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Design Solutions of the Mechanism of Energy-Saving Direct and Indirect Drive for Magnetic Starters

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Abstract: ***In this work, the operating mode of the magnetic starter analyzed and the design solutions of the model of an energy-saving drive for switching off the supply of the switching coils and the hanging of the operating state of the magnetic starter are considered.***

Keywords**:** ***magnetic shutoff, electric magnetic system, inductive pulley, magnetic conductor, electric technical steel.***

I. INTRODUCTION

Currently, energy saving and rational reduction of electricity consumed, taking into account the technological processes of production, is one of the urgent and priority tasks. This is due to the deficit and decline in basic energy resources, the increasing cost of their production, as well as global environmental problems. It is known that energy saving is the efficient use of energy due to the development and application of energy-saving equipment, technologies and solutions that are technically and economically justified, do not change and increase the operating mode of production and their individual equipment.

II. ANALYSIS OF LITERATURE DATA

An electromagnetic starter (MP) is the most common electrical apparatus for starting electrical consumers. Electromagnetic starters designed for using in stationary installations for remote start, direct connection to the network, stopping and reversing a three-phase asynchronous motor with a squirrel-cage rotor of alternating voltage up to 660 V, frequency 50 Hz. Its main advantages: remote control of starts, simplicity of circuits, protection against voltage and overload reduction, acceptable weight and size parameters, which can be called external properties, since they to a certain extent affect the quality of the entire system [1,2].

Magnetic starters are specialized electrical AC and DC switching devices designed for remote control and start-up of electrical consumers.

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Its main advantages: remote control of starts, simplicity of circuits, protection against voltage and overload reduction, acceptable weight and size parameters, which can be called external properties, since they to some extent affect the quality of the entire system.

Magnetic starter (MP) has the following disadvantages:

- The electromagnetic system of the magnetic starter

Consumes electrical energy under operating conditions;

- There is no drive designed to turn off the power of the magnetic starter coil in operating mode.

Research questions and the development of a direct and indirect action drive mechanism for all types of magnetic starter designed to turn off the coil power (including) in the operation processes considered. In this work, the operating mode of the magnetic starter investigated and analyzed, and the development of a model of energy-saving drives for the intended switching-off of power-on coils and hanging of the operating mode of the magnetic starter was considered. It is known that the main elements of the magnetic starter are the electromagnetic system 5, the main contacts 2 and 3, the block contacts and the arcing chamber [1, Fig-1]. The electromagnetic system is a detachable magnetic circuit, on the middle core of which a coil placed. To reduce the heating caused by eddy currents, the magnetic circuit is drawn from separate, insulated from each other, plates of electrical steel [1,2,3,4]. The fixed part of the magnetic circuit is called the core, the moving part is the anchor [1, Fig-1]. The armature mechanically connected to pins 2 [1, Fig-1]. When turned on, an electric current passes through the coil, creates a magnetic field that attracts the anchor to the core and thereby closes contacts 2 and 3 of the starter; when the anchor disconnected under the action of return springs 4 (and in some types of magnetic starters under the influence of its own weight) it moves away from the core and the contacts open [1, Fig-1].

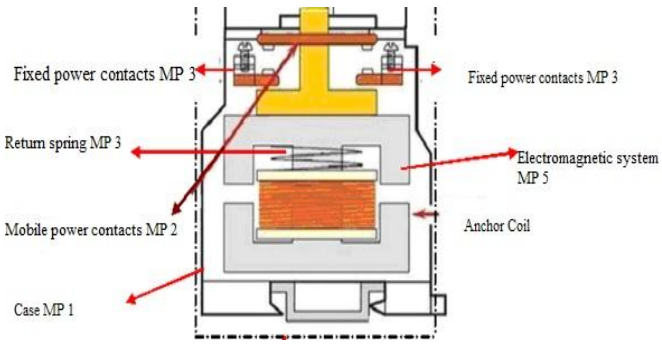

Fig-1. The current design of the magnetic starter type PME

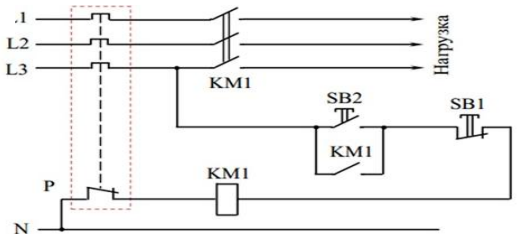

Fig-2. Schematic diagram of the magnetic starter connection

The essence of the connection scheme of any MP is reduced to power management of its coil. It is known that the actuation and shutdown of the magnetic field (retraction and return of power contacts) occurs by closing and opening the coil power circuit.

