УДК 621.825.5

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DESIGN FEATURES AND EFFORT OFFTORQUE LIMITERS

Описано конструктивні особливості та визначено силу вимикання обмежувача обертального моменту, який розроблений і запатентований як корисна модель. Наведено принципову конструкцію приладу, розрахункову схему для початку виходу кульки із зачеплення з пазом його веденої частини та аналітичний вираз зусилля вимикання.

There have been described the design features and there has been determined the shutdown force of the torque limiter, which has been developed and patented as a useful model. A fundamental design of the device, the design scheme for the early release of the ball from its engagement with the groove driven and the analytical expression of the force shutdown have been presented.

Problem. Famous safety clutches, which operate without destroying the connecting elements, primarily transfer energy through friction [1-7], that is separated at the end of the shaft torque increased to unwanted values by slippage of the clutch driving towards famous.

They are known to be called freewheel or overtaking [1-7]. As first as these mostly transfer energy through friction except ratchet. This circumstance requires constant follow-largest force springs and tightening her time to adjust.

Moreover, increasing the workload of safety couplings requires zhorstiyshyh springs, which leads to an increase in size of devices, which is not desirable in the case of such couplings in the kinematic chain of portable instruments for example nuts, which are used during assembly and disassembly or repair operations narizevyh connections. And overtaking car starters couplings stiffness springs advantageous to have economy mode to provide more accurate off sleeves. Such opposite problem prompted the author and other scholars of Mechanical Engineering and Transportation to develop preventive ball joints [9.8] on the basis of overtaking and overtaking with ball joints [10-12 ...]. In this case the other transmit torque from the driving to the driven pivmuft not due to friction and gearing balls that are in the same slots these pivmuft. Developed at different times such couplings acknowledged new and patented. Some of them were put into production and learning process.

The preliminary analysis of kinematics showed that the rest of the couplings can be effectively used as a device for limiting torque wrenches or in the transmission now only from the electric starter gear crown wheel to the crankshaft main engine, but never vice versa.It is clear that the process of implementation of any mechanical means requires a comprehensive study of kinematics - force parameters and perform calculations on the strength of all the elements that are involved in transmission of torque.

The purpose of this paper is to analyze the interaction force balls with side surfaces of grooves pivmuft during off couplings, ie the performance of the automatic operation of separation ends of shafts of light friction between contacting elements in order to better select and customize settings spring time off clutches after shutdown energy.

The main material. The paper summarizes the advantages and applicability prerequisite ballpoint overload clutch (Fig. 1), which operates on the principle overtaking clutch. It can zastosovuvatsya in

practice for mechanization of processes, for example tightening of screws narizevyh connections with effort desired value during assembly and disassembly operations of various technical means. Developed clutch is still the main advantages: manufacturing technology and its operation significantly easier, requires careful handling work surfaces lateral surfaces of grooves pivmuft; transmits torque through gearing, smaller size and strength delaying spring; suitable for tightening and unbolt thread connection right and left thread and others.Its disadvantages include increased requirements for convergence of the initial allocation of slots pivmuft and their inclination to agree with the direction of rotation of the executive instrument, ie the direction of rifling.

