gears also including an externally and internally toothed gear-wheel in constant gear with said train, a differential-gear case mounted on said shaft and having teeth, a sliding ring having external teeth adapted to engage the internal teeth of the last-mentioned gear-wheel and having internal teeth engaged with the teeth on the differential-gear case, a spring which holds the sliding toothed ring normally in engagement with the internally-toothed gear-wheel, said sliding gear being adapted to engage the said differential-gear case and to force the toothed ring out of mesh with the internally-toothed gear-wheel, and means for at will throwing the sliding gear-wheel into engagement with either of said two members of the train of gears or with the differential-gear case.

In testimony whereof we affix our signatures in presence of two witnesses.

ALBERT E. SCHAAF.
JOHN A. HERZOG.

Witnesses:
LOUIS SKRAUSMFKY,
ALMON HALL.