The power to the coil of the magnetic starter KM1 supplied through the contacts of the "Start" button — SB2, "Stop" SB1 and the thermal relay P. Stop buttons. The MP core attracts the anchor, closing the power movable contacts, and voltage applied to the load [Fig.-2].

When the "Start" button is released, the coil circuit does not open, since the contact block KM1 with closed contacts (the magnetic starter armature is retracted) is connected in parallel to SB2 - the phase voltage L3 to the coil will come through them [Fig.-2].

By pressing the "Stop" button, the coil power circuit breaks, the group of movable contacts returns to its original state and the load is thus de-energized. The same thing happens when the motor overloads over current, additional thermal energy is released on the heating elements of the thermal relay P, which causes the opening of the thermal relay to trip, interrupting, in this case, zero N supplying the coil KM1 of the magnetic starter [Fig.-2].

The electromagnetic system of the magnet starter consumes electrical energy under operating conditions and there is no drive designed to turn off the power of the magnet starter coil in operating mode [1,2,3,4].

The task is to create an energy-saving drive designed to turn off the power of the coil, improve technical indicators, increase the reliability of the shutdown state and turn on the power contacts, simplicity of design and wiring diagram for magnetic starters.

III. MAIN PART

The drive mechanism of indirect action, containing a disconnecting electromagnetic system 7 and a movable locking mechanism 2, connected to using a movable connecting lever 6 (made of textolite or plastic). The disconnecting electromagnetic system 7 and the movable locking system 2 are connected along the housing 1 with the regulating rod 4.

The disconnecting electromagnetic system 7 is a detachable magnetic core on the middle core, which is located a coil. The movable lever 5 along the housing 1 with a fixed rod 3. The fixed rod is fixed in the part of the housing 9.

The movable connecting lever 8 connected to the rods of the power contacts of the magnetic starters. The drive housing 1 connected to the magnetic starter housing (Fig.-3).

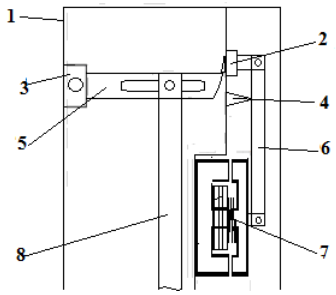

Fig. 3. The mechanism of the indirect drive MP

1- drive housing; 2-locking mechanism; 3-motionless draft; 4 adjusting draft; 5-move lever; 6-lever disconnecting electromagnetic system; 7-trip coil with anchor; 8-movable connecting lever with MP.

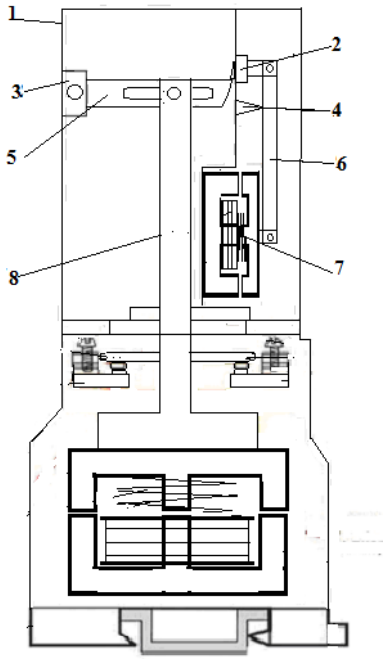

Fig. 4. The design of a magnetic starter with an indirect drive mechanism

1-drive housing; 2-locking mechanism; 3-motionless draft; 4 adjusting draft; 5-move lever; 6-lever disconnecting electromagnetic system; 7-trip coil with anchor; 8-movable connecting lever with MP.

When turned on, an electric current passes through the coil, creates a magnetic field that attracts the anchor to the core of the magnetic field and 7 thereby closes the contacts of the magnetic starter, and the locking mechanism of the drive 2 ensures that the power contacts of the magnetic starter stop. The electromagnetic system 7 is included in a closed contact block of the magnetic starter.

When the magnetic starter turned on, the electromagnetic system 7 fed until the closed contact is opened to reduce the frictional force of the movable lever 5 to the locking mechanism 2 and the locking mechanism blocks the shut-off electromagnetic system 7 under the action of return springs. When the magnetic starter turned off,

the MP electromagnetic system powered until the closed contact disconnecting the electromagnetic system 7 to reduce the action of the force of the return springs of the magnetic starter to the locking fur ism 2. When disconnecting the electric current flows through the coil an electromagnetic shut-off system 7 produces a magnetic field of the core, which attracts the armature towards the core of the mechanism, under the action of return springs MP and disconnects power contacts the magnetic actuator.

