JOURNAL OF ENGINEERING annals OF FACULTY OF ENGINEERING HUNEDOARA

POSSIBILITY OF APPLYING HYDRODYNAMIC COUPLERS FOR DRIVING BELT CONVEYORS

Svetislav Lj. MARKOVIĆ

Technical College, 32000 Čačak, Svetog Save 65, SERBIA

Abstract:
The analysis of the possibility of applying hydrodynamic couplers between the drive electromotor and the gear reducer was carried out in the biggest Serbian mine in order to improve and modernize the operation of belt conveyors. This paper contains the basic parameters of these couplers manufactured by Voith, as well as the critical comment on their eventual application.
Keywords:
hydrodynamic coupler, conveyor

1. INTRODUCTION

The hydrodynamic coupler consists of the two working circuits: the pump circuit (P) - the entrance, connected to the drive engine shaft and the turbine circuit (T) - the exit, which is connected to the working machine shaft. Both circuits are placed in the common housing filled with oil.

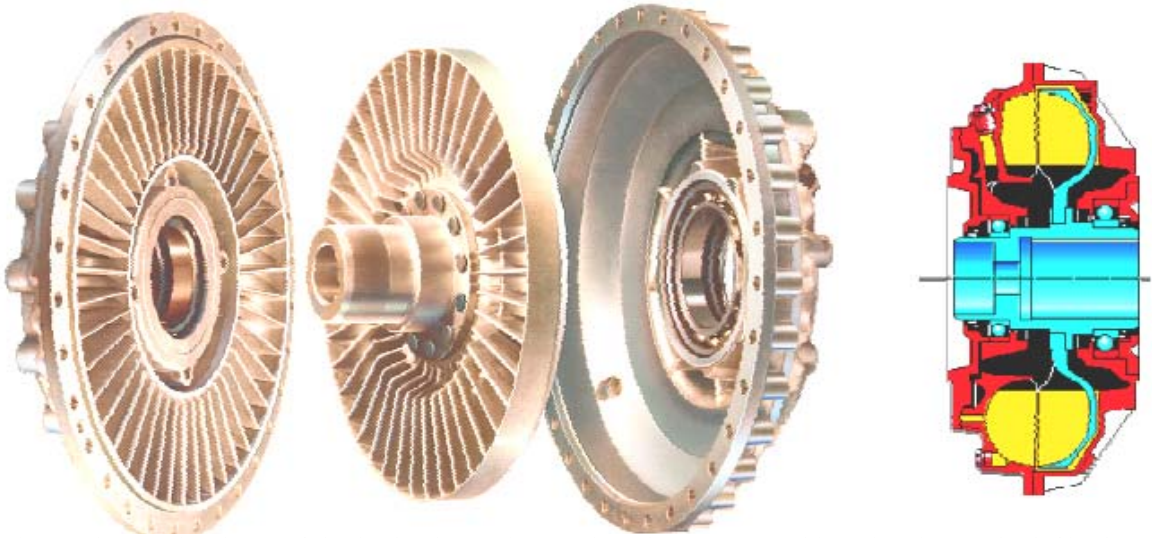

Fig. 1. The mechanisms of the hydrodynamic coupler: the pump working circuit (on the left), the turbine working circuit (in the middle) and the outer covering (on the right); the cross-section of the coupler

The rotation of the pump circuit speeds up the working fluid which enters the working space of the turbine circuit with the increased kinetic energy which is further transferred to the working machine. Namely, the oil as a working fluid flows at a great speed exposed to the low pressure in the closed circulation circle formed by the blades of the working circuits. When the speed of the working oil movement is increased, the mechanical energy of the engine is transformed into the kinetic energy of the oil in the channels of the pump circuit. The reverse process takes place in the channels between the blades of the turbine circuit. The oil is slowed down there, i. e. its kinetic energy is transformed again into the mechanical energy of the turbine circuit. In this manner the energy transfer from the pump circuit to the turbine circuit is performed hydraulically.