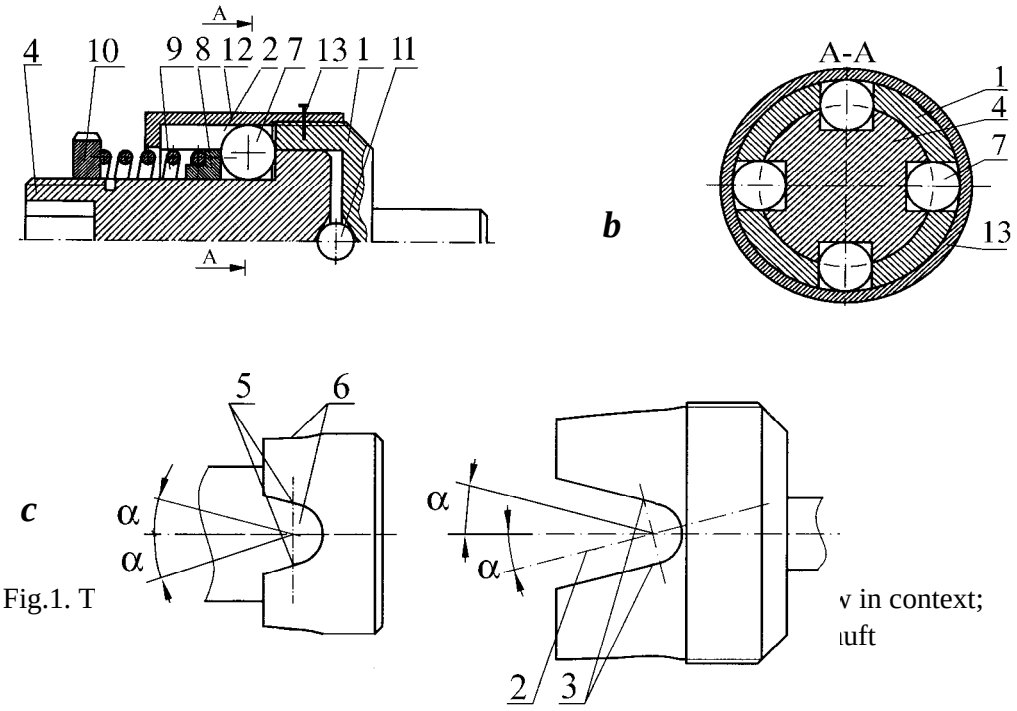


Fig.1. T v in context; uft

The structure of the torque limiter or tightening force nuts narizevyh connections has: driving pivmuftu 1 of grooves 2, with two sloping surfaces 3; driven pivmuftu 4 of grooves 5 which are also inclined surfaces 6 under the same angle as the in the leading pivmufti; balls 7, located both in the grooves of driving and driven pivmuft; screw drive 8, which nestles on the balls spring 9; adjusting nut 10, the ball 11 for centering, housing 12 with screws 13 for fixing it.

This device is effective because it allows tighten nuts narizevyh connections with right and left narizyami. Moreover, hecan function well with any source of rotary motion, particularly because it can easily change the direction of rotation. It could be an electrical current that has a switch to the movement, or other special wrench etc… In this case the device to its right end can be secured in a holder an electrical outlet while inserting driven pivmufty useful tool. Allows you to use a wide range of tools: screwdrivers, wrenches, drill, etc.. The value of torque is set by adjusting nut that with the right force compresses the spring that holds the ball in the grooves driven pivmufty. To increase the torque or force tightening screw joints during assembly operations more nut enough to click on the spring.

The principle of overload clutch like overtaking and is evident from its design. However, in her work are some of the features. Therefore, we consider the process of clutch operation, starting with its working condition (Fig. 1*a*), ie when it rotates as a unit and the torque applied to the manufacturing facility of execution given operation, ie in case of nuts, is tightening the nut to the desired preassigned efforts. With the growth of the moment resistance of the nut axial component of the total force overcomes the elastic force and the spring pushes the ball out of the groove driven pivmufty, thus separating the end of the shaft. Coupling becomes idle. This process is accompanied by some knocking, which facilitates the completion of the process. More fully working principle of the device described in [7].

Here again, remember that a full cycle of operation ballpoint overload clutch can be divided into four specific parts:

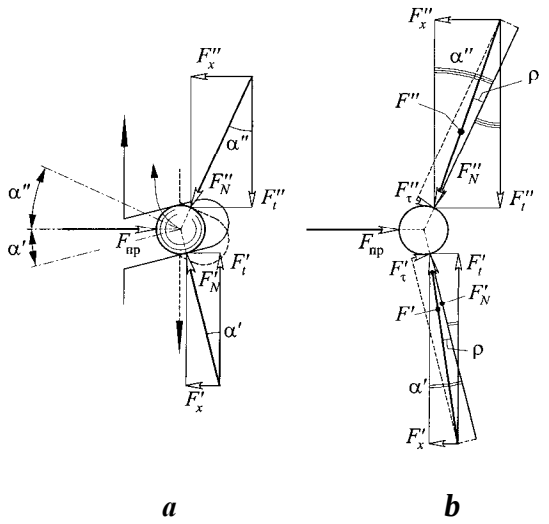
– entrance balls in grooves driven pivmufty, its switching;

– working condition couplings, perform basic technological operations;

– out balls with grooves driven pivmufty, her off;

– slip balls on the ends driven pivmufty (idling).

