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INFINATELY VARIABLE GEAR-DRIVE

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Serial No.
414,025

Fig. 1

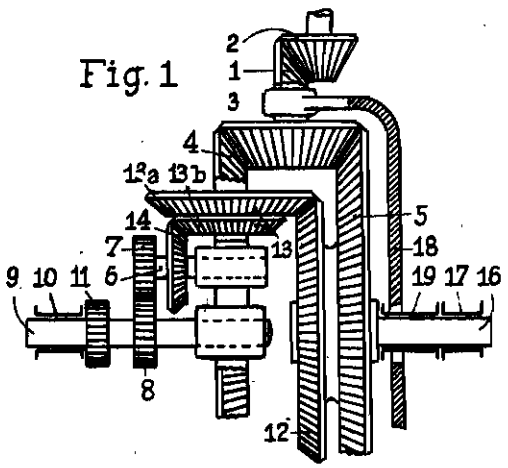


Fig. 4

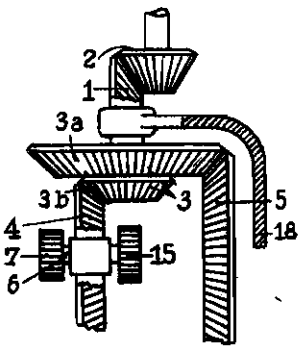


Fig. 2

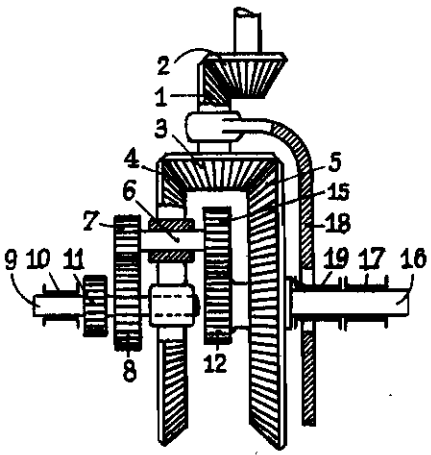
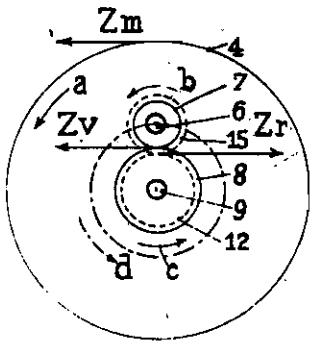


Fig. 3



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ALIEN PROPERTY CUSTODIAN

INFINATELY VARIABLE GEAR-DRIVE

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The subject of this invention is an infinately variable gear-drive, which is to be principally applied in the automobile industry, but which may also find application in many other machines and mechanical contrivances.

With the new mechanism it is possible to eliminate the normal form of stepped gear-drive with its respective disadvantages, thereby permitting a change-over from one stage of speed to all others to be made gradually and continuous. The three or four speed steps that hitherto exist in automobile gear-drives are dispensed with, and therewith the attendant mechanical device producing same.

This continuous speed change ensues automatically both on the increase and decrease, and acceleration and retardation adjusts itself automatically, and regulates itself, at constant motor output, according to the ground resistance, i. e. in accordance with the prevailing ground conditions and gradients. Variation of the motor output by regulation of the accelerator is therefore not effected.

The invention proceeds from the knowledge, that a driving-wheel revolving about a momentarily stationary wheel, and engaging with same (e. g. by cogging), whilst revolving about its own axis, only rolls; but that an impulse be given to the stationary wheel, when the driving-wheel maintains its speed of rotation, yet compulsory reduces its own revolutions. The stationary wheel is itself set into motion through this impulse and receives a determinable advance with every rotation, corresponding to the revolution decrease of the driving-wheel during each rotation. Therefore it follows that the advance is greater the more the revolutions of the driving-wheel are reduced, and is greatest when the revolutions of the driving-wheel are equal to nil; because at this limit driving- and driven-wheel form a rigid unit revolving about the axis of the driven-wheel. Consequently the advance of the impulsed wheel increases inversely proportional to the driving-wheel revolutions, and a corresponding revolution increase of the driven-wheel takes place. Contrary, a decreased advance and therewith retarded revolutions of the driven-wheel, must result in increased revolutions of the driving-wheel.

Therefore, rotation of the driving-wheel occasions the impulsed-wheel's propelling force, and its revolutions are determined by the gear-ratio of this mechanism. In the variation of these revolutions one has the means to vary the gear-ratio.

The influence of a rotating driving-wheel having revolutions implied upon it, on a driven-wheel, and revolution control of this driving-wheel therefore constitute a fundamental feature of the invention. Furthermore it is the rotation of the driving-wheel's function to evoke the revolution speed of the driven-wheel, whilst acceleration of same is a problem for the control of the driving-wheel's revolutions.

A further feature of this invention is the way in which the revolutions of the rotating driving-wheel are influenced, that is to say, how its control is effected, also the device by means of which this operation is attained. It is based upon the knowledge that a compensating gear making use of the kinematic theorems of differential drives proves itself as the simplest and most appropriate means with which rotary drive for the driving-wheel, as well as control of same can be attained. The one planetary-gear has to evoke the rotating motion of the driving-wheel, whilst the other has to occasion revolutions, simultaneously superintending acceleration and retardation of same. Hereby the planetary-gear which sets the driving-wheel into rotation is only subjected to power influence from the motor, the other however serving the control is subjected to the influence and torsional force of the motor, also an opposing force brought about by a reactionary torque set up in the driving-wheel shaft.

