GEAR CHANGE WHEEL-BASE AXES OF GEARS AS A WAY TO IMPROVE THE DYNAMICS OF CHANGE IN THE TRANSMISSION OF TRANSPORT VEHICLES

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Abstract: The base requirements for the synthesis of new transmission with shift change in center distance. The main elements and method of gear change in the wheel-base on the example of the transfer case Car «Urals». A method of administering a new transfer case Car «Urals».

Involute gearing is a unique cinematic pair for transmission and transformation of the angular and linear displacements, forces and moments in all transmissions, and particularly in the automobile transmission. This entanglement is the fundamental basis of kinematics of mechanisms and machinery for different applications in all areas of technology. The main advantages of involute gear are as follows:

– Consistency of the kinematic transmission ratio in a pair of meshing, which allows a high degree of precision transfer and transform the angular and linear displacement.

– Lack of sliding in the contact of two involute profiles linking and transfer of the rolling motion, which provides low friction loss, small surface wear contacts, high mechanical efficiency of the transfer.

– A special group arrangements, built on the involute mesh, are multistage transmission with several ratios, stepwise changes in the process of switching - gearbox and transmissions. They are a long time and are widely used in all branches of engineering. Typical of their representative are distributing boxes of automobile transmissions.

– Based on the experience of such mechanisms can formulate new basic requirements that must be implemented in the synthesis of programs with several ratios and that will create mechanisms with new properties.

In - the first is to ensure the gear without breaking the flow of power and the transmitted torque. This switching process will provide improved dynamic characteristics of machinery and implement new processes based on these characteristics.

In - Second, the use for gear level, under the influence of forces and moments acting in the mechanism and capable of moving it in the right direction at the right time. This requirement will ensure favorable conditions for the process automation gear in the mechanism.

B - Third, to ensure that the gear shift without breaking the cinematic communication mechanism and the transfer of angular or linear displacements with a given rate of transformation during the transition period of switching. This will get based on the involute gear mechanisms with fundamentally new kinematic properties.

In - fourth, to commission gear pair in mesh with the inclusion of the transfer of a complete line of contact, just as happens when working links in normal mode. This creates favorable conditions for the performance under the terms of the mechanism of mechanical loading.

In the known kinematics such switching is realized at a constant meshing of gears and lock the desired transmission shafts by switching on and off individual friction clutches.

Disadvantages of such schemes are well known - is the complexity, low reliability and increased energy losses. For example, the planetary gears are widely used in gearboxes and driving axles, but the transfer boxes are hardly used, because of the following:

– The need to have a transfer case at least three of the shaft (input and two output), of which only two can be coaxial, the introduction of a normal transfer reduces the advantage of planetary gears;

– Substantially limited range of gear ratios simplest planetary gear set.

In accordance with the above basic requirements of the new state the basic principles of synthesis of the kinematic scheme involute multistage transmission switching without breaking the flow of power. The problem for any arbitrary number of switching gears can be reduced to create a module from the two adjacent transmission, because when I switch to any mechanism works every time one of these modules. The mechanism that has n transmission, formed by n-1 modules. Synthesize a mechanism formed by a single input link, one output link, and n-switch links in the number of n-gear. The input link was established with the input shaft fixed on it n gear, one for each transmission. The output link was established with the output shaft fixed on him n driven gear wheels, each of which corresponds to one of the gear input shaft and forms with a single transmission. Input and output shafts are parallel and fixed axis. In such an arrangement to fulfill the fourth requirement to include the transfer of meshing teeth on the full line of contact is only possible change in the wheel-base, but on the condition of immobility shaft axes to change the center distance can only be an introduction to entanglement intermediate gear with a movable axis.

Using an intermediate gear with a moveable axis allows you to make the second requirement of the possibility of using existing meshing forces and moments to move level on-off transfer as the basis for the automation of switching. This further requires that the reaction from the forces and moments acting in the intermediate gears meshing and on its axis, were trapped in the shaft input or output link. Thus, the axis of the intermediate gears to be switching to perform rotational motion around an axis or input or output link.

To fulfill the first requirement of continuity of power flow must be some way to select an angular shift relative position of the axes of the intermediate gears nearby transmissions. All of the axis of intermediate gears must be tightly linked and moved simultaneously. When rotated idler gear engaged out of engagement by increasing the wheel-base, and an intermediate gear off before transmission gear by reducing the center distance. During this process, the switching occurs in both linkages increased lateral clearance, and a switch off transmission of the gap increases and in an include decreases. Free movement of the axes of intermediate gear mechanism provides an additional degree of freedom. Therefore, we can shift gears without breaking the flow of power and torque.

