

ELECTRIC DRIVES SYSTEMS WITHOUT TRANSMISSION - GLOBAL DEVELOPMENT DIRECTION OF INDUSTRIAL AND TRANSPORT ELECTRIC DRIVE

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Abstract

Designs of electric drives without transmission are presented: propellers, steering gear columns, working bodies of cargo-handling machines and mining mills.

Key Words

MARINE VESSEL, SUBMARINE, SHIP'S MECHANISMS, ELECTRIC MOTOR

Introduction

The General tendency of modern electric drives development is their computerization and the use of electronic power inverter mechanisms. However, nobody concerns with the power element - electric motor development. The submitted work refers to this problem.

Description of direct drive systems

Such systems or direct drive systems are those in which the transfer of mechanical energy from the electric motor to the working body of the mechanism is performed without mechanical parts: shafts, couplings, gearboxes, belt transmissions. Here constructive part of the motor itself becomes an element of the working part of the mechanism performing efficiency work. This gives the following advantages:

1. Costs materials reduction and electric drive labor expenditure;
2. Energy consumption reduction in the dynamic operations due to reduction of the total inertia moment;
3. Operating cost savings of materials consumed, for example, lubricating oil.

The examples of systems developed by the authors protected by patents of the Russian Federation are:

1. Electromagnetic propulsion in liquid medium.

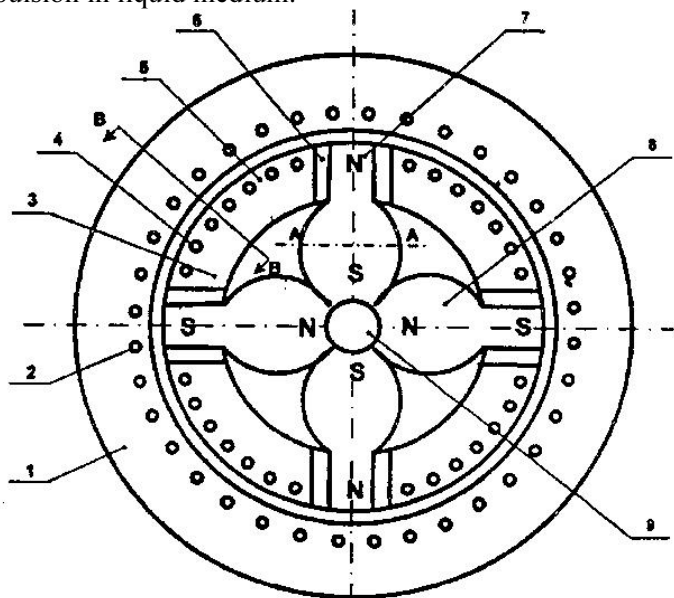


Figure 1 - Electromagnetic propulsion in liquid medium

This is synchronous motor, inside of which there are blades of the propeller, having in the cross-section of three-layer design. The two outer layers are made of non-magnetic conductive materials (copper, brass, bronze) or plastic, and the inner layer is made of pressed powder material, which is a permanent magnet.

2. Electromagnetic propulsion in liquid medium with electric reduction

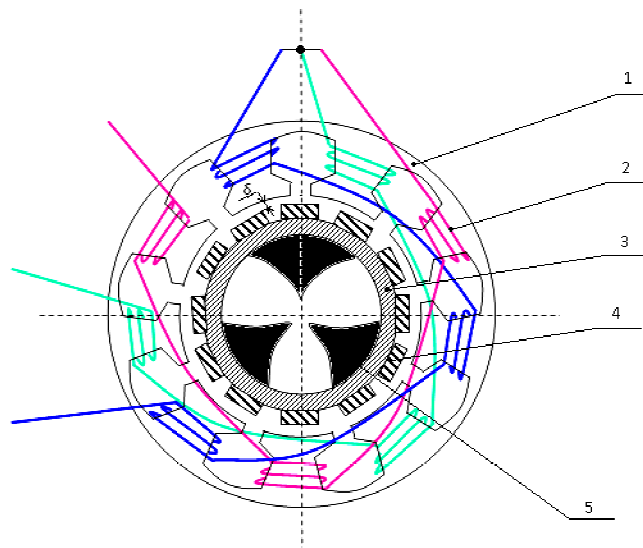


Figure 2 - Electromagnetic propulsion in liquid medium with electric reduction

It is so called "synchronous" motor with permanent magnets, inside of which there are screw blades reverse sweep wing.

The value of electrical reduction is:

$$i_3 = \frac{z_2}{z_2 - z_1} \quad (1)$$

where z_1 - number of stator core teeth;

z_2 - number of rotor teeth.