Of course, the interaction force between the clutch parts in different modes of work is changing, the laws which must precisely know the first stage in the design of safety devices, which require adjustments of torque with high accuracy. It is clear that one of the keys to identifying the desired accuracy of analytical adequacy ratios are dynamic schemes that underpin this identification. So when determining the value of the torque necessary to consider the manifestation of friction at the points of contact of the ball grooves pivmuft work surfaces. Then the significant factors can additionally become more cross-sectional shape and orientation in space grooves movement of balls that can be made of different types of cutters.Here we consider only important process timely completion tightening nuts when clutch is overloaded and begins to shut down. Strength of interaction in this case is shown in Fig. 2. For a visual comparison of two cases is, that in Fig. 2, and shows all the forces acting on the ball if the friction between contacting elements can be neglected. It is during the previous calculations. A in Fig. 2, *b* - a similar process, but with the friction.It should also be noted that throughout the process rozhlyadayemoho off clutch balls are still within the grooves driven pivmufty. But more common is a condition of early release balloons with these grooves when the balls start to put pressure on the clamping ring peresovuyuchy it and compressing the spring. Then there are already efforts elastic springs fpr and and - the total force acting on the ball by pivmuft Fig. 2, *b*.



a ***b***

Fig. 2. Power interaction between the ball and side surfaces of the grooves pivmuft during off coupling: a - friction is not included, b - considering friction

From a design scheme (Fig. 2, *b*) derive obvious ratio [7]:

$$F''^2 = F''^2_N + F''^2_\tau = F''^2_x + F''^2_t\,; \qquad F'^2 = F'^2_N + F'^2_\tau = F'^2_x + F'^2_t\,; \qquad F'_t = F''_t = F_t\,; \; F'_x + F''_x = F_{пр}\,;$$

$$\frac{F'_\tau}{F'_N} = \frac{F''_\tau}{F''_N} = \mu = tg\rho\,; \qquad \frac{F'_x}{F'} = \sin(\alpha' - \rho)\,; \qquad \frac{F'_x}{F'_t} = tg(\alpha' - \rho)\,; \quad \frac{F''_x}{F''_t} = tg(\alpha'' - \rho)\,. \qquad (1)$$

After solving the system of equations (1) received important for this case the relationship between the driving (circular) force that depends on the magnitude of the torque, which rely sleeve, elasticity and strength springs in such general terms:

$$F_t = \frac{Gd_д^4\lambda}{tg(\alpha' - \rho) + tg(\alpha'' - \rho)8D^3 i_ð} \quad (2)$$

Designating

$$\frac{Gd_д^4\lambda}{8D^3 i_p} = F_{np}$$

and assuming that $\alpha' = \alpha'' = \alpha$ the expression (2) beneficial simplified and, in particular, becomes public appearance [7]

$$F_{ið} = \frac{F_t}{2tg(\alpha - \rho)}, \quad (3)$$

confirming the reliability of the research results.

A characteristic of the spring is determined by the dependence

$$C = \sqrt[3]{Gd_д\lambda tg(\alpha - \rho)/(F_t i_p)}, \quad (4)$$

for which appointed need spring.

Conclusions. The analytical expressions (2) (3) and (4) have practical value, which is the ability to choose convenient geometric parameters and the desired characteristics of spring stiffness, knowing only the specific loading factors of the device, ie the desired value the efforts of previous tightening of screws narizevyh connections.

The results of the power analysis can be an important basis for further research and calculations on the strength of elements not only safety, but also overtaking couplings used in various fields of engineering.

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