To fulfill the third requirement of the continuity of the kinematic context switching is necessary to choose the parameters of involute links and the relative position of the intermediate gears to the total backlash in the linkages switching was within the permissible limit on the value of continuity for this mechanism.

Additional links in the mechanism must be n-latches of the axes of the intermediate gears of the inclusion of each transmission. Listed collection of links, their mutual arrangement, communication and interaction form the kinematic scheme of the mechanism of multi-stage transmission with given new properties.

Based on the developed scheme is designed transfer case switch in which there is direct input and output of conjugate gears of the gearing. The design developed by the Department of «Cars» under the guidance of Professor, Doctor of Technical Sciences Dragunov G.D. The proposed method patented RF switch [1]. On the topic of research is protected by a number of Ph.D. theses [2, 3].

In [2] the construction of a new transfer box car type Urals (Fig. 1 a) with the shifting change in wheel-base, which has several features:

1. Primary contact gear includes the transfer occurs on a full line of engagement of teeth.

2. Torque through the gears starting to be passed only at a fixed switching control mechanism, i.e. when the gear includes the transfer will take to the estimated center distance.

3. Speed of transfer is determined by the inclusion of an effort to control lever.

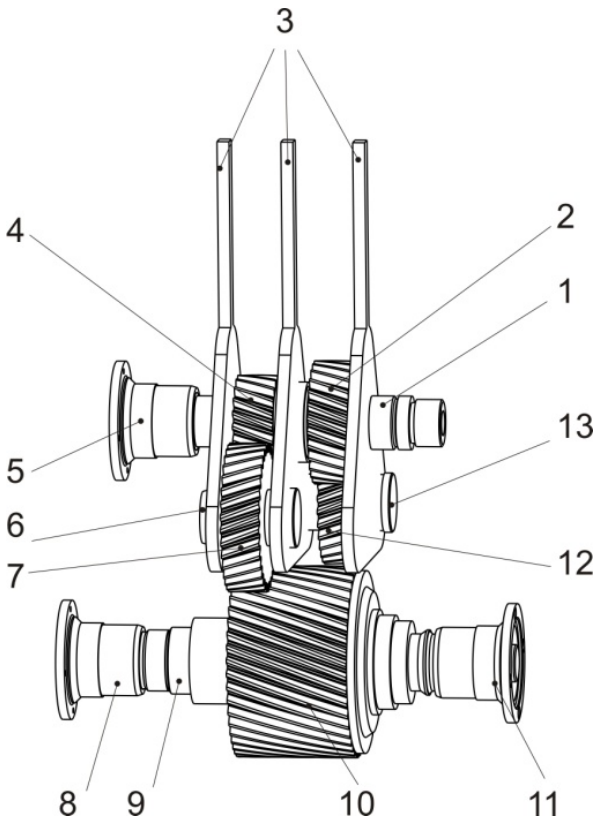
4. There is no need for a synchronizer to align the angular velocities of gears includes the transfer.

5. Ability to shift «under load», i.e. without soaking clutch.

6. Ease of automation drive gear.

7. Due to different initial angular velocity of rotation of gears includes the transfer is not a problem with jamming heads of teeth when switching.

The proposed transfer case, as well as the series has 2 speeds: high (includes gears 12 and 10), reduced (includes gears 7 and 10), and in neutral. Control switching via the pins on the upper plate 3. Neutral transfer is enabled when the intermediate gear 12 and 7 did not mesh with the crown gear center differential 10. Switching is the lever from the position II - reduced transmission (Fig. 1, b) a «neutral» H in the position I - increased transmission .