3. Steering gear column with electromagnetic driver without a shaft.

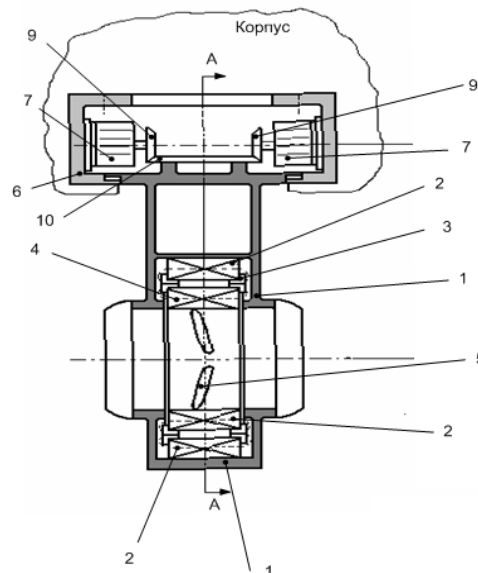


Figure 3 - Steering gear column with electromagnetic driver without a shaft

This design is the induction motor, inside the rotor of which there are blades of the propeller reverse sweep wing. The propeller rotation plane can be rotated around the vertical axis by means of two or one asynchronous motor with a built-in electromagnetic brake by means of the single-stage helical gearing.

4. Steering gear column of direct drive system.

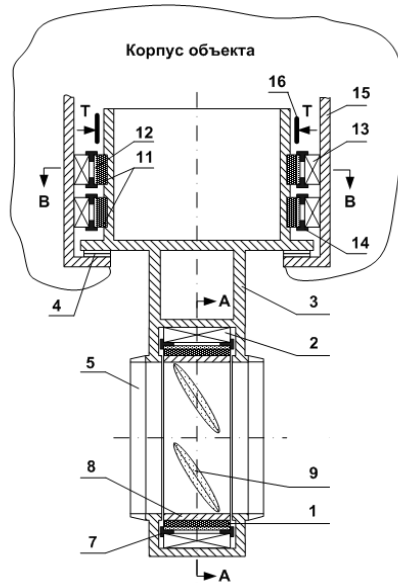


Figure 4 - Steering gear column of direct drive system

It's the same previous structure, but with a synchronous motor, as to part of a rotation of screw rotation plane helical gear is excluded and asynchronous motors are replaced by synchronous motors with permanent magnets.

5. Mining mill motor of direct drive system.

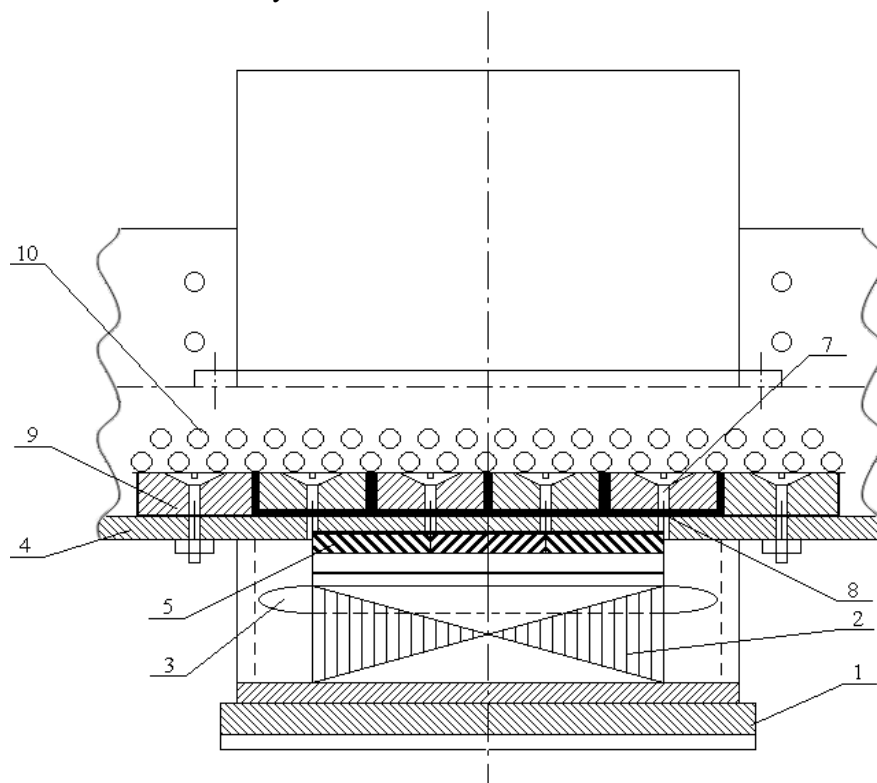


Figure 5 - Mining mill motor of direct drive system

This motor is with electric reduction, in the internal cavity of the rotor of which metal balls grind material.