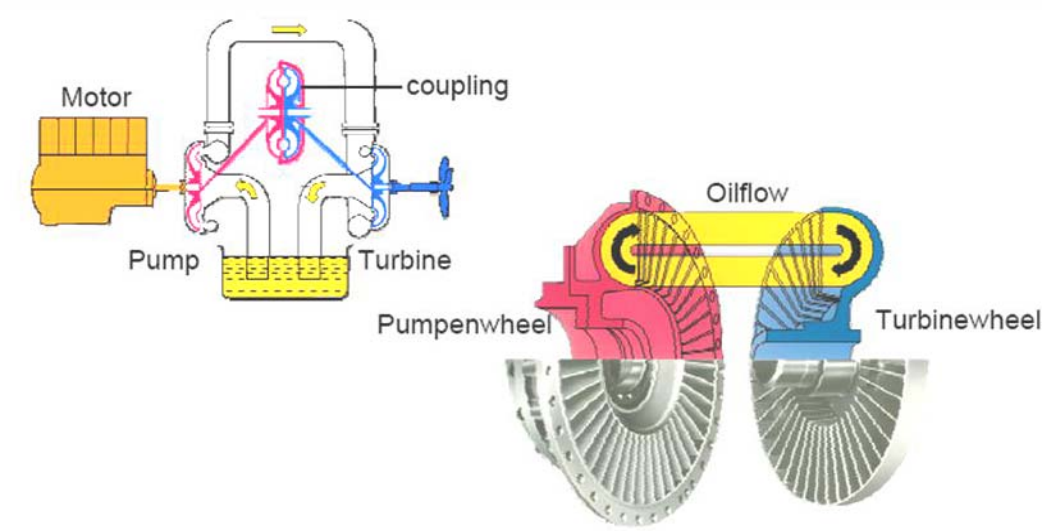

Fig. 2. The scheme of the principle of operation of the hydrodynamic coupler

2. THE ANALYSIS OF THE POSSIBILITY OF INSTALLING THE VOITH TURBOCOUP-LER TVVS ON THE BELT CONVEYOR

The Voith couplers are specially designed to adjust to working with different working fluids:

- Oil-standard use,
- Water-especially in underground exploitation (TVV couplers),
- EP fluid (Environment Pollution-free Fluid) – biodegradable,
- Hi-fluid (High flash point fluid) - does not contain chlorinated hydrocarbon or phosphoric ester. The fluid density is smaller than water density.

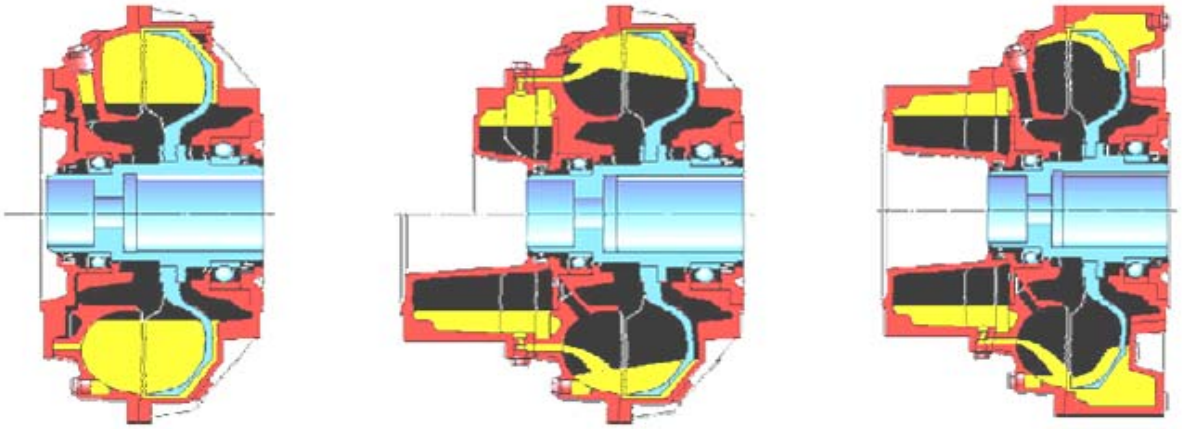

Fig. 3. The basic types of the couplers with the constant quantity of oil: T (on the left), TV/TVV (in the middle) and TVVS (on the right)

The consequences of irregular pouring of oil may be the following:

- When there is too much oil:
  - It takes more time to start the engine,
  - The engine cannot be started at all,
  - The engine cannot reach its nominal speed.
- When there is too little oil:
  - It takes more time to start the machine,
  - The machine cannot be started at all,
  - The machine operates with the increased slippage.