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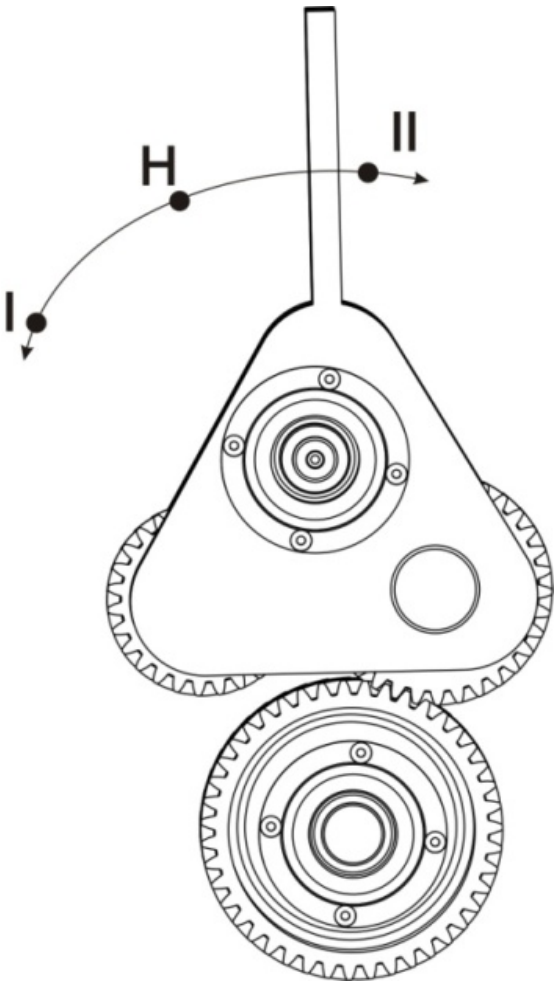

b

Figure 1: Main elements and a new way to switch the transfer case:
1- drive shaft; **2**-Leading high gear transmission; **3**-plate used to take; **4** - Leading low-gear transmission; **5**-flange of the drive motor; **6**, **13**-axis of the intermediate gears; **7**, **12** - intermediate gear; **8** - flange drive Front axle; **9** - output shaft; **10** - crownwheel center differential; **11**-drive rear axle flange; **I** - increased transmission; **II** - reduced transmission; **H** - «neutral».

To select and lock included in the transmission transfer case designed control mechanism (Fig. 2). Gear change in the direction of high occurs at a reduced force by turning the lever 11 by force «F2» around the hinge 10 and its withdrawal from the groove A fixing mechanism, the subsequent rotation of lever 11 around a fixed axis 13 under the influence of the power element 14 and the corresponding displacement (running on the drive gear) block PH axis of the drive shaft and the input power lever 11 «F1» into the slot «B» fixing mechanism. This is one of the switching gears out of mesh, and another, with a further rotation of the block PH gear with the crown gear center differential, that is, it switches gap. Reverse switching occurs by force «F3».

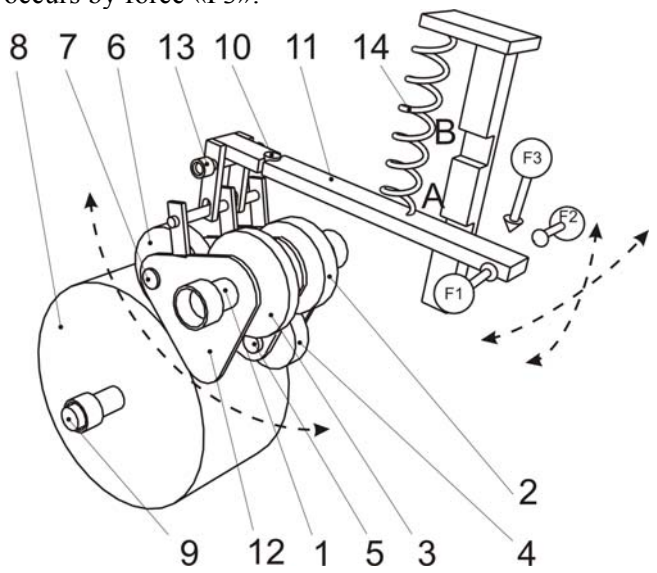

Figure 2: Gear selection in the new transfer case:
1 - input shaft; **2,3** - top gear low and high gears, respectively; **4, 6** - intermediate gear low and high gears, respectively; **5, 7** - axis of the intermediate gears; **8** - inter-axle differential; **9** - output shaft; **10** – hinge; **11** – lever; **12** - plate block of the intermediate gears; **13** - a fixed axis; **14** - load-bearing element.

Gear provided in the transfer case should be performed in certain dynamic modes of transmission, when the forces acting in the meshing of gears, contribute to, rather than hinder switching.
In such a situation may change gears when one has not gone out of mesh, and the other has already entered (overlap). Perhaps at first glance, the jamming does not occur, since the switching process is accompanied by an additional degree of freedom of the block of intermediate gears.

References

1. Dragunov GD RF patent for the invention № 2268162 «Method and device to switch gears in the multi-gear».

2. Automotive, № 7, 2010, p. 18-20.