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Drives of Pipelines' Block Valve based on the Pan Precess Gear

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Introduction- Nowadays in Russia and abroad the majority of hand and electric drives are based on a screw gear [1]. Despite the results achieved in the area of technology of screw gears production by leading domestic and international manufacturers and successful design arrangement of drive, the low performance coefficient of screw gears, limited load capacity and significant starting torque make a particular negative impact on the reliability of the drive when operating in low temperature conditions, and also the high specific metal content of drive represent the reasons for required development of drives based on other gear mechanisms. During the last few years a number of new constructions of block valves' drives were developed, among which the most promising ones are the drives based on the spiroid transmission [2], the harmonic drives with intermediate rolling elements [1] (TOMZEL, SibMash, Gusar) and eccentrically cyclo gear boxes (ZAO "Technology Market", Tomsk, Russia). In comparison with screw gear spiroid gear has a higher performance coefficient and higher load capacity and has better weight and dimensional characteristics, especially in case of steel gear wheels usage.

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Drives of Pipelines' Block Valve based on the Pan Precess Gear

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I. Introduction

Nowadays in Russia and abroad the majority of hand and electric drives are based on a screw gear [1]. Despite the results achieved in the area of technology of screw gears production by leading domestic and international manufacturers and successful design arrangement of drive, the low performance coefficient of screw gears, limited load capacity and significant starting torque make a particular negative impact on the reliability of the drive when operating in low temperature conditions, and also the high specific metal content of drive represent the reasons for required development of drives based on other gear mechanisms. During the last few years a number of new constructions of block valves' drives were developed, among which the most promising ones are the drives based on the spiroid transmission [2], the harmonic drives with intermediate rolling elements [1] (TOMZEL, SibMash, Gusar) and eccentrically cyclo gear boxes (ZAO "Technology Market", Tomsk, Russia). In comparison with screw gear spiroid gear has a higher performance coefficient and higher load capacity and has better weight and dimensional characteristics, especially in case of steel gear wheels usage. At the same time, the relatively high sliding velocity of screw turn's surface and wheel tooth surface in comparison with the similar relative velocities of gear and wheel teeth surfaces of cylindrical and pan gears leads to significant starting torques during the operation of manual drives of block valves in severe conditions of operation. The harmonic drives with intermediate rolling bodies and eccentrically cyclo gear boxes have high performance coefficient [1] and hence low torque strength during the multiple contacts of rolling bodies. At the same time, in addition to much more sophisticated technology of such gears production in comparison with traditional screw gears, the gear's load capacity with intermediate rolling bodies under conditions of their significantly point contact even taking into account the multi pair catching does not reach the load capacity of cylindrical or pan gears with identical weight and dimensional requirements.

This paper presents the results of development of block valve's drives based on the usage of pan precess gear [3, 4], which provides the gear ratio of 22 to 65 at a single stage, with multi pair contact of teeth in catching (up to 8 ... 12 pairs), having a high performance coefficient (88 ... 90%) and smooth operation in comparison with increased (up to two times) starting torque in case of identical weight and gear ratio based on the screw gear, and in case of the equal load capacity up to 40% decrease of specific metal content. During the operation, the gear teeth and the gear wheels roll of, and do not slide in relation to each other as in a screw or spiroid gear, resulting in significantly lower starting torque and the ability to remain functioning even under the severe conditions of operation.

Fig. 1 shows the kinematic scheme of the reductiondrive gearbox with the precess gear. In the gearbox the bevel pinion with the number of teeth z_1 is roughly fixed. On a drive eccentric shaft a double gearwheel with gear rims z_2 and z_3 is located through a bearing unit. The output shaft is roughly connected to the pan wheel having a number of teeth $z_4 = z_3$, and set against the shaft on bearings.

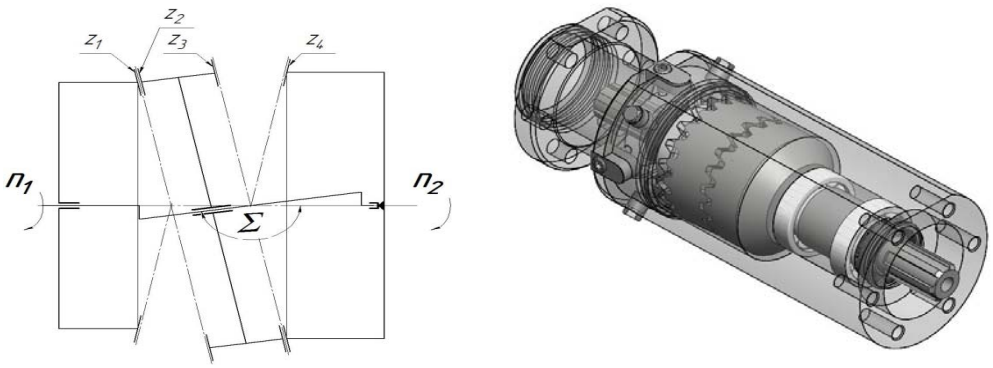

Figure 1 : Kinematic and sample layoutreducer

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Fig. 1 - Kinematic and sample layout reducer

When you rotate the eccentric shaft a pan double gear-wheel performs complex motion - a rotation around its axis, and with the drive eccentric shaft around the axis of gear box, causing the rotation of tooth coupling, composed of gear rims z_3 and z_4. Thus on a double gear-wheel located at an angle of 180 ° two zones of tooth contact are formed: meshed wheels z_1 - z_2 - and in mesh wheels z_3 - z_4 .The total gear ratio of gear box is performed by two gear rims z_1 and z_2 and is calculated as a dependence:

$$u = z_2/(z_2 - z_1)$$

In Fig. 2 shows the construction of a manual actuator valves using precess gear.

Figure 2 : Drive valves

Precess gear, which is generally pan with small interaxial angle, can be made with straight, slanting, circular, lentoid teeth on gear-wheel and concavo-concave teeth on wheel. The gear with lentoid teeth on gear-wheel and concavo-concave teeth on wheel is more preferable, because in comparison with the gear with circular teeth with mesh synthesis [5], during which the required contact localization is provided, has fewer geometric constraints on the technological process of the teeth cutting by circular cutter head on the tooth-cutting machines.

Developed on the basis of the pan precess gear with teeth manual drive for ball valve DU-300 (Fig. 3), produced by OOO Firma "STEK" (Kurgan, Russia), has a high load capacity and smooth operation. Under a force on the handle of the wheel of 28 kg the starting torque on ball valve is 2600 kg, the allowed load moment is 5000 kg M. The guaranteed service life is not less than 5000 cycles, is confirmed by the results of production tests in AK "KOR-VET" (Kurgan, Russia). A similar drive for ball valve DU-160 with elongating column is shown in Fig.4.

Figure 3 : Ball valve DU-300, the drive based on the gearbox a precess gear

Figure 4 : Drive of the ball valve DU-160 with extension column

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