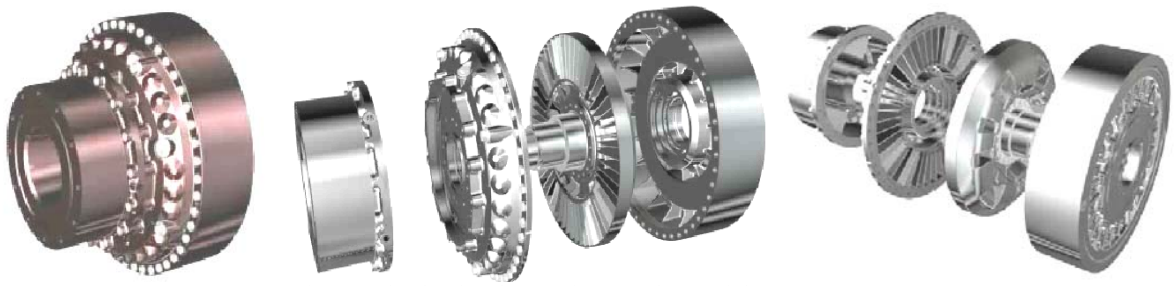

Fig. 4. The hydrodynamic coupler Voith 750 TVVS

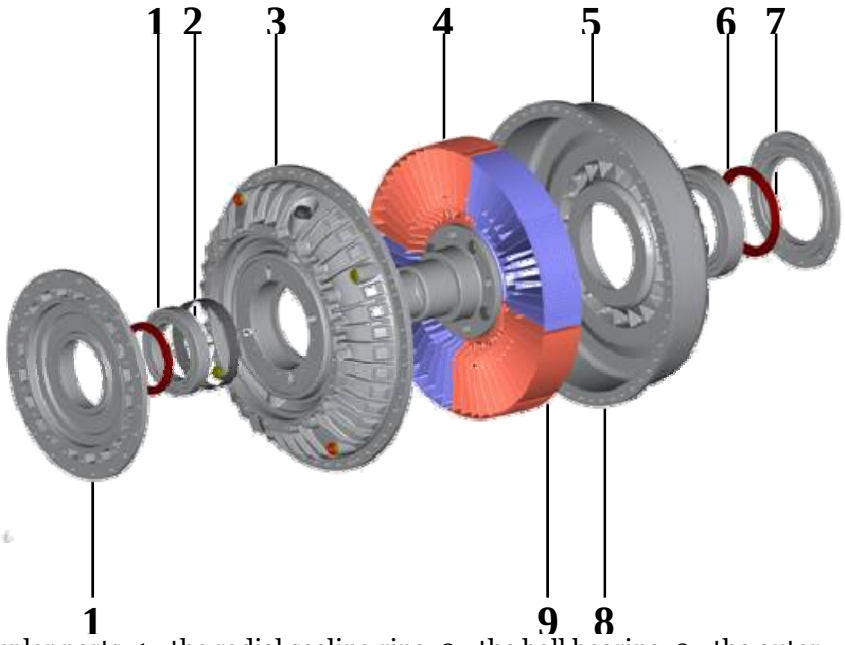

Fig. 5. The coupler parts: 1 - the radial sealing ring, 2 - the ball bearing, 3 - the outer working circuit, 4 - the inner working circuit, 5 - the coupler housing, 6 - the ball bearing, 7 - the radial sealing ring, 8 - the counterweight, 9 - the frictional covering, 10 - the lid

Table 1. The differences between the drive through the inner and the outer working circuit