A direct-acting drive mechanism comprising a disconnecting electromagnetic system 4 (attached to the housing 11) and a movable locking mechanism 3 (made of PCB or plastic and the external locking part of the locking mechanism made of steel, a locking rod 2 installed, and also connected to an electromagnetic system four). The disconnecting electromagnetic system 4 is a detachable magnetic core on the middle core, which is the coil 5. The movable lever 6 (made of steel) along the housing 1 with a fixed rod 7 (made of steel). A fixed rod is fixed in the part of the housing 2. The movable connecting lever 8 (made of textolite or plastic) connected to the rods of the power contacts of the magnetic starter. The drive housing 1 connected to the housing of the magnetic starter (Fig.-5).

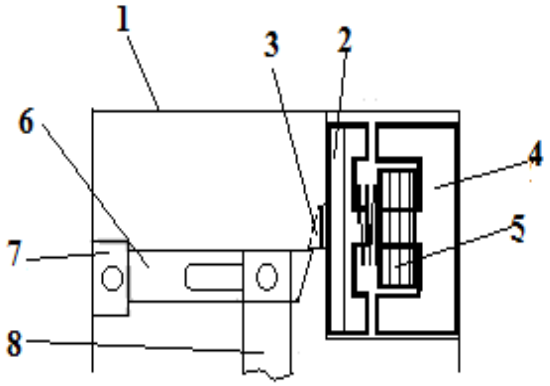

FIG. 5. DIRECT DRIVE MECHANISM MP.

1-drive housing; 2,3-locking mechanism; 4,5-disconnecting electromagnetic system; 6-move lever; 7-motionless draft; 8-move connecting lever with MP.

When turned on, an electric current passes through the coil, creates a magnetic field that attracts the anchor to the core of the magnetic field and 4 thereby closes the contacts of the magnetic starter, and the locking mechanism of the drive 3 ensures that the power contacts of the magnetic starter stop. Coil 5 electromagnetic system 4 turned on by a closed contact block of the magnetic starter. When the magnetic starter turned on, the electromagnetic system 4 is powered until the closed contact block of the magnetic starter is opened to reduce the frictional force of the movable arm 6 to the locking mechanism 3 and the locking mechanism blocks the shut-off electromagnetic system 4 by the action of return springs. When the magnetic starter turned off, the electromagnetic system powered until it opens closed contact block disconnecting the electromagnetic system 4 to reduce the action of the force of the return springs of the magnetic trigger switching to the locking mechanism 3. When disconnected, an electric current passes through the coil, the disconnecting electromagnetic system 4 creates a magnetic field of the core, which attracts the armature of the mechanism to the core 5 under the influence of MP return springs and open the power contacts of the magnetic starter.

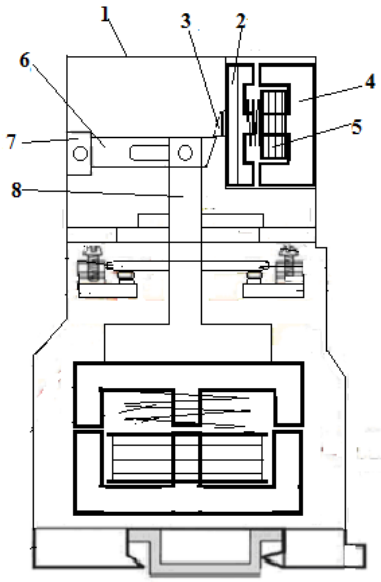

Fig. 4. Designs of a magnetic starter with a direct-drive mechanism

1-drive housing; 2, 3-locking mechanism; 4, 5-disconnecting electromagnetic system; 6-move lever; 7 - motionless draft; 8-movable connecting lever with MP.

IV. RESULT AND DISCUSSION

The magnetic starter drive containing the electromagnetic system main contacts, block contacts, characterized in that the additional one installed with a disconnecting electromagnetic system connected by a movable locking mechanism and connecting levers with the main movable contact of the magnetic starter. The disconnecting electromagnetic system is a detachable magnetic core on the middle core, which is located coil, a disconnecting electromagnetic system and a movable locking system connected to the housing with Uhlir thrust directly.

V. CONCLUSION

To sum up, the main advantage of this installation is the control of electrical consumers using a magnetic starter, which will provide a significant reduction in energy costs.

The drive mechanism relates to electrical engineering can be used for a magnetic starter in addition to the type of PAE designed control consumers of electrical energy.

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