These two moments, reaction-moment and torque communicated from the motor effectively remain in balance at the greatest ground resistance, for then the one planetary-gear remains at rest, whilst the other calls forth an advance. If however ground resistance and therewith torque decreases, not only the torque of the driving planetary-gear prevails (which in itself results in an acceleration of motor and road-wheel), but also the torque of the controlling planetary-gear prevails, resulting in a setting into motion and acceleration of this gear, and therewith a variation of gear-ratio; hence a torque transformation. Consequently, any increase in revolutions of the motor is prevented, but the road-wheel attains a higher revolution, and the automobile accelerates.

A schematic example of design is shown in the accompanying drawing.

Fig. 1 is a plan elevation of the gear-drive.

Fig. 2 is a simplified form of same.

Fig. 3 is a side elevation of Fig. 2 showing the effective forces of the gear-wheels.

Fig. 4 is a special design of Fig. 2.

The main-wheel 1, of a differential gear-drive,

driven by means of pinion 2 from the motor, operates both planetary-gears 4 and 5 by means of transverse-gear 3. The planetary-gear 4 instigates the rotation of driving-wheel 7 about axis-wheel 6 through shaft 6. Axis-wheel 8 is keyed onto shaft 8, whilst planetary-wheel 4 revolves upon it. The shaft 8 is fitted rotatory in bearing 10 and communicates its revolutions immediately to the differential gear-drive of the automobile rear axle by means of gear-wheel 11.

The revolutions of driving-wheel 7 together with shaft 6 is evoked by wheel 12, namely in the construction according to Fig. 1 by means of the transmitting bevel-gears 13 and 14, and in accordance with Fig. 2 by means of gear-wheel 15, which as well as gear-wheel 7 is rigid on shaft 6 and keyed. It therefore follows that since shaft 6 is fitted in planetary-gear 4 it is compelled to rotate about shaft 9, and therewith driving-wheel 7 about axle-wheel 8. On the other hand, since shaft 6 is fitted rotatory in planetary-wheel 4 it permits driving-wheel 7 to revolve in accordance with the revolutions of wheel 12 over wheels 13 and 14 (or 15 resp. in Fig. 2). Therewith the wheel 13 with double bevels of differing diameters 13*a* and 13*b* is fitted rotatory in planetary-wheel 4, wheel 14 however being rigidly keyed to shaft 6, and wheel 12 forms a rigid unit with planetary-wheel 5. In Fig. 1 shaft 6 and wheels 7 and 14 form a unit that is fitted rotatory in plantary-wheel 4. In Fig. 2 shaft 6 and the wheels 7 and 15 form the unit that is fitted rotatory in planetary-wheel 4.

At 16 the shaft denoted which carries the rigidly connected pair of wheels 5 and 12, and 17 the bearing of this shaft. The main-wheel 1 of the differential gear-drive is fitted rotable about shaft 16 by means of bearing 18 and through an arm or casing 18.

Fig. 3 is a delineation of the created forces or tooth pressures on the wheels as per construction in Fig. 2 in left-hand side-elevation, and the arrows, *a*, *b*, and *c* denote the direction of rotation of the wheels 4, 7, and 8, and arrow *d* the rotation of shaft 6. The motor creates in planetary-wheel 4 the force Zm which sets shaft 6 and the driving-wheel 7 into a rotating motion, and with it conforms the force (tooth-pressure) Zv between the wheels 7 and 9 (Fig. 2). In driving-wheel 7 this force is directed forwards, whilst the corresponding reactionary force Zr in wheel 15 is directed backwards, and this has to be overcome by wheel 12 which is rigidly connected with planetary-wheel 5, and upon the motor power also acts.

The advance of axle-wheel 8 occurs as follows, that the driving-wheel 7 whilst rotating about wheel 8 is prevented from completely rolling off same, since it is subjected to counter revolutions from planetary-wheel 5 via wheels 12 and 15. The relation of advance to pitch circle of axle-wheel 8 produces the gearing of the drive. If the advance (through the compulsory revolving of shaft 6) becomes greater, the gear-ratio of the drive becomes smaller, i. e., torque is transformed.

Due to the differing diameters of wheels 7 and 15 one has a means of preventing idling as long as planetary-wheel 5 is not set into rotation with planetary-wheel 4. The revolutions of these two planetary-wheels differ. The revolutions of wheel 5 increases or decreases according to the ground resistance; a decrease of this resistance results in a lesser tooth-pressure and the gear-wheels are thus subjected to higher revolutions from the motor. The revolutions of planetary-wheel 4 conforms to the motor output, but varies due to transverse-wheel 3 differentially with the variation in revolutions of wheel 5.

In constructing the transverse-wheel 3 as shown in Fig. 4 one has a means of driving the two planetary-wheels with varying power, since the double tooth-rim 3*a* and 3*b* acts as a double-sided yet unequal lever. By this means it is possible to attain an unequal distribution of the driving power of main-wheel 1 upon the planetary-wheels. In Fig. 4 wheel 4 is given preference so that it is set into motion first. Due to arranging wheels 7 and 15 with unequal diameters axle-wheel 8 is immediately set into motion, and with the largest gear-ratio, since hereby (by suitably dimensioning the wheels) the planetary-wheel 5 and with it wheel 12 remain stationary, consequently the starting of the automobile is very steady. When choosing wheels 7 and 15 of equal diameters planetary-wheel 4 runs idle until the starting of planetary-wheel 5 has brought about the necessary tooth-pressure between the wheel pairs 7, 8 and 15, 12; thus eliminating idling immediately, and then the planetary-wheel engages by means of driving-wheel 7 with axle-wheel 6 at the largest gear-ratio, thus again permitting a steady starting of the automobile.

From this it will be seen that the advance can be either originally provided if the wheels 7 and 15 have unequal diameters, alternatively be called forth when the drive is set into motion if the diameters are equal.

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