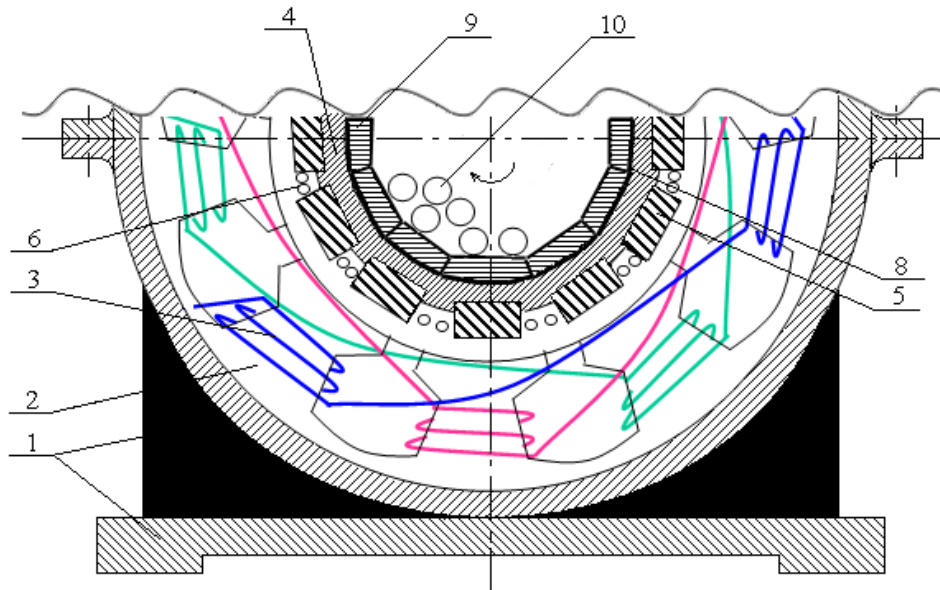


Figure 6 - Mining mill motor of direct drive system

6. The electric motor of the fuel-handling machine working body of direct drive system.

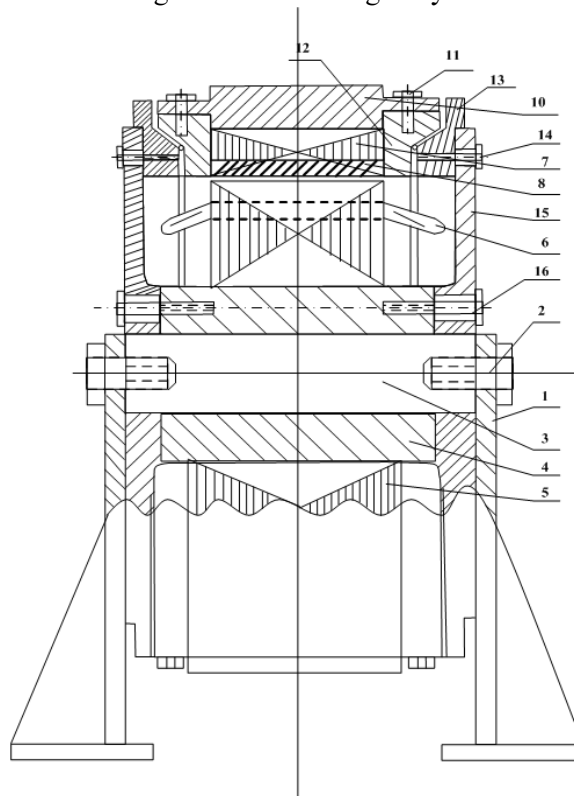


Figure 7 - The electric motor of the fuel-handling machine working body of direct drive system

This design is opposite synchronous machine with electric reduction, housing of which can serve as a reel of cargo winch or a roller trolley of a crane, or a roller moving gantry crane.

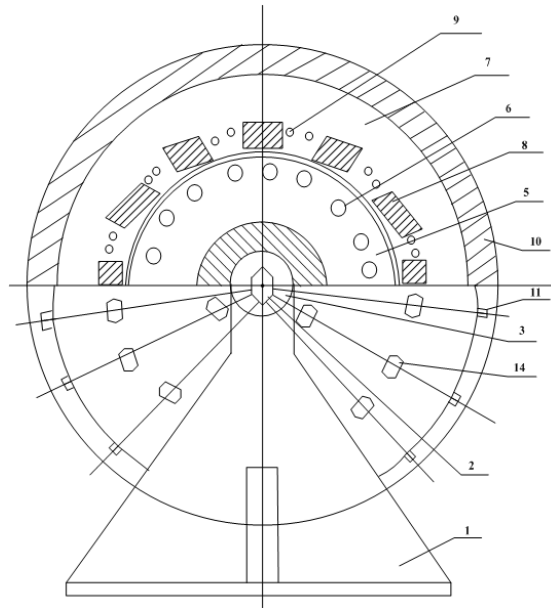


Figure 8 - The electric motor of the fuel-handling machine working body of direct drive system

Conclusion

The prospective construction of electric drives of the various mechanisms working bodies on industrial production, the ships and submarines of direct drive systems are described in the report. Article in "Морской флот" №5, 2012 magazine and production of thrusters "ring motors" for ships by Brunvoll in a full accordance with patent of Russian Federation №2421373 are confirmed the correctness of the proposed solutions.