	Drive through the outer working circuit	Drive through the inner working circuit
The weight of the coupler	Affects the reducer shaft.	Affects the engine shaft.
Inertia	Less inertia on the reducer side (fewer blows in the event of a sudden blockage).	Greater inertia on the reducer side.
Pouring of the fluids and the amount control	Easy - the coupler housing turns around even if the brake is closed.	The entire machine must be started in order to perform inspection.
Starting	Always acts the same at starting.	Emptying of the slowdown chamber depends on the characteristics of starting –the starting can be problematic during the blockage of the belt conveyor.
Cooling	Always the best possible.	Less-especially during the starting and blockage.
Starting characteristics	The Voith turbo couplers are optimal for starting the belt conveyors through the outer working circuit (the mixed profile in the inner working circuit).	
Slippage	Less.	Greater.
Brake installation	The construction with a shaft / additional brake flange necessary.	The lower price for the brake installed on the elastic coupler.

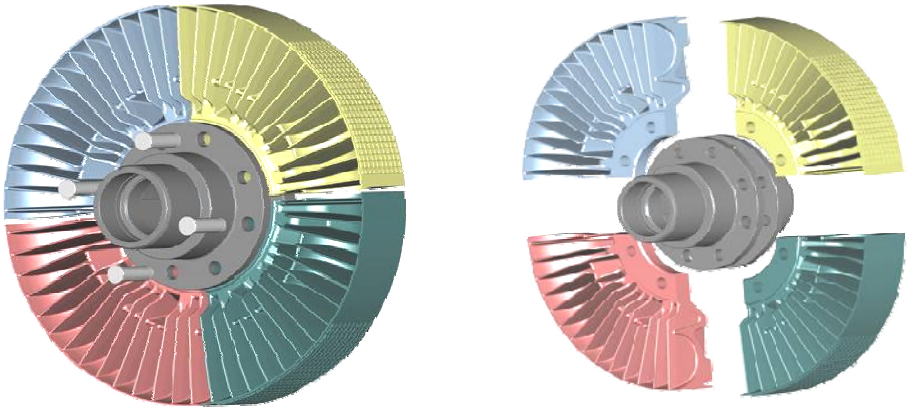

Fig. 6. The inner working circuit has freely movable separate segments

The special properties of TVVS coupler in comparison to the other types are:

- the lengthened slowdown chamber and the additional rim chamber,
- this type has thermal capacity increased by 15% which allows the coupler to be started more often,
- the heat removal is faster by 10% providing faster cooling and shortening the period between two consecutive starts.

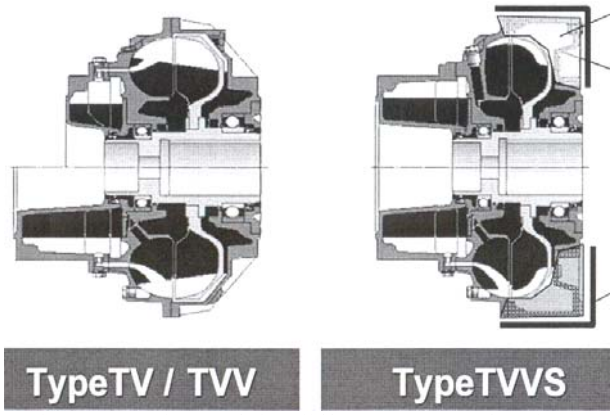

Fig. 7. The comparison of the different types of turbo couplers

3. CONCLUSION

Due to the characteristics of the hydrodynamic couplers, there exists the possibility of their application in belt conveyors in coal mines on condition of removing certain flaws which even this highly sophisticated equipment is not immune to. Generally speaking, the turbo couplers have many advantages and therefore should be included in exploitation as soon as possible.

REFERENCE

[1] Krsmanović Lj., Gajić A.: *Turbomašine, hidrodinamički prenosnici snage*, Mašinski fakultet, Beograd, 1998.
[2] Voith Turbo GmbH & Co. KG: katalozi, prilozi, aplikacioni programi, crteži, slike i ostalo.
[3] Marković S., Erić D., Veličković D.: *Analysis of testing the hydrodynamic coupler on the belt conveyor used for open-pit mining in the coal mine*, 12th International scientific conference „Mechanical Engineering 2008“, Proceedings, Bratislava, Slovakia, 13÷14. November 2008.